Woven Networks

Technological Upgrading, Standards and Chinese ICT Corporations in North Africa

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Declaration

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I confirm that an earlier version of Chapter 6 has been published as a sole-authored article in *The Journal of the Information Society*.

Abstract

This dissertation asks whether the globalisation of Chinese digital capital creates opportunities for technological upgrading and structural transformation in host developing countries or, conversely, hinders the accumulation of technological capabilities and broader economic transformation. Using a mixed-methods approach – including an original dataset, 107 fieldwork interviews with local, Chinese, and foreign stakeholders, and extensive documentary research – this thesis examines the role of Huawei and ZTE in Algeria and Egypt, two key recipients of Chinese digital projects. The analysis draws on a political economy framework that integrates two strands of the literature: (1) heterodox development theory to assess spillovers and the role of foreign firms in upgrading, and (2) technopolitics to analyse the politics, norms and standards conveyed through digital infrastructure.

The research finds that the role of Chinese firms in fostering technological upgrading in host developing countries is at best *mixed*. While the globalisation of China's ICT industry has helped expand internet access and is increasingly fostering managerial knowledge spillovers through greater labour localisation in senior roles, it does not substantially contribute to consolidating technological capabilities nor boosting productivity in the domestic ICT industries. What might initially seem like developmental connections promoting domestic capabilities are, in fact, linkages diffusing – through fibre optic cables, data centres, antennas, routers, and training programmes – new norms, protocols, and standards that reconfigure local ICT ecosystems and integrate them into distinct technopolitical regimes. Thus, Chinese digital corporations are disseminating, both intentionally and unintentionally, *de facto* standards from the ground up, via the construction of cost-competitive digital infrastructure.

Fieldwork findings from Algeria and Egypt reveal that the operations of the two Chinese firms, like those of Western competitors, have hindered local actors in expanding their share of domestic markets and consolidating their capabilities. Both governments appeared to prioritise *efficiency* and immediate access to cutting-edge digital infrastructure over long-term *learning* and *upgrading*. In the current context of heightened geopolitical tensions and increasingly bifurcated digital systems, developing countries face growing pressure from dominant actors that are extending their regulatory influence as a strategy to consolidate extraterritorial economic and political power. I argue that the extent to which developing countries can harness this intensifying competition for national development will ultimately depend on local configurations of power, capabilities, and the use of digital industrial policies to bolster strategic autonomy.

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Abbreviations

BRI	Belt and Road Initiative
CCP	Chinese Communist Party
CDB	China Development Bank
DSR	Digital Silk Road
FDI	Foreign Direct Investment
FOCAC	Forum on China-Africa Cooperation
FTTH	Fibre to the Home
GDPR	General Data Protection Regulation
ICA	Infrastructure Consortium for Africa
ICT	Information and Communication Technology
IoT	Internet of Things
ITIDA	Information Technology Industry Development Agency
ITU	International Telecommunication Union
MCIT	Ministry of Communications and Information Technology
MNC	Multinational Corporation
MoU	Memorandum of Understanding
NRC	National Research Centre
OEM	Original Equipment Manufacturer
PDPL	Personal Data Protection Law
PPP	Purchasing Power Parity
STEM	Science, Technology, Engineering, and Mathematics
WTO	World Trade Organisation
ZTE	Zhongxing Telecommunications Equipment Corporation

CHAPTER 1

Introduction

> "Information technology advances rapidly. I hope that Chinese enterprises not only observe local laws, operate credibly, and have sound management but also disseminate their advanced technologies and experience to the local enterprises and employees. We always say that give a man a fish, and you feed him for a day; teach a man to fish, and you feed him for a lifetime. Do you agree with me?"

Premier Wen Jiabao, citing the ancient philosopher Lao Tzu, to Egyptian ICT students on a visit to Huawei's Training Centre in Cairo in 2009 (MFA, 2009)

The above quote from Premier Wen aptly encapsulates the importance Chinese policymakers place on knowledge diffusion and strengthening local technological capabilities as part of the globalisation of China's digital industry. Since the early 2000s, encouraged by Beijing's "Go Out Policy" (走出去战略, *Zǒuchūqù Zhànlüè*), Chinese information communication technology (ICT) corporations have built the backbone infrastructure used by millions of internet users across the Global South (Gagliardone, 2019; Lou, 2019; Erie and Streinz, 2021). Although difficult to measure, some reports estimate that Huawei has built about 70 percent of Africa's 4G networks (Mackinnon, 2019). China's vast online population, the largest in the world, its thriving e-commerce sector, and its significant investments in technology and innovation, have propelled China's digital industry to the heights of global digital capitalism. As of 2022, nine of the world's 20 largest internet companies were headquartered in China (Heeks et al., 2024). China's domestic digital sector played a crucial role in driving its tech giants' global expansion, while simultaneously benefiting from their internationalisation, creating a virtuous cycle of growth and influence.

China's global footprint in the digital sphere has expanded significantly over the past decade. In 2015, under the leadership of Xi Jinping and Li Keqiang, the government launched the Digital Silk Road (数字丝绸之路, Shùzì Sīchóu Zhī Lù, DSR thereafter) often described as the digital arm of the Belt and Road Initiative (一带一路倡议, Yīdài Yīlù Chàngyì, BRI thereafter). Introduced through an official Chinese white paper, the DSR is operationalised through a complex network of nonbinding soft law instruments, including Memoranda of Understanding (MoUs) and policy guidelines that signal strong state support for the

international expansion of Chinese ICT firms. Rather than a tightly defined programme, the DSR has functioned as a broad umbrella term encompassing a wide range of telecommunications, digital infrastructure, and data-related activities undertaken by China-based tech firms abroad[1] (Greene and Triolo, 2020; Oreglia and Zheng, 2024).

With dozens of BRI projects put on hold due to the logistical disruptions caused by the Covid-19 pandemic as well as mounting concerns with debt in recipient countries, the DSR has gained increasing importance in China's global projections (Blanchette and Hillman, 2020). Departing from a focus on large-scale infrastructure like roads and ports, Beijing's policy circles have adopted new mantras like "tightening the belt" and "small is beautiful", favouring more cost-effective initiatives, particularly in the digital sector (Gyu, 2021). The DSR aims to increase digital connectivity among BRI nations. On the physical infrastructural side, it focuses on building fibre optic cables, 5G networks, data centres and smart cities. Firms like Huawei and ZTE are among the world's leaders in this sub-sector thanks to their capacity to provide high quality network equipment at much lower prices than their European and US competitors (Wen, 2020). On the digital platform front, social media apps like TikTok and Weixin (Wechat), Taxi-hailing apps such as Didi, and e-commerce platforms like Alibaba are facilitating communication and commerce between users across the world. The DSR also includes space-based infrastructure, most notably the BeiDou global satellite system, which is operated by the China National Space Administration and serves as an alternative to the United States' Global Positioning System (GPS) (Jennings, 2024).

The globalisation of China's digital industry has become a highly popular and contentious topic, reflected in a blossoming body of media reports, think tank publications, and conferences that single out Chinese capital as "problematic". Existing writings on China's global digital expansion have predominantly focused on the potential threat China could pose to the United States (US) and its hegemony over the Internet (Chenley, 2019; Hillman, 2021). Many observers, particularly ones in the US and Europe, presume that an all-powerful Chinese digital and ICT industrial complex smoothly grafts its uniquely "Chinese" internet model onto

[1] Far from a coherent top-level strategy, several scholars contend that the DSR is better understood as a political slogan, one that emerged from domestic economic and political struggles and has been appropriated by various domestic actors for their own purposes (Shen, 2017; Cheng and Zeng, 2024; Oreglia and Zheng, 2024). Acknowledging the term's inherent vagueness, this dissertation adopts a broad definition of the DSR, using it to refer to Chinese-built digital projects abroad since 2015.

developing nations by using loans. This narrative emphasises that the Internet is likely to become less open and more authoritarian with the greater prevalence of Chinese hardware and software. As put by Hillary Clinton: “With the spread of these [Chinese] restrictive practices, a new information curtain is descending across much of the world.” (Clinton, 2010). In this view, the globalisation of China’s internet industry is likely to lead to the spread of what these observers have dubbed “Internet authoritarianism”, “digital imperialism”, or even more vaguely as “digital Leninism” (Chalk, 2019; Chen, 2021). The prevailing superpower-centric focus in this literature often assumes that major powers are the primary agents of influence. Certain strands of the literature even exhibit a neocolonial tone, at times portraying the Global South merely as a passive backdrop to geopolitical rivalry.

Overblown claims about Chinese digital technologies represent the most recent layer to the already substantial body of alarmist writings on China's presence in the Global South, especially in Africa. A vast empirically grounded literature has dispelled many myths about China in Africa (Brautigam, 2009; Lee, 2018; Oya and Schaefer, 2019). Exaggerated concerns about Chinese influence stem from incorrectly inflating the scale of Chinese loans, such as when a journalist mistakenly interchanges the terms ‘US dollar’ and the ‘Chinese yuan’ or makes claims of Chinese land acquisitions and the use of prisoners in African operations on unfounded rumours. In reaction to the perceived scale of Chinese investment, a highly politicised debate has arisen between predominantly Western narratives of Chinese neo-colonial exploitation and disregard for human rights, and Beijing’s assertion that it is fostering South-South collaboration without the hegemonic ambitions or World Bank-style conditionalities of Western donors and investors.

In recent years, the spectre of a “Chinese scramble” has increasingly centred on China’s booming ICT sector. Scholars of global political economy have argued that the underlying catalyst driving the US and China tech war transcends ideological differences about how the Internet should be governed; rather, it primarily revolves around a race between the two nations to assert dominance in digital technologies, notably artificial intelligence (AI) and cloud computing (Sheng, 2022). In this scenario, Beijing is set to reap the economic, political and intelligence advantages that once flowed to Washington. Varoufakis (2024) contends that power in the new global economy stems from owning copious amounts of what he dubs Cloud capital, explaining that the real issue driving the new “Cold War” between the US and China lies in a fierce competition over securing supremacy over cloud capital. In this vein, several

measures have been undertaken by successive US administrations to halt China's rise as a digital superpower in order to safeguard American interests and maintain global influence.

Significant victims in the debate, which pits the two largest economic powers against each other, are the developing countries caught in the middle. While scholarly work in international relations has addressed some key geopolitical implications of China's digital presence (Malena, 2021; Eguegu, 2022; Dai, 2022), less attention has been paid in the existing development studies and political economy literature to what China's increased digital presence in other developing countries could signify for global digital inequalities and pathways for potentially reducing them. This doctoral thesis seeks to contribute to our understanding of China's digital footprint in developing countries by empirically investigating the developmental spillovers from Chinese ICT firms in host developing countries. In doing so, it aims to enhance our understanding of China's evolving role within global digital capitalism and the emerging opportunities and risks for host economies striving to harness digital technologies for sustainable growth and improved living standards.

The nascent literature in this area has focused on the impact of Chinese-built infrastructure in expanding ICT access and connectivity. Wang (2016) argues that digital infrastructure built as part of the BRI like fibre optic cables, data centres and smart cities, can improve the connectivity of poorer nations to the global economy allowing for the establishment of a more inclusive global economy. The development of such infrastructure is believed to remove institutional and technical bottlenecks (Liu and Dunford, 2016). Using quantitative methods, Ho, Narins and Song (2023) find that participating economies in the BRI and DSR experience a significant rise in ICT development. In these accounts, presumably apolitical, technically superior foreign actors combine an optimistic faith in technology with a dedication to market expansion (Burns, 2015). Yet, if improved access to ICT infrastructure is important, ICT development, or technological change more broadly, requires more than technological diffusion through free markets, as emphasised in the neoclassical school upon which these publications are premised.

Heterodox research has shown that improving internet connectivity alone does not yield the expected gains assumed by the neoclassical model (Murphy and Carmody, 2015; Foster et al., 2018; Mann and Iazzolino, 2019). Scholars identified with heterodox economics have argued that when it comes to development, the crux of the matter does not lie in boosting efficiency in

performing low value-added activities, but rather in the move towards higher productivity, and technological intensity, a process known as structural transformation (Chang, 2002; Rodrik, 2013a). They emphasise the importance of structural transformation for development (see Amsden, 1989; Wade, 1990; Chang, 1994, Foster et al., 2021). Scholars from this tradition contend that free trade *by itself* does not inherently generate wealth. Instead, it only becomes useful for wealth creation after a country has achieved competitive manufacturing sectors with economies of scale. Heterodox theory criticises neo-classical economics as a theory focused on exchange within equilibrium, deeming it inadequate for explaining production relationships. Unlike orthodox theory, which posits that growth arises from perfect competition and the efficient allocation of resources, heterodox theory asserts that economic development is driven by structural transformations that disrupt equilibrium, foster imperfect competition, strengthen technological capabilities and generate economic rents (Lall, 1992; Khan, 2000).

According to the heterodox school of thought, long-term development and value creation depend on several key strategies. These include using borrowed technologies, building forward and backward linkages within the domestic economy, improving productivity through process upgrading and learning by doing, and, ultimately, driving product innovation or producing higher-value goods based on accumulated technology, knowledge, and skills (Hirschman, 1958; Amsden, 2001). Seen from this perspective, the developmental contribution of the Digital Silk Road, or the globalisation of China's ICT industry, is contingent on several factors including the host country's political economy, existing industrial policies, and the capabilities of local firms and workers. Crucially, the developmental outcomes of the DSR hinge on how effectively governments in developing countries can leverage partnerships with Chinese digital multinationals to promote technological upgrading, as well as on the capacity of domestic firms to absorb and integrate new knowledge and technologies into their production processes, ultimately enhancing productivity and competitiveness (Lall, 1996; Amsden, 2001; Fu et al., 2011; Whitfield, 2023).

Drawing on this theoretical tradition, this dissertation aims to explore the grounded effects of Chinese ICT firms on technological upgrading in host middle-income countries by asking the following overarching question: *Does the influx of Chinese digital capital into host developing countries foster new opportunities for technological upgrading and structural transformation, or does it, instead, impede the development of technological capabilities and constrain broader economic change?* This question embeds the discussion of China's contribution to narrowing the digital divide within a framework centred on technological capabilities and structural transformation. By digital capital, I refer primarily to digital corporations that drive the transnational expansion of technologies and infrastructures. These firms embody and circulate distinct configurations of economic, technical, and political power through their investments in fibre networks, data centres, cloud systems, and training programmes, as well as through the diffusion of proprietary technologies and governance models. In using the term digital capital, the dissertation borrows from Ching Kwan Lee's notion of *varieties of capital* (Lee, 2017). Lee criticises the varieties of capitalism framework for its state-centric and nationally bounded focus, which fails to capture the diversity of capitalist practices emerging from a single country across multiple sectors and contexts. She introduces *varieties of capital* to shift analytical attention from national systems of capitalism to the situated forms and practices of firms as they operate across borders. Extending this concept to the digital sphere, I use digital capital to capture the diverse material, financial, and technological arrangements through which corporations interact and negotiate in different political economies.

To tackle this central question, this dissertation employs a mix of research methods from quantitative analysis to fieldwork interviews and observations. Importantly, the thesis examines the technological and regulatory spillovers emanating from the interaction between Chinese digital corporations with local configurations of power and skills in two North African countries: Egypt and Algeria. With its strategic location, connecting Asia, Africa, and Europe, North Africa holds a central position in China's BRI (Abdel Ghafar and Jacobs, 2019). Over the past decade, the region has become host to several hallmark Chinese digital infrastructure projects, including 5G networks, data centres, and smart cities built by Chinese ICT original equipment manufacturers (OEMs) (Kurlantzick, 2020). While the "digital industry" comprises various sub-sectors, this study specifically targets ICT OEMs, primarily Huawei and ZTE (Shen, 2017, p. 93). These two ICT OEMs are the predominant Chinese digital enterprises in North Africa. Unlike platform-based businesses, this sub-sector has the potential for creating multiple linkages, theoretically capable of fostering significant avenues for technological catch-up.

The dissertation introduces a theoretical lens that brings together two bodies of scholarly work that have largely evolved in isolation. First, it draws, as highlighted earlier, on heterodox approaches to economic development to understand the effect of these foreign firms on technological upgrading and emerging spillovers. Second, it deploys the technopolitics framework to analyse the politics, norms and standards conveyed through digital infrastructure. Technopolitics builds on an infrastructural lens commonly used in science and technology studies, the history of technology and anthropology. Coined by the historian of technology Gabrielle Hecht, the term refers to "the strategic practice of designing or using technology to constitute, embody, or enact political goals" (Hecht, 2001, p. 256). As will be discussed in the next chapter, previous research on the contribution of Chinese ICT firms to host economies has tended to neglect the politics embedded in infrastructure and the geopolitical ramifications of competing digital systems and standards on technological upgrading and development.

This dissertation's theoretical framework emphasises that the effects of foreign ICT firms are shaped by geopolitical, political and economic structures intertwined with ideological preferences, industrial policies, technological regimes and path dependencies. Thus, in lieu of the existing narratives of seamless connectivity-boosting infrastructure and unproblematic knowledge flows, the analytical approach offered here draws attention to the frictions, fractures, and opportunities arising from digital infrastructure built by Chinese and non-Chinese firms in their efforts to connect African economies to the circuits making up the global digital capitalist system.

1.1 Research questions

As highlighted above, this dissertation's central research question asks whether the influx of Chinese digital capital to host developing countries creates new prospects for technological upgrading or if it, conversely, hinders the accumulation of technological capabilities. To address this question and building on a theoretical framework elaborated in Chapter 2, this thesis takes an integrative perspective to studying technological upgrading in the digital sector by looking at three interconnected aspects of structural change and upgrading: 1) ICT infrastructure and connectivity 2) technology transfers and 3) data governance frameworks. The central research question is thus disaggregated into three sub-questions:

1. ***What impact does China's expanding role in infrastructure provision have on digital connectivity in host economies, and how does it shape emerging digital systems?*** Understanding the nexus between Chinese digital infrastructure and Internet access is crucial for unveiling the variegated effects of China's digital footprint on technological catch-up and the global digital divide. Enhanced access to digital infrastructure facilitates the digitalisation of local firms and industries and accelerates integration into global value chains (GVCs), which can in turn enhance productivity and foster structural change (West, 2015; Szalavetz, 2020). Chinese ICT firms, often backed by government funding, have played an increasing role in the financing and provision of digital infrastructure, however, the way in which these projects have influenced digital connectivity has remained largely underexplored. As the cost of infrastructure shapes developing countries' technological choices, this chapter further interrogates how the diffusion of Chinese artifacts and components is reinforcing distinct protocols and standards on the ground and thus redrawing digital industries against the backdrop of US-China rivalry.

2. ***Are Chinese tech giants creating new opportunities for technology transfer, learning, and innovation?*** This question zooms in on the heart of the issue by investigating the technology transfers and spillovers generated by Chinese tech firms in host economies. It aims to understand the intensity and quality of industry and university linkages established by Chinese subsidiaries in Algeria and Egypt. To what extent are Chinese ICT firms localising their supply chain in North Africa, and how are these linkages influencing domestic technological capabilities? How and why are Chinese digital corporations providing training to local engineers and students? To

what extent are these training programmes leading to a consolidation of domestic capabilities? These interconnected questions aim to go beyond the existence or absence of linkages to understand the tangible effects of linkages on the ground, including the diffusion of norms and standards that may reshape ICT industries in host countries, either by promoting or hindering technological upgrading.

3. ***In what ways are Chinese-built digital projects reshaping the global and asymmetric distribution of data ownership and control? And how are these infrastructural projects on the ground determining nascent data governance frameworks?*** With data becoming increasingly crucial for digital economies, the proliferation of Chinese-built data infrastructure prompts questions about its implications for domestic digital capabilities and data inequalities within and across countries. It raises concerns about whether the concentration of ICT infrastructure built by China fosters or exacerbates existing disparities in access to/and control over digital data. As the establishment of data infrastructure can shape the regulatory environment and policies related to data governance in host countries, this question also seeks to examine how data centres and cloud services influence the development of nascent data governance frameworks.

These sub-questions constitute three distinct empirical chapters. Along with the conceptual framework adopted in this thesis, these questions emphasise that only a deeper, empirical engagement with technical processes on the ground – rather than assumptions based on preconceived ideas – can allow an adequate understanding of the upshots from the globalisation of China's digital industry. As such, this dissertation brings evidence from a region where China has dramatically increased its presence and influence, and where the digital economy is still taking shape, at the level of infrastructure, capabilities, and governance, to empirically examine the extent to which China is (re)shaping ICT industries, and what this means for host country's prospects of technological upgrading and development. By zooming in on the actual dynamics of global digital China through traceable socio-technical linkages, these questions enable us to go beyond depoliticised and over-politicised debates about China's developmental role to capture a more complex reality.

1.2 Studying the Digital Silk Road in North Africa

From Mao Zedong's Three World theory to Xi Jinping's Belt and Road Initiative, China and North Africa have developed and sustained strong relations rooted in a shared experience of colonial domination (Pairault, 2017). While North African countries have different political economies, they all share middle-income status and have in common growing numbers of tech-savvy young people, a relatively high rate of internet penetration, and proximity to the EU market, making the region a strategic hub for the Digital Silk Road. One of the first high-level references made to the DSR was in the 13th Five Year Plan published by the Central Committee of the Communist Party of China (CCCPC) in 2016, which stated the aim to "develop an online Silk Road with the Arab countries and others through high-speed fibre optic networks" (CCCPC, 2016, p. 71).

As elsewhere on the continent, following the rapid socio-economic progress of the independence era, structural adjustment policies in the 1980s and 1990s contributed to a rapid deindustrialisation and a rise in inequalities across the region (White, 2001; Mkandawire, 2001). The free trade agreement signed with the EU in the early 2000s has failed to fulfil promises of sustained growth and wider social benefits, leaving the region's economies stuck in low added-value sectors and primary-commodity exports (Azmeh and Elshennawy, 2020, p.15). Remarkably, the youth unemployment rate in the MENA region was 24.4%, nearly double the global average of 13% in 2023 (ILO, 2024). More than ten years after the mass revolt against authoritarianism, poverty, and lack of economic opportunities, no notable change has materialised in the region. The Covid-19 pandemic exacerbated already fragile economies, forcing the elimination of thousands of businesses and jobs (Dabrowski and Dominguez, 2021). For countries in the region to produce and sustain economic growth and create high-quality jobs for the millions of unemployed workers, they need to undergo structural transformation.

In this context, the DSR is perceived by local governments as an opportunity to speed up their transitions to knowledge economies and escape the middle-income trap while creating quality jobs for millions of unemployed people in the region. North Africa has maintained a tradition in training high calibre IT engineers, and some countries like Egypt have positioned themselves as leaders in ICT services delivery (Göll and Zwiers, 2018). Local firms also engage in the production of ICT equipment, with Algeria's Condor and Egypt's Sico being two noteworthy examples. The technological gap between China and North African economies is thus less pronounced than in it would be with low-income countries, increasing their chances for

experiencing technology linkages and spillovers (Glass and Saggi, 2002).

Since the turn of the century, North Africa has witnessed an increase in Chinese FDI. Nonetheless, much of it has reproduced patterns of unequal trade between economies with diverging levels of sophistication and diversification (Pairault and Talahite, 2014, p. 23). The BRI and its digital component bear the promise, however, of bringing more investment in infrastructure, manufacturing and high-tech. Chinese tech giants have in recent years signed numerous large contracts across the region for the construction of digital infrastructure. In Egypt, Huawei signed a contract to establish the first system for cloud computing and artificial intelligence in Africa (Egypt Independent, 2019), while Telecom Egypt signed a deal with ZTE to create a joint technology training centre and innovation laboratory (Agence Ecofin, 2019a). Algeria is the only African country counting a Huawei manufacturing plant. The factory is a joint venture between Huawei and Algerian firm Afgo-Tech, with a capacity to produce 15,000 smart devices per month (Agence Ecofin, 2019b). The decision to set up the factory was reached after lengthy negotiations with the Algerian government, which placed a ban on the importation of mobile phones in 2018 to promote domestic production (Rabhi, 2021).

While both Algeria and Egypt face sluggish economic growth and seek to harness digital technologies for development, their strategies differ significantly, as will be explored in greater detail in Chapter 4. Algeria is a state-dominated economy where hydrocarbons represent 95% of export revenues, constituting the largest source of government income. Algeria is one of the last remaining countries that are not members of the World Trade Organisation (WTO), and it imposes strict control over foreign capital, with joint ventures required in strategic sectors (Laouisset, 2021). Historically, Algeria has pursued protectionist industrial policies to encourage the development of its local manufacturing base, including import substitution policies, and local content requirements. In recent years, the Algerian government has tried to welcome more FDI, but investors' appetite has been limited outside of the hydrocarbon sector (Beladi, 2023). The country relies on its public funds to ensure infrastructural catch up including in telecommunications.

In contrast, Egypt has a more market-friendly economy and is more open to foreign capital. Major economic liberalisation reforms were introduced as early as 1974 with the implementation of the Open Door Policy (انفتاح, infitāḥ) (Waterbury, 1985). In 2017, Egypt passed an investment law that promotes inbound FDI by easing barriers to entry, offering investors more incentives, and supporting foreign multinational firms' localisation efforts.

Cairo aims to capitalise on its strategic location and its market of over 100 million consumers - the largest market in the MENA region and the third biggest in Africa - to become a regional trade and investment gateway. The government also intends to attract investment in several mega-projects including the construction of a new national administrative capital in which China is a leading player (McGrego, 2022). However, many of these projects have raised concerns about the country's growing indebtedness, particularly given the substantial financial commitments required to undertake such large-scale initiatives.

Recognising the potential of the digital economy to help their structural transformation, both countries adopted national ICT plans designed to expand internet connectivity, upgrade workers' skills, and create flourishing knowledge economies. Egypt's ICT 2030 plan prioritises developing ICT infrastructure, fostering digital inclusion, building domestic capacity, and encouraging innovation (MCIT, [Ministry of Communications and Information Technology], 2016). Egypt has positioned itself as a regional leader in exporting information technology services and is home to a growing startup scene. Algeria initially lagged in initiating its digital transformation but has since made substantial progress in ICT infrastructure development, evidenced by a more than twentyfold increase in bandwidth capacity since 2014 (APS [Algeria Press Service], 2021a), with a significant portion of this expansion built by Chinese ICT firms. The creation of the Ministry of the Knowledge Economy, Start-ups and Microenterprises in 2020 was also part of the government's attempt to break away from the current hydrocarbon-dependent model toward a knowledge-based model.

In their efforts to foster technological upgrading, the two North African governments are investing heavily in upgrading network infrastructure. Egypt experienced substantial growth in internet usage, with the proportion of the population using the internet rising from 29% in 2009 to 73% by January 2023. Similarly, Algeria's internet penetration reached 74% in 2023, marking a significant increase from comparably low levels a decade earlier (World Bank, 2025a). The scale of growth, which represents tens of millions of new users across both countries, has intensified pressure on existing telecommunications infrastructure. This surge necessitates large-scale deployment of broadband networks, data centres, and 4G and 5G networks to maintain service quality and expand coverage, driving strong demand for core networking equipment from global ICT manufacturers like ZTE and Huawei.

1.3 Contribution

As ICTs have become multifunctional and pervasive technologies and as China has become an ever-more-important player in this sector, understanding the interplay between China and the digital economy is critically important to development studies and political economy. However, empirical research in this sphere remains scant. As such, this dissertation contributes to the literature by integrating the discussion of China's globalising internet into a developmental framework, bringing rich empirical evidence on how Chinese ICT firms are interacting with local configurations of skills and power in Algeria and Egypt and the implications of these interactions for technological upgrading and development.

This work builds upon and adds to ongoing discussions of China's presence in the Global South by moving from well-covered sectors such as agriculture (Brautigam, 2015; Amanor and Chichava, 2016; Kampini and Kalepa, 2024), construction (Auffray and Fu, 2015; Kirchherr and Matthews, 2018; Oya and Schaffer 2019) and low value-added manufacturing and mining (Yunnan et al., 2016; Tang, 2016a, 2019; Camba et al., 2022) to focus on the digital industry, highlighting the role of digital multinationals in the process. This research also seeks to advance our understanding of interconnected fields such as BRI, foreign direct investment (FDI), infrastructural catch up, and technology transfer, ICT for development (ICT4D), data governance, South-South cooperation, and contribute to the growing discussion on the globalisation of Chinese internet firms (Hong, 2017a; Shen, 2018).

Most significantly, this doctoral thesis makes a theoretical contribution by bridging two bodies of scholarly work that have largely evolved in isolation: heterodox development economics and technopolitics, putting forward an original multi-dimensional conceptual framework to examine the developmental spillovers from foreign ICT corporations. Heterodox development economics provides robust analytical tools for examining technology acquisition, capability building, and structural transformation, yet has traditionally treated infrastructure and technology transfers as politically neutral inputs. Technopolitics, conversely, reveals how technical systems embody and enact power through embedded standards, governance structures, and material infrastructures. Bringing these traditions into conversation is particularly critical in an era of competing technological regimes, where the developmental implications hinge not merely on whether new technology diffuses but on which standards, protocols, and governance models become embedded in recipient economies, ultimately shaping the parameters and possibilities of technological upgrading itself.

By combining these two traditions, this dissertation operationalises a novel multi-dimensional analytical approach spanning infrastructure, technology transfer, and data governance, three interconnected levels that together capture how digital technologies are acquired, controlled, and leveraged for development. While this framework draws attention to the power embedded in technology, it does not assume predetermined effects associated with it. It recognises that only a deeper, empirical engagement with technical processes – rather than assumptions based on preconceived ideas – can allow an adequate understanding of the complex interactions between foreign ICT firms and technological upgrading. In this sense, this multi-scalar framework transcends the binary between over-politicised geopolitical narratives and depoliticised technical assessments that has characterised much existing research. It also challenges frameworks that impose rigid distinctions between 'global' regimes and 'local' structures, instead emphasising dynamic interactions and strategic manoeuvring.

Building on this conceptual synthesis, the dissertation turns to the empirical domain to highlight the crucial role of local agency in shaping developmental outcomes from Chinese infrastructure projects and investments. It does so by extending the analysis to North Africa, a region that, despite its growing importance in China's global strategy, has received relatively little scholarly attention. By focusing on North Africa, this dissertation provides fresh empirical evidence on China's digital footprint adding to a growing literature on the topic, covering West and East Africa (Agbebi, 2019; Tugendhat, 2021; Rwehumbiza, 2021), Southeast Asia (Li and Cheong, 2017; He, 2024), Central Asia (Baldakova and Oreglia, 2025), and Latin America (Larios-Hernandez, 2024; Vila Seoane and Alvarez Velasco, 2024; Majerowicz and de Carvalho, 2024). Examining how local actors in Algeria and Egypt negotiate, adapt to, and shape Chinese digital MNCs offers potential for comparative perspectives that enhance our understanding of the broader patterns of China's engagement across the Global South.

Methodologically, this dissertation explores the use of mixed methods approaches to research the developmental implications of foreign built digital infrastructure, in a field that has traditionally relied on single-method research designs. By combining quantitative and qualitative methodologies, the study delves into the complex interplay between Chinese digital capital influx and technological upgrading in host developing countries. Leveraging statistical regression within a comparative framework, it provides a comprehensive examination of how ICT corporations influence local capabilities, while attending to the power dynamics that shape these processes. As discussed in the following chapters, and to avoid the trap of "Chinese exceptionalism" that characterises much of the existing literature, this thesis draws on a pool

of interviewees that includes representatives from both Chinese and non-Chinese ICT firms. This comparative approach enables a clearer distinction between practices specific to Chinese firms and broader industry-wide patterns.

Finally, and more fundamentally, this research seeks to offer evidence, analysis, and insight for developing countries positioned at the lower tiers of the digital economy, supporting their efforts to build technological capabilities and upgrade amid intensifying US-China tech rivalry. It explores how industrial policies can help these countries carve out a competitive foothold in the global digital economy and strategically harness global tech competition to drive structural transformation, generate quality employment, and ultimately improve living standards.

1.4 Chapter Overview

After this introduction, the thesis proceeds as follows. **Chapter 2** provides a review of the relevant literature and introduces the theoretical framework deployed in this thesis. It starts by examining interconnected strands of scholarly work, raising questions and identifying conceptual gaps. It then introduces the technopolitics lens, explaining how incorporating insights from this framework in studies of China's digital presence in the Global South, can help us move beyond both apolitical narratives of infrastructural development and overly politicised geopolitical perspectives by capturing the materially grounded impact of such infrastructure. This approach allows us to unpack the peculiar protocols and standards upheld in infrastructural systems and diffused technologies.

Chapter 3 presents this dissertation's research design that pragmatically leverages a variety of data sources and research techniques to explore the fallouts of the growing presence of Chinese ICT firms on host economies. The chapter begins by briefly examining the methods and data used in previous studies on the impact of digital investments on economic development, with a specific focus on China's evolving role in this context. It then clarifies the rationale behind mixed methods to address the multifaceted dimensions of China's digital influence and the dissemination of technopolitical frameworks. Subsequently, the research design of the thesis is elaborated upon, outlining both quantitative and qualitative approaches and detailing the specific methods employed for data collection, the datasets utilised, and the process of gathering and analysing interview data to inform the presentation of the primary findings.

Chapter 4 aims to chart the trajectory of the ICT sector in China, with a particular emphasis on the industrial policies that have shaped its development and its global expansion. By delving

into the evolution of China's ICT landscape, this chapter seeks to provide a comprehensive understanding of the strategies employed by the Chinese government to foster growth and innovation within the sector. Additionally, it aims to offer a thorough background on the ICT industries in Algeria and Egypt, contextualising their current state and highlighting key trends and challenges. This contextual information is essential as it lays the groundwork for the empirical analysis that unfolds in the subsequent chapters of the thesis. This chapter seeks to clarify both the political objectives and economic strategies that have shaped the development of each ICT industry, illustrating how ICTs are embedded within power dynamics and structures that serve distinct political aims. As such, ICTs are negotiated, adopted, and reconfigured by various actors to advance the interests of those in power, with varying degrees of economic success depending on objectives, policies, and how power, skills, and resources are organised locally.

Chapter 5 analyses the impact of China's role in ICT infrastructure provision on Internet access and host ICT ecosystems. A staggered propensity score reweighting Difference-in-Differences (DiD) regression approach is employed to establish the causal relationship between participation in the BRI – used as a proxy for stronger economic ties with China and its ICT firms – and internet access rates. The analysis relies on a unique dataset that I have developed, comprising data from 132 countries spanning 2008 to 2022. I account for country-specific and temporal variations, incorporating carefully selected control variables based on relevant theoretical frameworks. The findings indicate that BRI countries experience a 2.82 percentage point increase in internet access compared to non-BRI countries, even after controlling for other variables, with statistical significance at the 0.1% level. The findings satisfy the parallel trends assumption and are robust to alternative model specifications. This highlights the BRI's role in reducing the digital infrastructure gap and enhancing connectivity. Beyond macro quantitative analysis, the second section of this chapter further examines the tangible impact of expanded Chinese ICT infrastructure on domestic digital systems in North Africa, using Algeria's deployment of Fibre to the Home (FTTH) with Huawei and ZTE as a case study. The case study shows that collaboration between Algeria and these two Chinese ICT giants has facilitated the rapid rollout of digital infrastructure, significantly improving connectivity. However, the decision to designate these two firms as primary providers raises concerns about dependency in Algeria's ICT sector, as reliance on a limited pool of suppliers constrains development opportunities for local firms and restricts the country's future technological choices.

Chapter 6 examines the technology spillovers emanating from Huawei and ZTE in Algeria and Egypt by drawing on 107 interviews conducted during multiple fieldwork trips. It examines three types of linkages: horizontal linkages, vertical linkages, and connections with local universities, emerging between Huawei and ZTE and the Egyptian and Algerian economies. It finds that as technological latecomers, the two Chinese firms, and Huawei in particular, have been more engaged in providing training to university students, potentially bolstering the local ICT ecosystem by organising high-level competitions and providing scholarships and awards. However, despite localising activities that bear the promise of generating significant spillovers, closer scrutiny of the politics embedded in these linkages indicates that the two Chinese tech firms have created no obvious learning opportunities for domestic entities. What may appear to be developmental connections for technology transfer are, in fact, channels through which Chinese infrastructures, hardware, software, processes, and standards are diffused, shaping distinct digital systems oriented around the consumption of Chinese technologies. However, as technological latecomers, Chinese ICT firms have invested considerable resources in capacity-building initiatives. While these initiatives may be motivated more by public relations than commitments to development, they still have the potential to spark learning and innovation to the extent that they expose students, workers, and suppliers to increasingly dominant standards and cutting-edge technologies. This exposure, in turn, can in the long run promote learning and innovation within the ICT industries of host countries.

Chapter 7 investigates whether Chinese-built data centres in middle-income host countries contribute to reducing global asymmetries in data control. Drawing on fieldwork interviews, analyses of policy documents and cyber security laws, as well as reports published by firms, governments and financial institutions, it analyses the collection, processing, and management of digital data in two Huawei-built data centres: one serving Egypt's National Research Centre (NRC) and the other serving Algeria's state-owned energy firm, Sonatrach. The findings indicate that although Sonatrach and the NRC initially attempted to localise data by establishing in-house data centres, they later outsourced management and expansion to Huawei to achieve greater efficiency. This suggests that North African countries are *superficially* localising data in strategic sectors within their borders but continue to rely on Chinese and US tech giants for processing. Consequently, control over digital infrastructure and hosted data remains with foreign multinationals, limiting opportunities for technological learning and data sovereignty. While emerging data governance frameworks in Algeria and Egypt are failing to achieve their dual objectives of data sovereignty and economic development, both are still able to use the emerging data system to expand their surveillance capabilities and reach over their populations.

Chapter 8 provides a conclusion. It starts by summarising the key empirical findings and weaving them together to construct a comprehensive answer to the central research question of the thesis. This is followed by a discussion on the implications of the emergence of a competing technopolitical regime, characterised by distinct norms, standards, and protocols, with one centred on China and the other on the US, for digital development in third countries. As highlighted in the conclusion, while both technological superpowers risk trapping third economies within systems and technological regimes that reinforce path dependency, the emergence of an alternative to US dominance in the digital sphere also provides developing countries with greater bargaining power and increased agency to shape their own digital futures. Ultimately, the extent to which developing nations can leverage this competition for national development will depend on local configurations of power, capabilities, and industrial policies. I suggest pathways for digital industrial policies that can enhance developing countries' strategic autonomy. I conclude by identifying key areas for future research.

CHAPTER 2

A Conceptual Lens to Understand the Developmental Effects of China's Global Digital Expansion

This chapter discusses the theoretical framework used to analyse how Chinese ICT firms are shaping digital transitions in North Africa and implications for technological upgrading and digital inequalities. It reviews key debates, raises a few questions and discusses theoretical shortcomings in existing approaches before introducing the conceptual framework deployed in this research. I begin by examining three interconnected strands of literature: (a) ICT and development; (b) Industrial policy and technological transfers through foreign direct investment (FDI); and (c) The role of Chinese firms in the dynamics of infrastructure building and technological upgrading in the Global South. I then discuss the technopolitics lens and explain how integrating its insights can help to illuminate the politics embedded in infrastructure, including the protocols and standards upheld in technological systems and diffused artifacts and training programmes.

Building on conceptual gaps in the literature, I propose a multidimensional analytical framework that integrates heterodox approaches to economic development with insights from technopolitics. The former allows an examination of the influence of foreign firms on technological upgrading and provides a means to trace productivity spillovers. The technopolitics lens allows an exploration of the regulatory power embedded within digital infrastructures and the ways in which technological regimes are negotiated between global and local actors. Examining the role of foreign digital firms in host economies through this analytical framework enables us to reframe a dynamic that is often approached either from a detached macro-geopolitical standpoint or through a technical, depoliticised lens. Instead, my framework highlights how developmental outcomes are shaped by the complex interaction of competing forces within specific contexts.

2.1 ICT and Development

Does the influx of Chinese digital capital into host developing countries create new opportunities for technological upgrading or does it conversely, hinder the accumulation/acquisition of those technological capabilities? According to the prevailing orthodoxy, digital connectivity promotes economic growth by improving efficiency and spurring productivity (Aker and Mbiti, 2010; Bertot et al., 2010; Ndemo and Weiss, 2017). The discourse around digital technologies is often accompanied by futuristic predictions about their ability to achieve convergence and reconfigure the position of developing countries in the global political economy (Baldwin, 2019). As put by a Deloitte report: "By providing access to information, connecting people to businesses everywhere, and opening up new markets, the Internet can transform the very nature of an economy and support economic development" (Deloitte, 2014, p. 3). Seen from this perspective, infrastructural initiatives like the Digital Silk Road are inherently developmental as they improve connectivity and bring new technologies to less-developed economies.

This techno-optimistic view echoes the neoclassical or exogenous growth model in which the long-run growth rate is determined exogenously because technological change, a crucial explanatory factor of labour productivity, is viewed as an external factor to the economic system (Solow, 1956). In this model, countries behind the technological frontier would be better off competing by leveraging low labour costs and specialising in activities in which they hold a comparative advantage. This assumption is premised on the idea that production specialisation yields the maximum efficiency of resource allocation and, thus, maximum welfare among trading partners (Krueger, 1990, for a critique see Wade, 2017). Poorer countries can grow through their labour cost advantage while they also gain access to foreign technology over time.

Following the neoclassical orthodoxy, less developed economies should be unconcerned about producing advanced technology as their comparative advantage lies in low-cost activities such as agriculture or those areas of manufacturing with natural protection, that is activities where certain characteristics offer inherent insulation from foreign imports like cement and fizzy-drink production. Here trade barriers prevent the market's efficiency-enhancing mechanisms, distort the allocation of resources in the economy, and impose higher costs on its population (Krueger, 1998).

Seen from this perspective, industrial policy is harmful, and the role of government should be restricted to maintaining a sound macroeconomic environment, protecting private property rights and "getting the prices right" (Krueger, 1998; Lal, 2000). In more recent years, the theoretical underpinning of the neoclassical school was inherited by New Institutional Economics (NIE), a school of thought that understands the critical elements for improved economic performance in developing countries to be "better" institutions that ensure generalised property rights and accountable, transparent political systems (North, 1990).

For proponents of this model, the interconnected nature of the digital economy means that science, technology, and communication infrastructure are instrumental for rapid economic growth. The idea is that local firms, particularly small and medium-sized enterprises (SMEs), can benefit from improved broadband by accessing new knowledge and markets, collaborating with international partners, and adopting digital technologies that enhance efficiency. Studies from this tradition, indicate that broadband infrastructure drives economic growth, enhances productivity, and creates employment opportunities in the ICT sector and beyond (Minges, 2015; Katz and Callorda, 2018). According to Hjort and Poulsen (2019), the introduction of fibre-optic submarine cables in 12 African countries has led to positive outcomes such as increased employment due to new business entries, improved productivity, and higher export levels. Moreover, according to a study cited by the World Bank's World Development Report (WDR), a 10 percent rise in data centres correlates with a 1.6 percent growth in exports of data-related services (WDR, 2021). Although digital disruption is to be anticipated in both neoclassical and NIE models, the market is assumed to ultimately deliver ameliorative and compensating effects to this disruption, resulting in overall positive outcomes (Mansell, 2014, p. 11). Digital technologies are thus hailed as transformative tools that can help reduce information asymmetries and transaction costs narrowing inequalities within and across countries (See Mann and Iazzolino, 2019 for a critique).

Drawing on NIE thinking, international financial institutions (IFIs) repeatedly made grandiose claims about the social and economic goals ICTs can help achieve. Connecting the "unconnected" through investments in digital infrastructure has become a key mantra for IFIs, rooted in the belief that improved connectivity "strongly affects a country's growth prospects" (Schware, 2005, p. 13). Policy documents emanating from IFIs suggested that by investing in ICT infrastructure, such as broadband networks, fibre optic cables, and wireless communication systems, countries could improve the availability and quality of such infrastructure, thereby lowering operational expenses for service providers and reducing the

cost of ICT usage. This in turn would reduce transaction costs and information asymmetries. For instance, The World Bank's 1998 report on *Knowledge for Development* emphasised that "information problems", such as incomplete understanding of product quality or firm credibility, constituted significant knowledge gaps and impediments to development. The report emphasised that "new communications technologies and plummeting computing costs are shrinking distance and eroding borders and time" (World Bank, 1999, p. i), reflecting an optimistic outlook. This perspective suggests that the proliferation of ICTs can bridge these knowledge gaps and facilitate market-driven growth in developing countries.

In contrast with this view, heterodox scholars have argued that digital technologies are not different from other technologies and that market mechanisms alone cannot ensure technological upgrading and sustained growth (Castells and Himanen, 2014; Wade, 2003; Mazzucato, 2013). Scholars from this tradition have criticised neoclassical approaches for perceiving economic development as the mere outcome of incremental efficiency and productivity gains at the individual level (Graham and Mann, 2013). They have convincingly argued that the challenge for developing countries is to undergo structural transformation, the move from low-productivity activities with low margins to higher-productivity activities with greater returns (Chang, 2002; Kaplinsky, 2005; Rodrik, 2013a). This process necessitates the ongoing diversification and upgrading of existing industries towards more capital-intensive sectors. To achieve this, states must invest in technological learning and upgrading, alongside improvements in both tangible and intangible infrastructure (Lin, 2011). Without such structural changes, the potential for sustained increases in per capita income will remain constrained.

Recent empirical research has shown that connectivity alone does not yield the development outcomes assumed by the neoclassical model. Foster et al. (2018) argue that without additional efforts to boost capacity and competitive advantage, improving digital connectivity alone does not inherently benefit African firms in global value chains (GVCs) (See also Murphy and Carmody, 2015). Similar arguments are present in the literature on the digital divide where the uneven acquisition of digital skills and capabilities are found to further entrench inequalities both *within* and *across* countries (Carmody, 2013). Friederici, Ojanperä, and Graham (2017) contrast discourses made by IFIs, African governments and evidence from academic research on the role of internet connectivity in economic development. They find evidence of highly uneven economic impact of connectivity across geographies and social strata that contrast

sharply with the “Grand Visions of connectivity” used in official discourses (Friederici et al. 2017, p. 1). The authors attribute this mismatch to widespread technological determinism, acontextual modernism, and optimistic simplism in policy circles and call for more reflexivity regarding the opportunities of digital development.

According to Lauridsen (2010, p. 15), digital changes may be leading to serious structural problems where the “market cannot ensure a persistent structural change and technology upgrading”. In a similar vein, Carmody (2024) argues that most virtual capital in the Global South is of foreign origin, leading to the outflow of profits that, if they had been generated by local firms, could otherwise be reinvested domestically or within the region. This dynamic signifies a reconfiguration of dependence rather than its transcendence. Mann and Iazzolino (2019) argue that infrastructure built by foreign technology corporations can harm low and middle-income countries as these corporations try to lock in their competitive technological advantage, further weakening the capacity of developing countries to learn and innovate. Seen from this perspective, the developmental contribution of the DSR, or the globalisation of China’s digital industry, depends on a myriad of factors, including the technological base of the host country, local institutions, and industrial policies. This dissertation situates itself within this latest tradition in which questions of technological upgrading and structural transformation are paramount.

2.2 Technological catch-up and industrial policy

Given the lower technology base within latecomer economies, state intervention is needed to support firms' acquisition of technology and skills. Alexander Gerschenkron, one of the pioneers of development thinking, explained long ago that countries lagging behind the world technological frontier may catch up by imitating technologies discovered in countries at the technological frontier using state interventionism (Gerschenkron, 1962). Crucially, however, the catch-up process is not immediate and requires investment in “branches of industrial activities in which recent technological progress has been particularly rapid” (Gerschenkron, 1962, pp. 9-10), as is the case today with the digital economy. The emphasis of the state’s role in stirring up industrial development are part of a broader wave of similar theories (Rosenstein-Rodan, 1943; Lewis, 1954; Myrdal, 1957; Hirschman, 1958), collectively known as the structuralist approach to economic development. These early development theories argued that

the market was inherently flawed and that the state played a crucial supplementary role in accelerating economic development (Rosenstein-Rodan, 1943; Hirschman 1958).

The design, use and efficacy of industrial policy remain at the heart of heated debates. While the meaning of the term varies, industrial policy broadly refers to state interventions that aim to change the sectoral structure of production toward sectors that can provide better prospects for economic growth than would occur without such interventions (Amsden, 1990; Chang, 1993; Rodrik, 2009). A large spectrum of arguments has been put forward to justify industrial policy. Economist Justin Yi Fu Lin has argued that the state should play the role of a facilitator, enabling the private sector to exploit the country's comparative advantage (Lin and Chang, 2009, p. 485). On the other hand, scholars such as Ha-joon Chang have supported more radical approaches to industrial policy, that encourage countries to defy their comparative advantage to achieve industrial upgrading (Lin and Chang, 2009, p. 489). Yet, both these visions of industrial policy converge around the idea that state intervention is required to enable technological upgrading in latecomer economies.

Technological catch-up requires adopting new technologies that can lead to improvements in productivity and competitiveness across various sectors of the economy. Amsden and Hikino (1993, p. 243) suggested that late industrialisers in East Asia evolved as "learners", by borrowing and improving technology that had already been commercialised by experienced firms from more advanced economies. Such efforts require industrial policy to help build domestic technological capabilities through investments in education, workforce training, and research and development. Additionally, state intervention often played a critical role, as governments provided incentives, subsidies, investment in infrastructure and protectionist policies to support domestic industries during their learning and catching up phase (Amsden, 1989; Wade, 1990; Amsden and Hikino, 1993).

A key driver of technological upgrading is the acquisition of technology from foreign-invested companies through technology transfers (Lall, 1992; Markusen and Venables, 1999; Saggi, 2002; Blalock and Gertler, 2008). The idea behind technology transfers is that foreign firms are technologically superior to local ones, so once they enter a host market their presence can lead to the dissemination of knowledge and practices that can in turn lead to productivity gains (Saggi, 2002). If knowledge from foreign affiliates is made accessible, whether intentionally shared or unintentionally "leaked", it becomes a public good available for widespread use,

benefiting multiple actors in a non-rivalrous and non-excludable manner (Kopinski and Carmody, 2022). When local firms harness this knowledge to enhance their productivity, it results in a spillover. Crucially, a spillover effect depends on local firms possessing the necessary capacities and technological capabilities for learning and absorption from the foreign firm (Glass and Saggi, 2002). In the context of developing economies, such spillovers play a significant role in enabling local industries to narrow the gap with the global technological frontier while fostering the development of domestic technological capabilities, and structural change in the long run (Lall, 1992; Ning and Wang, 2018).

For knowledge-enhancing spillovers to occur, there must be connections, or "linkages," between foreign firms and the local economy. Based on Hirschman's work, the theory of linkages conceptualises the way in which a factory generates demand for primary materials like sand mining in a cement factory (backward linkage), while its outputs, cinder blocks, might be an input for the local construction industry downstream (forward linkage) (Hirschman, 1977, p. 103). The theoretical literature has recognised backward linkages as the most critical mechanism for learning and achieving productivity gains (Javorcik, 2004; Blalock and Gertler, 2008; Hirschman, 1977). There are also significant sectoral variations in the potential for technology spillovers. Manufacturing and infrastructure building are recognised as high linkage sectors in the literature (Lean, 2001; Hirschman, 1977). For instance, building digital infrastructure can foster inter-firm spillovers by encouraging industrial clustering and generating a broader supply chain in equipment and component manufacturing and services. Most fundamentally, installing new ICT infrastructure requires the transfer of know-how and skills to operate and maintain advanced technologies (Ockwell et al., 2008). In this sense, infrastructure development projects can serve as a vehicle for technology transfer, catalysing broader industrial and technological growth in the host country (Lall, 1992; Pietrobelli and Rabellotti, 2011).

Spillover effects have captivated the attention of many leaders in developing countries, who recognise the potential of leveraging multinational corporations to drive technological upgrading and structural transformation. While Chapter 6 delves deeper into the question of spillovers and linkages, it is important to note here that evidence regarding whether MNCs reliably produce positive spillovers remains scant (Haddad and Harrison, 1993; Liu et al., 2009; Kopinski and Carmody, 2022). A key issue in this literature is the problem of endogeneity– rather than boosting the productivity of local firms, MNCs may instead flock to countries that

already exhibit higher levels of productivity (Moran, 2011). In developing countries, foreign corporations have often fostered enclave economies – isolated zones with minimal connections to the broader economy (Aitken and Harrison, 1999). As Hirschman (1958, p. 110) aptly describes primary products from mines, wells, and plantations can "slip out of a country without leaving much of a trace in the rest of the economy." Moreover, foreign affiliates can outcompete local firms, capturing their domestic markets, resulting in job losses and potentially leading to monopolistic control in the host market (Haddad and Harrison, 1993).

Yet instances of technology spillovers have occurred. The development trajectories of East Asia's dragons are filled with cases of technological learning from foreign firms in a myriad of sectors. A large scholarship attests that state interventions have played an instrumental role in knowledge diffusion from MNCs and the growth of the high-tech industry in Japan, South Korea, and Taiwan (Wade,1990; Chang, 1993; Mathews and Cho, 2000; Amsden, 2001). The successful adoption, adaptation, and growth of the semiconductor industry in East Asia is a good illustration of how the astute use of industrial policy can facilitate and guide technological learning. These policies have entailed governments' hard-nosed negotiations over technology with foreign MNCs, local content requirements, the coordination of acquisition by individual firms, sponsorship of research and development (R&D) activities, development of labour capabilities, and the recruitment of overseas engineers (Mathews and Cho, 2000; Miller, 2022).

China represents a quintessential example of a country that managed to leverage access to its market to acquire technology from foreign firms. Research has explored the role of foreign firms in technology transfer in China (Young and Lan, 1997; Thompson, 2002; Lemoine and Ünal-Kesenci, 2004; Fu and Gong, 2011). In the ICT sector, the confluence of China's accession to the World Trade Organisation (WTO) in 2001, with the desire for tech manufacturers to relocate production to lower-cost regions than Taiwan and South Korea, led to growing trends of outsourcing and offshoring in mainland China (Thun and Sturgeon, 2019). Over time, the bulk of production, which was previously carried out in other East Asian countries, was transferred to mainland China, following Akamatsu's "flying geese" theory (Akamatsu, 1962). For instance, in semiconductor manufacturing, while much of the outsourcing initially focused on Taiwan due to the sizable capabilities of its electronics manufacturers and semi-conductor industry, increasing labour costs drove several firms to relocate some of their operations to mainland China (Saxenian, 2007).

There is a consensus in the literature today that technology transfer from foreign subsidiaries is contingent upon several factors. The first set of factors can be traced to variations in the characteristics of both domestic and foreign firms (firm-level heterogeneity). This variation includes the absorptive capacity of local firms and the mode of entry of the foreign investor – whether it is a joint venture or a wholly foreign-owned firm – while both shape the extent of spillovers, the former mode of entry generates significantly greater potential for spillovers (Javorcik, 2004). The second set of factors relates to the national political economy (country-level-heterogeneity). Available evidence suggests that the size of the local market (Mu and Lee, 2005; Malerba and Nelson, 2011), the proximity and accessibility of the host country to a strategic market (Ivarsson and Alvstam, 2005), and the type of institutions and policies (Mazzoleni and Nelson, 1998) all play a role in determining technology transfer from MNCs.

Crucially, government policy is central in shaping the ways in which foreign subsidiaries contribute to local technological capabilities (Ernst and Kim, 2002; Malerba and Nelson, 2011). While FDI is undoubtedly a powerful instrument for technology transfer, the relationship between FDI and indigenous technological development is far from straightforward. Lall (1992) explains that there are several stages between the import of foreign technology and the development of local capabilities. Scholarly work on technological capabilities in developing countries shows that the process of becoming and remaining technologically efficient is complex and requires the constant investment of surplus in learning and innovation (Lall, 1992; Fu and Gong, 2011). In the Chinese case, as will be detailed in Chapter 4, the Chinese Communist Party (CCP) recognised the pitfalls of its export and FDI-driven path of the 1980s and 1990s and feared that the country would be locked in lower value-added activities at the bottom of global value chains (Shen, 2017). Departing from the prescriptions of the neo-classical orthodoxy, the Chinese government introduced a series of policies to break away from its dependence on foreign technology and improve its own capabilities (Liu and Cheng, 2011).

In the ICT sector, the CCP aimed to break the hegemonic and oligopolistic control of the technology trajectory set by mainly western countries and major global technology firms (Ernst, 2011). As will be discussed in greater detail in Chapter 4, China adopted a handful of policies to move beyond the connectivity expansion approach and the mere informatisation of all fields, that is the integration of digital tools in various sectors, to boost the development of proprietary technology and standards, or "indigenous innovation" (Zhao, 2010). China's sensitivity to its reliance on foreign technology, particularly in telecommunications, a sector closely tied to

national security, strongly influenced policy perspectives. The 2000s witnessed a significant shift from technological dependence on foreign inputs to a systematic and purposeful build-up of domestic production and innovation capacities (Noumoff, 2003; Hong et al., 2012, p .924). Such industrial policies can be traced to the rise of ICT equipment manufacturers such as Huawei and ZTE and internet platform giants like Alibaba, Baidu, Tencent, and Weibo; a vibrant e-commerce sector; and booming innovations in areas such as AI and machine learning (Foster and Azmeh, 2019).

After over three decades of sustained growth, China's digital sector reached an expansionist moment. Overcapacity, falling profit rates, domestic underconsumption and market saturation, all contributed to driving China's tech champions abroad in search of new opportunities. The Digital Silk Road, with its promise to bring digital infrastructure and technology investment to developing countries, emerged as a state-led initiative to support the globalisation of Chinese digital firms. With the DSR, the Chinese government clearly hoped to absorb some of China's excess industrial capacity through large-scale infrastructure building while boosting the export of Chinese products and surplus ICT equipment through the expansion and restructuring of transnational manufacturing and trade networks (Shen, 2017; Cheng and Zeng, 2024).

But what has the influx of Chinese digital capital abroad meant for other developing countries? Does the DSR contribute to technological upgrading in host countries or does the initiative strictly serve Beijing's interests? According to the theoretical literature, the country of origin of the foreign subsidiary matters in shaping developmental outcomes. Due to cost considerations, the greater the distance from the source country, the more likely it is that inputs will be sourced locally, thereby increasing the likelihood of linkage formation and spillover effects (Halpern and Murakozy, 2007). Furthermore, the smaller the technological gap between the country from which the MNC is dispatched and the host economy, the more likely the foreign subsidiary will transfer technology and know-how that can more readily be absorbed and applied locally (Glass and Saggi, 2002, p. 497). South–South investments are thus assumed to generate more meaningful opportunities for technological upgrading than investments from high income countries (Takii, 2005; UNCTAD, 2012; Kubny and Voss, 2013). What follows delves into the literature discussing the role of Chinese firms in the dynamics of technological upgrading and structural transformation in the Global South.

2.3 China in the Global South: a developmental encounter?

The rapid growth of Chinese investment and turnkey projects across the developing world over the past two decades has spurred demand for research examining the role of Chinese firms in accelerating the process of technological catch up in host countries and bridging global inequalities. Proponents of the BRI have suggested that the initiative will reduce the marginalisation and underdevelopment of participating countries. In an article published in *Red Flag Manuscript*, the influential journal edited by the Central Committee of the Chinese Communist Party (CCCCP), Wang Yiwei, historicises globalisation into three major periods: Globalisation 1.0 led by the ancient Silk Road, globalisation 2.0 dominated by Western colonial and imperialist powers; and China's BRI which opens up the third period of "inclusive globalisation", with digital infrastructure such as smart cities and fibre optic cables improving the connectivity of poorer nations to the global economy through a more inclusive global trade and investment system (Wang, 2016a).

In a similar vein, Liu and Dunford (2016) describe the BRI as an initiative which departs from the neoliberal Washington Consensus to build a fair and equal globalisation model. This view echoes Beijing's official discourse about its foreign policy, emphasising that it promotes South–South cooperation without hegemonic aspirations or World Bank-style conditionalities. Proponents of the initiative have further argued that Chinese firms provide an alternative source of capital, technology and skills that are instrumental in helping other developing countries to close infrastructural gaps and upgrade production in a myriad of sectors (Davies et al., 2008; Huang, 2016; Wang and Shen, 2021).

On the other hand, another set of scholars have argued that China is the latest actor in a long line of self-interested powers whose expansion undermines the manufacturing capabilities and long-term growth of other developing countries (See Moreira, 2007; Torres, 2018; Stanlings, 2020 for a discussion on Latin America, Lumumba-Kasongo, 2011; Antwi-Boateng, 2017; Carmody et al., 2021 on Africa, Lee and Gray, 2016; Ejaz, 2019 on Asia). Authors have suggested that Chinese firms offer no meaningful employment opportunities to locals as they systematically favour Chinese workers (French, 2015). Low levels of labour localisation are also associated with limited efforts to develop the skills of local workers and, in more extreme accounts, exploitative working conditions (Baah and Jauch, 2009).

Critical political economy authors have argued that the new silk road is driven by China's domestic needs and that it risks creating new dependencies while contributing little to structural transformation. Scholars from this tradition have contended that if China is merely another participant in global capitalism, there is little reason to expect that its rise will inherently drive structural transformation or fundamentally alter Africa's position within the international division of labour, particularly given the historical trajectory of global capitalism in Africa and the Global South (Tull, 2006, p. 471). Rodriguez-Clare (1996) had put forward a notably pessimistic, assessment: low-income countries face systemic challenges in attracting high-tech multinationals with high productive linkage potential, as the very firms that establish operations in these economies tend to be those with minimal reliance on local supply. This dynamic, he argues, perpetuates a pattern of economic dependency rather than fostering deeper industrial integration or sustainable technological upgrading.

Drawing on Leninist theories of imperialism, Carmody et al. (2021, p. 6) argue that the mounting overaccumulation of capital has compelled the Chinese government to seek new investments overseas. Barry Naughton (2017, p. 10) had previously described excess capacity consolidation as a "traditional activity" of the Chinese state since 1978, forcing the expansion of capital to new markets when the domestic economy slows down. These arguments echo what David Harvey (1982) termed the "spatial fix"; the process of changing geographies of capital investment in long-gestation endeavours such as physical infrastructure (Sum, 2019; Zajontz, 2020). From this perspective, the BRI, much like earlier Western-led development initiatives, serves as a "vector of underdevelopment" perpetuating processes of profit extraction, exploitation, and the entrenchment of disarticulated economies, something that may only result in the diversification of sources of dependency and the deepening of inequalities (Taylor and Zajontz, 2020, p. 287).

While this trend in the literature uncovers important features of China's expansion and its implications, it tends to marginalise the agency of host countries and their capacity to shape the impacts of China's presence. Beyond minimising local agency, several studies suffer from what researchers have described as the problem of "Chinese Exceptionalism" or "methodological nationalism" (Oya and Schafer, 2019), which treats China as a homogenous entity with a clearly defined project and assumes intrinsic characteristics that apply to all Chinese actors. Yet, a growing body of empirical research indicates the existence of wide variations between companies' contribution to employment, knowledge transfer and industrial

upgrading depending on local context, sectors, and ownership type (public vs. private), among others (Brautigam, 2009; Gonzalez-Vicente, 2012; Lee, 2018; Calabrese and Tang, 2020; Jenkins, 2022).

For example, in a study on Chinese labour standards and skill building in the two sectors of manufacturing and construction in Ethiopia and Angola, Oya and Schafer (2019, p. 6) show that workforce localisation rates in Chinese firms are substantially higher than usually assumed and that variation depends essentially on the capacities of host states. On average, in Ethiopia, localisation rates were around 90%, and in Angola, rates were estimated at 74% due to less stringent labour policies and skills shortages. Comparing Chinese state capital with global private capital in the Zambian construction and copper sectors, Ching Kwan Lee (2018) convincingly illustrates how Chinese state capital, with its broader logic of accumulation – of seeking not only profit but political influence – is more accommodating of Zambian political and economic requirements than global private capital (Lee, 2018, p. 47).

Interestingly, downsizing the role of local agency and describing China as a homogenous entity are common features in both critical scholarship and mainstream writings emerging from Western-based think tanks and policy circles. In *The Digital Silk Road*, *China's Quest to Wire the World and Win the Future,* Jonathan Hillman (2021) pictures a monolithic "China, Inc." carrying out a master plan to conquer the global Internet. According to the author, Beijing is primarily concerned with the reproduction of its authoritarian Internet model abroad, a model that it manages to transplant without much local resistance. A deeper empirical examination of China's digital presence outside its borders indicates a different story. Iginio Gagliardone's book *China-Africa and the future of the Internet* compares how Chinese ICT actors and ideas interacted with two democracies – Kenya and Ghana – and two autocracies – Ethiopia and Rwanda. It reveals that China's intervention in Africa's information societies has been driven by the idiosyncratic preferences of different African states rather than those of Beijing.

Furthermore, the idea of a monolithic China operating cohesively to execute a master plan drafted by the CCP has been debunked by empirical studies showing the existence of competing interests among the actors involved in China's globalisation. In the ICT sector, Shen (2017) provides a political-economic analysis of how different units of Chinese capital and state agencies are shaping the international Internet system. For instance, Huawei and partly state-owned ZTE are fierce rivals in Africa, where the two Chinese firms have engaged in price wars to capture larger market shares. When Huawei first established its presence in the African

market in the late 1990s, its bidding price was up to 15% lower than that of Western competitors, something that allowed it to make significant inroads across the continent; but, when ZTE entered Africa, it offered even cheaper prices that were 30%-40% lower to outcompete Huawei (Shen, 2017).

Frictions between different actors making up China's digital sector increased after the 2008 economic crisis. In *Networking China,* Yu Hong (2017a) highlights the competing interests of the Chinese state and digital capitalists in realigning its digitalised sector within changing global market realities. The author describes the post-2008 period as a stage of "contested convergence" (p. 197) within global digital capitalism, during which China has largely been converging with the dominant global structure despite continuous contention on political and economic fronts. This contestation of the dominant order relied on the support of other countries across the Global South. For instance, Beijing has challenged the US centric Internet Corporation for Assigned Names and Numbers (ICANN) that gives US private business interests, and the US government, de facto, top-level control over the digital naming and addressing system, through drawing support from other developing countries at ICANN (Hong, 2017a).

Despite this growing literature, the question of what China's growing participation in global digital capitalism means for technological upgrading in host developing countries remains relatively unexplored. Some studies have discussed the role of Chinese-built-ICT Infrastructure on connectivity and digital development. Using regression analysis, Ho et al. (2023) find that BRI participating economies experience a significant rise in ICT development, measured with internet penetration, mobile penetration, broadband subscription, and telephone subscription. However, the authors find that both the BRI and DSR create and sustain unequal trade between China and the rest of the world. Other studies find that by investing in improving connectivity through relatively cheaper infrastructure construction, China has contributed to lowering trade costs (De Soyres et al., 2019; Baniya et al., 2020).

Scholars have underscored the critical issue of ICT infrastructure financing (Shenglin et al., 2017; Gottschalk, 2019). The expansion and modernisation of ICT infrastructure involves substantial fixed start-up costs (Bircan and De Haas, 2020). Without robust domestic infrastructure for data exchange, many developing countries rely heavily on international

bandwidth to transmit and receive data. This dependency typically involves routing data through submarine cables or foreign servers, which not only increases costs due to higher fees for accessing international networks but also results in slower connection speeds because of longer transmission distances and potential congestion on international links (West, 2015). The lack of local data centres, Internet exchange points (IXPs), and other critical infrastructure exacerbates this issue, hindering the efficiency and affordability of internet services. The lack of domestic ICT infrastructure also affects service resilience since a country is completely shut off from the internet if there is any disruption to international bandwidth. For example, after a commercial boat snapped the key submarine cable connecting Algeria to the internet in 2015, the SEA-ME-WE 4 submarine cable which connects the Algerian city of Annaba to Marseille in France, the country experienced an internet blackout (Zenina, 2016). Thus, climbing the data infrastructure ladder is crucial to achieve greater infrastructural independence and resilient digital economies.

Loans provided by China's principal financiers, namely the China Development Bank and the Chinese Exim Bank, have played a pivotal role in facilitating the modernisation of network systems in several developing countries (Tugendhat and Voo, 2021). As will be further discussed in Chapter 5, this funding is particularly significant in a global context where Western lenders and IFIs have exhibited limited interest in financing large-scale infrastructure projects, often citing concerns about long-term returns and political risks (Dreher et al., 2022; Landry, 2024). The relatively expedited approval processes characteristic of Chinese financing, combined with the absence of stringent political conditionalities, have arguably provided a crucial advantage for recipient nations. By reducing bureaucratic bottlenecks and offering terms that are more aligned with the immediate developmental priorities of recipient states, Chinese loans may be helping to bridge their infrastructural gaps.

The digital divide, while a complex issue, fundamentally reflects the chronic lack of investment in large-scale ICT infrastructure within less affluent nations (Shenglin et al., 2017; WDR, 2021). Countries in the developing world often contend with prohibitive costs associated with establishing fibre optic networks, constructing data centres, and deploying satellite systems (Gottschalk, 2019). These financial barriers are further compounded by limited access to financing mechanisms, a lack of technical expertise, and institutional inefficiencies, which collectively hinder the development of robust digital ecosystems. Consequently, many developing nations remain reliant on outdated or insufficient technologies, perpetuating

disparities in connectivity and restricting their ability to participate fully in the global digital economy. The globalisation of Chinese ICT firms may thus help close the digital divide by helping with infrastructural catch up.

A related body of scholarship has explored technology spillovers from Chinese firms in host developing countries. Existing research on Chinese investment has mostly focused on traditional sectors such as construction (Auffray and Fu, 2015; Kirchherr and Matthews, 2018), agriculture (Brautigam, 1993, p. 2015; Amanor and Chichava, 2016; Kampini and Kalepa, 2024), and low value-added manufacturing and mining (Seyoum et al., 2015; Yunnan et al., 2016; Tang, 2016a, 2019; Camba et al., 2022). In garment manufacturing, Brautigam et al. (2018) find evidence of weak linkages between Chinese and local firms in Ethiopia's leather sector. While for years Ethiopia articulated a comprehensive industrial policy, linkages remained limited due to the relatively short time Chinese firms have been in operation and the lack of sophistication of local clusters (Brautigam et al., 2018).

A 2022 paper by Li, Kopiński and Taylor finds that Chinese investments in Zambia bring limited linkage formation and spillover effects and that existing linkages entail low technology inputs with less prospects for long-awaited technological and industrial upgrading. Drawing on over 80 interviews with Zambian and Chinese institutions and firms, the authors suggest that the lack of spillovers is primarily due to Zambia's incapacity to boost its local supply. The research concludes that the chance of Chinese investment leading to structural transformation will remain limited as long as industrial policy fails to foster linkages and facilitate spillovers. However, despite limited linkages, Xiaoyang Tang (2019) argues, based on his case studies of the cotton industry in Malawi and Zambia, that Chinese firms still promote technological upgrading through the facilitation of vertical integration in GVCs (Tang, 2019).

Examining managerial skill spillovers from Chinese construction firms in Ghana, Auffray and Fu (2015) find that the limited localisation of managerial-level labour within these firms is the main barrier to effective knowledge transfer. Similarly to Gu (2009), the authors suggest "cultural and linguistic barriers" as potential explanatory variables for the lack of Ghanaians in managerial positions in Chinese firms (Auffray and Fu, 2015, p. 285). They argue that greater managerial localisation can help overcome these barriers and foster managerial knowledge spillovers. Broadly speaking, while earlier studies did not report significant evidence of skill and technology transfer, more recent research shows that training has become a widespread

practice among Chinese firms operating in developing countries (Kernen and Lam, 2014; Lampert and Mohan, 2014; Tang, 2016b). King (2013) asserts that Chinese businesses believe in the 'practical experience of learning on the job' in contrast to Western firms that place more emphasis on institutionalised, formal training. A 2017 McKinsey survey of a thousand Chinese businesses in Africa indicates that over two-thirds provide various types of training, primarily through on-the-job training (McKinsey, 2017). Important sectoral variations exist between firms, with those in the high-tech sector offering more frequent and formal training to their employees as the success of their operations relies on having well-trained workers (Te Velde, 2002).

In the nascent literature on the contribution of Chinese digital MNCs to technological upgrading, several publications claim knowledge transfers are occurring without rigorous evidence. For instance, in a book chapter discussing the internationalisation of Chinese tech firms, Li (2020, p. 330) states that "Huawei, ZTE and a few SOEs have realised the importance of technology transfer in the development of both local economies and their own business, and more Chinese enterprises should join the trend". But the author reaches this conclusion by taking the raw numbers of people trained by these corporations, cited by their own Corporate Social Responsibility (CSR) reports, as proof of technology transfer, assuming that such 'training' results systematically in technology transfer.

There is a shortage of fieldwork-based studies focusing on technology transfer from Chinese MNCs in the digital sector. A notable exception is the research conducted by Li and Cheong (2017), who argue that ZTE and Huawei contribute to technology transfer in Malaysia by collaborating with local universities and research centres. Their study highlights how both firms offer courses leading to ZTE and Huawei certifications, enhancing local skills. The authors attribute their success to their ability to navigate Malaysia's political economy and align with domestic industrial policies like the New Economic Policy. They also note shared patterns in Huawei and ZTE's localisation, shaped by their Chinese origins, the host country's political economy, and industry dynamics. Similarly, Agbebi (2019), based on 29 interviews with officials, Huawei staff, and trainees in Nigeria, underscores Huawei's role in human capital development, noting its engagement with over 500 local suppliers and widespread training efforts targeting employees, partners, clients, and state actors. In contrast, Tugendhat (2020, 2021), drawing on fieldwork in Kenya and Nigeria, offers a more critical view. He argues that Huawei, like other major ICT firms, carefully balances local training with the

protection of its intellectual property, ultimately limiting opportunities for meaningful technology transfer and technological upgrading by design.

These studies bring valuable insights into understanding the developmental implications of China's rise as a major global actor in the digital sphere by empirically assessing spillovers and their role in technological upgrading. Nonetheless, the emerging literature suffers from two key shortcomings. First, previous studies have largely relied on technical models that focus on the micro level to explain how China's expanding digital industry influences local mechanisms of technological upgrading. These analyses have tended to obscure the bargains around technology and the politics upheld in infrastructure and the transferred knowledge. What is perhaps as significant as the question of whether Chinese digital companies foster technological upgrading in developing host countries is the role of various spillovers in disseminating technological standards and processes – and their implications for structural transformation. Existing studies, however, often either prioritise geopolitical frameworks focusing on China-US competition while neglecting on-the-ground dynamics in third countries or focus on micro-level processes and spillovers emerging from China's ICT corporations without addressing their broader geopolitical ramifications. Analysing technology spillovers requires not only observing their occurrence through tracing various linkages but also taking a deeper look at what these linkages *actually* do. Concurrently, we cannot expect high-tech firms to willingly share their cutting-edge technology with poorer countries, nor can we assume the infrastructure they build and technologies they transfer are devoid of political content and consequences.

Secondly, and building on the previous point, much of the scholarship on the globalisation of China's digital industry in the Global South has adopted a unidimensional focus when studying technological upgrading. Studies often isolate infrastructure development, technology transfers, and governance frameworks, thereby neglecting the interdependent and interconnected nature of these dimensions. As visible manifestations of power, their developmental and political implications of infrastructure are rarely straightforward or unidimensional. The expansion and upgrading of ICT infrastructure, industry linkages, training programmes provided by tech firms, and the resulting spillovers have important regulatory implications, as they are intricately intertwined with broader processes of technology standard-setting at the macro level. China's strategy to strengthen its influence in digital technology standardisation is rooted in the dissemination of its own technical and industrial standards through the physical infrastructure

it constructs abroad (Peyrat, 2012). The use of and access to digital infrastructure, as well as the applications that operate on it, are governed by frameworks shaped by those who design and implement these systems at the ground level (Triolo and Sherlock, 2020). There is, therefore, a need for analytical frameworks that enable a more comprehensive examination of the developmental implications, taking into account not just the occurrence of spillovers but also their deeper regulatory and thus political effect.

2.4 The technopolitics of digital infrastructure

Engaging with the study of technopolitics can help overcome these shortcomings. Technopolitics builds on an infrastructural lens commonly used in science and technology studies, the history of technology and anthropology. Coined by historian of technology Gabrielle Hecht, the term refers to "the strategic practice of designing or using technology to constitute, embody, or enact political goals" (Hecht, 2001, p. 256). Here, technology is broadly defined as both artefacts and nonphysical, systematic means of making or doing things (Hecht, 2001, p. 257), while politics refers to the ways in which technological artifacts are intertwined with power dynamics, governance structures, and societal relationships.

Technopolitics unpacks the oftentimes *hidden* political work of technological artefacts and infrastructures (Mitchell, 2002; Larkin, 2013; Anand et al., 2018). Anand et al. (2018, p. 30) claim that the promise of adopting an infrastructural approach lies in "making more visible, indeed more political, the formative role of infrastructure". One strand of this intellectual tradition leads back to work of Langdon Winner (1980), who argued that all technologies, from forks to nuclear power stations, have politics embedded into them. Winner provides the example of Robert Moses, a New York City urban planner, who designed low bridges on parkways leading to Long Island to prevent buses from accessing certain areas. Winner argues that this seemingly innocuous design choice had profound social and political implications, as it effectively excluded low-income and minority populations – who relied on public transportation, from accessing certain recreational areas.

Drawing on this tradition, Graham and Marvin (2001) highlight how the availability and quality of digital infrastructure, such as internet access and telecommunications networks, varies across different urban neighbourhoods. Wealthier areas often have better digital infrastructure, including faster internet speeds and more reliable connectivity, while marginalised

communities may lack access to these resources. This spatial digital inequality reinforces existing socioeconomic disparities within cities, as access to digital technologies becomes increasingly vital for participation in economic, educational, and social activities.

As an analytical construct, technopolitics challenges the supposed neutrality of technologies and opens analytical space to capture the materiality of technological artefacts and the politics underpinning them. As Hecht puts it:

> "These technologies are not, in and of themselves, technopolitics. Rather, the practice of using them in political processes and/or toward political aims constitutes technopolitics. Why not just call that practice "politics"? The answer lies in the material reality of the technologies. These technologies cannot be reduced to politics. The effectiveness of technologies as objects designed to accomplish real material purposes matters – among many other reasons – because the material effectiveness of technologies can affect their political effectiveness."
>
> (Hecht, 2001, pp. 256–257)

A large body of the literature using technopolitics has focused on the ways in which the state increases its power through new infrastructure and technologies (Mitchell, 2002; Gagliardone, 2014). This strand of the literature draws on the work of Michael Mann who understood infrastructural power as deriving from the state's ability to control and manipulate infrastructures as core to its capacity to govern effectively, without having to resort to coercive power (Mann, 2012 [1986]). His work emphasised the role of states in creating and maintaining infrastructures as a means of consolidating their power and ensuring social order. Deploying technopolitics to examine how political regimes use and adjust technologies for achieving political goals, Mitchell (2002) examines how the ruling elite in Egypt used technology and expertise to consolidate their power and maintain control over society. The author delves into various case studies, including the construction of the Aswan High Dam and the development of irrigation systems, to illustrate how these projects are not neutral tools but rather instruments of power that shape social relations and governance. Mitchell contends that expertise and technology often exacerbate existing inequalities and reinforce authoritarian structures, leaving large segments of society disenfranchised.

The technopolitics literature has largely zoomed in on what Hughes (1993) calls large-scale technical systems (LTS), the massive infrastructural networks that have come to organise everyday life. Work on LTS shifts attention from individual innovations to the system of

relations in which technology is embedded, emphasising that the "same" technology can uphold different types of politics as it is negotiated, adopted, and reshaped by various actors to advance their own interests, constituting distinct technopolitical regimes (Edwards and Hecht, 2010). Based on a study of the distribution of electric power plants in London and Berlin, Hughes argues that electrification networks differed for no technical reasons but were products of the different political and regulatory regimes characterising Britain and Germany at the time of electrification.

In Britain, the electric power industry developed within a framework of *laissez-faire* capitalism, where private companies operated with minimal government intervention. This resulted in a fragmented electric network, with multiple smaller companies operating independently, which created disparities in service provision and access. In contrast, Germany had a more interventionist regulatory regime, with the state playing a more active role in shaping industrial development. As a result, Germany's electricity sector allowed for more coordinated planning and investment in infrastructure, leading to greater coverage and an overall more egalitarian system. Hughes emphasises the interconnectedness of electric systems, both physically (through transmission lines and distribution networks) and socially (through power dynamics between corporations, governments, engineers, and consumers).

There is a growing body of research using an infrastructural lens to examine digital technologies as part of the infrastructural turn in the social sciences (Borgman, 2007; Edwards et al., 2009; Pollock and Williams, 2010; Gagliardone, 2010, 2019; Kurban et al., 2017). A valuable contribution is the one made by Gagliardone's work on the development of ICTs in Ethiopia (2014). Focusing on government-led projects, he analyses how political and technical forces interact and negotiate in an authoritarian context. His study illustrates how the same ICT technologies can be appropriated in opposite ways according to different political motivations. He observes that despite the donors' (international assistance organisations) demands for openness and democratisation in using ICTs, the Ethiopian government has appropriated them to consolidate state power, while marginalising other uses of ICTs. This work illustrates how digital systems can become part of different technopolitical regimes and can be appropriated by a variety of actors, states, corporations, civil society groups, to advance their own interests. It could be argued that the different degrees of control exercised over digital data by state actors, or the greater or lesser use of types of hardware and software underpinning ICT infrastructure

are components defining different styles in the application of ICTs in various countries across the Global South.

Seen from the technopolitics framework, power and politics stem from both the social and the technical, as different stakeholders establish authority by ensuring that some technologies and standards prevail over alternative ones (Hecht, 2001, p. 2). In the case of Hecht's research on France's nuclear energy programme, she identified two distinct technopolitical regimes – networks of actors, artefacts, discourses and institutions – around nuclear energy performing different types of politics and competing over the definition of technology standards and their uses (Hecht, 1998). The use of the term 'regime' is explained by Hecht: "The first reason relates to the use of the term 'regime' in political parlance. [...] Second, 'regime' conveys the idea of a regimen or prescription. [...] Third and last, 'regime' captures the contested nature of power" (Hecht, 1998, p. 17).

It is noteworthy to highlight that in this framework technical artefacts do not simply adapt to the networks of power in which they become embedded. They also act as vehicles for exercising power. While choices regarding technological systems are understood as the outcome of social negotiations, once established, these systems - and the values they uphold - cannot be easily altered, as they acquire momentum. Winner observes: "technological innovations are similar to parliament acts or political principles, as they establish a frame of action for public order that will last for many generations" (Winner, 1986, p.29). In so doing technological artefacts "embody, reinforce, and enact social and political power" *(*Allen and Hecht, 2001, pp. 2-3).

A stream within this scholarship has gone beyond the top-down, state-centred analysis of technology and power to focus on corporations, highlighting how digital platforms have amassed substantial economic and political power (Zuboff, 2019; Langley and Leyshon, 2021; Schuster, 2021; Mann and Iazzolino, 2021, Shen and He, 2024). Here digital platforms are seen as politically charged nodes that can be appropriated or resisted by different actors creating winners and losers in the process, conceptualising development outcomes as more complex and contingent. In "Platform Capitalism", Srnicek (2016) highlights the growing significance of digital platforms in the economy, with companies like Google, Facebook, and Amazon playing a central role. Digital platforms accumulate vast amounts of data from

user interactions, which they use to optimise services, target advertisements, and shape user behaviour. Platforms are understood here to exert control over markets, consolidating their power, stifling competition and reshaping economic relations. Studies have argued that digital platforms have contributed to the rise of precarious gig economy jobs and the erosion of traditional employment structures, exploiting labour while circumventing traditional labour regulations (Srnicek, 2016; Graham et al., 2017, Palacio Ludeña, 2021). These studies situate digital platforms within broader scholarly and public debates on the political economy of digital infrastructures.

Attempts have been made to refine the definition and application of technopolitics to establish stronger connections between emerging regulatory transformations and tangible conditions on the ground. For Rasmussen (2007), it is impossible to draw clear distinctions between technology and politics, not because they are inherently intertwined, but because politics employs technical standards, which are often more effective than laws, and because technical expertise has increasingly assumed a form of political power that was never intended. According to Rasmussen, the Internet has, since its inception, been a contested terrain among various actors, particularly due to its open architecture. He emphasises that the history of the Internet, as a site of technopolitical controversies, "reveals prolonged tension – in fact, almost open controversy – between the closed and the open" (Rasmussen, 2007, p. 2). He particularly highlights how regulatory issues are contested and negotiated between these two opposing approaches.

Building on the idea of technopolitical regimes, Schmid (2011) looks at the Soviet Union's transfer of nuclear technology to Eastern Europe during the Cold War. The author shows how the cooperation started as bilateral technical assistance and later became a multidimensional, multilateral collaboration. He argues that the Soviets have attempted to establish the "rules of the game through technical designs and management structures" but ultimately failed in enacting their hegemonic goals over Eastern Europe (Schmid, 2011, p. 126). This failure is explained by the different pre-existing technical and organisational choices in each state, along with the evolving nature of cooperation with the Soviets. Schmid explains that the early diffusion of the Soviet technopolitical regime in nuclear power was facilitated by the framing of science and technology as politically neutral, something that was later halted by the rise of indigenous resistance to this technopolitical regime (Schmid, 2011, p. 132).

When brought into conversation with the literature on technological upgrading and China's digital presence in developing countries, the technopolitics framework opens analytical space to examine the ways in which these technologies uphold a politics and restructure regulatory environments especially through the dissemination of technological standards. Through this lens, the technologies disseminated by digital corporations, from source programmes and codes to the hardware and chip designs making up network infrastructures to the data generated and collected and the know-how embedded in training programmes, stop being neutral tools that respond to functional imperatives but become vehicles for diffusing and exercising power. This complex reality requires that we reconceptualise the typically passive role attributed to infrastructure in high-level geopolitical accounts and approach the political as an effect of socio-technical configurations rather than policy or corporate statements.

Much of the existing scholarly work examining the rise of China as a global digital power, is dominated by high-level political economic or geopolitical studies that frame the global expansion of China's digital industry as an extension of Beijing's international ambitions. This has been echoed in a recent commentary by Liu (2021, p. 2), who finds "an emphasis on geopolitics as a driver and explanation of China's actions on the international stage and a tendency to interpret and understand whatever China does internationally and even sometimes domestically using geopolitical reasoning". While the globalisation of the Chinese Internet industry is a valid field of geopolitical inquiry, understanding the implications and effects of the growing rivalry requires moving from macro analysis of geopolitical dynamics to examine the materially grounded effects of these tensions.

By recognising technological systems as deeply embedded within broader power structures that influence their design, deployment, and governance, the technopolitics framework provides a lens to analyse how digital systems not only operate within but also actively shape regulatory regimes. The question of standards is particularly crucial in the debate on the role of Chinese digital MNCs in building ICT infrastructure and contributing to technological upgrading in developing countries. Competition over who gets to set technological standards – the underlying regulations that define how telecommunication networks operate and interwork – has become intense between China and the US, with China trying to challenge the US-centric cyberspace (Beattie, 2019). At a basic level, standards set the "rules of the

game" that all players must follow. They encompass the technical specifications, protocols, and operational norms that ensure systems, devices, and networks can function together effectively. The core purpose of these standards is to achieve global interoperability and connectivity that underpin global trade (Chung, 2017; Park, 2022). The use of technology across boundaries is made possible by these intangible standards; it is what allows an American phone to connect to Wi-Fi in Japan and vice versa. Conversely, the lack of interoperability can lead to inefficiencies, illustrated by the mismatch of power socket designs between countries. As Chinese tech firms play an increasingly active role in developing, supplying, and maintaining the physical components that underpin future digital infrastructures, and as they intensify efforts to train local students and engineers, a likely outcome is the accelerated dissemination of Chinese technological standards.

While international technological standards are approved within multilateral institutions such as the UN's International Telecommunication Union (ITU), the increased number of actors integrated into digital systems built by Chinese tech firms gives a greater voice to China in international standard-setting bodies. China's ambitions in standard setting are embodied in strategies such as China Standards 2035, and more assertive positions in global standard-setting bodies (He, 2022; Chan, 2022). In recent years, the Standardisation Administration of China (SAC) has released the Standards China Unicom Joint Construction One Belt One Road Action Plan (2018-2020), calling for uniform standards ranging across technologies, including 5G, artificial intelligence, and satellite navigation systems (Chan, 2019). In 2020, Huawei, together with state-run companies China Unicom and China Telecom, and the Chinese Ministry of Industry and Information Technology (MIIT), put forward a new global standard for core network technology, named "New IP", at the ITU. This new standard aims to break with the US-set TCP/IP protocol, which the Chinese described as inadequate and unable to support the speed of package transfers needed in the upcoming 5G revolution (Smith et al., 2021). However, as of 2025, the proposal has not moved forward in the ITU standardisation process.

Behind this technical jargon lies a fierce fight over who gets to set the standards of the next technological wave. As a strategic instrument that confers a competitive edge to those who define them, standards lie at the heart of the political economy of development (Mattli and Buthe, 2003; Nadvi, 2008; Chung, 2017). The battle over standard setting has been a critical component of political economy for a long time in various key sectors shaping the trajectory of industries and economies alike. Unsurprisingly, actors from both the EU and the US have

dominated international technical standardisation in recent decades. In both systems are largely driven by private industry, although public actors do retain some influence. For instance, in the early 20th century, the US and Europe adopted different electrical voltage standards, leading to a divergence that persists today. This divergence was influenced by economic interests between various engineers and businessmen, and technological preferences. The lack of a unified standard has had lasting implications for international trade and the global compatibility of electrical appliances (Sioshansi, 2013). The establishment of ISO denominations underscores the economic importance of harmonised standards in facilitating international trade and ensuring interoperability (Delimatsis, 2015). These historical precedents mirror contemporary struggles in the digital sector, where standard-setting continues to serve as a battleground for geopolitical influence and economic advantage. The economies of scale of the Internet mean that once proprietary network standards become ubiquitous, they generate considerable royalties and help related equipment makers gain future market access.

By zooming in on the material nature of technologies, a technopolitics lens also allows us to scrutinise the idiosyncratic nature of digital infrastructure and its grounded effects on political and economic transformation. While social science research on infrastructure has tended to focus on the regulatory role of "physical infrastructure" such as water, roads, sewers, and electricity (Meagher, 2021, p. 731), looking at digital infrastructure through this lens provides us with the conceptual toolkit to unpack the materiality of these technologies. Here, the ways in which digital data flows in and out of these systems becomes significant, with the framework crystallising digital data into physical forms as it is stored, collected, and gathered in data centres, cloud systems, smart cities, surveillance equipment among others, and as it becomes economically and politically valuable.

Through this infrastructural lens, spillovers from digital infrastructure and knowledge transfer in the digital sector become multidirectional – not only flowing from tech multinationals to local firms and institutions – but also going from local economies to tech multinationals via the collection, processing, and usage of digital data. Unlike in conventional accounts where knowledge transfer is conceptualised as unidirectional, this approach allows one to capture the idiosyncratic characteristics of the digital industry by examining flows and frictions around data. With the economic value of data becomes ever more significant, questions about how today's versatile and expansive data systems are

being governed hold crucial developmental implications and must thus be included in studies of the effect of Chinese digital firms on the development of knowledge economies outside of China.

Beijing has long recognised the economic value of data and counts some of the world's most stringent policies for the localisation of domestic data within its territory (Azmeh et al., 2020). In 2020, it officially introduced data as a fundamental national resource, a key factor of production alongside land, labour, capital, and technology (CCP, 2020). But, to date, little is known about how Chinese digital projects in host low and middle-income countries are influencing local technological upgrading and innovation efforts. Since the inception of the Internet, standards developed by the US have been widely recognised as the de facto framework shaping the global digital landscape. However, the increasing dissemination of technological artifacts and processes by Chinese firms has introduced an alternative technopolitical regime. As Chinese firms diffuse their technological artefacts and processes, Chinese standards and governance regimes seamlessly become embedded into the technological matrix of the recipient country, challenging the US long-standing dominance over the Internet.

Shaping governance frameworks and setting standards is a key part of China's technology development strategy, allowing the Asian giant to establish a distinct technopolitical regime. Alongside calls for a greater share of domestically developed technology products, the CCP leadership pushed local actors to be more aggressive in claiming intellectual property rights; and defining indigenous Chinese standards (Lee and Oh, 2006; Yao et al., 2009). As part of a broader attempt at restructuring the country's standards regime to boost technological development, China relied on outright protectionist measures in the ICT sector, which consisted of delaying the deployment of 3G into China with foreign standards, to develop its own Time Division Synchronous Code Division Multiple Access Standard (TD-SCDMA) for 3G mobile telecommunications. As explained by Grimes and Yang (2018, pp. 11-12): "While delaying the introduction of 3G into China, its [TD-SCDMA] development provided experience for both Chinese engineers and telecommunications companies, which could, in turn, be used for developing the 4th generation wireless technology, allowing China to play a bigger role than heretofore in the development of global standards". This advantage carried on towards the next generation of wireless technology, enabling China to surpass the US in the race towards 5G.

Several questions emerge when looking at this dissertation's central research question through the technopolitics lens. Could Chinese-built infrastructure be simultaneously expanding digital connectivity while embedding technopolitical regimes that foster a new source of dependency? What if technology spillovers are observed, but foreign tech firms are building linkages with host countries and providing training in ways that reconfigure their digital economies around the consumption and use of these foreign firms' products, processes, and standards? In other words, what if the web of ICT infrastructure, emerging linkages and data governance frameworks are creating "closed-loop systems" (Mann and Iazzolino, 2021) that are locking in local ICT actors in activities and relationships captured and defined by foreign digital giants? Does the diffusion of these new standards facilitate greater interaction between global tech firms and local ones, promoting processes of technological upgrading? As technological latecomers, could it be that Chinese digital firms are building more infrastructure and further engaging in training local employees, students, and suppliers than their Western counterparts to promote their own standards? More fundamentally, are Chinese tech firms through the digital infrastructure they supply creating separate Sino-centric digital regime among BRI countries, challenging the dominant US-based regime? What we see being opened with the technopolitics framework is a different angle on the role played by foreign subsidiaries, whereby it no longer becomes a simple binary between the existence or absence of developmental spillovers, which diffuse (or not) know-how and technology in ways that are predominantly seen as developmental and unproblematic but instead questions the more profound and uncertain implications of extensive digital infrastructure, transferred technologies and emerging governance structures.

2.5 Weaving together heterodox approaches to economic development and technopolitics

Much has been written on opportunities for technological upgrading and structural transformation emerging from the expansion of Chinese capital into developing countries. Conversely, there is a vast scholarship looking at the political and geopolitical implications of digital technologies. Yet, these bodies of scholarly work have largely evolved in isolation from one another. To answer this dissertation's central research question – that is whether Chinese digital capital in developing countries fosters technological upgrading or impedes

capability accumulation – while integrating both the technical and the political dimensions, I build a conceptual framework that brings these two strands of the literature together. The framework draws on insights from heterodox approaches to economic development to examine the impact of foreign firms on technological upgrading and trace the occurrence of spillovers. It also draws on technopolitics to explore the politics embedded within digital systems and how technological artefacts, knowledge spillovers, and governance frameworks diffuse standards that are negotiated between global and national actors. Analysing the role of foreign digital firms in host economies through this analytical lens involves reframing a process often viewed either through a detached macro-geopolitical perspective or a technical, depoliticised lens. Instead, it emphasises that developmental outcomes are shaped by the intricate interplay of competing forces within specific contexts.

Before presenting the framework, it's important to highlight the significance of understanding the intertwined link between technological upgrading and the standards diffused through artefacts and socio-technical linkages. First, standards ensure that different technologies – produced by various firms stemming from a myriad of political economies – can work together seamlessly. Interoperability facilitates technology upgrading by enabling firms to adopt complementary technologies more readily (Zhao and Xia, 2014). Second, adherence to technology standards can facilitate market access for firms aiming to export their goods or services, as industries, especially high-tech ones, require compliance with certain technical standards (Gereffi, 2019). For many decades, the internet was predominantly shaped by standards established by US companies and governed according to the US internet governance model. However, China's emergence as a technological superpower has posed a significant challenge to this hegemonic position. Against the backdrop of fierce competition between two core technopolitical regimes, one with the US at its centre and one with China at its centre, who defines the standards holds an edge in shaping markets while encouraging less technologically advanced firms and corporations to follow idiosyncratic protocols, providing them with incentives to invest in technology upgrading to meet those specific standards and remain competitive.

Finally, technology standards can create opportunities for learning, knowledge spillovers, and innovation within industries. When firms adhere to common protocols and standards, they can learn from each other's experiences and adopt cutting-edge practices in

implementing technologies which can in turn boost productivity (Wang et al., 2023). This can act as a catalyst for innovation by providing a common framework within which firms can develop new technologies. When standards are well-defined and widely accepted, they reduce uncertainty for firms investing in R&D activities. This, in turn, encourages firms to innovate and develop new technologies that conform to established standards, leading to continuous technology upgrading. Here too, firms and states that have the influence to establish these standards gain considerable advantages. This is because setting the standards allows them to shape the direction of technological development, aligning it with their competitive edge or geopolitical interests. As such, where technological leadership is fiercely contested between the US and China, the control over setting standards becomes a pivotal battleground for the future of the digital sphere. The outcome of this battle not only influences technological progress but also has far-reaching economic and geopolitical ramifications.

Building on this assessment, the conceptual framework put forward stresses that the role that foreign affiliates play in technological upgrading is shaped by a confluence of factors as corporate strategies are embedded within technopolitical regimes that interact with host political economies, each characterised by distinct visions, interests, and industrial policies that evolve and adapt in response to domestic and global imperatives. The heterogeneity of findings in previous unidimensional analyses of the role of Chinese firms in technological upgrading and structural transformation cited earlier gives credence to the value of a multi-dimensional framework encompassing infrastructure, technology transfer and data governance frameworks. All three dimensions are firmly grounded in the relevant literature on technology upgrading and structural change.

At its core, the framework adopted in this dissertation embraces a broad understanding of "standards" that extends beyond formal technical specifications ratified by international standards bodies. Standards are understood here as encompassing not only technical protocols and architectural specifications, but also the operational practices, training regimes, professional certifications, and governance norms that structure how technological systems are deployed, maintained, and controlled. They not only regulate how technologies function but also define the conditions for interoperability between systems. Standards in this sense constitute mechanisms through which technological power is exercised and through which particular ways of organising digital systems become embedded and normalised (DeNardis,

2009). They operate as what Musiani (2013) terms "governance-by-architecture", where technical choices and infrastructural configurations establish the parameters within which actors operate.

Importantly, this conceptual lens moves beyond frameworks that impose rigid distinctions between 'global' regimes and 'national' or 'local' structures. Instead, it adopts the perspective that technological upgrading emerges from dynamic interactions among diverse actors operating across scales. It creates analytical space to recognise the often-overlooked agency of local actors and their strategies for navigating and negotiating between competing technopolitical regimes in pursuit of their own developmental goals. What follows elaborates on each dimension:

At the *infrastructural level*, this framework examines how global infrastructural initiatives shape digital connectivity and what the emergence of alternative technopolitical regimes signifies for nascent digital economies in the Global South. From a heterodox development economics perspective, sustained technological upgrading is inseparable from improvements in both tangible and intangible infrastructure (Lin, 2011). Tangible infrastructures—broadband networks, fibre-optic cables, and data centres—form the backbone of digital participation and constitute essential preconditions for technological upgrading. Without such infrastructural development, prospects for sustained growth remain fundamentally constrained. Access to and ownership of digital infrastructure enables developing countries to transcend competition based solely on low labour costs, instead pursuing structural transformation through moving into higher-productivity activities (Banga et al., 2023). Moreover, infrastructure construction in the ICT sector possesses the potential to create backward and forward linkages, generating demand for local suppliers whilst enabling downstream industries to exploit improved connectivity (Hirschman, 1977; Lean, 2001). When coupled with appropriate industrial policies, this can strengthen domestic technological capabilities, facilitate integration into global value chains, and enable domestic firms to compete in higher-value segments (Murphy and Carmody, 2015; Carmody, 2023).

Whilst heterodox approaches have treated infrastructure as an enabling condition for structural transformation, they have largely overlooked the embedded politics and regulatory power inherent within it. Technopolitics addresses this gap by revealing how infrastructure embodies and enacts power. Following Edwards and Hecht (2010), this framework recognises that large-scale technical systems (LTS) such as digital networks are not neutral platforms but carriers of

specific technopolitical regimes; configurations of actors, artefacts, standards, and governance structures that compete to define technological trajectories. These regimes embed visions of governance and control within the very architecture of technological systems, thereby shaping information flows, defining interoperability, and determining whose interests are prioritised. Once established, as Winner (1980) argues, technologies acquire momentum and path dependency, creating "frames of action" that endure across generations and prove difficult to reverse. Infrastructure thus does not merely facilitate development; it establishes the parameters of economic transformation itself.

This analytical level investigates the politics surrounding infrastructure financing and ownership, the diffusion of technical standards through physical artefacts such as cables, data centres, and network equipment, and the emergence of infrastructural dependencies that condition future technological choices. It also considers how host states negotiate between competing infrastructure providers and their embedded technopolitical regimes to advance national development objectives. Analysing who finances, designs, operates, and maintains these systems, and whose standards they institutionalise, offers critical insight into whether connectivity initiatives foster technological upgrading or reproduce novel forms of dependency within the evolving global digital order.

At the *technology transfer* level, this framework scrutinises the linkages between ICT corporations and local firms, universities, workers, managers, and students, examining both whether spillovers occur and what these linkages substantively accomplish. From a heterodox perspective, technology acquisition from foreign-invested enterprises can constitute a key driver of technological upgrading (Lall, 1992; Saggi, 2002). When foreign firms enter host markets, their superior technological capabilities can diffuse to local actors through various channels, including supplier relationships, employee training, demonstration effects, and labour mobility (Javorcik, 2004; Blalock and Gertler, 2008). Such spillovers, however, are not automatic. The state plays a crucial role in determining whether foreign subsidiaries contribute meaningfully to domestic capability building (Amsden, 2001; Ernst and Kim, 2002). Industrial policies like local content requirements, joint venture mandates, technology transfer provisions, and coordinated investments in education and R&D, can facilitate knowledge diffusion and compel foreign firms to deepen their engagement with local suppliers and institutions (Fu and Gong, 2011).

Technopolitics underscores that knowledge transfers are deeply embedded in power relations. They carry embedded technical standards, organisational routines, and managerial models that condition future technological trajectories (Hecht, 2001; Schmid, 2011). Training programmes, professional certifications, and skill-development initiatives, for instance, do more than impart generic capabilities, they socialise recipients into specific managerial and technological ecosystems, proprietary protocols, and vendor-controlled systems. Through linkages such as supplier relationships and subcontracting arrangements, foreign firms embed their particular approaches to designing, managing, and resolving technological problems. When these processes are structured around proprietary standards rather than the enhancement of local capabilities, they risk entrenching dependency rather than fostering technological autonomy.

This analytical level moves beyond assessing the quantity of linkages – whether vertical, horizontal, or with universities – to interrogate their quality and developmental depth. It examines the absorptive capacity of local firms, the design and orientation of training programmes for suppliers, employees, and students, and the state's strategies for promoting technological learning through local content requirements, innovation policies, and higher education systems. This dimension thus focuses on the perspectives of local firms and training recipients, exploring how they navigate and leverage competing digital technopolitical regimes to capture, adapt, and integrate new knowledge and practices.

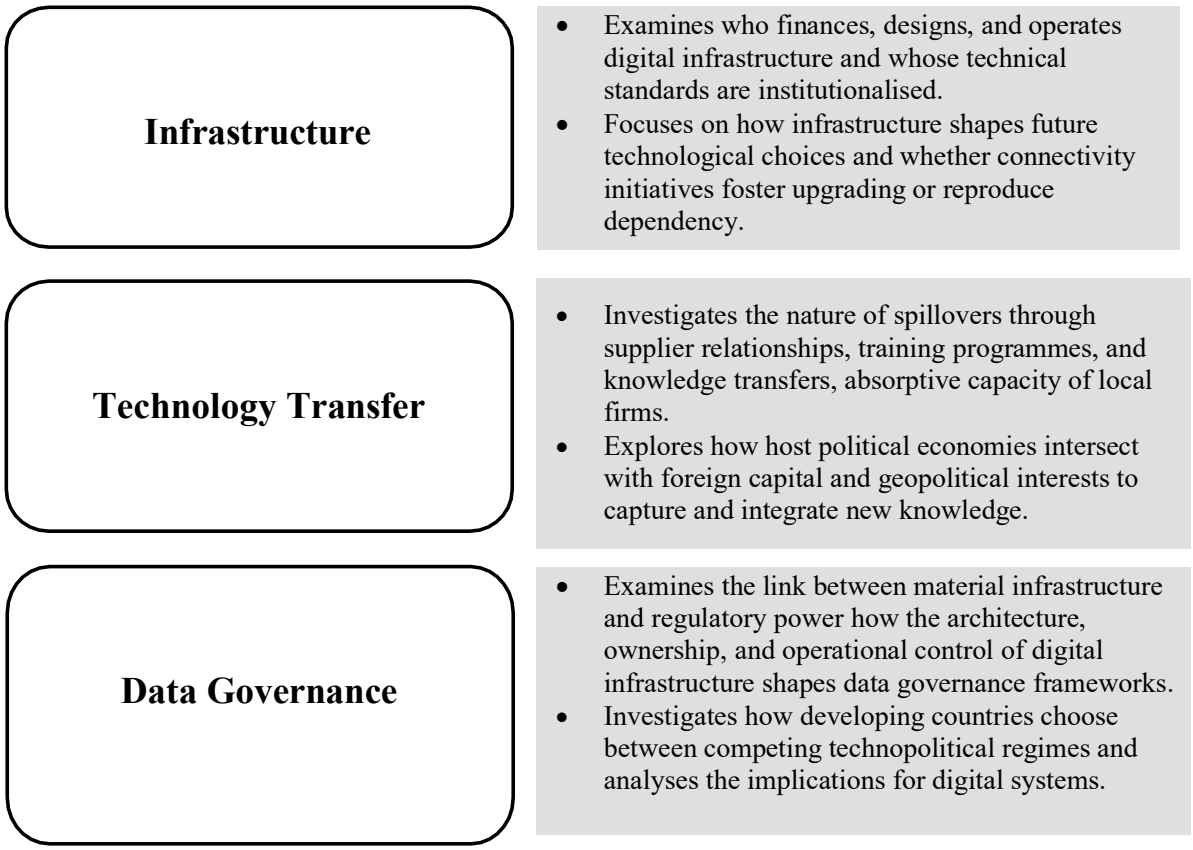
At the *data governance* level, this framework examines how digital infrastructure shapes the flow, control, and utilisation of data, and how these processes influence digital developmental trajectories. From a heterodox perspective, data constitutes a productive asset whose developmental potential depends on the capacity of economic actors to transform it into knowledge and innovation. The critical question concerns who holds the expertise, infrastructure, and institutional capacity to analyse, manage, and commercialise data. Control over data thus parallels control over technology: it determines who is best positioned to capture the rents generated within digital value chains and who remains dependent on foreign firms for storage, analytics, and digital services (Mann, 2018). This theoretical tradition emphasises that value creation from data relies on complex ecosystems of firms, universities, and public institutions, supported by investment in education, R&D, and digital infrastructure (Taylor and Broeders, 2015; Fischer, 2022).

Technopolitics reveals that data governance extends beyond the regulation of cross-border data flows to encompass the material infrastructures through which data is stored, processed, and

monetised (Srnicek, 2016; Zuboff, 2019). The physical architecture of these infrastructures plays a constitutive role in structuring digital regulatory regimes. Where formal regulatory frameworks remain underdeveloped, the materiality of infrastructure itself contributes to establishing the parameters of data governance. Regulatory frameworks are shaped by infrastructural materiality: the architecture, ownership, and control of data centres also determine how data is governed, accessed, and valued. Against this backdrop, competing global technopolitical regimes articulate distinct visions of data control and sovereignty. The US-led "open" model privileges market liberalisation and the unrestricted flow of data across borders, reinforcing the dominance of American digital platforms. Conversely, China's sovereigntist approach promotes data localisation and state-centred governance as instruments of both national security and development, having designated data as a fundamental factor of production alongside land, labour, and capital (CCP, 2020).

This analytical level examines how digital infrastructure, particularly data centres, shapes the possibilities for data management and how governance frameworks regulate data flows, localisation requirements, and sovereignty claims. It explores how states navigate competing technopolitical models, balancing domestic political priorities, economic imperatives, and geopolitical alignments. Moving beyond purely technical or legal interpretations, this framework conceptualises data governance as a site of negotiation shaped by technological capacities, institutional arrangements, and power configurations. It analyses how national data regimes emerge from these interactions, how they redistribute authority between states and corporations, and how they influence domestic capabilities for learning, innovation, and value capture. In doing so, this level connects debates on digital sovereignty to broader questions of industrial policy and technological upgrading, interrogating whether different data governance configurations enable or constrain pathways of development in emerging digital economies. Figure 2.1 provides a summary of each configurational level.

Figure 2.1 – Multi-dimensional configuration of technological upgrading in the ICT sector



While the above conceptual framework is by no means exhaustive, these three analytical dimensions – infrastructure, technology transfer, and data governance – are particularly suited to examining technological upgrading opportunities from foreign multinational corporations in the ICT sector because they capture the multi-layered processes through which digital technologies are acquired, controlled, and leveraged for development. From a heterodox development economics perspective, these dimensions represent critical sites where foreign ICT firms either facilitates or constrains structural transformation: infrastructure provides the material foundations for digital participation and economic upgrading; technology transfers determine the extent local actors learn and acquire meaningful capabilities; and data governance shapes who captures value from the digital economy. Examining these dimensions through a technopolitics lens reveals that these processes are neither apolitical nor purely technical but embedded in power relations. The

three dimensions establish the material conditions that contribute to shaping subsequent technological trajectories. This multi-dimensional framework enables us to trace the technical spillovers and their political effects at various levels of analysis within specific political-economic contexts. Far from conceptualising spillovers from foreign firms in host countries in ways that are predominantly developmental, this framework allows us to trace the bargains, frictions, and fractures around technology as competing firms, institutions and states try to connect developing economies to competing technopolitical regimes. These regimes are not conceptualised here as rigid and static but evolving as they are subject to new opportunities and constraints.

It is essential to address why this study does not adopt existing multi-scalar frameworks to examine the economic consequences of China's digital presence in developing nations. In particular, the widely used Global Value Chain (GVC) and Global Production Network (GPN) frameworks, which have dominated the analysis of economic upgrading for countries and firms since the 1990s. These two frameworks emerged alongside the increasing fragmentation and spatial division of production activities (Gereffi et al., 2005). The rich GVC/GPN literature examines processes of value creation and capture by considering structures and dynamics of power between different actors, markets, and processes beyond national borders (Coe and Yeung, 2015, p. 18). Studies mobilising the GVC/GPN framework have looked at global networks of firms, institutions, and other economic agents, recognising that they both shape and are shaped by the fundamental mechanisms of knowledge and wealth creation, enhancement, and exploitation (Henderson et al., 2002, p. 46).

GVC/GPN studies have explored the role of technical standardisation and its implications for technological upgrading and have highlighted that compliance with international standards has become a sine qua non condition for entry and upgrading into globalised production networks and markets (Gereffi et al., 2005; Nadvi, 2008). By combining global governance dynamics with processes of value creation and capture on the ground, this conceptual tradition is also innately multi-scalar and can enable the combination of interconnected levels of analysis to explain the complex determinants of structural change (Ernst and Kim, 2002; Gereffi, 2015; Coe and Yeung, 2015). More recently, the GPN lens was employed to analyse China's BRI (Chhetri et al., 2020) and to study Huawei's

integration of local capabilities in Europe (Drahokoupil et al., 2017).

While this framework presents great advantages in examining the economic outcomes of China's global digital expansion, it is primarily interested in production chains – i.e., buyers' and suppliers' value chains. Yet, China's digital presence in the Global South is less about the relocation of production activities than it is about supplying cost-competitive tech infrastructure. In Europe, Chinese tech firms have developed regional networks of suppliers and partners to support their global production, focusing on high-value-added activities like R&D (Drahokoupil et al., 2017). In contrast, in developing countries, these firms have

primarily focused on providing and maintaining ICT infrastructure, such as fibre-optic cables, 4G and 5G networks, and data centres. In this sense, adopting an infrastructural lens, as offered by technopolitics, provides more appropriate analytical tools to understand China's digital presence and its developmental footprint. By bringing together theoretical insights from heterodox economics and technopolitics, the conceptual lens suggested in this chapter highlights the salience of power in technological upgrading processes, connecting micro- processes with broader geopolitical struggles over digital dominance.

2.6 Conclusion

This chapter reviewed key debates regarding the role of Chinese ICT corporations in fostering technological upgrading in developing host countries. In doing so, it raised critical questions and identified conceptual gaps. It emphasised that much of the research on China's prominent development initiatives, including its digital projects, is dominated by two approaches: macro- level geopolitical analyses, which focus on how China's expanding digital influence challenges US hegemony over the internet; and country-level studies, which often rely on apolitical, technical assessments of the spillovers from China's digital footprint in the Global South, limited to a single level of analysis.

With the aim of cutting through the theoretical shortfalls of existing conceptual tools, this chapter puts forward an analytical framework that brings together the literature on heterodox economic development and technopolitics to analyse Chinese infrastructure development, focusing on its grounded, material aspects. This framework aims to foreground

the interlocking relationship between states, large foreign multinationals, local firms, institutions and individuals and their respective roles in defining and responding to the opportunities and challenges presented by large projects such as the Digital Silk Road. This approach entails rethinking the typically passive role assigned to infrastructure in high-level discourses and rather approaching the political as an effect of socio-technical configurations. In zooming in on the actual processes underpinning access to digital connectivity, technology transfer, and data regulations through traceable socio-technical linkages, this conceptual lens enables us to go beyond depoliticised and over-politicised debates about China's developmental role. Therefore, seen from this analytical construct, China's digital presence and its contribution to technological upgrading will end up taking very different shapes in different countries, with a mix of infrastructure, hardware, software, and standards that will reflect existing industrial strategies, capabilities, and political economies. What follows discusses this thesis's methodological operationalisation.

CHAPTER 3

Research Tools for Studying Global Digital China and its Effects

How can we capture the spillovers emerging from Chinese ICT firms in host countries given the complexity and layers that make up the ICT industry, or, even more vaguely, the "digital world"? Researching the grounded effects of the globalisation of China's digital firms comes with a set of methodological challenges. Foremost among these is the difficulty accessing core documents, which are not publicly disclosed for reasons ranging from commercial secrecy to national security. The Chinese government considers the details of its overseas investments and development projects to be a "state secret" (Brautigam, 2009, p. 2). At the same time, commercial entities, firms like Huawei and ZTE, like their non-Chinese competitors, do not have to publish their contracts with states nor the breakdown of their revenues per country, making the task of capturing the scale of Chinese ICT projects in host countries challenging.

To address some of these challenges and operationalise the conceptual framework outlined in Chapter 2, this dissertation adopts a mixed-method research design. Pragmatically utilising various data sources and collection techniques, it examines the ramifications of the influx of Chinese ICT firms on host economies. This chapter commences by briefly reviewing the array of methods and data employed in prior studies investigating the impact of digital investments on economic development, focusing on China's emerging role in this dynamic. It then elucidates the rationale for employing mixed methods to comprehensively capture the intricate aspects of China's digital footprint and the diffusion of technopolitical regimes. In the subsequent section, the research design of the thesis is expounded upon, elucidating the quantitative and qualitative approaches and providing details on the specific methods used for evidence collection, the datasets employed, and the process of collecting and analysing interview data to inform the presentation of the main findings.

3.1 The case for mixed methods

The scholarship on the spillovers from ICT infrastructure and their impact on technological upgrading and closing digital divides is characterised by huge methodological variety. Quantitative scholarship has typically focused on macro dynamics, measuring the impact of ICT infrastructure on economic growth, productivity, and employment. The bulk of the literature has either focused on high-income economies (Chaudhuri et al., 2005; Lee et al., 2009) or used cross-sectional data which entails collecting data at a single point without considering variations over time.

Departing from this earlier quantitative work, Gruber and Koutroumpis (2011) use data from 1990 to 2007 for 192 countries to explore the correlation between the adoption of mobile telecommunications and economic growth. The results indicate that mobile telecommunications are associated with average annual growth returns of 0.2 percent in high-income countries and 0.11 percent in low-income countries. Ghosh (2016) uses longitudinal data for the period 2001-2012 from MENA countries to examine the interrelationships among per capita income, financial inclusion and mobile telephony. The author finds that a 1 per cent increase in the fraction of population using mobile telephony improves incomes by roughly 0.3 percentage points, whereas a similar 1 per cent increase in financial inclusion has double the impact on income.

Not all quantitative studies present a clear association between technology and desirable development outcomes. A large body of quantitative studies that examine the diffusion of ICT in developing countries suggests a more complicated reality. Using a new ICT development index based on conventional ICT development indicators, Park et al. (2015) show that serious inequalities exist in access to and use of ICT within and across countries. In a similar vein, Rath (2016) tests the hypothesis that digital technologies lead to convergence based on data from 47 developed and emerging countries and finds that digitalisation divergence exists among countries as a whole. The author concludes by stating that emerging countries need to emphasise increasing fixed-broadband connections, providing internet facilities at an inexpensive rate and focusing on quality education. More recently, Rath et al. (2023) examine the convergence of ICT development in the case of 27 emerging market economies and find that ICT development is contingent on factors such as per capita income, human capital, and FDI.

A nascent literature has attempted to quantitatively capture the role played by the expansion of China's ICT industry in digital development. The main methodological challenge in this strand of the literature is in attempting to estimate the impact of changes to economic variables that are caused by China on outcome variables. To estimate the causal effect of China in a study investigating the impact of the BRI on ICT development, Ho et al. (2023) use a propensity score reweighting difference-in-differences (DiD) model. This method allows for causal inference by comparing changes in outcomes over time between treatment and control groups. Through an analysis of the differential changes in ICT development indicators, measured through metrics such as internet access, mobile penetration, broadband subscription, and telephone subscription, before and after joining the BRI between these groups, the authors find a notable increase in ICT development among participating economies. Furthermore, countries engaged in both the BRI and the DSR exhibit enhanced ICT development and greater involvement in global ICT value chains compared to those solely partaking in the BRI. Following the signature of memorandums of understanding (MoUs) to join the BRI, participating economies demonstrate an increased rate of imports of ICT products and services from China relative to the rest of the world.

Similarly, Ito, Lim and Yarime (forthcoming) use DiD estimation to examine whether China's expanding digital footprint, reflected in BRI participation, encourages partner countries to adopt Beijing-style policies, namely digital protectionism. The authors hypothesise that a possible pathway for China's protectionist practices to spread to relevant countries is through the various channels of the initiative as well as bilateral agreements including MoUs. The results of the analysis, which employs the OECD's Digital Services Trade Restrictiveness Index. suggest that the countries involved in the BRI have strengthened their regulation of digital services since the initiative was launched. This study among other quantitative studies has undeniable advantages in analysing large-scale data sets and capturing macro-level dynamics. By employing statistical techniques, such as DiD regressions, these studies are capable of isolating causal relationships and identifying broader trends that would be difficult to discern otherwise. However, studies solely relying on regression analysis have tended to oversimplify what ICT development entails as well as the effect of ICTs on economic development, obscuring significant aspects such as variations in the quality of access, skills, and usage patterns. Quantitative studies have also tended to overlook the complex socio-economic, political, and cultural dynamics that shape the relationship between ICT adoption

and development outcomes. Additionally, measurements in quantitative research often detach findings from real-world context (Moghaddam et al., 2003). The inadequacy of these tools in arriving at a deeper understanding of the local context and power relations between different stakeholders means that alone these methods cannot fully align with the theoretical framework of this dissertation, which understands power dynamics between states, foreign and local firms, and institutions and individuals as a cornerstone in defining developmental outcomes.

Research drawing on qualitative methods have offered more fine-grained analysis of ICT diffusion, usage and upgrading in the digital sector and the power dynamics underpinning them. Drawing on carefully selected case studies, Avgerou (2002) scrutinises the validity of the relationship between ICT and economic development as delineated in the discourse of certain influential international development organisations. According to the author, these recommendations rely on narrow economic theory while disregarding the empirical evidence supporting alternative development policies. This critique emphasises the need for a more nuanced understanding of the complex relationship between ICT and economic development, taking into account the socio-economic and institutional contexts of individual countries.

Research using ethnographies, semi-structured interviews and field observations has shown that the digital divide is a more complex issue, influenced by a range of political, social, economic, and cultural factors. If the majority of the world population now has access to the internet, and if this digital inclusion has brought development gains, it has also, in some instances, been associated with a growth in inequality (Gurumurthy et al., 2019). Individuals and firms in developing countries use the Internet only in quite limited ways that are generally focused around low added-value activities (Heeks, 2022). Barriers to more sophisticated uses of ICTs and more convergence emerge from a myriad of factors, including lack of human or financial resources, limited digital skills, and costs of online engagement.

A strand in this literature employing qualitative methods has highlighted how more technologically advanced firms may restrict smaller firms from reaping the full benefits of digital access and use, and they may create digital systems that only strengthen certain actors or processes (Carmody, 2012; Murphy and Carmody, 2015). Although connectivity fosters connections among businesses, it also has the potential to draw weaker firms into subordinate roles within these networks, leading to economic decline and a loss of skills rather than enhancing their technological capabilities (Molla and Heeks, 2007; Murphy and Carmody,

2015). These more critical qualitative studies reveal that the impact of digital connectivity may not benefit all, but rather ICTs can become a source of power and control between different types of firms and countries (Foster et al., 2018). Grounded qualitative research has delved deeper into the various dimensions of the digital divide, moving beyond the traditional focus on access to digital technologies. These additional aspects encompass a broader spectrum of factors that shape disparities in digital inclusion and usage. Scholars have explored intricacies such as digital literacy, skills development, socio-economic inequalities, and the differential impacts of technological advancements on various demographic groups (Clark and Wallsten, 2004; Madon and Krishna, 2017; Cobo and Levano, 2023). This expanded perspective sheds light on the complex nature of the digital divide.

While fieldwork-based analyses on the effect of Chinese ICT giants on host economies remain scant, the emerging body of scholarly work has highlighted the importance of in-country context. Drawing on interviews in Indonesia, He (2024) finds that the expansion of Chinese digital platforms has been influenced by various local contextual factors, such as Indonesia's institutional framework, industrial policies, and the nature of the labour market. These factors have compelled Chinese platforms such as Alibaba, Tencent and JD to adjust their strategies according to local policy priorities and the socioeconomic environment, leading them to collaborate with local partners and invest in enhancing local capacities. The findings indicate a more intricate relationship between the state and firms in the expansion of Chinese digital platforms than commonly assumed.

In another interview-based study of Huawei's presence in Nigeria, Agbebi (2018), cited earlier, finds evidence through in country-interviews that the Shenzhen-based firm has provided training to Nigerian students, employees, and subcontractors, contributing to strengthening domestic human capabilities. However, this finding is derived from a limited pool of informants, exclusively comprising current and former Nigerian Huawei employees and trainees. This narrow sample prevents researchers from discerning whether the provision of training is unique to Huawei or represents a broader industry practice within the ICT sector. Expanding the range of interviewees to include workers, managers, and subcontractors from other technology firms operating in Nigeria could potentially yield different insights, as shown by the work of Tugendhat (2020). By incorporating interviews with Huawei's key competitors in Nigeria and Kenya, Tugendhat reveals that the primary objective of Huawei's training

programmes, much like those of other international ICT equipment providers, is to cultivate digital ecosystems centred on the adoption and use of their proprietary technologies.

Despite the numerous advantages offered by qualitative methods, such as their ability to provide in-depth insights and capture contextual nuances, they have been criticised for their perceived subjectivity. For instance, ethnographies focusing on labour's perceptions of the value and efficacy of training schemes provided by digital firms can place too much emphasis on the individual's own experience at the expense of more structural factors, obscuring the institutional context and wider global and national dynamics (Lamont and Swidler, 2014). Studies using a single data source also bear the risk of heavily relying on the researcher's interpretation, leaving room for bias and subjectivity. Researchers may inadvertently shape the data collection process, interpretation of results, and conclusions based on their own perspectives and preconceptions. This risk can be mitigated by employing data triangulation, which involves leveraging multiple data sources and methods to corroborate findings and minimise the impact of individual interpretation and bias.

Ultimately, recognising the constraints inherent in both quantitative and qualitative methodologies for examining the variegated impacts of China's digital presence in host developing countries, this dissertation adopts a mixed-methods approach, contending that blending research methodologies can yield a more holistic understanding of complex processes (Onwuegbuzie and Leech, 2005; Small, 2011). I use a comprehensive approach that leverages the strengths of different methodological approaches in what they do best: using quantitative methods to capture large-scale macro-dynamics while mobilising thick data and qualitative approaches such as case studies and comparisons to examine power dynamics, identify the politics embedded in technologies and unpack struggles around competing technopolitical regimes.

The inclusion of both quantitative and qualitative methodologies within a single research endeavour has sparked considerable debate within the research methodology literature. Traditionally, social scientists have often adhered to either a qualitative or quantitative approach. Until recent decades, the integration of these two methodologies into a unified framework has been relatively uncommon (Onwuegbuzie and Leech, 2005; Tashakkori and Teddlie, 2003). This methodological segregation arises from the belief that each approach operates within distinct ontological and epistemological paradigms. Quantitative research is

typically associated with the positivist paradigm, which posits that research aims to uncover general patterns and trends (Zyphur and Pierides, 2020). Conversely, qualitative research aligns with the interpretive paradigm, which asserts that social reality is intricate and diverse, thereby emphasising the exploration of context, and subjective human behaviours.

However, despite their different epistemological grounds, both the qualitative and quantitative approaches can be combined in a single study exploring different aspects. Mixed methods research became increasingly popular during the 1990s, while the earlier calls for methodological separation that were prominent in the 1980s progressively faded (Tashakkori and Teddlie, 2003). In supporting the combination of quantitative and qualitative methods, Small (2011) argues that, since there are multiple constructions and interpretations of reality, mixed methods offer a tool for understanding complex problems. In development studies several important contributions have relied on mixed method strategies (See Mkandawire, 2001, 2010; Kabeer, 2019; Jerven, 2011), as has been the case in the China-in-Africa literature (Oya and Schaefer, 2019).

A mixed-methods research design aligns seamlessly with the theoretical framework outlined in Chapter 2, which integrates heterodox development economics and technopolitics. By leveraging various research tools, this approach enables the examination of both technical processes and power dynamics, providing a nuanced understanding of the complex interactions between foreign ICT firms and technological upgrading. Previous studies employing technopolitics advocate for integrating diverse data sources by interweaving multiple levels of analysis to gain a more profound understanding of the power dynamics shaping both technical and political dimensions (Gagliardone, 2010, p. 78). The empirically orientated theoretical approach of this thesis rejects the delegitimisation of "other ways of knowing" as well as the "ritual denigration" of knowledge gained through either qualitative or quantitative tools (Barrett and Carter, 2010, p. 527). It further acknowledges that a great deal of the existing knowledge pertaining to the complex processes of structural change, has not been, and cannot be, collected through a single method.

Drawing on this wider empirical strategy, the research design of this dissertation allows us to delve deeper into the concrete mechanisms driving infrastructural expansion, technology transfers, and the shaping of data governance frameworks, all while tracing identifiable socio-technical connections and the dissemination of standards, protocols and norms. Thus, in light

of the main research questions, the theoretical framework, and the insights gathered from the existing literature, I adopt the research design represented in **Table 3.1**.

Table 3.1- Research Design

Research Questions	Methods	Data
What impact does China's expanding role in infrastructure provision have on digital connectivity in host economies, and what are the consequences for emerging digital systems?	-Difference-in-Difference regression - Case study	- BRI Participation - The Green Finance and Development Centre - International Telecommunication Union (ITU) - World 's 'World Development Indicators' - Semi-structured interviews and secondary data.
Are Chinese tech giants creating new opportunities for technology transfer, learning, and innovation?	Comparative analysis	Semi-structured interviews, descriptive statistics, documentary research.
In what ways are Chinese-built digital projects reshaping the global and asymmetric distribution of data ownership and control? And how are these infrastructural projects on the ground determining nascent data governance frameworks?	Comparative case study	Semi structured interviews, descriptive statistics, documentary research.

This mixed method design is used for the purpose of expanding the breadth of the research by using different methods to investigate different components of the research problem. It integrates quantitative and qualitative techniques to offer a more comprehensive understanding of the interplay between technology, power and development outcomes. In doing so, this

research design responds to recent calls for the use of mixed-methods to study the Digital Silk Road (Oreglia et al., 2021), as well as earlier arguments for cross- disciplinary and mixed-method research in development studies (Austin, 2008; Jerven, 2011).

3.2 Quantitative approach

This section of the dissertation employs regression analysis to explore how China's expanding role in infrastructure provision is shaping digital connectivity in host economies. Analysing this necessitates meticulous attention to data sources, econometric methods, control variables, and the identification of potential biases within the data. In line with previous studies, this research employs participation in the BRI as a proxy for China's infrastructural footprint. As the most extensive infrastructural initiative ever undertaken, the BRI encompasses projects across a wide range of sectors, with ICT infrastructure increasingly emerging as a critical focus area. As it will be further elaborated in Chapter 5, participation in the BRI is closely associated with the implementation of large-scale projects, including as explained above the installation of fibre optic cables to enhance internet connectivity, the construction of data centres to support digital economies, and the deployment of advanced network equipment to improve telecommunications systems (Custer et al., 2024).

Accurately evaluating the effects of Chinese firms on internet access would require granular, longitudinal data on ICT-related investments and financing. However, such data is largely unavailable or inconsistent across countries. In light of these limitations, BRI membership is frequently used as an indicative measure of China's infrastructural engagement (e.g., Ho et al., 2023; Ito et al., forthcoming). This approach is supported by evidence from the Global China Initiative and AidData, both of which show that the bulk of China's development financing and infrastructure building projects are directed toward BRI countries, indicating a strong correlation between BRI participation and increased Chinese lending (Chen et al., 2022; Ray et al., 2023).

For this analysis, which forms the core of the methodology in Chapter 5, I treat 'BRI Participation' as an intervention or treatment for countries that have signed a Memorandum of Understanding (MoU) to join the initiative. A binary variable, BRI, is constructed, coded as one (1) for countries involved in the BRI and zero (0) for countries not participating. An

original country-level dataset was compiled, covering the period from 2008 to 2022 (Appendix 1). This dataset includes 132 economies, of which 104 are BRI participants, and provides details on the participating economies alongside the year they joined the initiative. Internet access, measured as the share of the population with access, serves as the main outcome variable. Data for this variable are sourced from the World Bank's World Development Indicators (WDI) due to their accuracy and cross-country comparability. The treatment variable, BRI membership, is also coded as binary and includes a one-year lag to address potential reverse causality. Control variables include GDP per capita, urbanisation rates, FDI, government expenditure on education, and ICT costs. These variables are included to capture key economic, demographic, and regulatory factors influencing internet access. More detailed information on the measurement methodology and its limitations is provided in Chapter 5.

Following previous research attempting to isolate the 'China effect' (Wu et al., 2021; Luo et al., 2022; Li and Todo, 2025), the thesis employs the DiD regression method. This approach compares changes in internet connectivity over time between countries that joined the BRI and those that did not. Given that countries joined the BRI in different years (a staggered adoption design), appropriate DiD estimators are used. The DiD offers key advantages: (1) It strengthens causal inference under the assumption of parallel pre-trends by comparing outcome changes before and after BRI membership (treatment) against non-member countries (control); (2) It controls for time-invariant unobserved heterogeneity across countries (e.g., fixed historical or institutional factors); (3) It helps mitigate selection bias from comparing groups with different baseline characteristics by focusing on within-country changes over time relative to the control group. Because BRI participation is not random and may correlate with observable country characteristics (e.g., developing nations are more likely to join), propensity score reweighting (Imbens, 2004) is employed to improve balance between the BRI and non-BRI groups based on pre-treatment covariates. Chapter 5 is further enriched by a case study of Huawei's Fibre to the Home contract in Algeria, which demonstrates how such initiatives are reshaping domestic ICT ecosystems – creating opportunities for digital transformation while also introducing new forms of technological dependency.

3.3 Qualitative analysis

The qualitative empirical strategy relies on a comparative case study approach. As mentioned earlier, a striking issue in the literature on China's footprint in the global South is the one of Chinese exceptionalism, the view of China as an externalised, separate, and self-contained "Other", that presumably acts in widely divergent ways from other actors (Franceschini and Loubere, 2022). The lack of comparative research on Chinese MNCs in other developing countries has thus led to accounts picturing Chinese firms as *unique* and somehow detached from broader sectoral practices characterising the global economy.

To avoid falling into a myopic outlook and to capture variation, the second part of the research design adopts a 2 by 2 comparative framework: two countries (Algeria and Egypt) and two firm origins (Chinese and other foreign). The choice of selecting only two countries is determined by the time and budgetary limits of this doctoral project. As outlined in the introduction, Algeria and Egypt hold particular significance as major markets for Chinese construction and ICT firms and as two of Beijing's closest partners on the African continent and in the MENA region. Beyond their empirical relevance as BRI countries and hubs for Chinese digital capital, I selected these cases because I had access to key informants in the two countries as a former Huawei employee in Huawei's Algiers office, which is regionally headquartered in Cairo. This prior experience provided me with rare access to typically insular networks of Chinese and local engineers and managers, offering valuable insights.

Table 3.2 – Comparative Framework

National Context	**Algeria**		**Egypt**	
Sector	ICT		ICT	
Firms	Huawei / ZTE	Other Foreign	Huawei / ZTE	Other Foreign

While the digital industry is made up of different layers, this dissertation focuses on the ICT Original Equipment manufacturing (OEM) sub-sector. The ICT OEM sector, of which Huawei and ZTE are the largest Chinese actors, is characterised by high linkage effects within the broader economy. Unlike platform-based businesses that primarily provide digitally mediated services, the ICT OEM sector involves infrastructural building, tech manufacturing and hardware and software production, all of which have extensive upstream and downstream

linkages with other industries. Comparatively analysing the developmental effects of Huawei and ZTE's activities provides insights into the mechanisms through which the globalisation of China's digital industry contributes or not to technological upgrading through its impact on digital connectivity, technology transfer, and digital governance frameworks in host countries. Furthermore, Huawei and ZTE have established a significant presence in North Africa, unlike Chinese platforms and applications such as Alibaba, Tencent, and Didi, whose footprint in the region remains nascent. Their activities in North Africa encompass diverse aspects of ICT infrastructure development, including the construction and expansion of telecommunications networks, broadband systems, and data centres, as well as the management of these facilities. Additionally, they engage in numerous training and capacity-building initiatives, further reinforcing their influence within the region.

Table 3.3 – ICT Original Equipment Manufacturers Core Business Activities

Business Area	Description	Competitors
Consumer Goods	Design and production of hardware (e.g., phones, tablets, laptops, smart watches, etc) and software (e.g., Android, HarmonyOS).	Apple, Samsung, Vivo, OPPO, Xiaomi, Transsion, Huawei, Google
Infrastructure for Telecom Carriers	Telecom infrastructure, networking hardware, and broadband equipment provided to carriers (e.g. Vodafone, O2), including 4G, 5G networks, optical fibre cables, networking hardware, software, and cloud-based solutions.	Huawei, Ericsson, Nokia, ZTE, Cisco, Juniper Networks.
Enterprise Business	Focuses on providing networking, cloud, cybersecurity, and digital transformation solutions to businesses, organisations and governments, and industries outside of traditional telecom carriers. enabling them to build private networks, cloud infrastructure, and AI-driven digital solutions.	Cisco, IBM, Amazon Web Services (AWS), Microsoft Azure, Google Cloud, Alibaba Cloud, Huawei Cloud, Tencent Cloud

Understanding the contribution of Chinese digital MNCs to domestic technological capabilities requires contrasting the practices of Chinese digital firms with other foreign firms in the analysis as a benchmark. Thus, this comparative analysis allows us to capture how tech corporations, dispatched from different political economies, interact with local configurations of power and capabilities, shedding light on the nexus between the macro and micro-level

dynamics of digital development. At the same time, this framework will help disentangle the different actors advocating competing technopolitical regimes, emphasising who gets empowered and who gets disempowered from the dissemination of competing types of artefacts, processes, and standards, and the emerging opportunities and challenges for technological upgrading.

Within country analysis here allows to disentangle the variation between what Chinese ICT firms are doing in contrast to their competitors, as a wide variety of factors – political systems, geography, social, cultural, and economic structures – can be held constant in this design (Seawright and Gerring, 2008, p. 305). This research design does not involve structured comparisons, as seen in Mill's methods, due to the challenge of identifying most similar or most different cases with the aim of inferring causality. There is a wealth of scholarly writings highlighting the risks associated with controlled comparisons, including selection bias, multiple causation and interaction effects between variables (Sekhon, 2004). Instead, the qualitative component of this thesis adopts a more flexible approach, in which I contrast data focusing on differences between Chinese and non-Chinese firms to identify patterns, similarities and variations in business practices, strategic priorities, and engagement models. This analysis enables a nuanced disentanglement of the distinct roles played by foreign firms, local institutions, policy frameworks, and state actors at both local and global levels. Drawing on extensive empirical data and grounding the analysis in the theoretical concepts outlined above and expanded upon in each chapter, this research meticulously investigates the contributions of Chinese ICT corporations to processes of technological upgrading, as well as the complex interplay between technology and standards diffusion. It further scrutinises the implications of these dynamics for the future development of digital economies in Algeria and Egypt.

3.3.1 Interviews

The interviews for this project were collected during multiple rounds of fieldwork undertaken between October 2021 and October 2024. The first round of fieldwork spanned six months, evenly divided between Algeria and Egypt from September 2021 to March 2022. This was followed by three additional fieldwork trips: two in Egypt (June 2022 and June 2023) and two in Algeria (December 2023 and May–October 2024). In total, I conducted 107 semi-structured interviews across the two countries. Interviews included employees, subcontractors, customers

of Huawei and ZTE, students and start-ups receiving training and support from Chinese tech-giants, ICT policymakers, government officials, university researchers, as well as Western ICT equipment manufacturers including Cisco, Ericson, and Nokia. **Table 3.4** provides a breakdown of my interviews (See Appendix 2 for full interview table).

Table 3.4 – Breakdown of interviewees by category

Interviewee category	Code	Number of Interviewees
Local subcontractors, suppliers, and customers of Huawei and ZTE	S	17
Current and former Huawei and ZTE engineers and managers	W	28
ICT experts and researchers	E	18
Students and instructors of Huawei and ZTE training programmes	U	19
Engineers and managers of Ericsson, Nokia, and Cisco	C	17
Policymakers	G	8
Total		**107**

Gaining access to the highly polarised world of tech multinationals represented the first methodological challenge during my fieldwork. Several potential informants responded with scepticism to my requests to contact them. However, the network of contacts I had built when I was working for Huawei North Africa in 2015 and 2016 was fundamental to facilitate access to many interviewees working for the Chinese firm or in the broader ICT industry in Algeria and to a lesser extent in Egypt. I combined techniques of purposeful sampling for high level managers, policy makers and local subcontractors with an element of snowball sampling in the selection of other interviewees. While snowballing has been associated with significant selection biases (Biernacki and Waldorf, 1981), I have tried to mitigate this risk with the large number of interviewees accumulated over my fieldwork trips, as well as a deliberate effort to speak to engineers, students, researchers, and ICT experts from different socio-economic backgrounds, working or studying in diverse firms and institutions.

To broaden the scope of my interviewee selection, I signed up for LinkedIn's premium service. This tool facilitated targeted searches based on parameters such as location, skills, and professional affiliations. Using this social media platform, I reached out to numerous ICT

engineers in Algeria and Egypt working for Chinese and non-Chinese tech companies. Securing access to ministers and high-ranking officials necessitated introductions through intermediary contacts for most cases, but I successfully initiated conversations with a few senior officials and managers directly through LinkedIn.

Given the sensitive nature of the topic and the repressive political climate prevailing in both countries, all interviews were conducted with a commitment to preserving the anonymity of informants. Ensuring the confidentiality of interviewees' identities was key in cultivating trust and securing access. While the recording of interviews was feasible in Algeria, where I was perceived as a national conducting doctoral research in a foreign university, it was not possible in Egypt, where I was viewed with a heightened sense of caution. Even in Algeria, certain interviewees opted to go "off the record" during the interview when delving into sensitive discussions. Notably, requests to go off the record were more frequent among high-ranking managers of technology firms as they shared insights into their strategies and criticised the practices of their competitors. Additionally, civil servants and government officials requested temporary pauses in recording when expressing critiques of the system to which they belonged. However, in both Algeria and Egypt, everyone was comfortable with me taking written notes on a small notepad. This allowed me to obtain detailed notes, which I later typed and thematically coded for analysis.

I conducted interviews in Arabic, French, and English. The ability to conduct interviews in the informants' native language helped me navigate nuances, expressions, and subtleties, ensuring a more accurate interpretation of the responses. It also allowed me to create a safer environment for the interviewees, particularly with government officials and bureaucrats. It is well documented that speaking the local language can foster a sense of familiarity and comfort, facilitating the establishment of rapport between the researcher and the interviewee (Hiller and DiLuzio, 2004). This can contribute to a more open and honest exchange of information. While I engaged in intensive Mandarin Chinese language training as part of my doctoral studies and have been learning Chinese for several years, my Chinese interviewees in North Africa – highly educated expatriate workers and managers in the tech industry – all spoke English more fluently than I could speak Chinese, making English the more suitable choice for conducting the interviews. Nonetheless, my knowledge of Chinese helped warm up the atmosphere during introductions and enhanced my trustworthiness and credibility as a young researcher.

I started each interview by providing an introduction to my research, explaining the purpose of the interview, and requesting verbal consent. However, this was not always enough to dispel preconceptions of what I might *actually* be doing. The most common assumptions were that I intended to collect information on behalf of a tech corporation or a country's secret services. These assumptions may have hindered the content of the interviews. Some representatives of corporations answered my questions by sticking close to a pre-defined public relations discourse. Similarly, workers may have feared that negative comments about their firms could get them into trouble, even though I made it clear that the content from interviews would remain confidential. In all interviews, I was particularly careful not to ask any politically sensitive questions at the start but rather left these for the end, beginning with more economics-centred questions.

To keep the interviews flexible and to allow conversations to evolve organically, I primarily relied on semi-structured interview techniques (Adams, 2015). Drawing on a set of predefined open-ended questions, I was able to probe the interviewees to explore additional topics and themes based on their responses. The goal here was to obtain in-depth information while allowing for a certain level of standardisation (Magaldi and Berler, 2020). I also combined semi-structured interviews with elements of narrative interviewing (Jovchelovitch and Bauer, 2000), especially with ICT engineers, students and subcontractors receiving training from digital MNCs. Narrative interviews provide efficient tools to explore learning experiences and perspectives, and to capture the impact of capacity building interventions. Due to resurging waves of the Covid-19 pandemic during fieldwork, a few interviews were conducted online. These interviews may lack the richness of non-verbal cues present in face-to-face interactions, diminishing the depth of understanding and interpretation of responses. That said, the vast majority of the interviews were conducted in person.

3.3.2 Data analysis

Interview data was analysed through both deductive and inductive reasoning, using thematic content analysis, which enables a closer scrutiny of the data, the identification of themes of interest, and the analysis of complex, contextual factors (Drisko and Maschi, 2015, p. 82). For content analysis to be trustworthy, it was important to conduct it in a precise, systematic, and detailed manner (Schreier, 2014). Accordingly, in Chapter 6, which looks at technology spillovers from ICT corporations, I used a theory-driven coding strategy to identify technology

spillovers with codes indicating the mechanisms accounting for linkages and spillovers between ICT firms and local universities and start-ups. Codes were later grouped into themes representing different channels of technology transfer. I followed an inductive approach to analyse the power dynamics between different actors and the content conveyed in linkages by iteratively comparing conceptualisations emerging from representatives of digital MNCs and other local actors against observations of what linkages, as technical artifacts, were producing on the ground and their effects at the national and global levels.

Similarly, in Chapter 7, which looks at the role of Chinese-built data centres in boosting local capabilities in data processing and control by analysing the two cases of Algeria's Sonatrach and Egypt's National Research Centre (NRC), I rely on a theory-driven coding strategy whereby I identify the justifications used to explain the choice of data localisation and the reliance on Chinese infrastructure constructors in the process. Codes also indicate the role played by local firms, institutions, and engineers in the process of storing and processing the data collected. The analysis endeavours to capture not only the role played by Chinese-built data centres in strengthening local capabilities but also offers broader insights for understanding ties between the physical infrastructure and emerging data governance frameworks and technopolitical regimes. In both chapters, crosstabulation was used to shed light on patterns and variations (Kamakura and Wedel, 1997, p. 487). Data analysis went beyond each case to analyse data across the Chinese and non-Chinese firms in each of the two countries.

Drawing on additional data from financial and business newspapers, the companies' annual reports, policies in the ICT sector, data governance regulations, and descriptive statistics and going back and forth between the technical and the political as described in Chapter 2, I thought through causal directions to explain the extent and nature of technology spillovers and power dynamics emanating from the interaction of foreign digital MNCs with local political economies, constructing an account of the effect of Chinese ICT firms on technological upgrading. As the central research question of this PhD thesis entailed two competing hypotheses – Chinese digital MNCs "create opportunities for technological upgrading" or "hinder the accumulation of such capabilities" – the data collected were organised in support of each of these possibilities as suggested by methodological research in process tracing (Fairfield and Charman, 2017, p. 155). This approach does not mean that the outcome of the data analysis is expected to be "black" or "white"; instead, by systematically weighing

evidence from different sources and assigning them in defence of each hypothesis, this approach helps reveal nuanced causal accounts.

3.4 Conclusion

This chapter presented the research design developed to operationalise the conceptual framework of this thesis that studies how the influx of Chinese digital capital shapes opportunities for technological upgrading in host developing countries. It pragmatically relies on quantitative and qualitative tools and techniques to trace the effect of Chinese ICT corporations on technological upgrading in the two North African case studies of Algeria and Egypt. Since the issues I investigate are politically sensitive, and subject to commercial secrecy, the use of a variety of data sources and data collection techniques was needed to ensure that each sub-research question could be effectively tackled and that each piece of information could be adequately cross-checked and substantiated by additional evidence. This research design enables a comprehensive exploration of the complex dynamics surrounding Chinese digital infrastructure investments and their implications for local economies and emerging standards and governance frameworks. By employing a mixed-method approach, this study aims to contribute to a deeper understanding of the intricate effects of China's digital expansion in the Global South.

Both the conceptual and methodological frameworks illustrated in this and in the previous chapter were tailored to study the grounded effect of China's ICT firms in Algeria and Egypt, but they arguably can be employed elsewhere. Employing tools and methods that scrutinise the processes that shape access to digital connectivity, technology transfer, and data regulations through traceable socio-technical spillovers and linkages, can help capture the complex empirical implications of China's globalising digital industry. Before delving into the analysis, the subsequent chapter provides a comprehensive overview of the emergence of China's digital economy and the policies behind it, along with an examination of the status of the ICT sectors in Algeria and Egypt.

CHAPTER 4

Industrial Policies, Technopolitics and Diverging ICT Growth Paths

A natural starting point when attempting to assess the contribution of Chinese ICT multinational corporations to technological upgrading in host countries is to clarify the political-economic dimensions behind the evolution of China's ICT sector and its global expansion. It is also essential to provide a background on the ICT industries of the two host countries – Egypt and Algeria – to contextualise the political goals and industrial policies used to develop domestic ICT capabilities and highlight key trends and challenges. Thus, this chapter maps out and historicises the intricate evolution of the three ICT sectors. It draws on extensive documentary research from state agencies, ICT corporations, and international financial institutions (IFIs), fieldwork interviews, and descriptive data on government spending in innovation, unemployment, ICT development indicators, market structures, and technological standardisation efforts.

Deploying this dissertation's framework, which brings together heterodox economics and technopolitics, what follows highlights how ICTs are embedded within power dynamics and structures that uphold different types of political objectives. ICTs are thus negotiated, adopted, and reshaped by various political systems to advance their own interests, with varying levels of economic success depending on objectives, policies and the specific political, economic, and institutional contexts in which they operate. This chapter acknowledges the stark differences between China and the North African economies of Egypt and Algeria, particularly in their positions within the global economy. China's digital economy, characterised by its vast scale and rapid innovation, stands as one of the largest and most dynamic in the world. The sheer size of the Chinese market, combined with its historically rooted tradition of strong state institutions, suggests that its industrial strategies are not replicable in other developing contexts.

The aim here is rather to examine three key digital sectors and the emerging technopolitical regimes within these countries, highlighting their levels of technological sophistication, domestic policy constraints, and political imperatives. This analysis lays the groundwork for understanding the impact of China's globalising ICT industry on local infrastructure and

connectivity, technology transfer, and data governance frameworks. This chapter demonstrates the complex interplay between technology, politics, and economic development, which are relevant to all developing countries aiming to leverage the digital economy for structural change.

4.1 China's Great Digital Leap Forward

Starting from a position of technological backwardness, China has managed in a few decades to not only catch up with the technological frontier in the ICT sector, but to also redefine it and set its standards. What follows describes the Chinese government's ability to adjust its strategies and reassess its industrial policies to meet ambitious targets. This adaptability was shaped by a strong techno-nationalist vision among leaders to use ICTs to help the country regain a status of prosperity and power within the global economy.

From 1978 to 2000s: Opening-up and informatisation

During Mao's era, the PRC's push to "leap forward" into the industrial age led to a focus on building a self-sufficient domestic heavy industrial base and developing strategic military technologies. This industrial strategy neglected the developmental potential of telecommunications (Zhao, 2010). Concerned about losing political control after the turmoil of the Cultural Revolution [1966-1976] and the economic chaos it caused, the new leadership under Deng Xiaoping recognised the need for stability and economic reform to regain legitimacy (Goodman, 1994; Vogel, 2011). This fear of losing its grip on power prompted the party to shift its focus towards pragmatic economic policies and the reintegration of China into the global economy. A central aspect of this strategy was the pursuit of the "Four Modernisations," [2] which encompassed agriculture, industry, defence, science, and technology (Vogel, 2011; Reynolds, 2014).

[2] The concept of the Four Modernisations was first articulated by Premier Zhou Enlai in 1963. It gained renewed prominence in 1975 when Zhou emphasised it as a strategy to rejuvenate China's economy. After Mao Zedong's death in 1976, Hua Guofeng, Mao's successor, revived the Four Modernizations and initiated an ambitious ten-year plan to accelerate economic growth. However, its full implementation occurred under Deng Xiaoping, who began leading the Chinese Communist Party in 1978 (See Mishra, 1988)

As put by Deng himself in December 1978 during the Third Plenary Session of the 11th Central Committee of the CCP:

> "The central committee had put forward the fundamental guiding principles of shifting the focus of all Party work to the four modernizations… a great and profound revolution…our new Long March to change the backward condition of our county and turn it into a modern and powerful socialist state"
>
> (Cited in Marti, 2002, p. 49)

The focus on science and technology later became the cornerstone of the CCP's approach to development (Baum, 2019) and a salient feature of China's techno-nationalist pursuits, laying the ground for China's emergence as a global leader in areas such as telecommunications and digital technologies (Zhao, 2010). Because of China's technological backwardness in the late 1970s, the CCP first relied on foreign firms for technological acquisitions. In 1979, four Special Economic Zones (SEZs) – Shenzhen, Zhuhai, Shantou, and Xiamen – were designated as pilot projects to test market liberalisation measures and attract FDI (Lin et al., 2003). The state provided substantial investments in infrastructure, including transportation networks, communication systems, and education to ensure the success of these zones (Fu, 2015). The SEZs provided foreign companies with access to China's vast domestic market, the largest in the world, in exchange for technology transfer. Despite a cautious beginning, SEZs emerged as catalysts for substantial technological catch-up and structural transformation (Yeung et al., 2009). Notably, places like Shenzhen transitioned from a humble fishing village to a thriving technological hub within a single generation.

Figure 4.1 – Picture of Shenzhen 1980 vs 2011

Source: Top Photograph via Gaoloumi.com
Bottom Photograph by SSD Penguin on Wikimedia Commons

Economic reforms deepened further in the 1990s to accelerate China's re-integration into the global economy. In 1992, Deng Xiaoping's "southern tour" further accelerated the opening of China's domestic market to international capital (Chatwin, 2024). China shifted its focus from offering preferential treatment exclusively to foreign firms in SEZs and specific coastal areas to implementing more widespread open policies for FDI across the nation. The fastest growth of FDI inflows into China in this era was witnessed after Deng's Southern tour, with FDI inflows reaching US$45.463 million in 1998, up from just above US$5 million in 1992 (Fu, 2015). The deepening of economic reforms further accelerated the need for modernised ICT infrastructure and digital services for global market transactions (Hong, 2013). China's push for deeper integration into the global capitalist system spurred a heightened demand from corporations for advanced information technologies to enable participation in transnational production and trade (Shen, 2017).

The Chinese leadership recognised early on that ICTs constituted crucial infrastructure for global market reintegration and progressively embraced a strategy of *informatisation* (信息, *xìnxī huà*) (Zhao, 2010). This strategy called for investments in building high-speed transmission lines, laying down fibre-optic cables to improve connectivity, and expanding mobile networks (Hong, 2017a). Simultaneously, government policies focused on bolstering

the country's ICT services to support its integration into the global economy. One notable initiative was the 1993 "Golden Customs Project," one of China's earliest state-funded projects aimed at expanding national information infrastructures (Zhang and Zheng, 2012). The platform was designed to develop electronic customs clearance services and facilitate international trade. The goal was to streamline customs procedures, enhance trade facilitation, and strengthen enforcement measures to combat smuggling and improve revenue collection (Karpova and Mayburov, 2019). The Golden Customs Project was touted as a huge success both domestically and internationally and established a foundation for China's continued modernisation efforts (Zhao, 2010; Hong, 2017b).

Driven by longstanding techno-nationalist aspirations to catch up with richer countries, the CCP attributed greater prominence to ICTs in policy discussions. In 1997, the Ninth Five-Year Plan for State Informatisation and the Long-range Objective for the Year 2010 were introduced, highlighting the Internet's significance in national economic digitalisation and development (Shen, 2017). In this vein, President Jiang Zemin declared in the 1990s that "none of the four modernisations would be possible without informatisation" (Zhao and Schiller, 2001). As argued by Zhao (2010), China's informatisation approach, which consisted of prioritising telecommunications network build-up and integrating information technologies in different sectors, initially positioned China as the good student of the dominant orthodoxy of ICT-led development.[3]

Yet, the government's informatisation strategy resulted in increased use of foreign-built technologies in economic activities without fostering domestic capabilities in technological production. Throughout most of the 1980s and 1990s, China's informatisation strategy primarily relied on foreign loans, most of which had stringent conditions requiring the purchase of products from lending nations (Tan, 2002). By the end of 1989, for instance, loans from foreign governments and banks had funded 63 percent of basic construction and 55 percent of system improvements (Sun, 1993). Consequently, the Chinese network manufacturing industry remained mostly captured by transnational corporations, leading to significant foreign dominance and technological reliance. For instance, in the first half of the 1990s, only 25% of newly constructed national fibre-optic trunks contained domestically made products (Harwit, 2007, p. 319). The dominance of foreign equipment manufacturers contributed to a decline in

[3] The 1984 International Telecommunications Union (ITU) Maitland Report praised China's ICT strategy and listed the country as one of the success stories across the developing world.

domestic manufacturing and a sharp increase in imported foreign technologies (Hong, 2017a, p. 82). The Chinese leadership was aware that the overreliance on foreign switches risked reducing national control over network expansion while entrenching technological dependence. Considering these risks, the government implemented import-substitution strategies and established partnerships with foreign firms to encourage domestic manufacturing and facilitate technology exchange through joint ventures. By 1998, this policy had dramatically curbed imports, with around half of the switches in the public telephone network being produced locally. A year earlier, joint ventures, rather than solely local manufacturers, provided 90% of the new switches in 1997 (Hong, 2017a, p. 82).

The CCP's techno-nationalist ambitions were met with converging interests from a growing class of ICT capitalists. On the one hand, the party aimed to secure national security and leverage telecommunications for sustained economic growth. On the other, rising tech entrepreneurs depended on state support to protect them from foreign competition and to capture a larger share of China's lucrative domestic market. Early on, in 1994, Ren Zhengfei, Huawei's founder, met with then-president Jiang Zemin, during which this alignment of state-business interests became apparent. Ren recalled in an interview:

> "I said that switching equipment technology was related to national security and that a nation without its own switching equipment was like one without its own military. Secretary Jiang replied, well said" (Harwit, 2007, p. 327).

A few years later, in 1998, the Ministry of Information Industry (MII) mandated the country's rapidly expanding mobile phone companies to prioritise local equipment when feasible (Tan, 2002). This preference effectively protected national firms like Huawei and ZTE, providing them with preferential access to the domestic market. Concurrently, foreign companies seeking to enter China's telecom market had to navigate stringent requirements, giving domestic firms like Huawei and ZTE an edge. Nevertheless, while Huawei and ZTE succeeded in capturing segments of the domestic ICT equipment market, foreign vendors continued to dominate China's 2G mobile communications sector (Chao, 2009). As put by Hong (2017) this experience taught the CCP that relying solely on import-substitution policies involving foreign firms would not be sufficient to overcome technological dependence "within a liberalised global investment and trade environment" (Hong, 2017a, p. 87).

Towards the late 1990s, despite spectacular growth, China's FDI-driven, export-oriented development strategy led to structural shortcomings and a concentration in low-cost manufacturing, particularly in labour-intensive industries with limited capacity for value-added production and innovation. The economy was vulnerable to fluctuations in global demand. Chinese officials feared the country would remain stuck at the bottom of global value chains, a concern eloquently captured by Bo Xilai, who, as Minister of Commerce, described China's role as "trading 800 million shirts for one A380 airbus," highlighting the need to escape this disadvantageous position in the global economy (Zhao, 2010, p. 270). It became apparent within Chinese policy circles that the informatisation strategy, combined with the low-tech, export-intensive model, would not allow China to catch up with technological leaders (Shen, 2017). Instead, policymakers came to view technological upgrading to increase domestic control and ownership over technologies as crucial for long-term structural change (For a theoretical overview, see Prebisch, 1950; Amsden, 2001; Wade, 2003; Fu et al., 2011).

2000 to 2010: Indigenous innovation and going out

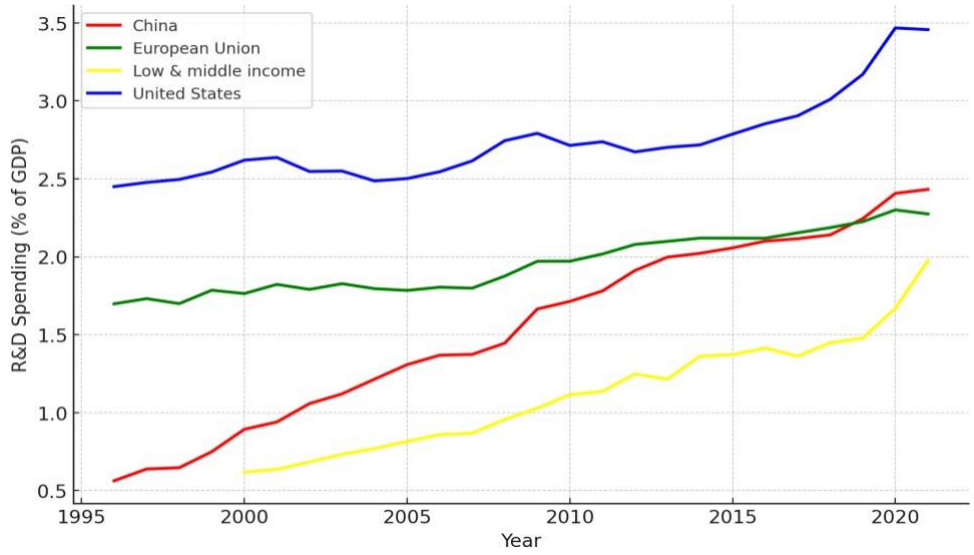
At the turn of the century, China underwent notable changes in its ICT strategy, transitioning from a focus on informatisation across various sectors to prioritising the advancement of indigenous technology and standards, commonly known as "indigenous innovation," in critical areas (Zhao, 2010; Fu, 2015). At the 16th World Computer Congress in 2000, President Jiang Zemin highlighted that the world was becoming increasingly split between the "information rich" and the "information poor" and that the capacity of developed countries to enjoy more sophisticated information technologies meant that the expanding reach of the Internet would not suffice to address the digital divide (Cited in Shen, 2017, p. 90). Following the spirit of this discourse, the 2000s saw a departure from relying on foreign technological and industrial inputs towards a deliberate effort to cultivate and utilise domestic innovation and production capabilities.

The Chinese state embarked on a journey aimed at progressively promoting economic activities beyond those in which China held a comparative advantage, defying the neoliberal orthodoxy. The November 2002 Report to the 16th Party Congress advocated using informatisation to propel industrialisation and urged technological innovation and ownership of intellectual property rights (Xinhua, 2002). This shift in strategy was further consolidated with the arrival of Hu Jintao in power in 2003 and the introduction of the "scientific concept of development,"

emphasising the need to adopt a more sustainable developmental trajectory and focus on science and technology as key drivers of economic prosperity (Fewsmith, 2004). The focus on indigenous technological development gained further prominence in central party-state documents, such as the CCP Central Committee Proposals on the 11th Five-Year Plan published in 2005 and the National Informatisation Development Strategy (2006–2020). Concurrently, the Ministry of Information Industry (MII) emphasised indigenous innovation in a 2006 report stressing the need not only to address technological bottlenecks but also to foster indigenous innovation and create local application (Hong, 2008). These documents underscored China's commitment to enhancing its national competitiveness by mastering core technologies in the information industries.

The turn towards indigenous innovation reshaped China's technopolitical landscape, leading to the emergence and growth of Chinese champions like Huawei, ZTE, Alibaba, and Tencent, which boosted the production of home-made artefacts and standards and progressively overtook foreign ones. State interventionism supported this approach with substantial subsidies. For instance, the government provided generous funding for R&D activities, helping companies to invest in learning and innovation. As **Figure 4.2** shows, in 2000, the country's gross domestic expenditure on R&D was 0.9% of its GDP; by 2010, this number had reached 1.7%, and by 2021, it had risen to 2.41% of GDP, indicating a massive commitment to research and innovation (World Bank Data, 2025b).

Figure 4.2 – Research and development expenditure (% of GDP) in selected countries

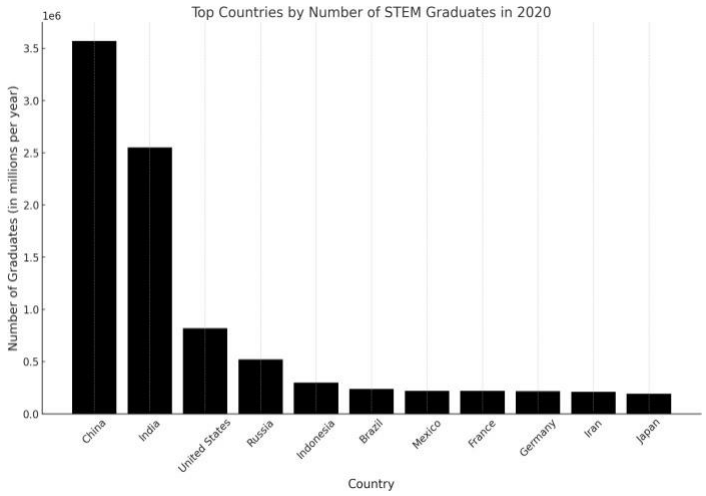


Source: World Bank data, "R&D as a share of GDP", available at: https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS

China also invested in research-oriented universities to cultivate high-level talent. The government introduced initiatives like Project 211 and Project 985, which aimed to build world-class research institutions (Lin and Wang, 2022). These projects channelled significant funding to key universities, enhancing their research capacities and fostering innovation. It's estimated that the central government invested a total of RMB 32.9 billion in special funds for Phase I (1999-2001) and Phase II (2004-2007) of this initiative, assisting thirty-nine universities (Gao, 2014). These substantial investments in the nation's research capabilities stemmed from policymakers' understanding that foreign technology transfer and indigenous innovation mutually reinforce each other. As argued by Fu and Zhang (2011), localised innovation is essential for developing domestic absorptive and innovation capacities, which are essential for effectively leveraging technology transfers.

In this vein, policy focused on developing a highly skilled workforce in science, technology, engineering, and mathematics (STEM) education as a vehicle for economic development. This ensured a steady supply of engineers, scientists, and technicians to meet the demands of the country's ICT industry as well as other high-tech industries (Gao, 2014; Hillman, 2021). According to the National Bureau of Statistics of China, the number of engineering and technology graduates increased from 50,000 per year in 2000 to 300,000 in 2010, representing a 500% increase over the decade (NBS, 2024). Policymakers also encouraged students and researchers to gain experience abroad. As a result, many Chinese students studied at leading universities worldwide, gaining valuable knowledge and skills that they brought back to China (Hillman, 2021). At the same time, Chinese universities fostered partnerships with foreign universities and research centres for collaborative research and faculty exchanges, which promoted the development of new ideas and innovation. As such, Chinese ICT corporations like Alibaba, Huawei, and ZTE could draw on a large talent pool, recruiting engineers and technicians in telecommunications, computer software, and hardware trained at China's top universities and abroad. Moreover, backed by state support, firms invested heavily in training and internal development programmes to ensure their staff were at the forefront of technological advances (Greeven, 2007).

Figure 4.3 – Top countries by number of STEM graduates in 2020



Source: OECD data on number of graduates in STEM per country (OECD, 2023)

One of the distinctive features of China's path to innovation is that, despite joining the WTO in 2001, Beijing managed to retain policy space for implementing industrial policies. During its accession negotiations, China agreed to a series of commitments to open its markets and align its policies with WTO rules. However, it also leveraged its large market and its developing country status within the WTO to negotiate favourable terms (Halverson, 2004). First, China utilised subsidies and other industrial policies to support strategic sectors like manufacturing, high-technology, and renewable energy (Zhao and Wang, 2009). Beijing astutely categorised some subsidies as non-actionable (e.g., for R&D), making them more difficult to challenge under WTO dispute mechanisms. Second, China negotiated terms that allowed a gradual adjustment period for strategic sectors, permitting a progressive phase-out of non-tariff barriers and tariffs, giving it time to protect and develop domestic industries (Buckley and Zhou, 2013). Third, China did not sign the WTO's voluntary Government Procurement Agreement (GPA), which requires non-discriminatory treatment of foreign companies in public contracts (Wang, 2017). Thus, it could continue favouring local firms in government procurement contracts, thereby supporting local firms and its domestic industries.

Finally, and arguably most significantly, China's regulatory environment often selectively enforced WTO rules, granting leniency to domestic firms or industries that the government wanted to develop (Buckley and Zhou, 2013). This flexibility allowed the Chinese government to support emerging sectors while outwardly complying with WTO commitments. A key

illustration of this flexibility lies in China's "malleable" compliance with the protection of intellectual property rights. China's ICT sector, similar to other high-tech sectors, advanced in the production of technological artefacts Central Processing Units, Graphic Processing Units, RAMs, internal memories, display panels, and batteries, among other things – by extensively using reverse engineering techniques (Minagawa et al., 2007; Zhang and Zhou, 2016). This approach allowed Chinese companies to dissect, analyse, and replicate foreign technologies, which helped them quickly develop their own technologies and innovative variations (Minagawa et al., 2007). By understanding the inner workings of these technologies, Chinese firms could bypass high R&D costs and accelerate the production of competitive alternatives at a lower price.

The bypassing of intellectual property protection did not go unchallenged. In 2003, the US-based company Cisco accused Huawei of intellectual property theft and filed a lawsuit, alleging that the Chinese firm had illegally copied its software, including source code, technical documentation, and patents (Lin-Liu, 2003). Cisco's charges included claims that Huawei's operating system for its Quid way routers contained identical strings, file names, bugs from Cisco's IOS software, and amusingly, even the same typos in user manuals (Justia law, 2003). The dispute was settled in July 2004, with Huawei agreeing to modify parts of its software (Liu, 2024). Huawei leveraged protectionist measures and state subsidies to gain a greater share of the global market by pricing its routers up to 40% lower than Cisco's (Hong, 2017a). By 2004, Huawei's share of the router and local area network equipment market had increased to 31%, while Cisco's had dropped to 56%, and domestic telecommunications companies were increasingly dominating China's telecommunications equipment market (Fu, 2015). Although China's strategy for technology acquisition drew – and continues to draw – criticism from wealthy countries and their businesses, theft of intellectual property is at the heart of the history of industrialisation and technological development, and was used by all late developers, including the US, Germany, and Japan in their catching-up efforts (see Chang, 2002 for a detailed discussion).

Concurrently with its WTO accession, Beijing adopted the Go Out Policy in 2001 to encourage Chinese enterprises to expand their operations internationally. The policy emerged in response to domestic crises in the political economy, as several sectors were still dominated by foreign firms and Chinese corporations needed to expand to new territories (Wang, 2016b). Through this framework, the Chinese leadership sought to enhance the global competitiveness of

Chinese companies by pushing them to establish a strong presence in international markets (Brautigam, 2011). This included setting up overseas branches, acquiring or merging with foreign firms, and forming joint ventures to capture new consumer bases and access new technical and managerial knowledge. Huawei and ZTE received significant government support through the Going Out initiative, which included export credits, diplomatic backing, and financial assistance (Shen, 2017). These policies enabled the companies to compete in emerging markets, particularly in Africa, Latin America, and Southeast Asia, where their cost-competitive products found receptive customers (Li and Cheong, 2017). The rising demand from developing countries to expand their network capacities (in terms of geographic coverage and the number of users, for instance) and upgrade network equipment (e.g., shifting from 3G to 4G to 5G), combined with the competitive prices of Chinese ICT equipment, meant that Chinese firms soon began generating the bulk of their revenues from outside China as shown in **Table 4.1**.

Table 4.1 – Huawei's Revenues

Year	Total revenue (billion yuan)	Total revenue (billion yuan) % of sales outside China
2020	891.4	34.4
2019	858.8	41
2018	721.2	48.4
2017	603.6	71
2016	521.6	59
2015	395	45.7
2014	288	62.2
2013	239	64.8
2012	220	66.6
2011	204	67.8
2010	183	66
2009	149	60.4
2008	125	75
2007	94	72
2006	66	65
2005	48	58
2004	31	40.9
2003	22	27.4
2002	18	n.a

Source: Compiled by the author based on several of Huawei's annual reports

During this decade, conversations around digital sovereignty intensified, fuelled by worries about national security, domestic economic interests, and cultural pride. To bolster its techno-nationalist endeavours, industrial policies went beyond protectionist measures and subsidies to shape China's own standards strategy. One early illustration of this can be traced to the dispute between VeriSign, the US company responsible for the ".com" domain name, and the China Internet Network Information Centre (CNNIC) (Mueller, 2011, p.183). In 2000, VeriSign unveiled plans to develop technical standards and registration for domain names in non-Latin characters, known as "internationalised" domain names. This initiative included standardising and registering domain names in Chinese characters, an activity that could generate high returns for whoever controlled it (Arsène, 2015). China viewed these efforts as undermining its authority over the domain names in its language and territory, something that constituted a threat to sovereignty and economic development. Consequently, China pushed back against VeriSign's involvement and created its own Chinese-language domain name registration system (Mueller, 2011; Arsène, 2015).

Recognising the importance of technological standards as a competitive tool in a global economy where intellectual property is highly valuable, the Chinese government launched an ambitious national standard-setting strategy (Breznitz and Murphree, 2012; Seaman, 2020). By developing national standards in telecommunications and electronics, Chinese firms could avoid paying high royalties to foreign companies and gain a competitive advantage in the domestic market. Significantly, the adoption of the homegrown TD-SCDMA (Time Division-Synchronous Code Division Multiple Access) standard in China, which was approved by the International Telecommunication Union (ITU) as one of the three official 3G standards globally, was a steppingstone in the country's telecommunications history (Hong, 2017a).

Against the backdrop of the 2008 financial crisis, the MIIT[4] (The Ministry of Industry and Information Technology), under the guidance of the State Council, released third generation (3G) mobile communications operational licences. The government allocated a 3G licence for TD-SCDMA exclusively to China Mobile, the largest telecom operator in China (Zhan and Tan, 2010). Other mobile operators received licences to use the other two globally recognised W-CDMA and CDMA2000 standards (Shen, 2017). The adoption of the homegrown TD-

[4] The MIIT was created in 2008, by merging several departments, including the Ministry of Information Industry and other government agencies, to oversee policies related to industrial development, telecommunications, and information technology.

SCDMA standard helped Chinese ICT equipment manufacturers establish a foothold in China's 3G market and illustrated the country's ambition to reduce reliance on foreign technology and to promote its technological standards.

By the end of the 2000s, China's ICT industry had grown by great leaps and bounds, making it the largest online user base in the world. Yet even though remarkable progress had been achieved, the 2008 financial crisis highlighted enduring vulnerabilities in China's development trajectory. Thirty years of reform and opening-up policies had produced an economy that was highly dependent on transnational corporations and global demand (Hart-Landsberg, 2013). As consumer demand plummeted in Europe and North America, China's export-oriented factories saw a sharp drop in orders, leading to widespread factory closures and unemployment in coastal manufacturing hubs (Overholt, 2010). The crisis engendered domestic, regional, and social forces with rising vested interests in the existing pattern of coastal-based and export-led economic growth. At the same time, strategic industries, such as semiconductors, still heavily relied on imports (Zhao, 2010). This reliance exposed China to potential supply chain disruptions and limited its capacity to innovate independently. These challenges called for doubling down efforts to promote indigenous innovation and bolster technological self-reliance.

2010 - 2023 – Competition over technological leadership Take off and the DSR

During this phase, China's government implemented a series of industrial policies aimed at tackling structural issues and further transforming the economy with the objective of becoming a technological superpower. The decade started with China's 2010 Strategic Emerging Industries (SEI) programme, aimed at bolstering the growth of high-tech sectors. Later, policies like the Internet Plus strategy, Made in China 2025, and the BRI, came as an arsenal of technical projects – backed by enormous investments – and driven by the ambitious political objective of redefining China's position within global capitalism.

Digital technologies were increasingly viewed by Chinese political leaders as tools to consolidate state power, increasingly laying the foundations of a distinctive technopolitical regime, characterised by its own actors, standards, and technologies. The Great Firewall, which progressively emerged starting from the late 1990s, had been filtering and blocking access to foreign websites and content perceived to be controversial or harmful to the government (Ensafi et al., 2015). Using various techniques such as IP blocking, DNS filtering and

redirection, URL filtering, and deep packet inspection to restrict content, the Chinese state had virtually succeeded in creating a "Chinese Internet". This Internet governance model was seriously challenged in 2010 by the US company, Google. Tensions rose when the US firm's operations in China were targeted by a cyber-attack. The attackers, traced by Google to the Chinese government, sought sensitive information, including Gmail accounts of Chinese human rights activists (Sheehan, 2018). In addition to cybersecurity concerns, Google's relationship with local authorities had long been strained due to its strict internet censorship policies. [5] In January 2010, the US tech giant announced it would stop censoring its search results, effectively defying Chinese powerholders (Helft and Barboza, 2010). This decision led to the shutdown of Google.cn and the rerouting of traffic to Google's uncensored Hong Kong site. Chinese authorities swiftly blocked many of Google's services, effectively driving the corporation out of the country (Sheehan, 2018).

The Google incident led to a strengthened sense of techno-nationalism in Beijing, with policymakers further committing to speed up the development of the country's own tech giants, proprietary standards, and governance structures. Between 2010 and 2015, a surge of new digital companies and products reconfigured China's tech landscape. Xiaomi, a hardware manufacturer valued at over $40 billion as of 2023, was established in April 2010. [6] A month earlier, Meituan – a Groupon-like platform that evolved into a powerhouse of online-to-offline services – was founded. [7] Didi, the ride-hailing service that ousted Uber from China and grew to compete internationally, was created in 2012.[8] The expertise brought by Chinese engineers and entrepreneurs returning from Silicon Valley, many of whom were former Google employees, played a pivotal role in this boom, introducing top-tier technical and managerial knowledge to the Chinese market. In 2014, Alibaba's IPO on the New York Stock Exchange raised approximately $25 billion and was registered as the largest IPO in history at the time, leading Jon Stewart, the Daily Show's presenter at the time, to claim: "The communists just beat us at capitalism" (Cited in Shen, 2017, p. 167).

This phase saw major institutional restructuring to enhance ICT sector governance. Reforms aimed to centralise power previously fragmented among state agencies and streamline

[5] Since its entry into the Chinese market in 2006, Google had operated a censored version of its search engine to comply with local regulations.
[6] Xiaomi, about us, accessible at: https://www.mi.com/global/about/
[7] Meituan, about us, accessible at: https://www.meituan.com/en-US/about-us
[8] Didi, About us, accessible at: https://www.didiglobal.com/about-didi/about-us

policymaking. The Cyberspace Administration of China (CAC), established in 2011, quickly became the central authority overseeing internet content, cybersecurity, and data governance (Miao and Lei, 2016). The Ministry of Industry and Information Technology (MIIT) and the National Development and Reform Commission (NDRC) played key roles in formulating economic plans for digital infrastructure and innovation, supervising telecommunications, software, and electronics industries, and overseeing next-generation technologies like 5G (Hong, 2017b). The Ministry of Science and Technology (MOST) coordinated research in emerging technologies like artificial intelligence, while the China Internet Network Information Centre (CNNIC) managed the .cn domain registry under the CAC's authority (Creemers, 2020).

Beijing's penchant for techno-nationalism was further bolstered by the disclosure by former US intelligence contractor Edward Snowden of information about the National Security Agency (NSA)'s extensive digital surveillance in 2013, which amplified Beijing's longstanding worries about reliance on foreign tech companies. Acknowledging China's vulnerabilities in the global internet, the newly established Xi Jinping-Li Keqiang leadership pushed forward the concept of a "strong Internet power" (Shen, 2017). The new administration brought a fresh array of industrial policies, including a substantial increase in R&D investment as shown in **Figure 4.1**. A hallmark policy during this period was the "Internet Plus Strategy," introduced by Premier Li Keqiang in 2015. This policy aimed to reshape traditional industries such as manufacturing, agriculture, and logistics by leveraging the power of mobile internet, cloud computing, big data, and the Internet of Things (IoT) with traditional industries (Hong, 2017b). This strategy intended to create new growth engines by enabling firms to deepen their digital integration for enhanced productivity and innovation.

Another key industrial policy designed to deepen China's digital transformation was the *Made in China 2025* initiative. Chinese policymakers conceived this policy as a strategy to modernise the country's manufacturing base by leveraging intelligent manufacturing technologies and AI, to achieve self-sufficiency in critical sectors such as semiconductors, robotics, industrial software, 3D printing, and other technology-intensive industries (Zenglein and Holzman, 2019; Agarwala and Chaudhary, 2021). The stated goal was to achieve 70% self-sufficiency in core technologies by 2025, reducing reliance on foreign suppliers (Wübbeke et al., 2016). A central part of this strategy was the development of China's domestic semiconductor industry. Recognising the strategic importance of semiconductors, the National Integrated Circuit

Industry Investment Fund was set up in 2014 by the Ministry of Finance and China Development Bank Capital to invest in the country's semiconductor industry with $14.2 billion in registered assets (Technode, 2023). It has since then conducted multiple rounds of funding including one in 2024 worth over 47 billion USD (Swain, 2024).

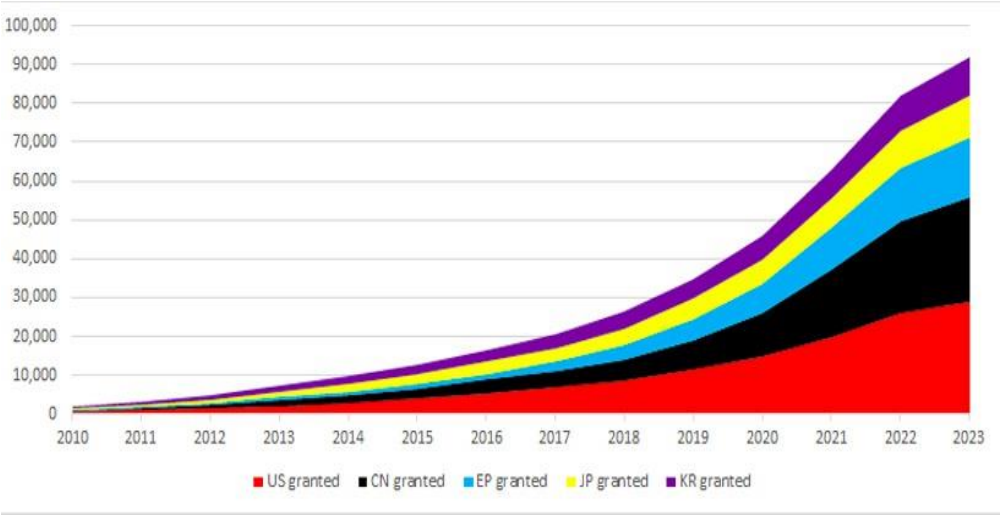
While continuous investments to move up the value chain were made, structural problems persisted, with industrial overcapacity being a prominent issue. Scholars have explained excess capacity as a recurring feature of the Chinese state, rooted in its early efforts to reintegrate into global capitalism through a low-wage, labour-repressing, export-oriented development model (Naughton, 2017). With the Chinese economy slowing down in the aftermath of the 2008 economic meltdown, the issue of overcapacity became even more pronounced. The BRI was launched at the end of 2013, primarily as an attempt to find a "spatial fix" to the country's overcapacity crisis. The CCP, under Xi Jinping's leadership, anticipated that the BRI would help address the problem by first utilising some of China's surplus capacity in major infrastructure projects, both within its less-developed regions and abroad (Carmody and Wainwright, 2022); and secondly, by boosting the export of Chinese excess equipment through the development and restructuring of cross-border manufacturing and trading networks, enabling China to further position itself at the centre of global economic activity (Zhang et al., 2022). By 2023, the BRI counted about 150 participating countries, covering nearly 75% of the world's population and accounting for over half of global GDP (The Economist, 2023).

As argued by Shen (2018), excess capacity was particularly acute in the ICT manufacturing subsector, which experienced a decline in global market demand following the financial crisis but was unable to compensate for losses within China's domestic market, characterised by insufficient absorption capacity for the vast quantities of ICT equipment produced. For instance, by the end of 2015, overcapacity in China's optical fibre and cable industry had surpassed 50%, highlighting a critical need for access to external markets (Shen, 2018). In response, the State Council issued the "Guideline on Boosting International Cooperation in Production Capacity and Equipment Manufacturing," which identified the telecommunications industry as one of 13 key sectors slated for expanded international industrial collaboration (State Council, 2015).

The Chinese state mobilised significant resources to facilitate the global expansion of its ICT champions via the BRI and DSR. Central to these efforts is the provision of substantial financial incentives, including subsidies, grants, and low-interest loans intended to enhance international

competitiveness (Naughton, 2020; Oreglia et al., 2021). The expansion of Chinese technology firms in BRI countries and the dissemination of Chinese technological artefacts – ranging from fibre optic cables, 5G networks, data centres, and telecommunications infrastructure to smart cities, software programmes, source codes, hardware, and chip designs – has arguably strengthened Beijing's strategic objective of enhancing its influence within international standard-setting bodies. The CCP has particularly emphasised the role of companies like Huawei and ZTE in shaping 5G and IoT standards (Kim et al., 2020). This ambition is further encapsulated in China's "Standards 2035" strategy, which aims to position China at the forefront of global tech standards (He, 2020). At the macro-level, Chinese officials have been playing an increasingly significant role by having more Chinese representatives in international standard-setting organisations, such as ITU, the International Organisation for Standardisation (ISO), and the Institute of Electrical and Electronics Engineers (IEEE) (He, 2020).

Figure 4.4 – Cumulative number of active and granted 5G patent families by jurisdiction and by year of grant



Source: Pohlmann et al. (2023, p. 11)

Note: Cn=China, EP= European Union, JP=Japan, KR= South Korea

Technological standards play a crucial role in shaping how political power is exercised and distributed. By setting the standards, China can dominate global supply chains in ICT, as BRI countries are likely to purchase Chinese technology, leading to economic benefits and strengthening China's industrial base (Rühlig, 2023). Control over ICT standards can also translate to control over data flows and cybersecurity norms. This can enhance China's ability to secure its own information while potentially influencing how data is managed globally,

giving China a strategic advantage (Erie and Streinz, 2021). Meanwhile, setting global standards positions China as a technological leader, attracting more talent and investment to Chinese tech companies, further accelerating innovation within China. Most significantly, standards are a tool for geopolitical influence. Countries reliant on Chinese technology and standards may be more politically aligned with or dependent on China, redrawing global alliances and power balances.

In sum, the growth trajectory of China's ICT sector reveals a compelling narrative of astute deployment of industrial policy to fulfil deeply ingrained techno-nationalist ambitions. Perceiving digital technologies as tools that could be used to consolidate state power, the CCP, especially after the arrival of the Xi-Li tandem to power, invested formidable resources to develop China's capabilities in this field and achieve greater technological sovereignty. Over the past four decades, China moved from leveraging foreign technology in SEZs and informatisation to fostering indigenous innovation and expanding globally. This evolution has elevated China to the status of a technological superpower and the only true challenger to US hegemony over the digital economy. With Chinese digital capital reaching an expansionist moment, the implications of its engagement with other developing economies become significant. Before delving into key aspects of this engagement in Egypt and Algeria in following chapters, the next section provides a description of the evolution and state of the ICT sectors of the two North African economies.

4.2 Egypt - Grand Digital Vision on a Shoestring

During Hosni Mubarak's three decades in power, the Egyptian leadership aimed to leverage ICTs as part of the country's social contract and provide jobs to ensure political stability. In post uprising Egypt General Abdel Fattah Sisi also sought to moblise ICTs for economic development, job creation, and regime survival, embodying a form of technopolitics based on using technology to reinforce political control and restore regime legitimacy. Yet a mismatch persisted under these different regimes, between the policies implemented and the political goal of using the sector for economic prosperity and maintaining power. As what follows illustrates, the adoption of neoliberal policies served to dismantle the necessary state capacities to build robust domestic capabilities, and support and develop a thriving ICT industry, ultimately undermining the country's ICT global competitiveness.

The 1970s and 1990s: "*No factories – no problems"*

From its genesis in the early 1970s, Egypt's ICT development has been shaped by neoliberal ideologies, following President Anwar Sadat's Open Door Policy (*Infitah*). The *Infitah* marked a noteworthy departure from the socialist policies of Gamal Abdel Nasser, the architect of Arab socialism, who emphasised state-led industrialisation and employed protectionist measures alongside other industrial policies to enhance Egypt's technological capabilities (Ikram, 2005). In contrast, Sadat's Infitah encouraged private and foreign investment, trade liberalisation, and the cutback of state interventionism in the economy (Weinbaum, 1985; Aoude, 1994). This policy undermined efforts towards structural change achieved during the Nasser period. The contribution of domestic manufacturing, measured by manufacturing value added as a share of GDP, declined significantly, from approximately 17% in 1974, when *Infitah* was first introduced, to around 12% by 1980 (Tradingeconomics, 2025).

When Hosni Mubarak assumed power in 1981, his administration prioritised expanding telecommunications access. Leveraging infrastructure projects financed by foreign loans, Egypt, via the Arab Republic of Egypt National Telecommunication Organisation (ARENTO), substantially increased the availability of telephone lines (Abdulla, 2007). Between 1980 and 1992, Western countries provided around $1billion for telecommunications infrastructure (USAID, 1992). The global ICT revolution in the 1990s compelled the Egyptian government to upgrade its ICT systems through close partnerships with the US and European countries. The internet debuted in Egypt in 1993 when the Egyptian Universities Network (EUN) established an internet connection, using a low-speed link to France (IDRC, 1999). Internet connection later expanded to include links to the United States and other parts of Europe. Egypt's integration into the global web coincided with an intensification of neoliberal reforms during the 1990s. These reforms led to chronically low investments in domestic capabilities, which shaped the development of the country's ICT sector and hindered its ability to thrive, as subsequent analysis will demonstrate.

About a decade after Sadat's *infitah* reforms, Egypt was mired in a deep fiscal crisis. The 1979 Volcker shock deepened the country's debt crisis and shifted power towards international creditors (Elyachar, 2012; Roccu, 2021). Consequently, Egypt entered a stand-by agreement with the IMF in 1987 and soon became trapped in a cycle of indebtedness and deepening neoliberal transformation. The Egyptian government implemented substantial economic

liberalisation initiatives as part of its first Structural Adjustment Programme (SAP) in 1991, introduced under the guidance of global institutions such as the IMF and the World Bank (Roccu, 2021). The reforms aimed at further opening the Egyptian economy by lowering trade barriers, slashing state subsidies, privatising state-owned enterprises, and promoting foreign investment (Hanieh, 2015; Aldy, 2021).

The government's approach to ICT development emphasised a market-oriented strategy, centred on regulatory reforms and the provision of economic incentives. These measures included allowing greater domestic and foreign capital participation, privatisation and competition, especially after joining the WTO in 1995 (Badran, 2012). Mubarak's successive governments further liberalised the telecommunications market by licensing private operators for mobile telephony, breaking Telecom Egypt's monopoly (Kamel, 2010). The ruling elite also used incentives to attract foreign technology investment including tax breaks, technology parks, and a simplified investment process (Aubert and Reiffers, 2003).

This period marked a notable advance in the diffusion of ICT within the country. During the early years of President Mubarak's tenure, Telecom Egypt achieved a significant milestone by launching digital mobile telephony in November 1996, making Egypt one of the first in the Arab world to adopt mobile services (Kamel, 2007). From 1995 to 2000, the annual growth rate of telephone lines was approximately 15%, and the fixed line teledensity[9] nearly tripled from 1990 to 2000, indicating a substantial increase in accessibility and connectivity (CEIC, 2024). The creation of the Ministry of Communications and Information Technology (MCIT) in 1999 was a critical strategic initiative aimed at centralising and amplifying efforts to leverage ICT for economic growth.

However, the neoliberal ideology of monetary control and fiscal discipline meant that the expansion of Egypt's telecommunication infrastructure and services was not matched by investments in education, research, and development, which are critical for nurturing indigenous technological capabilities. By the end of the 1990s, Egypt's spending on R&D was insignificant at 0.19% of GDP (World Bank Data, 2025b). And its investment in education, at just 4.1% of GDP, fell at the lower end of UNESCO's recommended range of 4% to 6% for developing countries (World Bank Data, 2025c). Public spending was even more parsimonious

[9] The number of main telephone lines per inhabitant

with respect to higher education. Throughout the 1990s, investment averaged merely 1% of GDP, below the global average of 1.3% for developing countries, including nations with lower income levels than Egypt (World Bank Data, 2025c).

Strict fiscal and monetary policies cut inflation below 5 percent and the budget deficit from 15% of the country's GDP to under 3%, and in some years, even below 1 %, which were among the lowest levels globally (Mitchell, 1999). In the meantime, IFIs celebrated Egypt as a diligent adopter of the Washington Consensus. In May 1998, the IMF lauded Egypt's privatisation efforts as "remarkable," ranking it fourth globally, after Hungary, Malaysia, and the Czech Republic, for privatisation income relative to GDP (Handy, 2001, p. 52).

During this time, international organisations like the IMF and World Bank portrayed the East Asian miracle, including in China, as the result of free-market policies, overlooking the instrumental role of state intervention and the selective protection of strategic industries (Page, 1994; Wade, 2003; Kohli, 2004), as exemplified by China's ICT sector explored above. Conversely, the Washington Consensus sought to reduce state intervention, urging countries like Egypt to integrate into the global economy in ways that favoured the financial sector over the productive economy. From 1980 to 1994, Egypt's public sector investment fell from 12% to 7% of GDP and was focused on infrastructure and social services, leaving manufacturing and telecommunications to the private sector (Zavajil, 1995).

While promoting a narrative of fiscal restraint regarding subsidies for developing domestic technological capabilities, the state simultaneously subsidised financialised urban property developments nationwide, catering primarily to the demands of economic elites. A flagship initiative of this period was the "Dreamland" project, promoted as "the world's first electronic city." Prospective buyers were invited to invest in luxury fibre-optic-wired villas, set amidst shopping malls, theme parks, golf courses, and polo grounds, rising from the desert landscape west of the Giza pyramids (Mitchell, 1999). Ironically, the advertisement promised "No factories, no pollution, no problems", encapsulating Egypt's embrace of a neoliberal development paradigm (Mitchell, 1999, p. 455).

This reallocation of state support away from industrial activity and tertiary education towards real estate and imported consumer goods, led to a weakening of Egypt's industrial capabilities, consolidating its reliance on foreign countries for ICT equipment. Despite the adoption of neoliberal policies that were intended to integrate Egypt more fully into the global market, the

actual result was counterproductive: Egypt's share of global exports more than halved between 1985 and 1997. Notably, the value of non-oil exports declined in successive years from 1995 to 1997, increasing the economy's reliance on petroleum products, which accounted for 52% of export income by 1997 (OEC, 2024). Egypt's structural reforms consequently reversed earlier efforts to promote industrialisation and structural change – a trend observed across the African continent. Mkandawire (2005) describes this process as one that reconfigured African economies, effectively reverting them to colonial-era economic structures.

2000-2011: The BPO Turn and a broken social contract

At the turn of the millennium, Egypt's ruling elite adopted a more assertive approach to integrating ICT into the country's economic and social fabric. The emerging technopolitical regime under Mubarek positioned ICTs as tools to attract foreign investment, modernise the economy, and absorb surplus labour – particularly among educated youth – to mitigate social discontent (Aubert and Reiffers, 2003). The "ICT Vision 2010" launched in the early 2000s marked a significant step towards achieving this goal. The policy plan covered various areas including ICT education, infrastructure development, e-government services, and fostering a competitive ICT industry (Rizk and Kamel, 2013).

Importantly, in the early 2000s, the government selected the Business Process Outsourcing (BPO) industry as a pivotal sector for economic development. BPO refers to the practice of contracting certain business tasks or processes to external companies (Mitra, 2013). These processes typically involve activities such as customer and technical support, call centres, IT services, data entry, transcription, digitisation, software development, network management, and data centre operations, among others. BPOs enable multinational corporations, primarily headquartered in high-income countries, to concentrate on their core functions while delegating non-core but essential tasks to external providers. Therefore, BPO leverages skilled labour at a reduced cost in developing countries, instead of maintaining these functions in-house where it would be more expensive (Graham and Mann, 2013).

A convergence of global and national factors shaped Egypt's approach towards the development of the country's ICT industry in this era. On the transnational level, financial institutions, in line with neoliberal orthodoxy, have promoted BPO as an activity that can allow

countries to leapfrog industrialisation (Mukiri-Smith et al., 2022). The rationale for promoting BPO, rooted in neoclassical economic trade theory and embraced by Egypt's ruling elite, was that advancements in ICTs would enhance the tradability of services. This shift would allow developing countries to export ICT services, thereby reducing their dependence on primary commodity exports and transitioning towards the export of tertiary services. This strategy would incrementally diversify the economic base, acquire new skills and capital, create jobs, and ultimately build a high-value-added service economy.

Moreover, Egyptian elite coalitions failed to converge around an approach that would help achieve a more knowledge-intensive, globally competitive ICT sector. Frictions rose between on the one hand, the state capitalist class, led by the army and favouring a gradual approach to market reforms, and on the other, an emerging private capitalist class aligned with Mubarak's son Gamal, which pushed for more sweeping reforms (Adly, 2021). The proximity of the latter capitalist class to the Mubarak family resulted in connivance and a preference for quick-win, rentier economic activities. When this faction gained control of the ruling party, a new wave of neoliberal reforms was introduced in 2003, marked by a fresh round of privatisations and further deregulation of labour markets (Hanieh, 2015). The nature of state-business relations in this period fostered a limited appetite for engaging in knowledge-intensive activities that would require technological learning and upgrading, and an overreliance on foreign capital.

Thus, the government sought to leverage the country's comparative advantage in the BPO sector claiming that this would help Egypt transition towards a knowledge-based economy (Larsen et al., 2023). It argued that the country's strategic geographic location, along with its skilled and multilingual workforce proficient in English, Arabic, and to a lesser extent French, made Egypt a favourable destination for BPO services. Moreover, ICT labour costs were seen as relatively low. For instance, as of 2010, the monthly salary for a quality BPO worker in Cairo ranged between US$225 and US$250, which is roughly half the cost of similar positions in India and the Philippines, the two leaders in ICT BPO services (Ghoneim, 2011). Thanks to its competitive labour costs, Egypt has supplied around 70 percent of the Gulf region's demand for BPO software since the 1990s, primarily serving clients in Saudi Arabia and the United Arab Emirates (Ghoneim, 2011).

Seeking to harness ICTs for growth and stability, Egyptian authorities implemented policies to strengthen the ICT ecosystem and expand service exports (Hamza, 2016). They established a

600-acre park west of Cairo to attract tech giants like Microsoft, Intel, IBM, and Oracle, aiming to boost Egypt's ICT sector. [10] In 2004, the Information Technology Industry Development Agency (ITIDA) was established to enhance Egypt's position in the global BPO market, offering incentives to support ICT and BPO companies and create an enabling environment for the digital economy. A 2006 report from the Egyptian Ministry of Communications and Information Technology envisioned the strategy would provide over 35,000 specialised IT jobs and 15,000 subsidiary opportunities by 2010 (MCIT, 2006, p. 60).

Despite important investments in infrastructure and marketing strategies to picture Egypt as an Eldorado for ICT outsourcing, the North African country's BPO sector struggled to take off. In 2008, Egypt's BPO sector ranked 33rd globally, facing stiff competition from countries like India and the Philippines. While the government had invested in infrastructural catch up, parallel investment in human capital had remained modest. Egypt's spending on public higher education is considerably lower than the average per-student expenditure in low- and middle-income countries (LMI) when adjusted for purchasing power parity (PPP), as shown in **Table 4.2.** This underfunding has disadvantaged Egyptian university graduates in the global BPO market compared to their international counterparts.

Table 4.2 – Expenditure per student in higher education in 2005 ($ PPP and %)

Country/Region	US$ PPP	(% GDP per capita)
Egypt	902	23.38
OECD countries average	9,984	36.65
LMI countries average	2,712	55.66

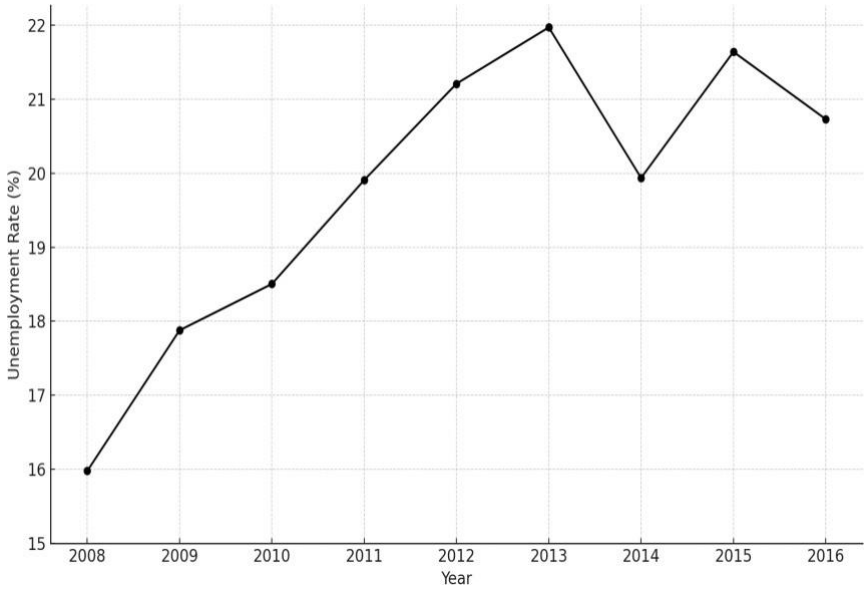
Source: Fahim and Sami (2011, p. 50)

Lack of public funding resulted in outdated curricula, inadequate resources, and a mismatch between graduates' skills and labour market needs, all of which have contributed to high graduate unemployment rates. The financial crisis further exacerbated competition with several large firms cutting down on their outsourcing operations. Egypt found itself in a dilemma. Its workforce was not cheap enough to compete with some of the most-cost competitive BPO

[10] I had the opportunity to visit Cairo's smart village on several occasions for conducting interviews between February 2022 and June 2023.

destinations when it came to low skilled tasks, but it was not trained enough to enter the most knowledge-intensive activities in outsourcing (E8, E9).

Figure 4.5 – Unemployment rate with advanced education (% of total labour force with advanced education) in Egypt



Source: World Bank Data (2025), available at: https://data.worldbank.org/indicator/SL.UEM.ADVN.ZS?locations=EG

The state's low investment in quality higher education and R&D activities meant that Egypt's ICT engineers had to compete with increasingly well-trained engineers elsewhere. As shown in Figure 4.6, this, in turn, fuelled high levels of unemployment among university graduates, reaching over 20% when the popular uprising broke out in 2011. Ultimately, while Mubarak's regime sought to leverage the digital economy for power consolidation, the neoliberal policies it pursued hindered the development of a robust ICT sector capable of absorbing the country's university graduates and competing on a global scale.

2011- 2022 - Tech for regime restitution

In 2011, President Mubarak was overthrown by a popular uprising during the wave of protests that came to be known as the Arab Spring. The movement, which brought millions of Egyptians to the streets, was fuelled by widespread dissatisfaction with decades of rising economic inequality. Two out of the three demands among the revolutionaries – "Bread, freedom, and

social justice" – were economic in nature and illustrated the fractured social contract (Dahshan, 2015). Despite an official growth rate exceeding 6% in the five years prior to the revolution, liberalisation in the 2000s had caused widespread distress among the people (Dahshan, 2015). Under Mubarak, corruption was rampant at the highest levels of government and business, and the economy largely revolved around rentier activities that failed to generate long-term quality jobs (Hanieh, 2011). This led to a significant concentration of wealth among a small elite, while the majority faced high unemployment rates, low wages, and limited upward mobility.

The global trade contraction after the 2008 financial crisis further hindered Egypt's economic recovery, increasing its reliance on foreign aid, especially from oil-rich Gulf countries, and substantial external borrowing under IMF conditions (Roccu, 2021). Following the revolution, Mohamed Morsi, a leading figure of the Muslim Brotherhood, was elected President of Egypt. His presidency was abruptly ended in 2013 by a military coup led by General Abdel Fattah al-Sisi (Bou Nassif, 2017). The new military regime combined a business-friendly approach with an expanded military economic role. As argued by Adly (2021, p. 2), the ability of Sisi's regime to impose unpopular austerity measures has been a precondition for creating "a macroeconomic environment conducive to securing foreign loans".

At the same time, access to foreign borrowing, primarily from the IMF, has played a critical role in ensuring regime survival. In a speech at Euromoney's Egypt conference in September 2014, President al-Sisi outlined his vision for reform. Reflecting the priorities of international financial institutions, he emphasised:

> "For too long, excessive and ineffective government spending, wasteful energy subsidies, endemic corruption and economic mismanagement had undermined the promise of our country, strangling our economy and our people's dreams."
>
> (al-Sisi, 2014)

This period witnessed intensified neoliberal reforms, pushed by powerful international and regional interests. Aiming to drive substantial economic growth primarily through private investment, he asserted that his administration had established a business climate that was "attractive, stable, equitable, and globally competitive" (al-Sisi, 2014), while enacting drastic reductions in public spending. Crucially, this phase marked the return of the military to the forefront of political life, alongside its growing role in the economy (Joya, 2017; Adly, 2021). Under the guise of "economic nationalism," the army has pursued a strategy characterised by

the construction of numerous megaprojects, often described as “military-led developmentalism” (Joya, 2018). Mega infrastructural projects like the New Suez Canal and the partially Chinese-built New Administrative Capital aimed to reconfigure the landscape of the “new Egypt” while restoring a new authoritarian social contract through job creation and improved living standards in exchange for political stability (Wahdan and Elshayal, 2024). These infrastructural ventures have also significantly increased Egypt's dependence on foreign creditors, contributing to a sharp rise in external debt and placing considerable strain on the country’s fiscal capacity.

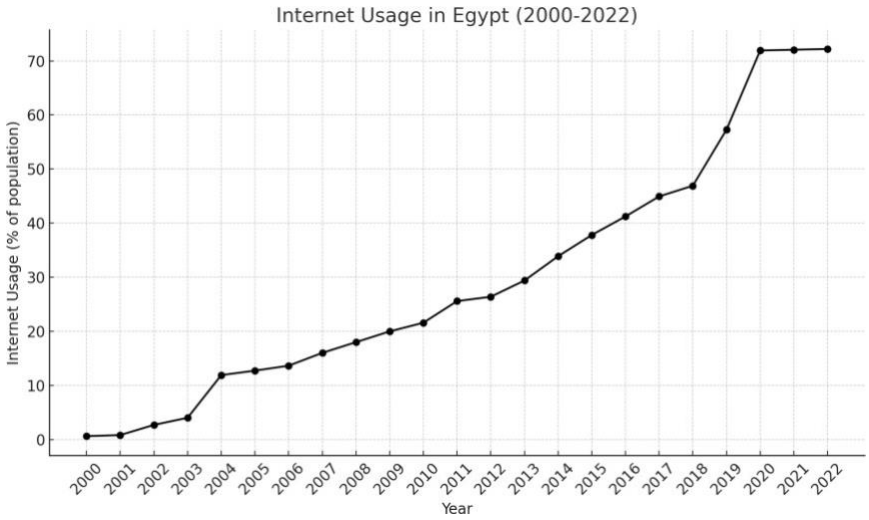
Some may interpret the focus on large-scale infrastructural projects as a return to Nasser-era state-led developmentalism; however, a growing body of literature has explained this trend as a manifestation of authoritarian neoliberalism (Tansel, 2017; Roccu, 2021; Adly, 2021).While policies are couched in nationalist terms and call for the strengthening of the state, they sustain the prevailing neoliberal order (Arsel et al., 2021). Joya (2018, p. 681) contends that the Egyptian military represents its own class and that it has emerged as a dominant faction within the ruling elite under the contemporary phase of Egypt’s neoliberal development. Thus, while Sisi's economic policies, with their focus on ambitious infrastructural projects arguably diverge from the neoliberal brand of Sadat and Mubarak, they do not depart from it.

The leadership under Sisi acknowledged the political and economic importance of ICTs and digital platforms in redefining a new social contract. Politically, the use of digital technologies during the popular uprising – for organising protests, spreading information, building solidarity, and countering state propaganda – heightened the regime’s awareness of their disruptive potential. This recognition marked a shift in Egypt’s technopolitics: the regime moved to consolidate control over the digital sphere as a means of political survival (Faris, 2013). It enacted laws and regulations to monitor and restrict digital content. For example, the Cybercrime Law of 2018 granted authorities the power to block websites deemed a threat to national security and to prosecute individuals for spreading false news online (AFTE, 2018). This law has led to the blocking of over 500 websites by the Egyptian government (BBC, 2018). Meanwhile, digital surveillance intensified, with reports indicating that the government invested in sophisticated monitoring technologies to track the online activities of dissidents and activists (Švedkauskas, 2019).

Economically, ICTs were seen as a rare growth source for Egypt’s transformation. Vision 2030, launched in 2016 by President Sisi, emphasised ICT development within a private-sector, market-driven approach. The strategy included improving digital literacy, supporting ICT start-

ups, and expanding digital public services. Telecom Egypt, 80% government-owned, invested around $3 billion between 2014 and 2019 to replace copper cables with fibre optics, aiming to connect 4.5 million units in 2020 (Telecom Egypt, 2023). In 2017, 4G services were launched with spectrum licences auctioned to Vodafone Egypt, Orange Egypt, Etisalat Misr [Egypt], and Telecom Egypt, totalling approximately $1.1 billion in investments. These initiatives boosted internet usage from 20% in 2020 to 72% in 2022 (Mingas, 2020). The government also prepared for a gradual 5G rollout to enhance digital infrastructure supporting AI, cloud computing, data centres, and IoT (Rahim and Grau, 2024). According to ITIDA, Egypt's ICT sector's contribution to GDP reached 5.8% in 2023 (ITIDA, 2024).

Figure 4.6 – Individuals using the Internet (% of population) – Egypt



Source: World Bank Data (2025), available at:
https://data.worldbank.org/indicator/IT.NET.USER.ZS?locations=EG

Nonetheless, despite much fanfare about the success of Egypt's ICT sector, the neoliberal framework shaping Egypt's political economy hindered the emergence of large home-grown champions – like those seen in China or other emerging economies – that could have fostered greater national ownership of the internet and its underlying infrastructure. Although Egypt hosts an important number of homegrown ICT firms (ITIDA, 2024), the nature of state-business relations in the country failed to incentivise the emerging ICT capitalist class to innovate and upgrade. Consequently, many major groups opted to divest from the sector, redirecting their investments towards activities offering higher rents and lower knowledge intensity.

Arguably, the most telling illustration is Orascom Telecom, founded by Egyptian billionaire Naguib Sawiris in 1997 (HBS, 2023), the corporation rapidly became a leading telecommunications company in Egypt and expanded abroad, including in Algeria, Iraq, and North Korea (HBS, 2023). Known for its innovative services and flexibility, it bolstered its reputation as an Egyptian telecom giant. However, Sawiris' interest in the ICT sector waned due to political and regulatory challenges, especially in Algeria (Ould Khettab, 2020). The global economic downturn strained the company's operations, making large profits elusive. In 2010, Orascom Telecom's parent company, Weather Investments was sold to Dutch company VimpelCom (now VEON), marking the Sawiris family's exit from the telecom industry (Reuters, 2010). Sawiris then shifted to real estate and financial investments, ensuring high rents for little investment in technological capabilities.

Egypt's venture into the ICT BPO sector, in a context of fiscal austerity and underinvestment in human capital, doomed it to average competitiveness at best. As put by an ICT expert interviewed in Cairo:

> "There was the aim to export 1 billion USD of services from Egypt, but this never happened. The Smart village was initially supposed to be a Silicon Valley - but it ended up being a business centre. The government produces ICT agendas with ambitious targets, but they don't put the necessary means and policies to achieve them" (E9)

The BPO sector has created about 215,000 jobs (ITIDA, 2024), a meagre rate for a country that produces around 50,000 IT-related graduates annually from a total of 480,000 university graduates. The lack of labour absorption by the BPO sector highlights the challenges in leapfrogging industrial development in favour of a service-based economy (Kleibert and Mann, 2020). As argued by Chang (2002), manufacturing tends to have higher productivity growth compared to services. It also creates a significant number of jobs, both directly in the factories and indirectly through the supply chain. These jobs are typically more stable and better-paying than those in the service sector, which often comprise low-skill, low-wage positions. Furthermore, manufacturing has been more significantly associated with driving technological innovation and skills development (Rodrik, 2013b). These advancements often create spillovers into other sectors, including services (Hauge, 2023). The case of Egypt illustrates that without a strong manufacturing base; a country may struggle to develop the necessary technological and skill capabilities required for a globally competitive service sector.

Amidst a reconfigured political landscape, the post-uprising Egyptian regime refocused on developing digital components and devices production by attracting global manufacturers. In the mid-2010s, agreements with major companies in mobile phones, tablets, and fibre optics led to significant foreign investments. Vivo, Nokia, and Samsung began operations in Egypt, investing 2 billion EGP (about 39.5 million USD). and establishing a production capacity of 20 million devices (Egypt Business, 2023). China's OPPO invested $20 million to build a factory with an annual capacity of 4.5 million devices, aiming to serve Arab and African markets (Ahram, 2022). Sico, partially owned by the Egyptian Ministry of Communications, became the first Egyptian company to manufacture smartphones, also producing components for Indian and Chinese firms (Egypt Today, 2021). Additionally, two fibre optic cable factories with a production capacity of 8,000 km started operations, targeting local, regional, and European markets (MCIT, 2023). This recent shift towards manufacturing was described by interviewed ICT engineers and experts as “too little, too late” (W19, W21, E9). Interview insights echoed shifts in the global political economy whereby knowledge-intensive activities capture the lion’s share of value and are largely concentrated in high-income countries, while lower-cost manufacturing and assembly activities, capture comparatively little value (Bernard and Ravenhill, 1995; Kaplinsky, 2015).

In its efforts to develop the ICT sector, Cairo has increasingly sought to align itself with China, with respect to both digital development and data sovereignty. Since the launch of the BRI in 2013, which coincided with the arrival of President al-Sisi to power, Chinese ICT giants have played a pivotal role in providing advanced infrastructure at competitive rates, a boon for Egypt's cash-scarce economy. Beijing has facilitated financial support through loans, aiding Egypt's infrastructure projects and easing economic constraints (Le Maistre, 2018). The launch of China’s BRI in 2013 coincided with Egypt's need to diversify its international partnerships, especially after strained relations with Western countries (Jiuzhou, 2021). The BRI has been instrumental in bringing much-needed infrastructure investment to Egypt during a period of political instability and regime restoration. For example, the Suez Canal Economic Zone has seen important Chinese investments, enhancing Egypt’s role as a trade hub (Chen, 2018). The partnership between Beijing and Cairo under the BRI framework not only aids in building critical infrastructure but also strengthens Egypt’s geopolitical position by diversifying its diplomatic and economic relations.

In sum, successive political configurations of power in Egypt have attempted to leverage ICTs for economic development and regime survival. These objectives, however, were challenged

by the country's adherence to a neoliberal framework that encouraged limited public spending in promoting domestic capabilities and prioritised service-oriented sectors over manufacturing. This ideological leaning, combined with the proximity of those who wield political power to the capitalist class, resulted in the emergence of an ICT sector with high levels of reliance on foreign technology firms and limited international competitiveness.

4.3 Algeria's ICT Journey: Energy Winds and Digital Waves

Similarly to China and Egypt, Algeria's ICT development strategy has combined state-led initiatives with market reforms, adapting to the shifting economic and political landscape. But while the country prioritised industrialisation and technological upgrading through state interventionism in the first years after independence, these efforts were eventually supplanted by liberalisation and privatisation measures in the 1990s. The reliance on hydrocarbon rents, combined with the fragmentation of power among competing ruling factions and political violence, significantly undermined the state's capacity to implement cohesive policies. This fragmentation not only weakened the state apparatus but also led to inconsistent polices and a diminished commitment to structural transformation. As a result, the necessary conditions for fostering a competitive ICT sector – such as sustained investment in technological capabilities, retention of human capital, and a clear long-term vision – failed to materialise, leaving the country ill-equipped to enter the race in an increasingly competitive global digital economy.

1970s-1990s: Foundational Phase

Shortly after gaining independence in 1962, Algeria launched a bold strategy aimed at closing the technological gap with wealthier nations. Algeria initially adopted a socialist, centrally planned economic orientation, underscored by strong military rule. Under the leadership of Houari Boumediene (1965-1978), industrialisation and technological upgrading were seen as channels to combat the backwardness accumulated during over a hundred and thirty years of French colonial domination (Bennoune, 2002). Industrial policy focused on import substitution industrialisation and promoted unbalanced growth, favouring manufacturing over agriculture and investment over consumption (Tlemcani and Hansen, 1989). While priority was given to heavy machinery, hydrocarbons, and chemicals, the country also started building the foundation of its telecom sector.

Information and telecommunication technologies were perceived as tools that could help the FLN-led coalition consolidate its power. The central goal was to reduce technological dependence on foreign entities and foster local expertise. Policies included the establishment of state-owned enterprises and institutions responsible for the development of telecommunications infrastructure (Khelfaoui, 2007). Research centres like CETIC (Centre d'Études des Techniques de l'Information et de la Communication [Centre for the Study of Information and Communication Techniques]) [11] and firms like ENIE (L'Entreprise Nationale de l'Industrie Électronique [National Electronics Industry Enterprise]) [12] were established in the first years after independence. They were tasked with providing IT solutions tailored to the specific needs of different public administrations and supporting national infrastructure.

Driven by a strong desire to break free from the legacies of poverty and colonial domination, the FLN, under the leadership of President Boumediene, engaged not only in building basic telecommunications networks and expanding telephony and radio systems but also in manufacturing IT devices. For instance, the early 1980s witnessed the domestic production of the "Mitra 125," a series of computers used in educational environments and small businesses (E2). The CNI (Le Commissariat National de l'Informatique – National Commission of Computer Science) started manufacturing devices like the 300 and 9600 baud modems used to modulate and demodulate digital signals over telephone lines, enabling communication between computers over long distances (E2, E3). These manufacturing endeavours reflected the desire of the ruling coalition to establish their authority through the development of local technological capabilities and steady efforts towards structural change.

Commitment to achieving greater technological independence decreased towards the 1980s due to mounting financial constraints and political instability. Much of Algeria's ambitious industrialisation plan during the 1970s was funded by external debt (Haouas and Lin, 2024). Boumediene and his team hoped that the country's substantial hydrocarbon exports would

[11] CETIC, à propos de Cetic [about CETIC], accessible at: https://cetic.dz/historique/
[12] ENIE, à propos, accessible at : https://www.enie.dz/

continue to finance industrial catch-up and support the repayment of the debt (Lawless and Findlay, 1984). However, the country's financial outlook worsened in the early 1980s with plummeting oil prices. This crash drastically reduced Algeria's export revenues, which were crucial for funding the government's ICT strategy. By the late 1980s, Algeria found itself in a severe debt crisis, with its debt-to-GDP ratio reaching around 70% (Aissaoui, 2001). Grippling national debt and the consequent slowdown in public investments resulted in the premature interruption of the country's endeavour for achieving structural change (E1).

In 1991, a political crisis emerged when, fearing an Islamist victory, the military stepped in and cancelled elections. Political violence erupted and Algeria entered a decade long civil war. At the same time, the country was compelled to undertake an IMF structural adjustment programme in 1994, pushing the government towards deregulation and gradual liberalisation (Page, 2000; Roberts, 2003). Algeria was forced to remove trade barriers, privatise large SOEs, and adopt good governance reforms to attract foreign investment. In the ICT sector, the 1998 Telecommunications Decree, liberalised internet provision and deregulated and privatised parts of the sector (Noumba, 2004). The World Bank suggested these reforms would increase competition and attract foreign investment (Noumba, 2004).

However, political turmoil made it challenging for the government to attract foreign investment, implement industrial policies, and maintain consistent regulatory frameworks. Widespread violence also encouraged ICT engineers to leave the country, draining the country of much of the capabilities that had been built since independence. Interviewees referred to this brain drain up until the present day as a real "national disaster." (U1, U8, E15). Thus, although there were some improvements – notably with the introduction of the internet to the country in 1994 and the rollout of the country's telecom infrastructure – the actual achievements were thin and largely fell short of Boumediene's grand ambitions of catching up with Europe.

2000 - 2014: Power and Algeria's challenging path to 3G

The ideology of ruling elite was somewhat undetermined, combining features of both neoliberalism and economic nationalism depending on whether the price of oil was up or down (Werenfels, 2007). When prices were low, the government would adopt pro-FDI policies and speed up privatisation to cash in on large SOEs. When prices were high, powerholders would adopt more protectionist and statist policies. This approach was feasible as the country had

repaid a substantial portion of its external debt thanks to rising oil revenues and remained one of the few nations that had not joined the WTO. [13] With the arrival of President Abdelaziz Bouteflika to power in 1999, and as the price of oil averaged just $20 a barrel, an aggressive plan was adopted to liberalise the ICT sector. There was strong political interest in a fast-track telecommunications reform. The main objectives were first to signal political change and attract FDI, and second, to raise fiscal proceeds to fill the state's coffers through the sale of telecommunication licences to foreign corporations (E3).

This period saw an expansion in ICT infrastructure and use, but with little ambition to strengthen the country's domestic innovation capacity. Policies facilitated the entry of foreign mobile carriers like Egypt's Orascom Telecom (Djezzy) in 2002, and Qatar's Ooredoo (known as Nejma then) in 2003, as well as the establishment of state-owned telephony firms such as Algérie Telecom (AT) and Mobilis in 2004. All these contributed to the expansion of mobile telephony and internet services (Meddah and Charef, 2022). The government established regulatory bodies like the ARPT (Autorité de Régulation de la Poste et des Télécommunications [The Regulatory Authority for Post and Telecommunications]) with prerogatives to regulate the telecom sector. The launch of the first Algerian satellite, Alsat-1, by the Algerian Space Agency (ASAL) in 2002 marked a critical milestone in the country's ICT capabilities, as it aimed to enhance national information gathering for development (Cooksley et al., 2003).

Increased oil prices and power fragmentation among various factions resulted in weak state capacity and a lack of interest in structural transformation. ICT initiatives were promulgated without mobilising resources for implementation. A notable example was the "E-Algeria 2013" initiative, launched in 2008. This project aimed to harness ICTs to foster innovation and enhance competitiveness across various sectors, thereby accelerating the nation's digital transformation (Yahiaoui, 2016). However, the project achieved minimal progress, primarily due to inadequate coordination among ministries and state agencies. The absence of a centralised authoritative entity to oversee implementation, coupled with diminished state capacity, resulted in E-Algeria 2013 amounting to little more than a series of well-intentioned but ultimately unfulfilled goals (E2).

[13] In the early 2000s, Algeria's external debt was approximately $25.5 billion but by 2006, it had significantly decreased to about $5.9 billion. See Macrotrends 2025, Algeria External Debt 1970-2025, https://www.macrotrends.net/global-metrics/countries/DZA/algeria/external-debt-stock.

Fearing that the deployment of ICTs would lead to greater openness and a loss of power, the Algerian regime delayed the rollout of 3G infrastructure. The country was, in fact, one of the last on the African continent and in the MENA region to deploy 3G. While neighbouring countries like Morocco launched 3G technology in 2006, Algeria only authorised and launched 3G in December 2013 (Driouchi, 2014). Initially, the delay was explained by the military's fear of terrorist groups using the internet in remote areas to organise. As a former minister put it, "Expanding 3G is tantamount to endowing people who go underground with tools for effective communication" (Morocco World News, 2011). This decision to block mobile internet resulted in major delays in the internet penetration rate. As of 2011, only 15% of the population had access to the internet, compared to 26% in Egypt and 38% in China (World Bank Data, 2025a).

Algeria's persistent delay in internet expansion after 2011 cannot be solely attributed to its violent past. The use of mobile connectivity and social media platforms by pro-democracy protesters in Tunisia and Egypt made Algeria's political leaders wary of disseminating high-speed data services such as 3G (Bacha and Gasmi, 2022). The regime chose to defer the rollout of advanced internet technologies, reflecting a broader apprehension about the potential for social media to maintain political instability. This manoeuvre underscores how the interplay between political power and technology can influence the adoption or obstruction of ICTs, based on political imperatives. It also demonstrates, as suggested by the technopolitics framework, how technology is embedded in social and political processes and is often manipulated – or in this case, withheld – by various stakeholders to fulfil specific goals (Hecht, 2001; Gagliardone, 2014).

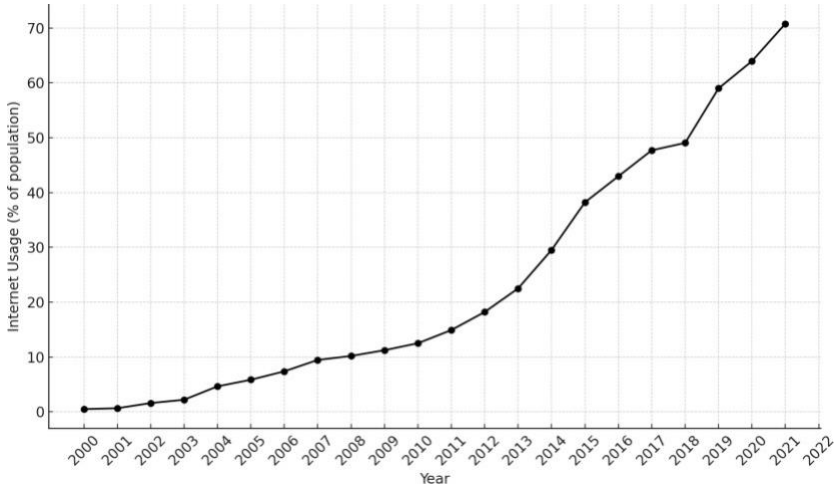
Such deliberate stalling was ameliorated by the country's access to large hydrocarbon rents. The average price of oil between 2004 and 2014 was around $80 a barrel (Macrotrends, 2024). The availability of hydrocarbon revenues provided the ruling elite with the financial means to disregard the potential developmental benefits of digitalisation, prioritising their immediate political objectives instead. The reliance on hydrocarbons reduced the incentive for leaders to diversify the economy, favouring short-term gains from oil over long-term economic strategies, delaying investment in ICTs and the development of a knowledge-based economy (Driouchi, 2014). Eventually, the launch of 3G services took place in December 2013, allowing for meaningful catch-up in Algeria's ICT infrastructure and internet access as shown in **Figure 4.7**.

2014-2022 – Going digital to navigate energy rent falls and entry of Chinese ICT firms

Between 2014 and 2022 successive Algerian governments adopted a series of innovative economic initiatives aimed at modernising Algeria's ICT infrastructure and enhancing workforce skills to align with global digital advancements. A precipitous drop in the price of oil in 2014 provided the impetus to diversify the economy and invest in digital transformation. The oil price downturn, which saw a staggering 48% decline between 2014 and 2015 (Macrotrends, 2024), significantly reduced state revenue, precipitating budget deficits and economic instability. Consequently, ICT was designated as a cornerstone of Algeria's new development strategy.

The government-initiated policies to enhance internet accessibility, develop e-government services, and support ICT in the educational sector. This included significant investment in ICT infrastructure, with over $22 billion spent on ICT equipment imports from 2015 to 2019, according to data from the US International Trade Administration (ITA, 2023). As a result of these investments, fixed internet subscriptions doubled from 2.1 million in 2014 to 4.3 million in 2022, and mobile subscriptions increased from 19 million subscribers in 2014 to over 42 million in 2022 (Datareportal, 2022). The expansion of 3G and the introduction of 4G in 2016 contributed to a sharp increase in digital data use.

Figure 4.7 – Individuals using the Internet (% of population) – Algeria

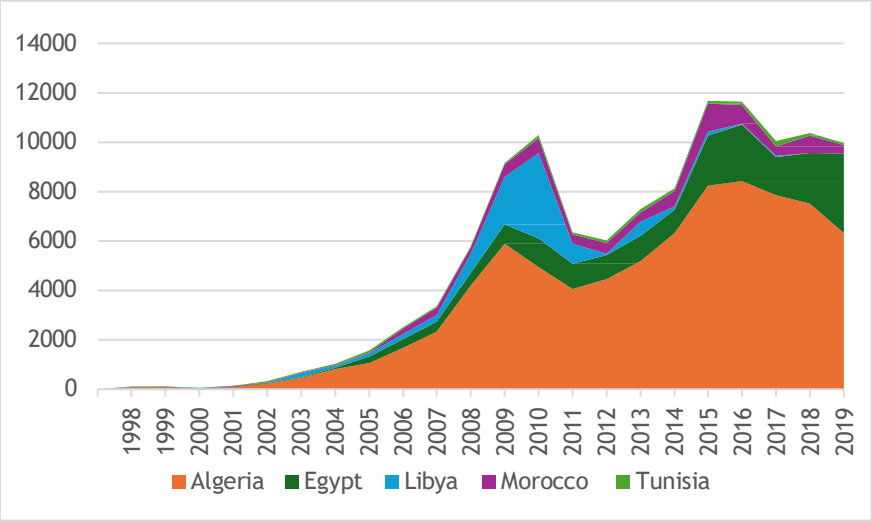


Source: World Bank Data, available at:
https://data.worldbank.org/indicator/IT.NET.USER.ZS?locations=DZ

Chinese ICT equipment manufacturers have significantly contributed to Algeria's ICT infrastructure development. Recognising Algeria's telecom growth potential, firms like Huawei and ZTE entered the market in the 1990s, with Huawei establishing its subsidiary in 1998 and ZTE in 1999. Their ability to provide high-quality tech infrastructure at competitive prices made them key players in the Algerian ICT sector. Importantly, and as will be discussed in further details in Chapter 5, in 2017, Algérie Telecom signed a $335 million contract with Huawei to install 1 million high-speed fibre-to-the-home internet connections, enhancing internet speed nationwide (Agence Ecofin, 2018). The deal drew media attention due to its hefty costs and the peculiar manner of its procurement. It was secured through a private agreement instead of the customary competitive bidding process, sparking objections from rival tech firms (Algerie360, 2017).

The choice of Huawei for expanding the country's ICT infrastructure was part of a broader turn within public procurement towards Chinese firms. Major infrastructure initiatives in Algeria, including the East-West Highway linking Tunisia with Morocco, the new airport in Algiers, and the Great Mosque of Algiers, have been largely contracted to Chinese companies. From 2009 to 2019, Algeria emerged as Africa's prime market for Chinese construction companies, with the North African country awarding Chinese firms contracts estimated at $70 billion (SAIS-CARI Data, 2024). Despite substantial capital inflows from Chinese FDI, these are significantly lower than the outflows related to turnkey contracts managed by Chinese construction companies. For example, in 2019, while China's FDI in Algeria stood at $1.7 billion, the contracts awarded to Chinese companies in the country amounted to $6.3 billion (SAIS-CARI Data, 2024). In 2017, China successfully launched Alcomsat-1, Algeria's first communications satellite, which facilitates broadcasting, television, broadband connectivity, as well as mobile and emergency communications. Its importance is underscored by its depiction on Algeria's 500 Dinar banknotes, serving as a national symbol of pride (Xinhua, 2024).

Figure 4.8 – Chinese contract revenues in North Africa



Source: China Africa Research Initiative, Johns Hopkins University (SAIS-CARI, 2024) http://www.sais-cari.org/data-chinese-contracts-in-africa.

Following the decline in oil prices in 2014, the Algerian government implemented measures to diversify its economy, including efforts to enhance domestic production of ICT devices and equipment. This approach reflected a changing technopolitical regime, in which technology was strategically mobilised to reduce reliance on hydrocarbons, generate employment opportunities, and sustain political authority amidst widespread popular uprisings across the region. Interestingly, Condor Electronics, an Algerian-based electronics manufacturer, part of the Benhamadi family conglomerate, emerged as a national champion in smartphone production. Established in 2002, Condor quickly evolved from a small local player into a major electronics manufacturer in the North African region.[14] With the launch of 3G in Algeria, Condor decided to enter the smartphone production market in 2014. At that time, Samsung in the smartphone segment and Nokia in basic mobile phones (feature phones) together held 85% of the local mobile phone market (Vincent, 2019). Condor entered the competition by initially purchasing 40,000 Chinese smartphones on which it placed its logo, a way to test the market.

[14] Condor, about us, accessible at: https://www.condor.dz/en/condor-electronics-en/about

By October 2014, assembly lines began producing the company's first own devices with a capacity of 3,500 phones per day. While this high-tech market was initially daunting for the Algerian firm, it ultimately made the leap. As stated by the firm's CEO Abdelmalek Benhamadi:

> "In the beginning, I did not want to invest in the manufacturing of mobile phones. It was a very difficult market with products that change all the time. But the situation changed with the arrival of smartphones. As we were already active in the IT field, we noticed that the differences were not very great. I was also driven by managers who wanted to take up the challenge."
>
> (Condor, 2014)

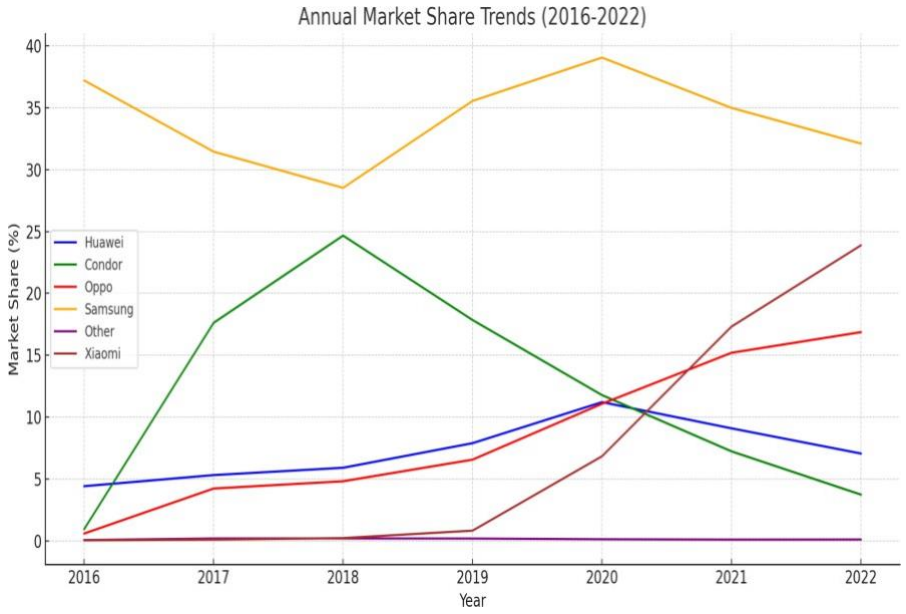
The objective was to allow people with low budgets to acquire a modern mobile phone. In 2018, Condor claimed almost 30% of the domestic market (Statcounter, 2024). The Algerian brand also successfully captured market shares in other North African markets and expanded to West Africa and the Middle East. Yet, despite Condor's initial success, fieldwork interviews revealed that the domestic integration rate of Condor, that is the extent to which industry incorporates locally produced components, technology, and labour into its production processes, remained low (E5). Smartphone and tablet manufacturing heavily relied on the import of Semi Knocked Down (SKD) kits, which are partially assembled smartphones shipped to be fully assembled elsewhere. This type of manufacturing entails a continued reliance on imported components and reduces opportunities for backward linkages within the economy. Although SKD-based production is common in the early stages of manufacturing, Algerian authorities, failed to introduce industrial policies to promote further technological upgrading and domestic integration (E1).

Without state incentives to invest in technological learning, R&D, and innovative capacity, Condor's product gradually lost momentum and ultimately collapsed under the fierce competition of Asian smartphone manufacturers, among which China's own Xiaomi and OPPO took a sizeable share of Condor's market. By 2022, Condor only represented 2.8% of the Algerian market, while Samsung maintained its lead with 30% of the market. Xiaomi accounted for 25%, followed by OPPO at 16%, and Huawei at 7% (Statcounter, 2024).[15]

[15] The decline in Huawei's market share within Algeria's phone sector reflects a broader downturn in the company's performance within the device sub-sector, which was severely affected by the United States' export ban on semiconductors to China. This ban disrupted Huawei's access to critical components essential for manufacturing competitive devices, significantly weakening its position in both domestic and international markets.

Consequently, the Algerian smartphone market became dominated by imported Chinese products, reflecting a broader trend of weakened domestic capabilities and increased reliance on foreign technology. This experience is reflective of broader unproductive capitalism (Werenfels, 2007), where local industries struggle to compete and sustain themselves against more technologically advanced and well-funded foreign competitors.

Figure 4.9 – Smartphone Annual Market Share Trends – Algeria (2016-2022)



Source: Statcounter (2024), available at: https://gs.statcounter.com/vendor-market-share/mobile/algeria/2022

Unlike Egypt, Algeria's enduring socialist tradition has ensured that government spending on higher education has remained high over the past decades. Algeria's public spending on education, including higher education, accounts for approximately 7% of its GDP as of 2020 (World Bank Data, 2025c), placing it among the higher spending developing countries, compared to the global average of around 4.42% for developing nations. However, the quality of university training, including in the STEMs and the broader innovation system in the country remains weak (U1, U2). A key challenge lies in the persistent mismatch between university education and industry requirements, which hampers graduates' employment prospects (Nahla, 2023). Many Algerian universities operate with outdated curricula that fail to reflect the evolving needs of the labour market. Moreover, these institutions face issues such as overcrowded classrooms, inadequate funding for research, and limited access to modern teaching tools, all of which stifle the development of advanced skills and hinder innovation

(Bouchikhi and Zine, 2017). Compounding these challenges, Algeria allocates relatively little to R&D, providing few prospects for students and graduates to participate in cutting-edge research or innovative projects. Meanwhile, the lack of promising local opportunities contributes to a brain drain, with many highly qualified individuals seeking better prospects abroad (U8).

The widespread dissatisfaction with Algeria's political system and lack of economic opportunities, gave rise in 2019 to the Hirak movement, a popular uprising characterised by peaceful protests that ultimately led to the resignation of President Bouteflika (Northey, 2021). However, the military swiftly moved to consolidate its control by orchestrating a tightly managed presidential election, the outcome of which was widely anticipated. This strategy enabled the army to re-establish a civilian façade, allowing it to maintain its grip on power while projecting an image of democratic legitimacy (Ghanem, 2022; Willis, 2022). The new team in power sought to reinvest in ICT capacity building and use digital technologies and start-ups to rebuild a new civilian façade after the Hirak. The new coalition in power pushed for the creation of a ministry dedicated to start-ups and the knowledge economy.

The Covid-19 pandemic and the corresponding strain on the Algerian economy, further consolidated the government's commitment to speed up the country's digital transition (G1). This resulted in policies that support technology start-ups and digital enterprises through various incentives and support programmes. These efforts were part of a broader strategy to revitalise the economy, modernise the country's infrastructure, and project a new progressive image both domestically and internationally, breaking with Bouteflika's two decades in power. Through these initiatives, the government hoped to harness the potential of the youth and the entrepreneurial sector to generate employment and stimulate economic growth.

In this vein, China emerged as a key partner. As in post-uprising Egypt, the regime sought to reinstate political control, including over the Internet. Here, the Chinese Internet model, which combines spectacular rates of digital development with overt political control, became even more attractive in the eyes of Algerian rulers. Under the leadership of Abdelmadjid Tebboune, a series of announcements designated Chinese ICT firms as Algeria's partners in digital transition. Importantly, President Tebboune ordered that a contract to build a large data centre for Algeria's High Commission for Digitalisation be awarded to Huawei during a meeting of the Council of Ministers in March 2024 (Maghreb Emergent, 2024). The presidential

communiqué justified a lack of open tendering by highlighting the “urgent nature” of the infrastructure for strengthening the country’s digital sovereignty and consolidating the cooperation between the two countries.

Overall, Algeria's ICT development strategy combined elements of both state-led and neoliberal approaches, depending on the global economic context and political interests. The country’s initial focus on industrialisation and technological upgrading through state intervention faced significant setbacks and was ultimately abandoned in favour of liberalisation and privatisation reforms in the 1990s. Hydrocarbon rents, power fragmentation and increasing clientelist tendencies reduced commitment to structural change, resulting in weak state capacity and inconsistent policy implementation in efforts to build a competitive ICT sector. The delayed rollout of 3G and 4G networks, driven by political concerns over political unrest, underscores the complex interplay between technology and political power. While the country has made promising strides in improving digital infrastructure, it continues to struggle with reducing its reliance on foreign tech multinationals.

4.4 Conclusion

Looking at the evolution of the ICT sectors in China, Egypt, and Algeria indicates that their ICT sectors diverged in part due to the different political and regulatory regimes characterising the three countries. The existing literature discussing national digital policies has often either focused on economic goals or over-emphasised the politics of these strategies without discussing industrial policies. By deploying this dissertation’s analytical framework which brings together heterodox economics and technopolitics, this chapter has attempted to clarify both the political goals and economic strategies shaping the evolution of each of these ICT industries, showing how ICTs are embedded within power dynamics and structures that uphold different types of political objectives. ICTs are thus negotiated, adopted, and reshaped by various political systems to advance the interests of those who hold power, with varying levels of economic success depending on objectives, policies and how power, skills, and resources are distributed and mobilised locally.

Early on, Chinese leaders saw digital technologies as strategic tools that could help extend the party’s survival and consolidate state power. Consequently, the country adopted an interventionist regulatory regime, with the state playing a more active role in shaping the

development of its ICT network and economy. Industrial policy was used to acquire technology and incentivise learning and upgrading. Driven by a deep sense of techno-nationalism and a class of capitalists eager to grow and capture new markets, the Chinese leadership implemented industrial policies that promoted indigenous innovation and internationalisation, leading to greater technological sovereignty. This resulted in the rise of China's own Internet system, made up of both physical components (fibre-optic cables, antennas, processing units, mobile devices, and semiconductors) and regulatory ones (technological standards, data governance frameworks, and norms and values shaping the internet).

In contrast, in Egypt, the ICT industry developed within a neoliberal framework, where the government prioritised services over manufacturing and where foreign corporations operated with minimal government intervention, resulting in an ICT sector highly dependent on foreign tech firms. During Mubarak's three decades in power, efforts were made to leverage ICTs as part of the country's social contract, providing jobs in exchange for ensuring political endurance. However, the policies implemented did not support this political objective. The adoption of Washington Consensus policies led to the dismantling of the state's capacities that would have been necessary to build a thriving ICT industry and boost the country's competitiveness. The failure of neoliberal policies fuelled social and political tensions, leading to the 2011 uprising. To date, Egypt's ICT industry, largely concentrated in the BPO sector, is characterised by limited value addition and vulnerability to external shocks.

Algeria's ICT development strategy has been a balancing act between state-led and neoliberal approaches, influenced by fluctuating oil revenues and political interests. Initially driven by socialist ideals and underpinned by military leadership, Algeria aimed to bridge the technological gap left by over a century of colonial rule. Under President Boumediene, the focus on industrialisation and technological advancement was not just an economic strategy but a political tool to solidify power and reduce foreign dependency. The debt crisis and political instability of the 1990s disrupted early catch-up efforts, triggering a substantial brain drain and halting numerous developmental projects. Despite some achievements, such as the expansion of telecom infrastructure and the emergence of a few promising ICT firms, the hydrocarbon-rich country fell short of its ambitious goals due to inconsistent policies and external economic pressures. The journey has been marked by ambitious plans, significant setbacks, and renewed efforts towards digital transformation, highlighting the complex relationship between technology, politics, and economic development in Algeria.

By tracing the evolution of the ICT industries in China, Egypt, and Algeria within a political economy framework, this chapter provides valuable insights relevant to other developing counties that may choose to use the digital economy to achieve broad-based growth and structural change. Although the sheer scale of the Chinese market and China's historically rooted tradition of strong state institutions (Fan et al., 2009; Xu, 2011) suggest that its industrial strategies may not be directly replicable in other developing countries, there remain valuable insights to be drawn.

First, the development of China's ICT sector underscores the importance of strategic and adaptive state intervention. This does not imply the state's role as described in the neoliberal doctrine which holds that the state's main functions should be to correct market failures, enforce laws and regulations that ensure fair competition, maintain economic stability, and overall, just intervene when things go wrong. Rather, the trajectory of China's Internet industry shows that the state acted as what Mazzucato (2013) described as an entrepreneurial state by heavily investing in innovation, providing targeted support to the sector, applying protectionist measures, and picking winners. Ultimately, the Chinese government did not only 'fix the market' but engaged in activities that shaped it and allowed it to thrive both within and beyond China's borders. This approach facilitated significant technological upgrading and global competitiveness relevant for other developing countries.

Second, mapping out the evolution of China's ICT industry shows the need for countries to find a sweet spot between integration in the global digital economy and protectionism to promote domestic development. China's astute integration into the global economy – characterised by selective openness, strategic partnerships, and gradual liberalisation – offers a blueprint for other developing countries (Weber, 2021). The recipe for success in this instance was finding a balance between global integration and the cultivation of local industries capable of competing on the global stage. Conversely, China's model combined openness to foreign investment with strong policies to foster domestic champions and even engage later on in setting home-grown technological standards. In the digital sector, which is relatively less regulated compared to traditional economic activities in the international political economy, developing countries have more space to craft strategies that would help bolster their domestic ICT industries.

Finally, and relating to the first two points, opening markets for FDI and technology can only be efficient when associated with domestic capability building and efforts to boost indigenous innovation. Technology transfer in China generated considerable spillovers largely because of the country's absorptive capacity, supported by large investment in R&D and quality higher education (Fu and Zhang, 2011). The state's initial selective and instrumental approach to intellectual property protection, its commitment to nurturing a skilled workforce and fostering innovation through substantial investments in R&D institutions, have all driven continuous technological upgrading, ultimately reaching indigenous innovation. If breaking away from hardwired neoliberal practices can be challenging, developing countries like those in North Africa would benefit greatly from making more substantial investments in quality higher education and R&D within the ICT sector, to shift away from their current positions of dependency at the lower ends of global value chains.

In sum, this chapter has offered a panoramic account of the three ICT industries, by delving into the evolution of China, Egypt and Algeria's ICT landscapes, historicising their development and describing their current state, including recent policies and challenges. This contextual information is essential for laying the ground for the empirical analysis that will unfold in the subsequent chapters of the thesis. It provides the background for assessing how the globalisation of China's digital industry is shaping development prospects in Egypt's and Algeria's digital sectors, focusing on digital infrastructure and connectivity, technology transfers, and data governance frameworks. The next chapter will address the first of these aspects.

CHAPTER 5

Wiring the World: How China's Belt and Road Initiative is Shaping Digital Connectivity

> "I am very confident that this moment - this moment where the Chinese Communist Party failed to be transparent and open and handle data in an appropriate way - will cause many, many countries [to] rethink what they were doing concerning their telecom architecture….And when Huawei comes knocking to sell them equipment and hardware, that they will have a different prism through which to view that decision."
>
> Mike Pompeo, Former U.S. Secretary of State, White House, 8 April 2020 (Reuters, 2020)

The quote above highlights the concerns of wealthy countries over the global spread of Chinese-built ICT infrastructure. US officials, like Pompeo, have framed Huawei's expansion as a major security threat, but this framing masks deeper fears about losing control over global digital infrastructure and ceding technological influence to China (Rühlig and Ten Brink, 2021; De Seta, 2023). This discourse largely ignores the realities facing many developing countries. For states with limited capital, Chinese digital infrastructure often presents the most viable option. Calls to exclude Chinese equipment overlook the question of how these countries can otherwise access the ICT systems needed to participate in the digital age.

Ironically, although US-led development agencies, consultancies, and tech companies have for decades presented digital connectivity as a crucial tool for achieving various social and economic development objectives – often without strong empirical evidence (See Friederici et al., 2017; Mukiri-Smithet al., 2022) – they have shown little enthusiasm for large scale Chinese infrastructure initiatives like the BRI. While the digital divide is a complex phenomenon, the persistent disparity in internet access between wealthy nations and the rest of the world is rooted in unequal access to capital and sustained structural constraints on investment (Shenglin et al., 2017; WDR, 2021). Developing countries often grapple with substantial costs related to laying fibre optic cables, building data centres, and deploying satellite technology (Gottschalk, 2019). These expenses are particularly challenging in the context of high debt levels, limited or unfavourable access to international financial markets and the existence of more urgent needs like healthcare, education, and basic infrastructure.

This chapter tackles the dissertation's first empirical question by scrutinising the impact of China's expanding role in infrastructure provision on digital connectivity in host economies. Understanding the nexus between Chinese digital infrastructure and internet access is crucial for capturing the effects of China's digital footprint on technological catch-up and the global digital divide. Initially focused on transportation and energy infrastructure, the BRI has increasingly shifted to focus on digital infrastructure, a shift that gained momentum in the wake of the Covid-19 pandemic (Buckley, 2020). The share of the global digital infrastructure market controlled by Chinese firms like Huawei and ZTE has surged, as they have become major suppliers of telecommunications technology, including 5G networks, data centres, cloud computing systems, and subsea cables. By 2020, Huawei's share of the global telecom infrastructure market had increased to 31%. ZTE also saw growth, with its share rising from 9% to 10%. Thus, together, the two Chinese ICT vendors accounted for nearly 40% of the global ICT infrastructure market (Waring, 2021).

This chapter's central hypothesis is that China's expanding role in infrastructure provision, captured through BRI participation, enhances digital connectivity in participating countries. To test its validity, I build an original dataset covering 132 countries spanning the period from 2008 to 2022. I use a staggered propensity score reweighting Difference-in-Differences (DiD) regression approach to assess the causal impact of BRI participation on internet access rates, incorporating country-specific and temporal factors, as well as a set of theoretically justified control variables. This quantitative analysis treats the BRI as an "intervention", allowing for the control of confounding factors by comparing changes in Internet access over time between BRI (treatment group) and non-BRI countries (control group), effectively isolating the impact of BRI participation from other external influences that might affect both groups. Unlike previous studies examining the impact of the BRI on ICT access (Ho et al., 2023), this study takes the cost of connectivity seriously, incorporating it as a control variable in the model to determine whether changes in connectivity are attributable to the BRI's influence or merely the result of reductions in ICT costs. This innovation is critical to isolate the specific contribution of the BRI, as it ensures that the analysis accounts for broader industry trends and separates them from the direct effects of China's investments and turnkey contracts in host countries.

Despite the consistent warnings from the US about the risks of partnering with China in the digital realm, the quantitative analysis shows that countries that have joined the BRI experience an increase in Internet access of 2.82 percentage points compared to those that do not, after

controlling for other factors. The results are statistically significant at the 0.1% level. This finding suggests that BRI participation plays an important role in bridging the digital infrastructure gap and enhancing digital connectivity in participating countries. The findings satisfy the parallel trends assumption and are robust to alternative model specifications, varying time-lags, and the inclusion of additional control variables.

To answer the second part of the research question, I focus on Algeria's decision to assign the deployment of its Fibre to the Home (FTTH) programme to Huawei and ZTE without going through a public tender. While this collaboration has enabled the rapid expansion of digital infrastructure, significantly improving both the reach and quality of connectivity, it also raises concerns about the country's dependency within the ICT ecosystem. The exclusive reliance on these two Chinese firms limits the role of local ICT companies and constrains future technological choices. Drawing on this dissertation's conceptual framework, this chapter argues that while the BRI's push to expand connectivity infrastructure is improving internet access in host countries, the growing presence of Chinese ICT corporations is also reinforcing technological lock-in, embedding host ICT industries within a foreign technological regime. This entrenchment stems from reinforcing mechanisms such as cost advantages and the pre-existing technological stack. As a result, domestic ICT firms face barriers to learning, limited pathways for upgrading, and reduced prospects of securing a share of the domestic market.

The chapter is structured as follows. The first section examines the mechanisms by which BRI participation could theoretically contribute to expanding internet connectivity in participating economies. It emphasises the critical role played by Chinese development banks and tech firms, such as Huawei and ZTE, in building cost-effective ICT infrastructure globally. Section 2 outlines the empirical strategy used to test the hypothesis, addressing the assumptions and limitations of the quantitative analysis. Section 3 presents the findings, showing that BRI participation increases internet access in participating countries, and discusses these results in relation to existing literature on infrastructure development and structural change. Section 4 focuses on a case study of Algeria's decision to award its FTTH programme to Huawei and ZTE. I highlight how this decision accelerated infrastructure deployment but raised concerns about the diffusion of Chinese digital standards and the risks of technological path dependency. Finally, Section 5 concludes by summarising the key findings and discussing their broader implications.

5.1 Global digital China and value for money infrastructure

Sharp inequalities in internet access persist globally. In 2023, over 93% of people in high-income countries used the Internet against just 62% of people in low and middle-income countries (World Bank Data, 2025a). While the digital divide is undoubtedly complex, involving several interrelated factors such as digital skills, the productive capacities of local firms, and broader socio-economic conditions, the existing infrastructural gap remains a key driver of persistent digital inequalities. This section examines the mechanisms underpinning the hypothesis that the BRI contributes to closing the infrastructure gap and expanding internet access in participating economies, namely: (1) Chinese development finance, and (2) the cost competitiveness of its ICT firms.

5.1.1 China's Development Finance

In the wake of the 2008 financial crisis, the vacuum in global infrastructure financing presented Chinese leaders with an opportunity to adopt a novel approach that addressed both their domestic political-economic imperatives, as well as those of developing countries (Chin and Gallagher, 2019). The primary source for infrastructure financing has been through China's two major policy banks – the China Exim Bank and the China Development Bank – both operating under the supervision of the State Council. In China's infrastructure financing, policy banks are lenders of first resort, offering loans with minimal conditions beyond awarding construction contracts to Chinese firms (Brautigam, 2009; Chen and Landry, 2017). This method, often referred to as integrated financing packages, is designed to reduce project-cycle time frames, supply scarce management capacity and cut costs.

Significantly, China's policy banks are able to provide loans with subsidised interest rates lowering the cost of capital. These policy banks get their funding from capital injections provided by the state budget and the substantial Renminbi (RMB) bond market, estimated at around RMB 157.9 trillion, making it the second largest in the world (China Foreign Exchange Trade System, 2023). The policy banks borrow from the Chinese bond market at the prime sovereign interest rate and benefit from a "pledged supplementary lending facility" from the People's Bank of China, which effectively subsidises their development lending (Gu and Carey, 2019, p. 152). This helps Chinese policy banks provide loans at lower interest rates compared to commercial banks (Brautigam, 2011; Gu and Carey, 2019).

In essence, China's policy banks play similar roles as traditional development banks, acting as intermediaries between bond markets and borrowers, including those in developing countries. China's policy banks and newer institutions like the Asian Infrastructure Investment Bank (AIIB), the Silk Road Fund, and the New Development Bank (formerly BRICS Development Bank) rely on sovereign wealth. This contrasts the alternative offered by Bretton Woods institutions, which in recent years have promoted a model of financialised infrastructure provision through private sector actors. They have shifted focus toward matching the surplus in private financial capital with developing countries' infrastructure needs through a renewed push for public-private partnerships (PPPs) (Bayliss and Van Waeyenberge, 2017). However, PPPs have tended to increase the cost of infrastructure for poor countries (Engel et al., 2010; Hall, 2015). This is acknowledged by a World Bank report which highlights that "over the long term no additional funding or fiscal space is created" by PPPs as their financing costs can exceed other public infrastructure financing methods (World Bank, 2013, p. 15).

Another key issue with the financialisation of infrastructure provision is that private investors have limited interest in risky infrastructure projects in poorer countries. Data shows that 61% of private investment in developing countries between 2003 and 2013 went to upper-middle-income countries, 37% to lower-middle-income countries, and only 2% to low-income countries (Bayliss and Van Waeyenberge, 2017, p. 24). In contrast, China has taken more risks in its lending, with a disproportionate share of its loan commitments being attributed to countries with high credit risk levels compared to Western lenders and IFIs (Landry, 2024). In a study examining how Chinese policy banks responded to the launch of the BRI, Chen et al. (2022) found that they provided greater support to BRI countries with weaker economic performance and fragile institutional quality compared to non-BRI countries.

Prior to the BRI, China was already the single largest source of funding for Africa's infrastructure catch-up. According to the Infrastructure Consortium for Africa (ICA), over the period from 2011 to 2017, China allocated an average of US$13 billion annually to African infrastructure projects (ICA, 2018). This timeframe coincides with the fifth Forum on China-Africa Cooperation (FOCAC), during which China's Export-Import Bank provided US$20 billion in concessional and preferential financial credits between 2013 and 2015 (ICA, 2018). Moreover, the China Development Bank had extended loans totalling US$50 billion to African nations by mid-2017 (CDB News, 2017). Additional funding also came from other Chinese commercial banks, including the Industrial and Commercial Bank of China (ICBC). To put

these numbers in perspective, from 2012 to 2017, the average yearly investment in African infrastructure from all sources was US$77 billion (ICA, 2018). African countries were the primary contributors, investing over US$30 billion annually as a group. Other members of ICA, mainly OECD countries, contributed about US$20 billion combined. Even though China, provided less than 20% of the total at US$13 billion annually, it was by far the most important single source of bilateral or multilateral financing during this period (Gu and Carey, 2019).

At the turn of the century, China adopted a notably risk-tolerant approach to international lending, aiming to channel its substantial foreign exchange reserves–accumulated from its trade surplus–while expanding its footprint in the global economy. However, as debt sustainability concerns grew in many borrowing nations and China's own economic growth began to decelerate, Beijing's lending strategy underwent a noteworthy shift. Data from Boston University shows a sharp decline in China's outbound lending after 2016, with new loan commitments from the country's two main policy banks falling significantly (Ray et al., 2021). Similarly, according to the John Hopkins SAIS CARI database, Chinese loan commitments to Africa reached nearly US$30 billion in 2016 before sharply dropping to US$10 billion in 2017 and stabilising around this range due to China's recalibration of its lending commitments to the continent (SAIS CARI, 2024). The mounting debt burdens in some recipient countries prompted greater caution in loan disbursement, reflecting a shift towards a more selective and strategically focused approach to overseas lending.

This new reality has led to an emphasis on smaller, less costly projects, particularly in sectors such as digital infrastructure. China's infrastructure financing, particularly in ICT, has seen a major boost through concessional financial credits (Peltola et al., 2021). In 2017, Zhao Houlin, a Chinese national, then head of the International Telecommunication Union (ITU), highlighted the potential of China's BRI to narrow the global digital divide stating that "the BRI is a great opportunity, and the ITU has worked closely with China to expand cooperation" (CGTN, 2019). During the first Belt and Road Forum held the same year, the ITU signed a memorandum of understanding with the Chinese Ministry of Industry and Information Technology to assist over 60 countries in expanding their ICT infrastructure and services (CGTN, 2019).

China's approach to infrastructure lending is deeply rooted in its own development experience, where private sector growth was shaped and driven by strategic public-sector investments within a broad developmental vision. This philosophy underpins Beijing-led initiatives like the

BRI, the Asian Infrastructure Investment Bank (AIIB), and regional platforms like the FOCAC. These initiatives emphasise the importance of strong foreign direct investment flows and increasing public revenues to support sustainable transformation (Oqubay and Lin, 2019). As a result, political leaders from developing countries praise the Chinese government for "its willingness to bankroll the "hardware" of economic development—roads, railways, power plants, electricity grids, and telecommunication systems." (Dreher et al., 2022, p. 125).

Overall, even though Chinese lending has reduced since 2016, Beijing remains an important lender in the Global South. Unlike conventional lenders, China has shown an appetite for putting money in large-scale infrastructure projects, a critical foundation for initiating structural transformation. By focusing on these tangible, long-term assets, China has positioned itself as a central player in the development strategies of numerous economies, the majority of which have eagerly joined the BRI. In recent years, ICT projects have been taking centre stage, reflecting China's strategic emphasis on digital economy connectivity, even as broader financial commitments scale back.

5.1.2 The Competitiveness of Chinese ICT Equipment Manufacturers

Another key factor supporting the hypothesis that BRI participation is contributing to improving digital connectivity is the price competitiveness of Chinese ICT companies like Huawei and ZTE. These firms have been instrumental in developing ICT infrastructure across the Global South. As previously mentioned, Huawei is estimated to be responsible for around 70% of Africa's ICT backbone infrastructure (MacKinnon, 2019). The affordability and technological sophistication of these companies may have brought down the cost of expanding and upgrading backbone ICT infrastructure in countries with limited financial resources. China's comparative advantage in ICT components is the outcome of three key factors:

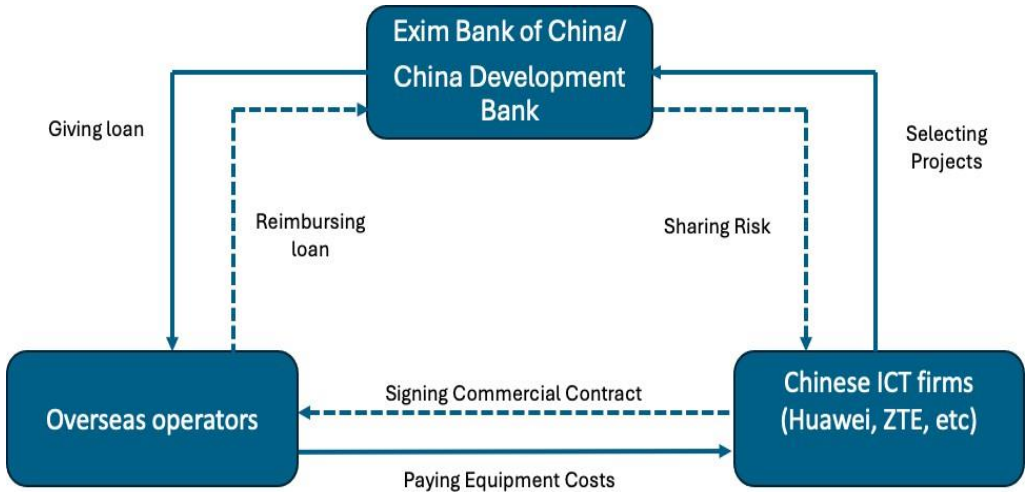
First, Beijing's designation of the telecommunications equipment industry as critical for technological development and the consequent support of national champions in the sector has effectively led to the subsidising of its domestic firms in China and abroad (Shen, 2017; Atkinson, 2020). As detailed in Chapter 4, Chinese authorities provide an array of support to the telecommunication equipment industry, including through grants, loans, and investment in R&D activities and training, all of which reduce the cost of their operations. While estimates vary widely depending on the type of technology, on average, Huawei and ZTE provide high-

quality equipment that is around 20% to 30% cheaper than that of their competitors, such as Ericsson and Nokia. This price difference is a key reason why many telecom operators, especially in low and middle-income countries opt for Chinese equipment (Noone, 2022).

Second, Chinese ICT firms benefit from economies of scale thanks to their access to the large Chinese market, relatively low labour costs and extensive global operations, particularly in developing countries. As dominant players in GVCs, Huawei and ZTE procure material and components at lower costs for the production of switches, fibre-optic cables, routers, wireless equipment and terminal devices (Sun and Grimes, 2018). Their massive production volumes enable them to reduce per-unit costs significantly, which is then reflected in the pricing offered to customers. The integration of Chinese tech multinationals into the BRI facilitates access to cheaper components from within China and other BRI-participating countries, further driving down costs (Wen, 2020). Importantly, and unlike what is often reported in media outlets, this cost advantage does not compromise quality. Expert analysis shows that Huawei equipment in 5G is not only less expensive than Ericsson's, but it is also of better technical quality (Noone, 2022).

Finally, and related to the earlier discussion on Chinese development financing, a notable factor behind China's cost advantage is their access to financial mechanisms like the 'EPC + F' scheme. In this scheme, Chinese companies such as Huawei or ZTE manage the engineering, procurement, and construction of infrastructure projects, with Chinese banks providing state-backed financing (Hillman, 2021). When a developing country needs to upgrade its network infrastructure from 3G to 4G or from 4G to 5G to enhance internet speed and reliability, the cost of upgrading the backbone infrastructure can be substantial – often amounting to several million USD. In cases where governments or operators lack the financial capacity to fund such upgrades, companies like ZTE or Huawei may step in with comprehensive packages that include equipment supply, installation, and financing. China's two key policy banks – the Exim Bank and the China Development Bank – have been the primary providers of these supplier loans, though MOFCOM and Chinese commercial banks are sometimes also involved.

Figure 5.1 – Mechanism of Chinese funding of ICT equipment through its firms



Source: Adjusted from: Tugendhat and Voo (2021, p. 13)

For instance, as an early signatory of the BRI, Egypt has benefitted from this 'vendor financing' scheme to help fund its 4G network rollout. In 2018, Telecom Egypt secured a US$200 million loan from the Bank of China and China Export & Credit Insurance Corporation (Sinosure), a deal brokered by Huawei. Then CEO of Telecom Egypt, Ahmed El Beheiry explained the aims of the deal:

> "Telecom Egypt has several strategic long-term expansion plans to be delivered in the coming years. To achieve such plans, we have worked on attaining long-term financing at the lowest possible cost as well as the most convenient payment terms to match our cash flow generation while proceeding with our rollout plans […]. The facility benefits Telecom Egypt by providing a simplified purchasing process through a packaged financial solution, while it allows Huawei to further expand its business in Egypt."
>
> (Connecting Africa, 2018)

This arrangement gives Chinese contractors a significant advantage over competitors like Ericsson or Nokia, who do not have deep enough pockets to include self-sourced capital in their offerings. International agreements including those of the OECD Development Assistance Committee (OECD-DAC), restrict conventional donors or lenders from tying their grants and loans to investment contracts with their domestic companies. In contrast, China offers full-package deals that speed up the construction of infrastructure. Given there is a fixed cost to

realise ICT infrastructure, lower costs in building and maintaining this infrastructure can translate into more affordable ICT services, something that can in turn speed up the digital transition in developing economies.

Besides the inherent cost advantage of Chinese ICT firms, their mere presence in a market can substantially drive infrastructure price down by intensifying competition. Without Chinese players like Huawei and ZTE, European firms like Ericsson and Nokia would dominate the market, potentially leading to higher prices for equipment and services due to limited competition. The entry of Chinese ICT vendors forces these established firms to lower their bids, creating a more competitive environment that ultimately benefits governments and consumers, reducing the overall cost of digital infrastructure (Otero-Iglesias, 2019). This is why for instance, GSMA, the telecoms lobby group which represents the interests of mobile operators has warned that if Chinese firms are banned from Europe's 5G networks, the cost of providing the service would be US$62 billion higher and come 18 months later (Barzic, 2019). The scope, scale, and speed of project realisation are all characteristics that make Chinese ICT vendors attractive for rapid and affordable infrastructural progress.

Based on the preceding discussion regarding the nature of Chinese development funding and the characteristics of Chinese ICT firms, one can hypothesise that participation in the BRI, which promotes among other things, the globalisation of China's digital industry, leads to the expansion of ICT infrastructure and enhances digital connectivity. The following section outlines the empirical strategy used to test this hypothesis.

5.2 Empirical strategy

To analyse the impact of BRI participation on digital connectivity, I constructed a country-level dataset combining information from multiple sources spanning the period from 2008 to 2022. The dataset encompasses 132 economies, 104 of which are participants in the BRI (see Appendix 1). The subsequent sections provide a detailed overview of the data employed and the empirical strategy adopted, highlighting both its strengths and its limitations.

Outcome Variable

This analysis uses internet access to capture digital connectivity. Internet access is a widely accepted proxy for digital connectivity because it directly correlates with individuals' ability to engage with online services, digital technologies, and the broader digital economy (Rath et al., 2023). Thus, the primary outcome variable is Internet access measured as the percentage of the population with access to the internet. I use the World Bank's World Development Indicators (WDI) dataset which provides a comprehensive measure of internet penetration within a country. Specifically, it reflects the proportion of individuals who can access the internet, regardless of the type of device or network they use. The dataset ensures comparability across different countries and regions, making it a useful metric for analysing the impact of policy interventions such as the BRI.

Treatment Variable

For this analysis, I treat BRI participation as a form of intervention or treatment for countries that have signed a memorandum of understanding (MoU) to join the initiative. I created a binary variable, BRI, which is set to (1) if a country is involved in the BRI and (0) if it is not. To build this variable, I compiled a list of economies participating in the BRI along with their respective start years. This data was collected from the Green Finance and Development Centre.[16] and cross-checked with recent information published in press articles.

Given the expectation that the impacts of joining the BRI on economic outcomes, such as internet access, are not immediate, I introduce a one-year lag in the BRI participation variable. This lag addresses potential reverse causality, ensuring that any observed effects on digital connectivity are a result of BRI participation rather than pre-existing trends. The lag also aligns with standard practices in studies measuring the economic impact of the BRI (De Soyres et al., 2019; Ho et al., 2023).

A key limitation of this analysis is that BRI participation does not necessarily capture the full extent of Chinese corporate involvement in the ICT sectors of host countries. As noted in Chapter 3, a more accurate assessment of the digital footprint of Chinese firms on internet access would require disaggregated, longitudinal data. This would include indicators such as the volume of Chinese ICT investment over time, the value of contracts awarded to Chinese

[16] The Green Finance Development Centre: https://greenfdc.org/category/belt-and-road-initiative-bri/

firms, and the loans issued by Chinese financial institutions to support digital and telecommunications projects. Yet, such detailed, sector-specific data remains largely unavailable, and where it does exist, it is often patchy, inconsistently reported, and scattered across disparate sources using varying measurement methods.

Due to limitations in publicly available data, BRI participation is often used as a proxy for increased Chinese engagement in recipient economies. According to Boston University's Global China Initiative, between 2000 and 2021, BRI countries received 82% of China's total overseas development finance, amounting to $462 billion out of a total $561 billion (Ray et al., 2023). Similarly, AidData's Global Chinese Development Finance Dataset, which tracks over 13,000 projects across 165 countries, affirms that the BRI has become synonymous with China's expanding footprint in the Global South. The dataset shows that the majority of China's development finance flows to BRI member states, corroborating empirical findings by scholars such as Chen et al. (2022), who show that BRI participation is strongly associated with increased Chinese lending.

Infrastructure building under the BRI continues to concentrate in member countries, with a sectoral focus on energy, transport, and telecommunications. Chinese ICT infrastructure financing in African countries that participate in the BRI surpassed the combined funding from multilateral agencies, G7 nations, and the African countries themselves in both 2015 and 2017, with annual Chinese funding exceeding USD 1 billion (Eder et al., 2019). Moreover, recent survey results from AidData suggests that 50% of policymakers in BRI countries reported improvements in access to technology as a result of Chinese partnerships - a benefit rarely reported in non-BRI contexts (Custer et al., 2024). According to the China Belt and Road Initiative Investment Report 2024, Chinese tech investments in BRI countries reached $30 billion in 2024 alone (Wang, 2025). In light of such trends, and given the absence of more granular, large-scale cross-country data, BRI participation offers a theoretically and empirically grounded proxy for broader patterns of Chinese digital engagement. This is reflected in a growing number of empirical studies that use the signing of bilateral MoUs between China and host countries as a treatment variable to evaluate the effects of Chinese involvement on digital infrastructure outcomes (Ho et al., 2023; Ito et al., forthcoming).

One might ask why BRI status is used in this analysis, instead of the DSR, which specifically focuses on ICT projects and investments. The answer lies in the limited number of countries

having signed an MoU to specifically join the DSR. As of 2023 only 32 countries of the 145 – BRI signatories had signed a memorandum of understanding to join the DSR (Ho et al., 2023), despite the presence of substantial Chinese contracts, investments, and loans in their ICT sectors. This disparity between formal commitments and the actual scope of China's involvement in digital infrastructure suggests that the DSR serves largely as an umbrella term and that the BRI provides a more appropriate framework for examining the effect of China's globalising digital industry on connectivity.

As in other studies assessing the various effects of the BRI (Wu et al., 2021; Luo et al., 2022; Li and Todo, 2025), this research includes countries across all income groups. This inclusive approach ensures that the estimated effects reflect the initiative in its entirety, rather than being distorted by the exclusion of particular categories of participants. Incorporating high-income countries not only expands the dataset but also enhances the statistical power of the analysis, thereby improving the robustness of the findings. It facilitates more accurate identification of causal effects and reduces standard errors. By contrast, excluding high-income countries would unnecessarily constrain the sample size, potentially weakening both the precision and reliability of the results. Moreover, the few high-income countries that joined the BRI may also experience its effects on digital connectivity, benefiting from Chinese financing for advanced digital infrastructure and access to cost-effective ICT equipment from Chinese firms. Omitting these countries could introduce selection bias by implying that the BRI only operates in certain types of economies or that high-income countries do not experience similar mechanisms of impact. That said, as outlined below, the model controls GDP per capita to account for underlying economic differences between countries, ensuring that observed effects are not simply driven by disparities in wealth, infrastructure investment capacity, or baseline levels of digital adoption.

Control Variables

To isolate the effect of BRI participation on internet access, I include several control variables that capture key economic, demographic, and regulatory factors identified by the literature as important in determining internet access.

First**, GDPPC**, measured as the natural log of GDP per capita, adjusted for Purchasing Power Parity (PPP). Higher GDP per capita is associated with increased investments in ICT infrastructure, as wealthier nations tend to allocate more resources towards building and

maintaining robust digital networks (Ngwenyama and Morawczynski, 2009). Additionally, higher income levels generally correlate with greater access to education and higher human capital, which in turn drive Internet adoption (Rath et al., 2023). This makes GDPPC a key determinant of internet penetration rates across countries. Second, **urbanisation** is used as a control variable. **Urban** areas typically have better ICT infrastructure due to higher population densities, which makes the deployment of broadband networks more cost-effective and efficient, leading to higher Internet usage (Furuholt and Kristiansen, 2007; Fong, 2009).

Third, I use **FDI as Percentage of GDP** as foreign investments can introduce advanced technologies, innovative business practices, and capital necessary for expanding and upgrading ICT infrastructure (Gholami et al., 2005). FDI can theoretically help stimulate competition within the ICT sector, leading to lower prices and increased access to digital connectivity and services (Belloumi and Touati, 2022). The fourth control variable is **Government Spending in Education** as a percentage of GDP [17]. Education investments influence human capital development, digital literacy, and technological adoption (Timotheou et al., 2023). Higher education spending can enhance a population's ability to utilise and access the Internet (Hargittai and Hinnant, 2008).

Crucially, the model incorporates ICT Cost, which examines the affordability of various ICT services across countries over time. This control variable sets this study apart from prior research on the impact of the BRI on ICT development in host countries, as previously discussed. Ho et al. (2023) acknowledge the importance of accounting for connectivity costs but exclude this vector from their analysis due to insufficient data for their sample countries. To address this gap, I construct the variable by averaging two ICT cost baskets: fixed broadband and low-usage mobile cellular (PPP), both sourced from the ITU's database.[18]

[17] For all of the following variables: Spending in Education as Percentage of GDP, FDI as Percentage of GDP, Urbanisation, and GDP per Capita (PPP), were collected from the World Development Indicators.

[18] For more details on the data used, see : https://www.itu.int/en/ITU-D/Statistics/Dashboards/Pages/IPB.aspx

Table 5.1 – Descriptive Statistics for BRI and non-BRI Economies

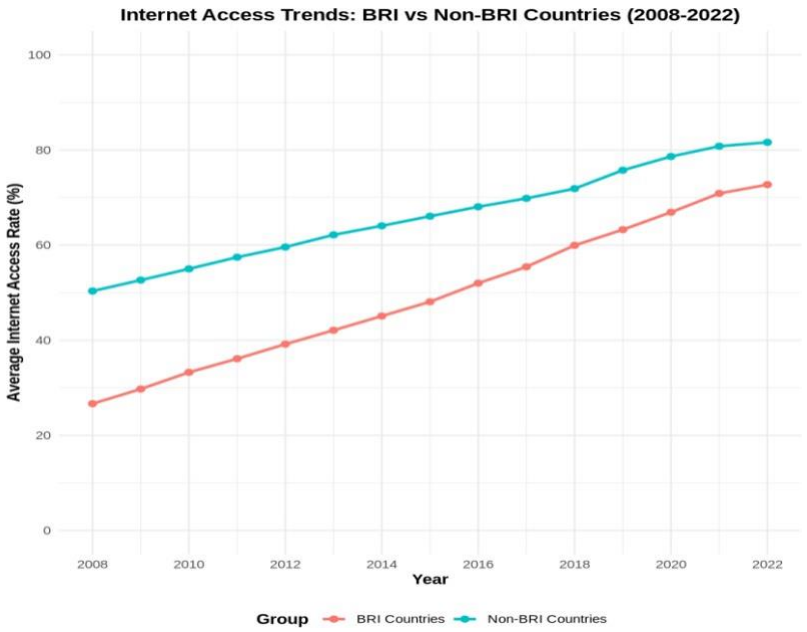
Variable	BRI Economies			Non-BRI Economies		
	Mean	SD	N	Mean	SD	N
Country Characteristics						
GDP per capita	19913.28	21779.80	1575	33389.53	23325.96	420
Urbanisation	57.43	20.65	1575	67.99	23.10	420
FDI%GDP	2.00	21.65	1575	2.64	8.71	420
ICT Cost	40.41	50.87	1575	47.87	137.11	420
Education Spending %GDP	4.27	1.52	1555	5.26	1.25	419
Outcome Variable						
Internet Access	49.45	28.29	1563	66.26	28.17	420

Note: S.D. indicates the standard deviations, and N indicates the number of observations. Data sourced from the World Development Indicator (WDI) and the International Communication Union (ITU)

A cursory glance at the descriptive data indicates a significant difference between BRI and non-BRI countries. BRI economies are poorer than non-BRI economies measured in GDP per capita (PPP), with an average of $19,913 compared to $33,390 in non-BRI economies. This makes sense given that wealthier nations in Europe, North America, and the broader OECD are generally not participants in Beijing's global initiative, which predominantly includes developing countries. Urbanisation rates are also lower in BRI economies, with a mean of 57.4% compared to 68% in non-BRI economies. FDI as a percentage of GDP is also slightly lower in BRI economies (2.0%) than in non-BRI economies (2.6%). As expected, the wealthier non-BRI economies spend a higher percentage of GDP on education (5.26%) compared to BRI economies (4.27%). The average ICT Cost is lower in BRI economies at 40.4, compared to 47.9 in non-BRI economies (USD PPP adjusted).

Importantly, the outcome variable, internet access rate, is lower in BRI economies, with an average of 49.5% compared to 66.3% in non-BRI economies during the period between 2008 and 2022, indicating important inequalities in internet access between the two groups. **Figure 5.2** illustrates the evolution in internet penetration rates over time.

Figure 5.2 – Internet access trends: BRI vs non-BRI countries (2008-2022)



Both BRI and non-BRI countries show an upward trend in internet access over the period. As expected, non-BRI countries consistently have higher average internet access rates throughout the entire period. Interestingly, the gap between BRI and non-BRI countries appears to narrow slightly towards the end of the period. To what extent does the mass infrastructural project that is the BRI, contribute to this decline, if at all? Specifically, is the BRI playing a role in reducing the global digital divide by expanding internet access in developing countries? The remainder of this section outlines the empirical strategy employed to estimate the Difference-in-Differences (DiD) model, including a discussion of robustness checks such as parallel trends testing, alternative model specifications, and the use of Principal Component Analysis (PCA).

Propensity Score Reweighting DiD

To estimate the impact of BRI participation on internet access, I employ a staggered DiD approach using panel data. This framework is particularly well-suited for situations where the timing of treatment varies across units, as is the case with different countries joining the BRI

at different points in time. By including fixed effects, it is possible to control for unobserved factors that remain constant within each country or year, thereby strengthening the credibility of the results.

However, simple DiD estimates may be biased if the countries that join the BRI differ systematically from those that do not. Because BRI participation is not randomly assigned - for example, developing countries are much more likely to join the BRI than wealthier OECD countries - this non-random selection can introduce significant bias. To address potential confounding due to these systematic differences, I employ a propensity score reweighting estimator, as proposed by Imbens (2004), which helps balance observed characteristics between BRI and non-BRI groups. This involves calculating the probability that each country joins the BRI based on observable characteristics and then weighting the control group so that its distribution of covariates more closely matches that of the treated group. This procedure helps to ensure that the comparison between BRI and non-BRI countries is as fair and balanced as possible. To estimate the propensity score, we can assume each BRI participation is governed by a Probit model following Ho et al. (2023):

$$BRI *_{it} = z_{it-1}\alpha + \eta_{it}, \quad BRI_{it} = 1\{BRI_i^* t \geq 0\}$$

where $\eta_{it} \sim \mathcal{N}(0,1)$ and $BRI_{it} = 1$ if the BRI participation occurs for country i in year t, and $BRI_{it} = 0$ otherwise. Here the model assumes that the decision to join the BRI is influenced by economic indicators from the previous year t-1. The set of explanatory variables z_{it-1} includes GDP per capita (PPP), urban population share, FDI as a percentage of GDP, average ICT costs, and government expenditure on education. The results suggest that countries with lower GDP per capita, reduced investment in education, and lower FDI inflows are more likely to join the BRI. Based on the estimated propensity scores, I apply the following weight to each of the 28 countries in the control group (non-BRI economies).

$$\frac{Pr(BRI_{it} = 1 \mid z_{t-1})}{1 - Pr(BRI_{it} = 1 \mid z_{t-1})}$$

After applying these weights, one can estimate the effect of BRI participation on internet access using the following regression model:

$$Internet\_Access_{it+1} = \alpha \cdot 1_{\{0 \leq \Delta_t\}} \times BRI_i + X_{i+1}\beta + \gamma_i + \gamma_{t+1} + \epsilon_{i+1}$$

The dependent variable $Internet\ Access_{it+1}$ measures the annual level of internet access for country *i* in year *t*. BRI_i is an indicator variable equal to one if the country joins the BRI during the sample period. The model assumes that infrastructure and construction projects require at least one year after the signing of a MoU to significantly influence outcome variables. Here $1_{(\Delta t=r)}$ is an event time indicator, which equals one if the observation is *r* years before (r < 0), in (r = 1), or after (r > 1) the year of BRI participation (the year t_{BRI}). The parameter α captures the effect of BRI participation and is estimated as the coefficient on the interaction between the event time indicators and BRI_i: that is, $1_{\{0 \leq \Delta t\}} \times BRI_i$. This interaction equals one if the country is in the post-treatment period, and zero otherwise. I use the years prior to BRI participation ($r \leq 0$) as the baseline, the parameter α reflects the difference in outcomes between treated and control countries at year *r* relative to the baseline period. After the BRI indicator switches on, it remains on for the rest of the sample period. To account for unobserved heterogeneity in internet access across countries, such as differences in government spending in ICT infrastructure, I include a set of country fixed effects γ_i. Year fixed effects γ_t control for global shocks affecting all countries in a given year. The fixed effects absorb the main effects of BRI_i and the event time indicators $1_{(\Delta t=r)}$. The error term is denoted by $\epsilon_{i,t}$.

5.3 The BRI and expanding digital connectivity

This section analyses the results of the propensity score reweighting estimation, assessing the effect of BRI participation on internet access rates. **Table 5.2** shows that economies participating in the BRI experience a statistically significant rise in internet access.

Table 5.2 – Regression Results

BRI and Internet Access

	Dependent variable:
	Internet_Access
BRI Membership	2.819***
	(0.658)
GDP per Capita (PPP)	-0.0004***
	(0.00003)
Urbanisation	0.885***
	(0.132)
FDI % GDP	-0.008
	(0.009)
ICT Cost	0.008***
	(0.002)
Expenditure on Education % GDP	-0.462*
	(0.269)
Country FE	Yes
Year FE	Yes
Observations	1,962
R^2	0.947
Note:	*p<0.1; **p<0.05; ***p<0.01

The coefficient for BRI participation is 2.82 and is statistically significant at the 0.1% level ($p < 0.001$). This suggests that, on average, countries that have joined the BRI experience an increase in internet access of 2.82 percentage points compared to countries that did not join the infrastructural initiative, after controlling for other factors. In other words, a year after signing a MoU joining the BRI, countries record a 2.8 people (per 100 people) rise in internet usage. This finding supports the chapter's hypothesis that participation in the BRI promotes digital connectivity. While a 2.82 percentage point increase may seem modest, its significance becomes clearer when scaled to the population level. In a country with 50 million people, for example, this would translate to approximately 1.4 million additional individuals gaining internet access.

Looking at the control variables within this model reveals complex relationships, illustrating the variegated impact of economic and infrastructural factors on internet access. Both GDP per capita and expenditure on education show significant, albeit negative, effects. However, the magnitude of these effects is relatively small. While this negative relationship might seem

counterintuitive, it makes sense within the context of a model that specifically measures the influence of a foreign-led infrastructural initiative. In wealthier countries, which often possess more advanced infrastructure and human capital, the marginal gains from BRI-related projects may be smaller, potentially resulting in negligible, or even slightly negative, increase in internet access compared to less developed nations.

In this case, FDI as a percentage of GDP does not exhibit significant effects, whereas urbanisation shows a positive and significant relationship. A 1 percentage point increase in urbanisation is associated with approximately a 0.89 percentage point rise in internet access. This relationship is statistically significant at the 1% level, corroborating the well-established influence of urbanisation on internet infrastructure and access (Hindman, 2000; Fong, 2009). ICT costs are positively correlated with internet access, exhibiting a coefficient of 0.008 and strong statistical significance. While one might typically expect a negative relationship, where lower ICT costs result in greater internet access, this positive association could suggest that higher costs reflect better quality services or more advanced infrastructure in more developed economies. This trend is evident in the descriptive data presented in **Table 5.1** which contrasts BRI economies to the more advanced non-BRI countries.

The results of this analysis align with prior research by Ho et al. (2023), who show that economies participating in the BRI experience noteworthy growth in what they describe as ICT development, measured through increased internet penetration, mobile and broadband subscriptions, and telephone access. Similarly using a propensity score reweighting DiD model; the authors find that countries involved in both the BRI and the DSR see even greater ICT development and integration into global ICT value chains compared to those in the BRI alone. The authors also note that DSR participating economies become "more involved in the global ICT value chain" (Ho et al., 2023, p. 13). Interestingly, these economies increase their imports of ICT-related services, particularly from China in comparison to other countries.

Beyond the digital sphere, the results of this chapter align with research exploring the BRI's effects in various sectors. Studies have shown that BRI participation is linked to a reduction in trade costs through infrastructure development (De Soyres et al., 2019; Baniya et al., 2020). Fardella and Prodi (2017) find that the BRI enhances trade flows by focusing on the impact of new railways and port infrastructures on bilateral trade. In the same vein, Zhou et al. (2021) report that the BRI improves infrastructure connectivity and reduces transportation costs in participating countries. Wu and Han (2022) add that the initiative accelerates improvements in

total factor productivity and reduces trade costs in high-tech manufacturing and service industries, while also optimising factor allocation among industries. This body of scholarly work, along with this chapter, brings empirical evidence to back the claims made by authors such as Liu and Dunford (2016, p. 337) who state that: "The BRI is clearly a project from which China can gain, but it is designed in such a way that there are significant potential gains for all other countries that choose to take part".

Robustness check

What if the findings were only significant when applying this specific model? To examine the robustness of my model, I run various types of robustness checks that help ensure the validity of my findings.

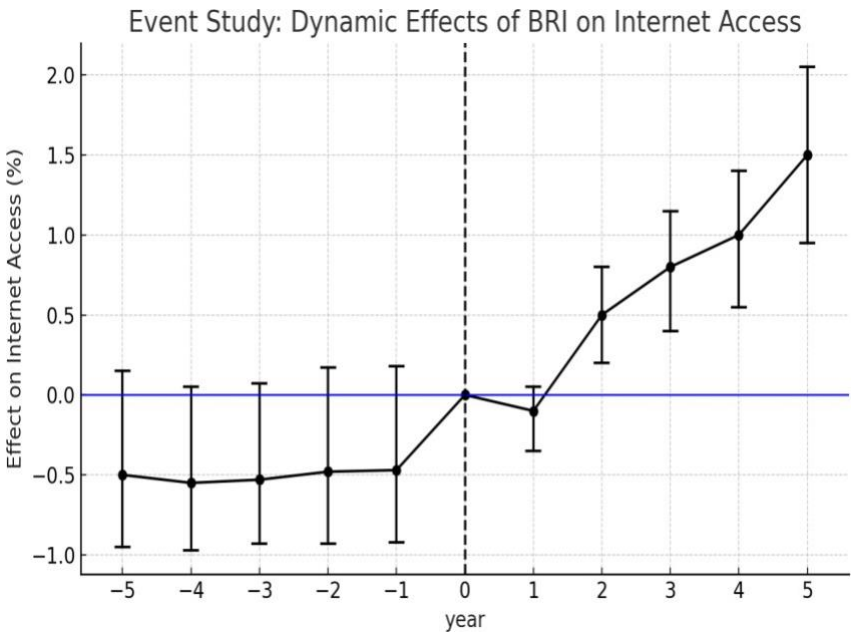
First, I run a parallel trend test. The key assumption here is that, prior to the BRI intervention, the trends in outcome variables for both the treated (BRI-participating) economies and the control (non-BRI) economies would have evolved in a similar manner (Goodman-Bacon, 2021). If, instead, these groups already exhibited different trends before the intervention, any estimated effect from the DiD approach could be biased, potentially reflecting those pre-existing differences rather than the true impact of the BRI. To address this, I use an event study approach. This involves estimating how the outcome variables evolve over time for both groups, both before and after the BRI is introduced. By examining the coefficients corresponding to different periods around the treatment event (the BRI), this approach can visually and statistically assess whether the parallel trends assumption holds.

If the pre-treatment coefficients are not significantly different from each other, it supports the validity of our identifying assumption and strengthens our confidence that the DiD estimate reflects the true effect of the BRI. The event study approach relies on the estimate of the following equation:

$$Internet\_Access_{it+1} = \left(\sum_{r=-5}^{-1} \alpha_r \cdot \mathbf{1}_{\{\Delta t = r\}} + \sum_{r=1}^{5} \alpha_r \cdot \mathbf{1}_{\{\Delta t = r\}}\right) \cdot BRI_i + \gamma_i + \gamma_t + \varepsilon_{it}$$

The equation interacts event-time dummies with BRI participation status. Here, $1_{\Delta t=r} \cdot BRI_i$ denotes an event-time indicator for country i being r years away from BRI participation (where r < 0 are pre-treatment leads and r > 0 are post-treatment lags), interacted with the BRI treatment indicator. I omit the event-time dummy for r = 0, which serves as the baseline (year of BRI entry). The coefficients α_r thus measure the differential effect on connectivity outcomes for treated versus control countries relative to the baseline year. Country and year fixed effects are represented by γ_i and γ_t, respectively, and $\epsilon_{i,t}$ is the error term.

Figure 5.3 – Event study results



All point estimates for the pre-treatment period (years -5 to -1) are close to zero, and their associated confidence intervals consistently include zero, indicating no statistically significant differences in internet access trends between BRI and non-BRI countries prior to BRI participation. Moreover, the coefficients display no discernible upward or downward trajectory before treatment, suggesting the absence of differential pre-trends. These results support the validity of the parallel trends assumption underlying the DiD design. In the post-treatment period, the estimates begin to increase, with effects becoming positive and statistically significant from year two onward. This pattern provides suggestive evidence that BRI participation contributes to improved internet access in participating countries, following a lag consistent with the time required for infrastructure implementation.

My second robustness check entails adjusting my model by using a Principal Component Analysis (PCA). A big concern in multi-regression analysis like the one used in this chapter is the problem of multicollinearity, that is when two or more independent variables in a regression model are highly correlated with each other (i.e. GDP per capita and urbanisation) (Gwelo, 2019). Multicollinearity can lead to unreliable or unstable estimates of the regression coefficients, making it hard to assess the true causal relationship between BRI participation and digital connectivity. PCA helps address multicollinearity by combining highly correlated control variables into uncorrelated principal components, reducing potential biases (Ho et al., 2023). Thus, PCA allows one to test whether the effect of BRI participation remains significant with a different data representation. As shown in **Table 5.3**, the use of PCA results in findings that are very similar to those in the original model (2.426) and are statistically significant at the 0.1% level, providing evidence for the reliability of the findings.

Third, I use different time lags to check the stability of the model. The main regression model makes the assumption that the effect of the BRI on ICT infrastructure and in turn on internet access would take a year after the signature of a MoU to materialise (t+1). To further test the robustness of my findings, I run the analysis with alternative time lags (t and t+2). Encouragingly, as shown in **Table 5.3**, the results of the alternative time lags are close to the original findings. For the time lag, t (Year Joining), the coefficient for BRI Treatment is 3.135 and is statistically significant at the 0.1% level ($p < 0.001$). t+2 (Year Joining + 2), the coefficient for BRI Treatment is 2.620 and is also statistically significant at the 0.1% level. This suggests robustness in the effect of BRI participation on internet access rates.

Finally, I apply alternative DiD specifications. A significant factor that could be driving the observed effect of the BRI on internet access is ICT regulation. A large body of literature has documented the importance of regulatory measures in shaping the development of digital economies and promoting connectivity (Kira et al., 2021). Effective ICT regulation ensures that the necessary policies, standards, and guidelines are in place to promote competition, protect consumer rights, and encourage investment in digital infrastructure (Serafica and Oren, 2022). This can lead to improved service quality, wider network coverage, and more affordable access, which are essential for expanding internet access, particularly in underserved areas.

So, what if the expansion in internet usage shown above was the outcome of better regulation in recent years and not the outcome of BRI participation? To test this, I add a new variable to

the model, measuring the quality of ICT regulation[19] in the 132 countries of my original panel. While findings show that the ICT Regulatory Score has a positive and statistically significant effect on internet access, the inclusion of the ICT Regulatory Score does not substantially alter the effect of BRI participation on internet access. As shown in **Table 5.3**, adding ICT regulatory score as a control variable maintains the coefficient for BRI Treatment at 2.426 and is statistically significant at the 0.1% level.

Table 5.3 – Summary of Robustness Checks

Summary of Robustness Checks

Model	BRI_Treatment	Std_Error	Observations	R_Squared
DID with PCA	2.476* * *	0.665	1,962	0.946
No Time Lag	2.778* * *	0.625	1,962	0.949
2 Year Time Lag	2.237* *	0.690	1,962	0.949
DID with ICT Regulatory Score	2.426* * *	0.650	1,962	0.949

The robustness checks conducted in this analysis provide strong evidence for the positive impact of BRI participation on internet access rates. Across various model specifications, the BRI Treatment effect remains consistently positive, statistically significant, and of similar magnitude. The findings of this analysis are consistent with previous studies establishing the strong link between infrastructure development and reductions in digital inequalities (Rao, 2005; Greenstein, 2021; Kouladoum, 2023).

As digital infrastructure expands and scales up through the BRI, a potential implication is that the unit cost of delivering internet services decreases. Larger networks can distribute fixed costs over more users, resulting in lower per-user costs (Roller and Waverman, 2001). This is particularly important in densely populated urban areas in developing countries. At the same time, modern digital infrastructure incorporates advanced technologies that enhance efficiency and reduce operational costs (Roller and Waverman, 2001; Thinyane and Terzoli, 2009). For instance, upgrading networks from 3G to 4G offers higher bandwidth and more reliable connections, leading to lower maintenance costs and improved user experiences. Lower

[19] I use the ITU's ICT Regulatory Score, available at: https://app.gen5.digital/tracker/about. A higher ICT Regulatory Score suggests a more favourable regulatory environment for telecommunications and Internet services.

operational costs can translate into more affordable internet access for economically marginalised groups. Cheaper internet access can in turn foster inclusivity by reducing financial barriers to internet access, enabling wider participation in the digital economy.

Some regression-based studies have suggested that digital connectivity reduces the barriers to entering global markets by allowing small businesses in developing countries to participate in international trade through digital platforms (Freund and Weinhold, 2002; Clarke and Wallsten, 2006; Vemuri and Siddiqi, 2009). Authors have also argued that digital connectivity helps diversify the economy by moving labour and capital into more productive sectors like digital services where technology-driven productivity gains are more significant. In his "New Structural Economics" framework, Justin Yifu Lin emphasises the role of "hard" and "soft" infrastructure in facilitating processes of industrial upgrading (Lin, 2011). He explains that hard infrastructure (e.g., transportation, energy, and telecommunications) is crucial for reducing transaction costs and enabling industries to grow by connecting markets and improving productivity. This being said, one should not fall into the trap of overblown statements about the potential of digital connectivity in contributing to structural change. To better understand the developmental implications of China's global digital expansion, it is important to move beyond broad macro-level analyses and investigate its concrete, localised impacts – as Chapters 6 and 7 will do. The discussion that follows focuses on the potential risks of technological lock-in, using the case of Algeria's fibre optic network expansion as a point of analysis.

5.4 Chinese ICT firms at the heart of Algeria's fibre revolution

In this section, I examine ZTE and Huawei's securing of Algeria's Fibre-to-the-Home (FTTH) contract, awarded by Algérie Télécom in 2020.[20] The case represents a compelling case study of China's global ICT industry and its role in expanding digital connectivity as well as technological artifacts, equipment, and standards making up a distinct technopolitical regime, showcasing both the opportunities and challenges associated with such partnerships.

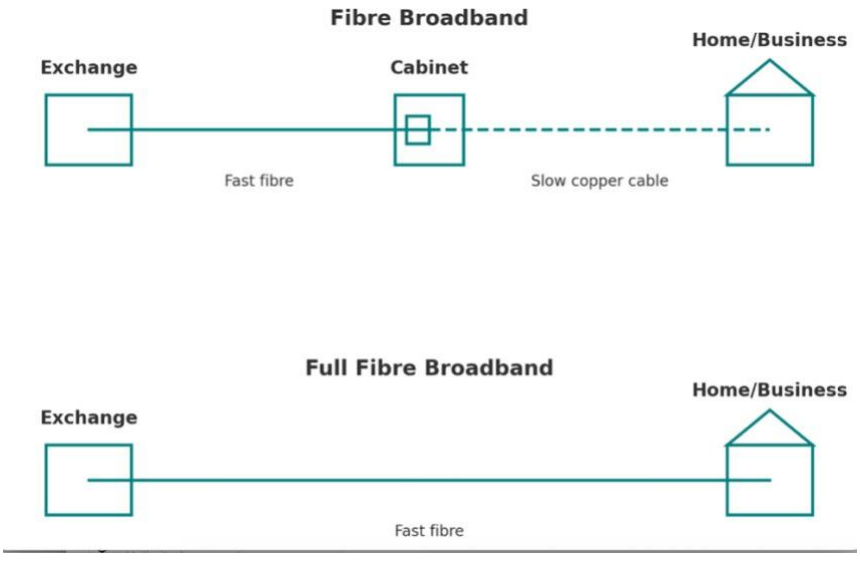
In 2018, faced with declining hydrocarbon revenues, Algerian authorities sought to diversify the economy by prioritising the expansion of digital connectivity. At that time, the country was still lagging behind in terms of ICT infrastructure. Although the rollout of mobile internet,

[20] In February 2024, Telecom Egypt and Huawei signed a partnership granting Huawei responsibility for developing the country's 5G networks. However, due to the recency of this agreement and the limited availability of data and fieldwork interviews discussing it, I have opted not to include an analysis in this chapter. The joint statement by Huawei and Telecom Egypt can be accessed here: https://ent.news/2024/2/2584.pdf

despite initial delays discussed in Chapter 4, proved highly successful, fixed broadband infrastructure remained underdeveloped. Providing high-speed internet directly to people's homes through fibre-optic technology (FTTH) became a top priority for the leadership of Algérie Télécom (ITmag, 2018). FTTH consists of providing a direct fibre optic connection from service providers to households and businesses. ICT experts have described it as a milestone in connectivity, citing its ability to reduce latency, improve reliability, and enhance overall network performance (Hamza et al., 2023). The ultra-high-speed internet provided by FTTH enables seamless access to bandwidth-intensive activities like video streaming, remote work, and cloud computing.

Importantly, while several ICT equipment manufacturers offer FTTH solutions, Algérie Télécom awarded the multi-million-dollar contract directly to Huawei and ZTE without conducting a public tender. The state-owned Algerian company justified its decision under Article 38, paragraph (h), of its internal procurement regulations, which allow direct agreements to be made without open tenders in specific circumstances (Ntic-dz, 2020). In defending its decision to bypass an open bidding process, Algérie Télécom emphasised the leading positions of both Huawei and ZTE in the FTTH industry and the broader Passive Optical Network (PON) markets. Before sealing the deal, Huawei conducted a pilot operation in the Algiers digital cluster of Sidi Abdallah demonstrating the high performance and reliability of the FTTH technology, with speeds of up to 1 Gbps (Ntic-dz, 2020).

Figure 5.4 – Differentiating 'Fibre' and 'Full Fibre' Broadband



The Algerie Telecom partnership with ZTE and Huawei in deploying of FTTH has achieved notable progress in connecting Algerian households and businesses. In 2024, the Algerian Ministry of Post and Telecommunications reported that the number of households connected through the FTTH project had reached 1.5 million by November 2023 – an impressive 2,730% increase from the 53,000 subscribers recorded in November 2020 (Ecomnews Med, 2025). That said, the growth rate largely reflects the fact that Algeria started from a low baseline. Despite these advancements, FTTH adoption in the country remains limited, with only 25.6% of households with internet access connected via fibre. This underscores the need for continued efforts to expand its reach. Globally, FTTH penetration rates vary considerably by region and country, with some leading nations boasting near 100% coverage whereas others lag behind. For instance, in 2023, FTTH coverage reached 70% in Europe (FTTH Council, 2024), but remained below 10% across most of the African continent (Omdia, 2023).

A closer examination of Algeria's FTTH contract awarded to the two Chinese firms reveals emerging concerns about lock-in to specific technopolitical regimes. Fieldwork interviews with experts and representatives from Algérie Télécom revealed that the decision to select Huawei and ZTE for the FTTH initiative was largely influenced by the ease of integration with the existing infrastructure, as the two Chinese equipment providers were already present in multiple layers of Algeria's technology stack. With Huawei and ZTE's devices, cables, routers and switches embedded within Algeria's telecommunications network, continuing to work with these firms allowed the deployment of FTTH technology to be seamlessly integrated (W2). This choice minimised technical challenges and ensured full interoperability across the network, streamlining the deployment process (E2, S8).

Huawei’s embedded Optical Time Domain Reflectometer (eOTDR) illustrates how infrastructural expansion can enhance connectivity while simultaneously creating risks of technological lock-in. Traditional fibre-optic networks require expensive external testing equipment to diagnose faults and locate cable breaks. Huawei’s innovation embeds this monitoring functionality directly into its Optical Line Terminal equipment, enabling real-time, remote fault detection from centralised locations, reducing maintenance costs by 30-40% and accelerating repair times from hours to minutes (Cabling, 2013). For Algeria, where infrastructure spans vast distances and maintenance capacity is limited, these advantages are substantial. Yet eOTDR’s efficiency gains come bundled with profound dependencies. The system is not based on open, industry-wide standards but on Huawei’s proprietary algorithms, software protocols, and hardware integration. The eOTDR

functionality is deeply integrated with Huawei's Optical Line Terminals, network management systems (specifically Huawei's iManager U2000), and the broader suite of technologies that comprise a functioning FTTH network. These components are designed to work seamlessly together within Huawei's ecosystem but are not interoperable with equipment from other vendors. An interviewed Ericsson engineer explained:

> "The eOTDR is a Huawei solution. If we wanted to bring in Ericsson equipment for one part of the network, the carrier would lose the monitoring capabilities. Everything has to match, or nothing works properly. We can't just swap out one piece for another." (C4)

This interdependency means that adopting eOTDR effectively commits Algeria to Huawei equipment across multiple network layers. Switching to alternative vendors would require replacing not just individual components but entire integrated systems, at prohibitive cost. This pattern is not unique to Huawei. Like Ericsson, Nokia, and Cisco, Chinese ICT Original Equipment Manufacturers (OEMs) design their equipment and systems around proprietary technologies and standards. They offer their own network management systems, software interfaces, and hardware configurations, all designed to operate seamlessly within proprietary ecosystems (Jiang et al., 2020). However, such proprietary designs are rarely interoperable with equipment from other vendors, creating barriers to technological integration.

For Algérie Télécom, switching to a different OEM would therefore entail replacing entire systems, a process that is both technically challenging and financially prohibitive. The scale of investment required for such transitions is substantial. This includes hardware such as base stations, routers, and optical nodes, as well as software systems for network management. Interviewed policymakers and experts in Algeria identified cost optimisation as a critical deciding factor for opting for Chinese OEMs (G2, E6). The North African country faces relatively high internet costs, and increasing affordability is a government priority. According to the ITU ICT Prices Index, fixed broadband internet in Algeria costs 3.9% of gross national income (GNI) per capita, whereas the ITU defines affordability as below 2% (ITU, 2024). In this context, Algérie Télécom's choice of Huawei and ZTE equipment allowed it to capitalise on existing network management and supervision platforms, avoiding the financial and operational burdens associated with transitioning to alternative systems. Additionally, the workforce, already trained in Huawei's technologies, as will be discussed in the following chapter, could seamlessly manage the new infrastructure, further lowering implementation costs.

Whilst the cost-efficiency and convenience of maintaining the same infrastructure offer undeniable advantages, they simultaneously give rise to long-term dependencies and technological lock-in. This occurs when an OEM's infrastructure becomes deeply entrenched within a country's digital ecosystem. The concept of technological lock-in, long discussed in the literature, highlights the tendency of certain technologies to become embedded within a "natural trajectory" or "technological regime" (Rip and Kemp, 1998). This entrenchment results from reinforcing mechanisms: cost advantages, workforce specialisation, and compatibility with existing systems. Arthur (1989) explored the phenomenon of increasing returns to adoption, positive feedback loops whereby the more a technology is adopted, the greater its likelihood of further adoption. He argued that these dynamics lead to the lock-in of incumbent technologies, thereby hindering the adoption of potentially superior alternatives. The standards governing how networks infrastructure operates are not abstract technical choices but concrete expressions of whose technological regime structures host digital economies.

The ubiquity of Chinese ICT infrastructure entails the emergence of a distinct technopolitical regime that challenges the long-held dominance of the US-centric regime, which has traditionally encompassed ICT equipment manufacturers from Europe and allied countries. These regimes are underpinned by networks at the national or supranational level that depend on particular systems, devices, standards, norms and values operating on the ground (Hecht, 1998). These standards can be disseminated through the market dominance of a particular company's product, *de facto* diffusing technological standards through infrastructure. For instance, the limited variety of operating systems makes the technical specifications of Microsoft Windows and Apple macOS the de facto standards for software developers. Neither international standards set by formal bodies nor de facto standards that emerge from the ground up are legally binding, yet both carry significant practical influence (Brunsson et al., 2012) and have profound implications. Examining the construction of railway networks by Chinese firms in BRI countries, Rühlig and ten Brink (2021) show how the PRC seeks to disseminate its technical standards through comprehensive package deals offered to BRI countries, which encompass financing, design, and the construction of railway infrastructure. According to He (2022), the promotion of Chinese standards in strategic industries like next- generation ICT and smart manufacturing became a priority for the Chinese government shortly after the BRI's launch.

In 2015, China's National Development and Reform Commission (NDRC) introduced the first "Action Plan for Harmonisation of Standards along the Belt and Road" (2015–2017), aiming to internationalise Chinese domestic standards in BRI countries (NDRC, 2015). The plan called for translating 500 national standards into foreign languages. The 2018–2020 plan expanded cooperation to sectors like e-commerce, health, and finance, emphasising mutual standard recognition (SAC, 2018). By 2019, China had signed 85 standardisation agreements with 49 countries and regions along the BRI (Rühlig and ten Brink, 2021, p. 1211). Of all sectors, none has been as much the focus of the state's global standardisation efforts as the digital economy. In 2018, SAC officials noted that R&D in next- generation ICTs that are still developing, such as AI, big data, and cloud computing, offered China an opportunity to lead in industrial growth and related standards (He, 2021). The Ministry of Industry and Information Technology (MIIT) made China's digital standards ambitions clear in a 2018 opinion document (State Council, 2018). By integrating Chinese technical specifications into telecommunications networks, railway systems, and other infrastructure projects, these standards become a functional necessity in the recipient countries.

For the Algerian government, these technical advantages increased the appeal of Huawei. However, this reliance on Chinese firms – much like the past overreliance on US, European and Japanese firms in the sector – may inadvertently constrain the future diversification of the country's ICT ecosystem. This pattern is not unique to China but reflects a broader historical trend where dominance by a limited set of foreign firms can shape technological trajectories, restrict competition, and reduce the scope for domestic innovation. Such constraints may reproduce and even exacerbate digital inequalities, as alternative suppliers – especially domestic ones – are effectively excluded from the market, lacking opportunities to compete, develop, and establish a foothold in the industry.

The absence of a public tender and the direct agreement with the two Chinese firms excluded domestic competitors in areas where they possess expertise (S1, S2, S5, S7). The decision to bypass local firms arguably deprived these firms of the chance to engage in technological learning and in building further capabilities. Furthermore, when tenders are issued, the bar is often set so high, particularly in terms of technical specifications, that many domestic operators are effectively shut out, as explained by a manager of local ICT firm:

> "The design of large-scale tenders puts us at a disadvantage. The technological requirements and standards outlined in the documents are often unnecessarily high compared to what the project actually needs. As a result, smaller firms like ours are effectively excluded. Only large multinationals are in a position to win these contracts." (S2)

Without the ability to participate in large-scale projects like the FTTH rollout, local firms missed out on a critical growth avenue that could have helped them to enhance their technical expertise and market competitiveness (S2). Instead, they remain relegated to peripheral roles, such as subcontracting or providing minor services to these large firms, with limited influence over the broader technological trajectory of the sector. Fieldwork findings indicate that similar patterns of local firm exclusion and limited integration also characterise projects led by other foreign technology providers such as Ericson and Nokia (S1, S2, S4, S7), highlighting a broader structural issue in the organisation of global ICT infrastructure rollouts. These projects are often designed in ways that concentrate value capture within large firms, while creating minimal linkages or spillover benefits for the local economy. That said, the decision to select Huawei and ZTE for the project reflects Algiers' deepening alignment with Beijing. A series of official announcements have positioned Chinese ICT firms at the centre of the country's digital transformation (Maghreb Emergent, 2024). While the immediate advantages of partnering with these Chinese OEMs – particularly in terms of cost efficiency and rapid fibre to-the-home deployment – are clear, the longer-term implications merit critical scrutiny, especially regarding the trade-offs between short-term gains and sustainable technological development.

5.5 Conclusion

This chapter has sought to operationalise the infrastructural dimension of this dissertation's multi-dimensional analytical framework. In doing so, it assessed the tangible effects of the globalisation of China's ICT industry on digital connectivity and its broader implications for technological upgrading in host countries. The quantitative analysis which takes BRI

participation as a proxy for China's increased presence in the ICT sector of host economies, shows that BRI is associated with increased internet access, controlling for potential confounding factors and accounting for time-invariant country-specific characteristics. Chinese ICT firms, backed by state financing and competitive pricing strategies, are enabling developing countries to bridge the connectivity divide and boost internet access. Despite the Western-driven propaganda about the risks of collaborating with China in the digital sector, evidence shows that BRI countries outperform their non-BRI counterparts in terms of growth in internet access rates, a crucial first step toward advancing digital transformation. Unsurprisingly, cost-effective access to ICT is a pressing priority for developing countries, and the prism through which they view decisions about telecom equipment is shaped less by global power struggles and more by the immediate need to bridge the costly digital infrastructural divide.

The last section of the chapter zooms in on the case study of Algeria's decision to contract two Chinese firms, Huawei and ZTE for its Fibre-to-the-Home project. It highlights how the partnership with the two firms addressed Algeria's urgent need to modernise its fixed broadband infrastructure, driven by declining hydrocarbon revenues and the government's efforts to diversify the economy through digital connectivity. Yet while the partnership resulted in rapid deployment and connected over a million households, the decision raises concerns about long-term technological lock-in. Relying on Huawei and ZTE risks embedding China's technopolitical regime within the country – just as reliance on US and European firms entrenches distinct regimes – characterised by proprietary standards and equipment that constrain interoperability and limit future diversification. On the other hand, access to Chinese technologies is also accelerating Algeria's digital transformation by providing state-of-the-art equipment, access to increasingly dominant standards and cost-efficient solutions, which allow developing countries to keep up with fast changing digital innovations.

Observed advancements and the changing architecture of developing countries' infrastructural composition are not without political implications. By providing essential digital infrastructure and services, Chinese tech firms are playing a crucial role in mediating the digital transformation of BRI participants. The centrality of infrastructure in China's global projection, combined with its competitiveness in technological manufacturing has prompted scholars to suggest the emergence of a "Chinese register" of digital infrastructure-building that is likely to become increasingly relevant for development studies and political economy scholarship. This is not only because of its connection to variegated developmental models and forms of governance, but also because infrastructure is intricately tied to global geopolitical struggles.

This ambition is hardly surprising given the country's growing innovativeness (Fu, 2015) and the fact that the most technologically advanced countries traditionally shape international standardisation (Mattli and Büthe, 2011; Zúñiga et al., 2024). Yet, as the BRI and DSR progress, China's rise as a significant player in technical standard-setting has intensified geopolitical tensions with the US, increasing the risk of a fragmented digital space where countries must align with competing standards. This dynamic has led some scholars to describe the situation as a "Second Cold War," in which technical standardisation processes are central to a new wave of militarised rhetoric and strategic manoeuvring (Schindler et al., 2023). Nonetheless, the effect of China's expanding technopolitical regime does not have pre-determined outcomes on host developing countries. The emergence of a technopolitical regime that challenges US hegemony over the internet could create a new layer of technological dependence but may also increase the bargaining power of developing countries that can leverage competition between the two digital superpowers to shape their own digital futures. In the end, such leverage will be contingent on the industrial policies put in place by host countries and the efforts made to leverage the presence of foreign ICT giants for strengthening domestic capabilities and moving towards greater technological intensity. The analysis thus calls for a critical examination of the balance between rapid implementation and the potential erosion of long-term technological independence, alongside the impact on local innovation.

This chapter contributes to advancing our knowledge of the role of the BRI in digital connectivity and what it means for developing countries aiming to climb the technological ladder. However, as explained in Chapter 2, understanding whether the influx of Chinese digital capital to host countries creates new opportunities for technological upgrading requires more than an assessment of its effect on digital access. The next chapter delves into the role of Chinese digital corporations in transferring technology to local economies and their contribution in promoting domestic technological capabilities.

CHAPTER 6

Learning Along the Digital Silk Road: Technology Transfers and the Effects of Chinese ICT MNCs

Over 2,200 years ago, the movement of people and goods across the ancient silk roads facilitated the diffusion of Chinese inventions and technologies to Eurasia, the Middle East and North Africa. This trade network constituted a channel for Chinese innovations such as papermaking and woodblock printing, which enabled large-scale printing for the first time and transformed information dissemination in Europe (Hernandez, 2019). The movement of medicine and pharmaceutical knowledge across the Silk Roads encouraged translations of medicinal writings from Chinese into Arabic, making a broad array of scholarship accessible to local polymaths, with profound effects on medical practices in the Middle East and elsewhere (UNESCO, 2022). In the 21st century, the global expansion of Chinese digital capital could play a similar role in spreading new technologies and practices. This chapter, therefore, engages with the second configuration of the thesis's theoretical framework, exploring whether Chinese technology giants foster technology transfer, facilitate learning processes, and enhance the development of technological capabilities within host countries.

There is a dearth of empirical studies looking at China's contribution to technology transfer in developing nations' ICT sectors. The authors have either argued that Chinese ICT MNCs create extensive avenues for technology transfer (Tsui, 2016; Agbebi, 2019) or, conversely, that there is weak evidence of such opportunities (Rwehumbiza, 2021; Tugendhat, 2021), depending on the cases and methodologies used. Such emerging research has tended to focus more on the quantum of linkages rather than a qualitative investigation of their content. By narrowly focusing on the *existence* or *lack* thereof of spillovers, existing research tends to obscure the underlying politics and regulatory effects embedded in technology transfers and training programmes. What is perhaps as important as the question of whether Chinese digital companies engage in technology transfer in host developing countries is the role played by spillovers in diffusing specific technological protocols, practices, and standards and what this means for structural transformation.

This chapter examines the technological spillovers emanating from the interaction of two Chinese telecommunication giants – Huawei and ZTE – with local configurations of power and skills in Algeria and Egypt and their grounded effects. It finds that despite localising seemingly developmental activities that can produce considerable linkages, the two Chinese tech firms created limited learning opportunities that could effectively contribute to technological upgrading. Instead, the technologies disseminated by Chinese digital corporations, from codes to the hardware making up network infrastructure, as well as the know-how embedded in training programmes provided to local employees, suppliers, and students, are reconfiguring ICT ecosystems in ways that render the use of Chinese firms' products, processes, and standards ubiquitous. In this sense, Chinese ICT giants are diffusing, both *intentionally* and *unintentionally*, a distinct technopolitical regime, which risks locking local ICT actors into new dependencies that resemble those of Western powers.

This being said, as labour costs continue to rise in China, fieldwork findings suggest that Chinese ICT firms are increasingly localising mid-level managerial roles and, to a lesser extent, top-level leadership positions. Findings indicate increasing instances of managerial spillovers. Discussions on knowledge spillovers from MNCs have largely neglected the transfer of managerial expertise. Yet, changes in management practices – such as organisational structures, decision-making processes, strategic implementation, and human resource management – can significantly enhance firms' competitive performance (Lall and Narula, 2004). At the same time, as latecomer firms dispatched from a developing country, Chinese ICT corporations, and Huawei in particular, have devoted substantial resources to capacity-building efforts to capture markets that were historically dominated by US and European firms. These efforts bear the promise to foster interest in ICTs, and help local stakeholders become familiar with technologies, processes, and standards that are increasingly becoming dominant in the global digital economy.

This chapter offers an in-depth empirical analysis of the complex mechanisms determining technological spillovers from Chinese digital MNCs and examines how these dynamics shape local development. Through this exploration, the chapter contributes to ongoing debates on FDI, the BRI and technology transfers. By unpacking these relationships, this segment of the thesis gives us a better grasp of the potential opportunities and challenges for host countries seeking to leverage Chinese ICT investments for technological learning and innovation. For

this section of the dissertation, I rely on extensive and triangulated field evidence, drawing on over 107 interviews in Algeria and Egypt conducted between October 2021 and October 2024. Interviews included employees, subcontractors, customers of Huawei and ZTE, students and startups receiving training and support from Chinese tech-giants, ICT policymakers, government officials, university faculty/researchers, as well as Western ICT equipment manufacturers including Cisco, Ericsson, and Nokia (see Appendix 2 for full interview table).

After this introduction, the first section starts by reviewing the existing literature on technology transfer with a focus on Chinese ICT MNCs in developing countries. The next section discusses Algeria and Egypt's respective absorptive capacities, and the policies put in place to leverage the presence of foreign ICT MNCs. This is followed by a discussion of the chapter's findings, which analyse the channels of knowledge spillovers from digital MNCs in terms of three types of linkages: horizontal linkages, vertical linkages and linkages with local universities and research institutions. The final section wraps up by synthesising the chapter's key findings and reflecting on their significance within the wider scholarly and policy debates.

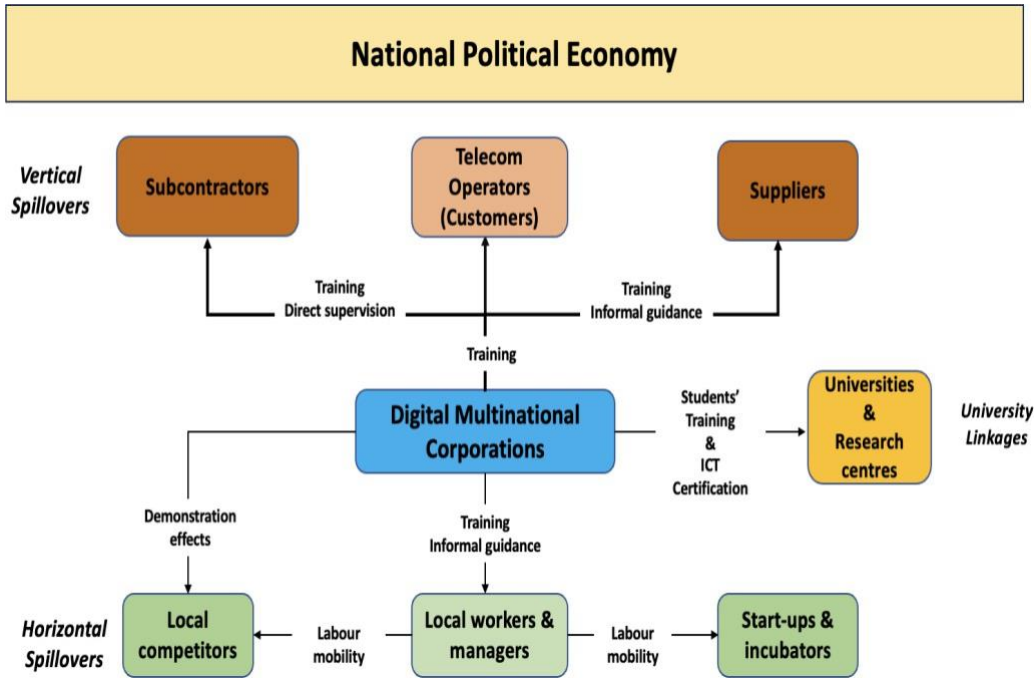
6.1 Technology transfer and Chinese ICT corporations

Technology transfer – the dissemination of technical knowledge and know-how embodied in products, processes, and management (Wahab et al.,2011, p. 62) – through FDI has long been regarded as a major engine of technological upgrading and structural transformation (Globerman, 1979; Markusen and Venables, 1999; Amsden, 2001; Saggi, 2002; Blalock and Gertler, 2008; Fu et al., 2011). The basic premise underlying the existence of technology spillovers is that foreign-invested firms are technologically superior to local ones; thus, their interaction with local economies is assumed to lead to technology transfers which, in turn, lead to productivity gains (Saggi, 2002). Given the lower technology base within developing economies, these spillovers may help local industries build up their domestic technological capabilities and catch up with the international technology frontier (Lall, 1996; Ning and Wang, 2018). As explained in Chapter 2, technology spillovers are unlikely to emerge when foreign firms operate in isolation from the host economy, functioning as self-contained enclaves with minimal interaction with local industries. Such spillovers rely on the establishment of meaningful connections, or "linkages," between foreign enterprises and the domestic economy – a concept central to Hirschman's seminal work on backward and forward linkages, discussed earlier (Hirschman, 1977).

The theoretical literature identifies two primary channels through which foreign firms can facilitate technology transfer: vertical and horizontal spillovers. Horizontal spillovers involve the transfer of skills and knowledge between firms within the same industry, typically through mechanisms such as worker mobility, imitation, or competitive pressure (Rojec and Knell, 2018; Del Giudice et al., 2019). For instance, local firms may acquire knowledge by observing the practices of foreign firms or, more directly, through labour mobility. This includes scenarios where workers and managers leave a multinational corporation to join a local firm in the same industry or go on to set up their own venture, enabling the transfer of technical and managerial expertise and best practices (Liu, 2008; Iršová and Havránek, 2013). Vertical spillovers, on the other hand, occur along the value chain and can be classified as either upstream (to suppliers, reflecting the backward linkage channel) or downstream (to customers, akin to forward linkages) although less theoretically significant than spillovers involving suppliers (Javorcik, 2004). Significantly, when foreign firms collaborate with local suppliers, they often provide training, direct supervision, and access to advanced technologies or demand higher production standards. These interactions can foster meaningful technological learning and capacity building, resulting in vertical spillovers (Blomstrom and Kokko, 2001; Rojec and Knell, 2018).

Another important type of linkage is the one established between ICT corporations and universities. In high-technology sectors, such as the ICT industry, multinational corporations often establish partnerships with universities to strengthen local expertise for their operations. These collaborations typically involve providing training to ICT students, offering industry-recognised certifications, and facilitating hands-on learning opportunities through internships and research projects (Perkmann and Walsh, 2007). By engaging in these university linkages, ICT multinationals play a crucial role in shaping the workforce's skill set, enhancing students' employability, and ensuring a supply of talent that aligns with industry standards and technological requirements (Tijssen and Winnink, 2018). Digital MNCs can thus theoretically transfer technology and skills that contribute to technological upgrading and the building of competitive ICT industries in host countries. These channels are captured in **Figure 6.1**.

Figure 6.1 – Channels of technology spillovers in the ICT sector



Note: The thickness of the lines indicates the relative strength of each channel for technology transfer. Vertical are represented with thicker lines, reflecting their theoretically greater impact. In contrast, horizontal spillovers and university linkages are depicted with thinner lines to signal their relatively weaker or more indirect influence.

However, the existing empirical evidence on the transfer of technology through FDI is*, at best*, mixed. In their seminal study of technology spillovers in Morocco, Haddad and Harrison (1993) found that if domestic and foreign firms compete to capture the same market, the latter does not have the incentive to promote technology linkages. In some instances, foreign firms operated as enclaves with little connection to the local economy (Aitken and Harrison, 1999). Measures adopted by foreign companies to limit technology transfer include protecting their intellectual property and trade secrets, hiring mainly foreign workers, and forestalling labour turnover by offering significantly higher wages than local industry averages (Liu et al., 2009). In other instances, research showed that foreign subsidiaries did more harm than good to the local economy by capturing the domestic market and crowding out local competitors without engaging in any meaningful technology transfer (Amendolagine et al., 2013).

Recent scholarship has raised concerns that the fragmentation of production along value chains distributed across various countries makes today's backward linkages more complicated to capture domestically, compared to the 1960s and 1970s when Hirschman's ideas gained traction. As explained by Kopinski and Carmody (2022, p. 27), amid the expansion of GVCs, "backward linkages have stopped being a largely domestic phenomenon and instead gone global as it is cheaper and easier to source inputs from different localities". Moreover, the structure of global value chains enables lead firms, typically based in more developed economies, to capture the majority of productivity gains (Selwyn and Leyden, 2022). Any discussion on the developmental potential of foreign subsidiaries needs to tackle the difficult but pragmatic question of whether it is sound to expect technology transfer to occur in the first place, as corporations would naturally be expected to preserve their technological edge, which is paramount to profit making.

This being said, instances of technology spillovers are not unicorns, and the East Asian miracle is proof of this. As discussed in Chapter 2, technology transfer has often depended on a complex set of factors. Notably, well-crafted industrial policies have played a crucial role in promoting and guiding technological transfer and learning. Such policies typically include strategic negotiations between governments and foreign multinational corporations, local content requirements, coordinated acquisitions by domestic firms, support for research parks, workforce development initiatives, and the recruitment of skilled engineers from abroad (Mathews and Cho, 2000; Miller, 2022).

While the internationalisation of Chinese tech firms in developing countries has promoted local economies' catch-up efforts in terms of ICT infrastructure and internet access as shown in Chapter 5, the role played by these corporations in diffusing knowledge and technology remains unclear in the existing body of scholarly work. Agbebi's (2018, 2019) studies of Huawei's presence in Nigeria point to the existence of dynamic horizontal linkages, finding several instances of trained Huawei staff leaving the firm to join other ventures. The author also indicates "considerable backward vertical linkages with local suppliers" (Agbebi, 2019, p.201), with Huawei Nigeria counting over 500 local partners in its supply chain, many of which receive training from the Chinese tech giant. In a similar vein, Li and Cheong (2017, p. 764) argue that ZTE and Huawei contribute to technology transfer in Malaysia through partnerships established with Malaysian universities and research centres, through which the

Chinese firms have been found to provide courses for local students that led to ZTE and Huawei certifications.

A somewhat different take emerges from the more critical work of Tugendhat (2020), who finds from his fieldwork in Kenya and Nigeria that Huawei, like Ericsson, Nokia, Cisco, and other competitors, treads a fine line between training local engineers and keeping control of its intellectual property. In a subsequent publication, he argues that the Chinese tech giant offers no significant opportunity for technology transfers that could contribute to technological upgrading and stresses that the firm has a "limited impact on knowledge transfer by design" (Tugendhat, 2021, p. 19). Likewise, based on fieldwork in Tanzania, Rwehumbiza (2021) finds that while there is some evidence of local staff and suppliers' training, Huawei Tanzania does not seem to build backward linkages with local firms.

These studies provide valuable insights for understanding the developmental implications of Chinese investments in the ICT sector of developing countries. Yet, the emerging literature has tended to measure technology transfer by assessing the existence or absence of linkages. This framework conceals the idiosyncratic rules, standards, and politics conveyed in the transferred technologies and training programmes. Analysing technology spillovers requires not only observing their occurrence through vertical and horizontal linkages but also scrutinising what these linkages actually *do* on the ground. In the same way that we cannot expect high-tech firms to willingly share their cutting-edge technology with poorer countries, neither can we assume that the transfer of technology is devoid of political content and consequences. To date, however, there is still a need for a more effective theorisation of technology transfer processes to untangle both its technical and political aspects. In this regard, the theoretical framework developed in this dissertation – which draws on heterodox development economics and technopolitics – offers valuable insights for the analysis.

Several possibilities emerge when looking at the issue of technology transfer through this lens. One possibility is that vertical and horizontal spillovers exist, as approvingly observed by Agbebi (2019, p. 201), but tech firms are building through these linkages markets for staff and subcontractors that revolve around the consumption and use of their products, processes, and standards. As technological latecomers, could it be that Chinese ICT firms are engaging more in training employees, students, and suppliers than their Western counterparts to promote their own brands? Is the technology transferred by Chinese digital firms creating a separate Sino-

centric internet among BRI countries? Before assessing the main channels of technology spillovers from Chinese ICT multinationals in Algeria and Egypt, what follows provides some remarks to understand the technical capabilities in both countries and their Absorptive capacities.

6.2 Absorptive capacity in the ICT sector in Algeria and Egypt

As two economies largely concentrated in low-value-added sectors, and suffering from sluggish growth, Algeria and Egypt need to reallocate economic activity away from less productive sectors to more productive ones that require advanced skills and technology. At the level of political rhetoric, high-ranking Algerian and Egyptian politicians have declared on multiple occasions that acquiring new knowledge, both technical and managerial, lies at the core of their respective strategies for achieving digital development. As explained in Chapter 4, pressing political-economic imperatives, particularly the need to provide jobs for ensuring political survival has turned the digital economy into a strategic tool for addressing social and political needs in the eyes of political leaders in the two countries.

Fostering a robust digital economy in Algeria and Egypt requires not only investments in ICT infrastructure but also the capacity to absorb, adapt and effectively utilise new knowledge and practices of foreign MNCs for consolidating domestic technological capabilities. While MNCs can contribute to local innovation systems, the extent of effective FDI spillovers depends largely on the absorptive capacity of local firms and organisations – that is, their ability to recognise, assimilate, and apply external knowledge (Cohen and Levinthal, 2000; Girma, 2005). It is usually proxied by the technological capabilities of domestic firms and the gap between the foreign and the domestic firms, that is measured in technology and R&D intensities of the local firms, the human capital embodied in local firms and the institutional framework (Kokko et al., 1996).

The majority of Algerian and Egyptian policymakers interviewed for this doctoral thesis were concerned with their country's capacity to gain from the presence of foreign tech MNCs. While the two countries have sought to enhance local capabilities by tapping into global knowledge networks, a few structural constraints have hindered their ability to fully leverage technological spillovers from multinationals. First, there is a technological gap between domestic and large foreign ICT MNCs. The ICT sectors in Algeria and Egypt exhibit medium levels of

technological capabilities, with wide variation in sophistication (E7, E11, E12). This spectrum spans from large, capital-intensive firms and innovative start-ups harnessing cutting-edge technologies to small and medium-sized firms that lag far behind the technological frontier. The disparity in technological sophistication can create significant barriers to the absorption of new knowledge from foreign MNCs, as less advanced firms may lack the necessary skills, infrastructure, and managerial expertise to effectively integrate and utilise these innovations (Crespo and Fontoura, 2007).

Second, although both countries have historically produced high-calibre ICT engineers, declining public funding has taken a toll on local universities. In recent years, local universities have struggled with outdated curricula, insufficient resources, and weak industry linkages, hindering the development of a highly skilled workforce capable of fostering innovation (U1, U8, U15). Finally, and as explained earlier, both countries suffer from underdeveloped R&D capacities, hampering the ability to generate homegrown innovations, and undermining local firms' potential to absorb and build upon the advanced technologies brought by foreign MNCs (U8, U18).

To capitalise on the presence of foreign firms, authorities in the two North African countries have adopted a set of policies. In Egypt, General Abdelfettah al-Sisi's successive governments since 2014 introduced measures to incentivise technological learning and boost firms' capabilities, primarily through the creation of industrial clusters, innovation hubs and building partnerships between Egyptian and foreign firms (E13, G5). The first step in this strategy was to foster the country's attractiveness to foreign capital. In 2017, the government passed an investment law that promotes inbound FDI by easing barriers to entry, offering investors more incentives, and supporting foreign multinational firms' localisation efforts (Gafi, 2017). Cairo aims to leverage its strategic location bridging three continents, and its market of over 100 million consumers to attract FDI, along with the advanced technology such investments are presumed to bring.

Concurrently, the government passed policies to promote local innovation capabilities. Egypt's R&D spending has increased from 0.4% of GDP in 2010 to 1.02% in 2022 (World Bank Data, 2025b). Yet, firms' innovation capabilities remain constrained by the absence of a robust and consistent institutional framework, as well as insufficient funding. Public and private R&D expenditure is relatively modest compared to other middle-income countries, amounting to just

half of the average for this income group (World Bank Data, 2025b). Most R&D efforts are concentrated in a few universities and research centres located in major cities (E2, C6). The authorities have promoted collaboration with international organisations and established technology parks, such as the Smart Village in Cairo, aimed at fostering collaboration between industry, academia, and government, and to ultimately strengthen the competitiveness of the country's BPO sector. This being said, interviewees highlighted that the link between industry and academia remained weak, limiting spillover effects (W5, W8, W24, W26, C1, C10).

The neoliberal policies adopted by Egypt both prior to the 2011 popular uprising and after, have generated overreliance on foreign corporations for technological acquisition. Egypt's high levels of indebtedness have further dampened ambitions to develop domestic innovation capabilities. This sentiment was echoed by a former Egyptian finance minister, who stated:

> "Given fiscal constraints, the [Egyptian] government cannot invest in higher education. It must rely on foreign universities to provide quality education and forge partnerships with leading corporations across various strategic sectors" (G5)

In this vein, the Egyptian ICT ministry has made concerted efforts to consolidate foreign partnerships to improve domestic technological capabilities in the sector. This led to initiatives like the "Digital Egypt Builders Initiative" (DEBI), which seeks to equip young Egyptians with the skills necessary to compete in the global digital economy (DEBI, 2022). Through DEBI, the government provides scholarships and partners with leading technology companies like Microsoft, IBM, Huawei and Cisco to offer training in data science, AI, and cybersecurity. Most recently, Egypt's Information Technology Industry Development Agency (ITIDA) sought to support start-up incubators and accelerators like Flat6Labs and the Technology Innovation and Entrepreneurship Centre (TIEC), which have emerged as some of the key instruments deployed to promote local innovative start-ups (TIEC, 2022). Overall, at the time of fieldwork, the technological capabilities of Egyptian firms were highly uneven. Large ICT companies spearheaded digital transformation efforts, while smaller, underfunded firms often lagged due to financial and skill constraints.

Algeria was slower than Egypt to start its digital transformation but has made important strides since the 2014 drop in oil prices with the aim to break away from the current hydrocarbon-dependent economic model toward a knowledge-based one. The leadership implemented several policies to enhance the technological intensity of firms including in the digital sector.

Unlike Egypt's ICT 2030 plan which clearly states the country's development goals in the ICT sector, Algeria does not have a coherent ICT development strategy. But it has adopted a myriad of initiatives to modernise ICT infrastructure, support tech-based entrepreneurship, and foster learning and innovation (E6). For instance, the government established tech hubs, like the Sidi Abdellah Cyber Park, to promote start-ups and attract foreign investments, particularly in software development (Arabeche, 2022). It also introduced incentives for FDI in the high-tech industry, but foreign investors' interest has been limited outside of the hydrocarbon sector (Beladi, 2023).

In light of limited foreign investment in the high-tech sector, Algerian authorities have attempted to foster domestic capabilities by investing in human capital. In the years following the 2019 popular movement, the ministry of higher education and the ministry of the knowledge economy and start-ups introduced various initiatives to develop a digitally proficient workforce, including by increasing funding for STEM programmes and establishing partnerships with foreign universities to improve technical aspects in university curriculums (Ahmaid, 2021). Additionally, new ICT-focused research centres and incubators have been established to support student-led projects in emerging technologies like AI and blockchain. But while for several years, Algeria's socialist leaning regime channelled revenues from hydrocarbon sales into modernising the country's infrastructure and promoting human capital development, dwindling hydrocarbon rents compelled the government to revise its spending approach to adopt a cost/benefit analysis in determining its expenditures. This shift was expressed during an interview with the minister of start-ups and the knowledge economy:

> "We are trying to find the right balance between interventionism and laissez-faire. We are especially trying to reproduce the experience of countries that were rentiers like us and that have succeeded in their diversification. We need to invest in the ICT sector strategically, with clear returns on investment: 1 USD invested should generate 1 USD in return. We have spent a lot for too long, without tangible returns" (G2)

Despite these renewed efforts, Algerian ICT firms surveyed during my fieldwork faced several financial and institutional constraints. Some larger enterprises and start-ups have adopted advanced technologies, as was the case for Condor Electronics cited in Chapter 4, which succeeded in manufacturing sophisticated digital components. However, the majority of small and medium-sized firms struggled with limited access to capital, outdated equipment, and a lack of technical expertise. Bureaucratic challenges, obsolete university training that failed to

keep pace with the rapidly evolving market demands, and enduring dependence on hydrocarbons have hindered the competitiveness of Algeria's ICT sector and its broader economy (E5).

In sum, while both Egypt and Algeria made substantial investments in enhancing their network infrastructure, the outcomes of their efforts to strengthen technological capabilities have been mixed. As middle-income countries with relatively well-educated workforces and established industrial sectors, they demonstrate a reasonable level of absorptive capacity, allowing them to benefit from the presence of global tech giants more effectively than poorer economies. In addition to fostering linkages with the local economy through infrastructure development, ICT equipment manufacturers such as Ericsson, Nokia, Huawei, and ZTE have traditionally invested in capacity-building programmes, vocational training initiatives, and partnerships with local firms, which are expected to facilitate technology transfer. The following section empirically examines the role of these firms in generating technology spillovers and contributing to domestic capabilities in the two North African economies.

6.3 Findings: Mixed evidence on spillovers from digital firms

This section identifies and assesses the intensity and grounded effects of three core types of linkages: horizontal linkages, vertical linkages and linkages with universities and research institutes as shown in **Figure 6.1**. While Huawei and ZTE have localised activities that appear to support development and could potentially generate significant linkages, the two Chinese tech firms have provided limited opportunities for meaningful learning that could contribute to technological upgrading. The technologies introduced by these companies – ranging from software codes to the hardware used in network infrastructure – along with the training offered to local employees, suppliers, and students, are restructuring the ICT ecosystems. This restructuring is occurring in a manner that makes the use of Chinese firms' products, processes, and standards almost unavoidable, embedding them deeply within local markets.

In doing so, Chinese ICT giants, whether intentionally or not, are promoting a distinct technopolitical regime that risks creating new forms of dependency for local ICT stakeholders, reminiscent of the dependence historically linked to Western powers. Nevertheless, as latecomer firms to global technology markets, Chinese ICT companies, particularly Huawei, have made considerable investments in capacity-building initiatives to capture new markets.

These initiatives could in the long run increase interest in ICTs among local actors, providing exposure to technologies, processes, and standards that are becoming increasingly central to the global digital economy.

6.3.1 Horizontal linkages

As trained workers and managers at multinationals move to domestic firms or start their own businesses, knowledge may be disseminated from MNCs to other firms within the same industry (Kneller and Pisu, 2007; Iršová and Havranek, 2013). Due to growing labour costs in China, ZTE and Huawei have in recent years localised a bigger share of their labour in North Africa. Huawei employs an estimated 1,000 workers in Egypt, counting both in-house and outsourced contracts and about half as many in Algeria, with about 70 per cent of the staff made up of local employees and the remaining 30 per cent consisting of Chinese and other foreign engineers. ZTE Algeria counts about 200 employees in-house, 70 per cent of whom are locals and 500 outsourced workers, most of whom are local Algerians (W6).[21]

Local engineers and managers at the two Chinese firms, both on in-house and leased contracts, reported going through training programmes when they were first hired. The training covered technical and soft skills and continued throughout their employment period, with mandatory tests undertaken at different stages of their careers. International OEMs also send their local employees abroad for further training. A key motive driving many young engineers to work with Chinese MNCs, and Huawei in particular, is the learning opportunities provided by the companies (W1, W3, W4, W19, W23, W24, W26). When asked to attribute a grade from 1 to 5 assessing the quality of the training received by the Chinese tech firms, with 1 indicating low levels of satisfaction and 5 indicating high levels of satisfaction, respondents converged towards a grade of 4. These responses differ from the results of a 2019 survey, in which African workers viewed Chinese firms' training efforts as underwhelming (Oya, 2019). One possible explanation accounting for this divergence could be the nature of the ICT industry, a knowledge-intensive sector in which training staff is paramount for firms' operations and profits (Te Velde, 2002).

[21] The exact number of employees at ZTE Egypt remains unknown. A senior ZTE manager refused to divulge the number of employees in the Egyptian subsidiary, stating that the information was confidential (W12).

The distribution of local managers followed a pyramidal structure in both countries, with local employees well represented at the bottom of the pyramid and Chinese nationals dominating top managerial positions. Similarly to other studies (Auffray and Fu, 2015; Oya and Schaefer, 2019), my research findings suggest the existence of a glass ceiling for local employees. At the time fieldwork was conducted, acting CEOs of Huawei and ZTE in Egypt and Algeria were Chinese nationals, while CEOs of Ericsson, Cisco and Nokia were host country nationals.

When questioned about the lack of locals in top-managerial positions, Chinese managers explained that Chinese nationals were more familiar with the firm's work culture, ethos, and processes, giving them an edge in operating projects effectively and in short timeframes (W16). As labour costs rise in China, fieldwork findings indicate that Chinese ICT firms are localising a growing proportion of mid-level managers, and increasingly more top-level managers. This aligns with other studies showing that Chinese firms operating in Africa and across the global south are increasingly localising their workforce, including in managerial roles (Kernen and Lam, 2014; Tang, 2016b; Oya and Schaefer, 2019).

In the two countries, fieldwork suggests limited horizontal spillovers. While, as highlighted by Agbebi (2019, 200), the ICT sector experiences high turnover rates, with labour mobility largely occurring between foreign multinationals operating in the country rather than towards local firms. Similar to Tugendhat (2021), I found that employees of Algerian and Egyptian OEMs were more likely to transition between companies such as Huawei, Nokia, ZTE, Ericsson, and Cisco, among others (W4, W10, W12, C2, C4, C7). About 80 per cent of local workers and managers at Huawei and ZTE responded that they would leave the company for another foreign competitor or to go work abroad. The high salaries offered by international OEMs created a disincentive for local engineers to join local firms or set up their own ventures and constrained the capacity of most local companies to poach talent working for multinationals. This finding is in line with studies that show that MNCs use high wages as a mechanism for labour (and knowledge) retention (Aitken et al., 1996; Liu et al., 2009; Calabrese and Tang, 2020). Most of the younger respondents at Chinese and non-Chinese tech multinationals said that they would go abroad if they were to take up another job. Policymakers in both countries expressed concerns about the high rate of locally trained ICT engineers who were poached by big tech firms in Europe and the US (G1, G2, G4).

There were few instances of horizontal spillovers, that is respondents indicating that they have left previous jobs in ICT OEMs to join local firms in the same sector or launch their own firms. In the few cases observed, two key factors explain labour turnover towards national companies. First, Algerian and Egyptian employees at foreign ICT multinationals leaving to take up higher managerial responsibilities in large national telecommunication firms such as Mobilis in Algeria and Etisalet in Egypt. Some of the surveyed subcontractors operating in ICT sector stated that they launched their ventures after years of employment at foreign OEMs, including Huawei and ZTE. Managers of these firms reported taking with them useful Chinese work culture and management ethos that helped them better operate their businesses (S1). Second, local employees and managers would leave foreign firms to join smaller local companies and organisations, seeking relief from the demanding workload of international OEMs, particularly Chinese ones, known for their long working hours.

Thus, despite the limited labour mobility towards domestic firms, findings indicate that these rare instances still present some opportunities for managerial knowledge spillovers. Managerial knowledge has been relatively overlooked in discussions of knowledge spillovers from foreign MNCS. Yet changes in management practices, such as organisational structures, decision-making processes, strategy implementation, and human resource management, can have a profound impact on firms' competitiveness (Fu, 2011). Lall and Narula (2004) discussed how managerial knowledge spillovers contribute to the broader development of human capital in host countries. By exposing local employees to international standards and modern managerial techniques, Huawei and ZTE can indirectly foster a more skilled and capable workforce, further enhancing productivity at firm and industry level.

Moreover, beyond the transfer of managerial skills, spillovers can also facilitate the diffusion of distinct work ethics. In *The Spectre of Global China*, Lee characterises the *Chinese work ethos* as a unique blend of socialist discipline, market-oriented pragmatism, and state-driven developmentalism, shaping how Chinese firms interact with workers in Africa and beyond. At the core of this ethos is a strong emphasis on discipline, hard work, and high productivity, encapsulated in the Chinese expression *"eating bitterness" (*吃苦*, chī kǔ)* (Lee, 2018, p. 95). Lee explains that Chinese managers and workers regard *eating bitterness* as a virtue, embedded in a nationalist teleology that values effort and sacrifice for collective progress.

The limited time frame of this research project does not allow for a long-term assessment of the effect of emerging managerial knowledge spillovers. Important points to consider in assessing the extent of these spillovers is the knowledge gap between Chinese ICT MNCs and Algerian and Egyptian firms and the appropriateness of Chinese management practices for the local context. The shorter experience of ZTE and Huawei in international markets compared to Cisco, Ericson and other competitors means that the management system of Chinese ICT MNCs is likely to be less mature than the one of Western MNCs. This could, as explained by Fu and Auffray (2015, p. 289), impact managerial knowledge spillovers in two ways, either positively (management practices could be easier to identify and reproduce) or, negatively (the amount of managerial knowledge available could simply be insignificant for domestic firms). Importantly, managerial knowledge spillovers entail a significant share of tacit knowledge, which implies that good personal interactions are crucial to promote this type of spillovers. It is possible that cross-cultural differences between China and the two North African countries may impede managerial knowledge spillovers.

In summary, fieldwork in Algeria and Egypt identified only limited instances of horizontal labour turnover, largely due to the high salaries offered by multinational ICT firms, which discourage engineers and managers from moving to local companies. However, despite these constraints, the findings indicate some evidence of managerial knowledge spillovers. The growing localisation of employees and managers within Chinese ICT firms, driven by increasing labour costs in China, create opportunities for the transfer of managerial expertise, which, over time, could contribute to productivity gains.

6.3.2 Vertical linkages

Technology transfer occurs via backward linkages from foreign firms to local suppliers and forward linkages from foreign firms to local buyers (Javorcik, 2004; Liu et al., 2009). In Algeria and Egypt, foreign companies undertake the biggest ICT infrastructure contracts. In doing so, they often rely on local subcontractors – to install fibre optic cables, towers, and other infrastructure across various regions of the country and suppliers – who provide subsidiary equipment, components, administrative and management services, technical assistance and expertise, logistics, etc. This creates potential for backward linkages, alongside potential forward linkages to the customers who use this ICT infrastructure.

Fieldwork findings in Algeria and Egypt suggest this potential was realised, with the existence of both backward and forward linkages. For instance, interviewed suppliers, subcontractors and customers indicated that Huawei and ZTE provided them with training similarly to other foreign ICT OEMs (S1-S11). The training covered a few different areas, including the operation of machinery and equipment, technical training on the technologies used, and health and safety measures. Local subcontractors, suppliers and customers also reported having well-established and long-term relations with the two Chinese tech firms and highlighted no notable differences between foreign companies. The length and intensity of the business relationship are important for technology spillovers because frequent and lasting links create greater training and supervision opportunities and pressure the supplier or subcontractor to learn and upgrade to preserve the business relationship (Auffry and Fu 2015, p. 293). However, there is a need to look beyond the quantum of linkages to scrutinise their actual content and deeper effects. I will here analyse two cases: Huawei's mobile phone factory in Algeria and the provision of digital infrastructure by ZTE and Huawei in the two countries.

The case of Huawei's phone factory in Algiers, one of the flagship Chinese investment projects in the country, illustrates how even linkage-intensive activities like manufacturing can be scarce in technology spillovers opportunities. The factory opened in the Algiers neighbourhood of Oued Smar in 2019 after lengthy negotiations between the Algerian government and mobile phone manufacturers for the localisation of production, following the rapid decline in the country's foreign reserves due to dwindling oil prices. The manufacturing plant was the first of its sort in Africa and one of the few outside of China and was set up as a joint venture between Huawei and Algerian firm AFGO-Tech (Agence Ecofin, 2019b). The plant has a monthly production capacity of 15,000 smartphones and started operating with about 40 workers, among which 18 local engineers were sent to China to observe Huawei's factories and learn about production processes. Later the factory expanded to 140 workers as extra production lines were added (W7). Commenting on Huawei's manufacturing endeavours in Algeria, one of the Chinese firm's representatives stated that: "The Oued Smar plant is equipped with the latest generation equipment and uses the most innovative technologies and all of Huawei's know-how" (Djazairess, 2019).

This rhetoric tied to developmental imaginaries of seamless spillovers and unhindered knowledge flows tells us little about how mechanisms of technology transfer operate on the ground. A closer examination of the factory's embeddedness in local production networks

raises concerns about its rate of technological integration. Strong backward linkages would involve important supply inputs from local firms, a mechanism that would help upgrade local suppliers' technical and managerial capabilities (Javorcik, 2004; Rojec and Knell, 2017). Yet, Huawei's phone production relied on imported SKD (Semi Knocked Down) and CKD (Completely Knocked Down) kits, which are built in China and then exported to Algeria for the final stages of assembly. According to an Algerian line manager working at the factory:

> "In the beginning we were just producing 15 to 100 phones per day, then we increased production to 2800 per day with two assembly lines. Though, every component of the phone was imported from China. Even the phones' boxes and the tape used to close the boxes were purchased directly from China" (W7)

Local suppliers consisted of Algerian firms turned into import companies focussing on the purchase of Chinese electronic and non-electronic components. Forward linkages, in this case, consisted of phone distribution and retail companies aimed at boosting the sales of Huawei devices. While manufacturing activities are assumed to generate considerable spillovers, the nature of the emerging linkages around Huawei's factory resulted in flooding the market with Chinese artefacts without much technology transfer. When asked about the reasons behind the factory's low rate of local integration, a manager at Huawei Device explained that the firm had the plan to increase local integration to 40 per cent by localising the supply of the phone's batteries and chargers, but that they had challenges finding suitable firms and start-ups to partner with (W11). Low levels of local supply seem to be a pattern in Chinese investments in Africa, with other research indicating that Chinese investors tended to prefer having Chinese suppliers along the value chain rather than sourcing locally citing supply chain reliability and familiar supplier relationships (Tang, 2021; Rwehumbiza, 2021). In some cases, Chinese firms have breached agreements on local content, in the building of Kenya's Standard Guage Railway, for example, arguing that local suppliers are insufficiently reliable to source from (Kopinski and Carmody, 2022). However, it is worth noting that local sourcing rates among Western firms are not substantially higher. Although fine-grained comparative data remains limited, procurement strategies – whether Chinese or non-Chinese – tend to be shaped by sector-specific requirements, national procurement regulations, and cost considerations (Gereffi et al., 2005). In Algeria, the government ultimately labelled the assembly practices adopted by manufacturers headquartered in various parts of the world as "fictitious production" and "disguised import". In January 2021, the factory's activities were suspended following a

government ban on the import of CKD and SKD kits, and workers were laid off for an indefinite period (W7).

The picture is similar when analysing spillovers emanating from digital infrastructure building, Huawei and ZTE's core activity. Effective forward linkages, in this case, would involve the transfer of knowledge to enable customers (e.g., mobile operators) to learn how to use the technologies and to operate them independently, ultimately allowing technological appropriation and customisation. While contracts between mobile carriers and foreign ICT equipment producers in Algeria and Egypt include clauses stating that the equipment's seller transfers know-how on how to operate and maintain the equipment, local engineers working for Huawei and ZTE highlighted that they *intentionally* provided minimal levels of details to customers. As explained by a ZTE engineer in the Algiers office:

> "We probably give our customers just about 50 or 60 per cent of information. ZTE wants to keep control over its technology and sustain the customers' need for its maintenance services" (W10)

Customers of Chinese ICT equipment highlighted that the user guide accompanying the purchased technologies would often come in Mandarin only to constrain the extent of knowledge diffusion. Likewise, effective backward linkages promoting technology transfer would entail significant local provision of infrastructure components, training, and involvement in equipment installation. But, as with the phone factory, fieldwork interviews and observations indicated that the bulk of components used in digital infrastructure built by Chinese OEMs were imported from China. This practice was also observed among non-Chinese OEMs. Unlike Auffray and Fu (2015), who find that the weak absorptive capacity of Ghanian firms plays a major role in hindering knowledge transfer from Chinese firms, Egyptian and Algerian subcontracting firms responded that the training received by Chinese OEMs fell short of meeting their perceived absorptive capacity. The lion's share of training focused on health and safety procedures, while the more technical content entailed learning how to install, maintain and troubleshoot the equipment of specific ICT equipment manufacturers (S3, S4, S5, S11). In this sense, training provided by Chinese tech MNCs could not be the basis for effective local appropriation or of movement up the value chain. Instead, it primarily serves as socio- technical links creating ecosystems of identifiable local firms that support value retention by the Chinese firms.

Chinese technology companies are emerging as important infrastructure agents with the power to shape digital ecosystems and keep a tight rein over their maintenance, undermining other actors in the process. Local ICT firms reported being marginalised from public infrastructural bids and highlighted that even when they had the technical capacity to conduct the work (e.g., providing and installing data centres, fibre optic cables, antennas, etc.), governments would issue public bids with such high requirements that only large foreign ICT OEMs could bid. These OEMs would win large, attractive contracts and then subcontract only limited parts of them to local firms, keeping most of the value (S1, S7, S11).

With developing countries like Algeria and Egypt showing an appetite for digital infrastructure provided by Huawei and ZTE, these companies are increasingly defining the conditions under which countries transition towards digital economies. The rapid construction of digital infrastructure without concurrently establishing meaningful backward and forward linkages with the local economy raises serious concerns about a new kind of technological dependency. While Chinese tech firms are helping developing countries catch up in terms of infrastructure for digital connectivity, they may be concurrently capturing lucrative markets, excluding potential local competitors, and consolidating dominant positions.

6.3.3 Linkages with universities

If there is limited evidence of vertical and horizontal linkages emanating from Huawei and ZTE in Egypt and Algeria that are leading to technological upgrading, what about the emerging linkages between these two firms and local universities? University-FDI linkages can support the cross-fertilisation of ideas and develop the national innovation base by embedding the existing R&D activity of MNC subsidiaries (Heidenreich, 2012; Guimon et al. 2018). Through partnerships with universities, foreign firms can provide training, internships, and certifications to local students, exposing them to cutting-edge technologies and helping them improve their technical and managerial capabilities to match industry practices (Vaaland and Ishengoma 2016).

Whereas ZTE maintains some partnerships with educational and research institutions in the region, no foreign OEM matches Huawei's level of university engagement. Huawei has

implemented significantly more capacity-building programmes than the partially state-owned ZTE. This divergence can seem puzzling given that state-owned firms, as Lee (2018) shows in her comparative analysis of Chinese investments in Zambia, state-owned firms often operates according to a broader logic of accumulation that extends beyond profit maximisation to encompass diplomatic and political objectives. As such, one might have expected ZTE to engage more heavily in visible capacity-building initiatives that could serve China's soft power ambitions and strengthen bilateral relationships. Yet the opposite pattern emerges; it is the ostensibly private Huawei that has made training centres and educational partnerships integral to its localisation strategy in North Africa and elsewhere in the Global South. By 2024, Huawei had established over 200 ICT academies across the African continent, trained more than 15,000 students, and certified thousands of engineers in its proprietary systems (El Kadi, 2022). Huawei certifications cover several themes like 5G, cloud, artificial intelligence, big data, switches, and routers. Trainees are selected on a competitive basis from a dozen Egyptian universities, such as Port Said University and the University of Suez, among others. Interviewed Egyptian graduates from Huawei's ICT academy who received the training stated that it covered high-quality technical and theoretical content that would facilitate their job hunt after graduating (U9, U10, U11). In contrast, ZTE's training footprint remains considerably smaller, with fewer dedicated academies and more ad-hoc training arrangements This asymmetry is particularly evident in Egypt and Algeria, where Huawei's ICT Talent Bank and Seeds for the Future programmes have achieved substantial visibility and government endorsement.

That said, Huawei's more extensive capacity-building initiatives do not necessarily equate to more meaningful technology transfer. University-industry linkages are often perceived to be beneficial *per se*, yet shifting to a technopolitics framework, these training initiatives appear less as benevolent capacity-building endeavours than as politically charged artefacts embodying power and creating winners and losers on the way. Traditionally, the ICT OEM enterprise subsector has been dominated by Cisco certifications, the Cisco Certified Network Associate (CCNA), Cisco Certified Network Professional (CCNP), and Cisco Certified Internetwork Expert (CCIE), which have long been the gold standard taught in university curriculums worldwide. As a technological latecomer, Huawei has been actively trying to reverse Cisco's hegemony through its ICT academies by establishing a parallel certification ecosystem that operates according to distinctly Chinese technical standards and protocols.

The differences between Cisco and Huawei certifications extend beyond mere branding. While both systems train engineers in similar competencies – network configuration, routing protocols, security implementations – they do so through proprietary command-line interfaces, configuration syntax, and troubleshooting methodologies specific to each manufacturer's equipment. For instance, configuring a router using Huawei's Versatile Routing Platform (VRP) operating system requires learning command structures and protocols that differ from Cisco's IOS (Internetwork Operating System), even when accomplishing similar technical objectives. An engineer certified in HCIA learns to configure networks using Huawei-specific protocols and interface commands that are incompatible with Cisco equipment, and vice versa. This means that students trained in Huawei systems become proficient in a distinct technological ecosystem – one that embodies Chinese approaches to network architecture, security implementations, and data management –rather than acquiring transferable, vendor-neutral skills.

The Shenzhen-headquartered firm created several incentives to raise the rate of students certified in Huawei technologies, one of which consisted of gifting costly technological equipment to universities that succeed in achieving a significant number of Huawei-certified students per year (U1, U9). Another strategy to promote the number of ICT engineers certified in Huawei technologies entailed providing significant discounts on the certification fees, which tend to be paid directly by students. These certifications can cost between 200 and 600 USD for Cisco certifications (CCNA to CCIE) and 100 to 500 USD for equivalent Huawei certifications (HCIA to HCIE) (U3, U4, U9). During the COVID-19 pandemic, Huawei made all its certifications free, while Cisco only introduced a 50 per cent discount. With free certifications, many interviewed students in Algeria and Egypt opted for Huawei certifications instead of Cisco's. The director of an ICT department in Algeria explained that OEM certifications are not mandatory in the curriculum but that they are highly recommended electives that make graduates more employable. She highlighted the tense competition between big ICT manufacturers on campus and noted that Algerian curriculums avoid training students on a unique system to avoid creating dependencies (U1, U2). Nonetheless, the fee waivers provided by Huawei to students, along with the free training in its ICT academies, made it an easy choice for university students.

In the race to dominate the ICT enterprise business, Huawei has reached out to local channel partners that are already Cisco qualified and financed their conversion to become Huawei

partners (S5, S11, S15). Due to the interrelated and interlocking nature of technological regimes, as more engineers train to install, maintain, and troubleshoot Huawei technologies, and as more channel partners sell Huawei products, government departments, mobile carriers, and local companies may all increasingly decide to buy Huawei equipment.

The experience of a final year student in ICT engineering sums up this evolution well:

> "During my first year's internship at a large Algerian state-owned company, there was equipment from different vendors. But during my final year's internship at the same firm, I realised that most of the equipment had changed to become Huawei's" (U7)

By providing subsidised or free training, MNCs create a workforce that is skilled in the use of their proprietary systems and technologies. This strategy encourages the use and consumption of the corporation's products, thus increasing market share and ensuring long-term presence. As students and engineers become proficient in Huawei's tools, they are more likely to advocate for and implement these technologies in future professional settings, leading to a form of market entrenchment. Chinese firms have thus adjusted national visions for the development of the ICT industry while mapping out and structuring digital communities revolving around the consumption of their artefacts and standards. This finding corroborates Tugendhat (2021), who finds that Huawei's training centres in Kenya and Nigeria serve to establish a network of trained technicians, distributors, and salespeople qualified in Huawei technologies.

In the context of the technological competition between the United States and China, micro level ramifications in training students and suppliers may be diffusing new technological standards and reshaping digital geographies at the micro-level. Training initiatives can serve as a means of setting industry standards, which further consolidates a company's influence within the sector. This approach has been particularly prominent among US tech giants like Microsoft, Google, and Cisco which offer extensive certifications and training to ensure that their software and hardware products become industry norms, thereby limiting competition and enhancing their competitive advantage (E7, C10). Huawei and ZTE have arguably been adopting similar practices to expand their global presence and secure greater market shares, while diffusing a distinct technopolitical regime centred around Chinese technologies and standards.

Yet, in their strategy to adopt capacity-building initiatives to respond to the demands of developing countries and penetrate markets traditionally dominated by Western firms, Chinese ICT multinationals may be creating prospects for skills transfers. Firms such as Huawei are keenly aware of their status as relative newcomers to the global market and, as such, are compelled to invest more heavily in branding, education, and capacity- building initiatives, outcompeting Western firms in training and scholarship programmes. A hallmark in Huawei's training efforts is its "Seeds for the Future" programme, which is designed to cultivate interest in ICT among university students worldwide[22]. The programme encourages students to engage in competitions related to ICT, exposing them to cutting-edge technologies and industry standards. If this initiative primarily aims to ensure that Huawei is developing a pipeline of future ICT talents, skilled in its technologies and standards for its own competitive edge, it also exposes local students, workers, managers, and suppliers to the global technological frontier.

As explained above, fieldwork findings show that Huawei and ZTE, like their Western competitors, do not transfer cutting-edge technology or critical skills that might enable the emergence of domestic competitors. Though, their dynamic presence in host economies may nonetheless stimulate greater interest in ICTs, foster competition, and contribute in turn to capacity building in the sector. Most notably, the training programmes provided by these firms expose local stakeholders to what are increasingly becoming key technological standards in a strategic sector of the global economy. Assuming that the technological war between China and the US does not result in a bifurcated digital space, learning and adhering to Chinese developed components and standards can help ensure that local firms and workers in developing countries integrate more seamlessly into the global digital economy. As Chinese technologies become more dominant, particularly in fields like 5G, AI, and telecommunications infrastructure, mastering these standards can position domestic firms to become suppliers in GVCs, increasingly shaped and designed by the Asian giant, enhancing their capacity for learning and upgrading in the long run.

This chapter's findings illustrate the analytical power of integrating heterodox development economics with technopolitics to examine technology transfers in the digital sector. Where conventional approaches would simply count the number of linkages or measure their

[22]Huawei, Seeds for the Future initiative : https://www.huawei.com/minisite/seeds-for-the-future/index.html

existence, this framework reveals how seemingly developmental activities, training programmes, supplier relationships, university partnerships, simultaneously function as mechanisms for embedding specific technopolitical regimes. The heterodox lens allows us to trace spillover channels and assess their potential contribution to structural transformation, while technopolitics exposes the embedded norms, protocols, and dependencies these linkages carry. This combined perspective shows that the question is not merely *whether* Chinese ICT firms transfer technology, but *what kind* of technology transfer occurs and *whose knowledge, protocols and certifications* become institutionalised through these processes. By examining how training in Huawei systems creates ecosystems of certified engineers, how supplier relationships revolve around Chinese components, and how these micro-level processes connect to macro-level competition between competing techno-political regimes, this framework captures dynamics that would remain invisible in either purely economic or purely geopolitical analyse.

Another important finding worth reporting here relates to the role of the Chinese state in the localisation of Chinese ICT firms and their contribution to technology transfers. Fieldwork evidence indicated that the presence of Huawei and ZTE, including their engagement in knowledge transfer initiatives, is shaped by a much wider variety of Chinese and non-Chinese economic and political forces. Although the Chinese state has supported the presence of Chinese tech firms via access to preferential loans (Shen, 2018), the need to meet commercial imperatives was guiding firms much more strongly than Chinese state political priorities. In terms of policy, Algerian and Egyptian government ICT agendas were more important in shaping Huawei and ZTE strategies to capture markets and increase profits. This finding goes largely against dominant accounts which tend to assume that the Chinese state holds a tight rein over its tech champions, which in turn strictly align with large policy plans such as the DSR (Hilman, 2021; Chen, 2021).

6.4 Conclusion

After demonstrating in Chapter 5 that BRI membership expands digital connectivity – albeit with some risks of technological system dependency – this chapter has addressed the thesis's second sub-question: whether Chinese ICT multinationals are generating new opportunities for technology transfer, learning, and innovation. Accordingly, this chapter assessed three different types of linkages: horizontal linkages, vertical linkages, and

linkages with local universities.

The chapter finds that despite localising seemingly developmental activities that can produce considerable linkages, the two Chinese tech firms created limited learning opportunities that could effectively contribute to technological upgrading. Instead, the technologies disseminated by Chinese digital corporations, from codes to the hardware making up network infrastructures, as well as the know-how embedded in training programmes provided to local employees, suppliers, and students, are reconfiguring ICT ecosystems in ways that render the use of Chinese firms' products, processes, and standards ubiquitous. In this sense, Chinese ICT giants are diffusing, both intentionally and non-intentionally, a distinct technopolitical regime that risks locking local ICT actors into new dependencies that resemble those with Western powers. Without effective learning opportunities that could lead to technology and skill transfers and ultimately usher in structural transformation, the globalisation of Chinese ICT corporations may only strengthen the global position of Chinese tech multinationals while exacerbating cross-country inequalities.

The comparison between tech firms headquartered in different countries reveals that keeping a tight rein over intellectual property is by no means an exclusively Chinese practice. In Algeria and Egypt, both Chinese and non-Chinese firms are found to limit knowledge transfer *by design* to protect their technological edge. Nonetheless, as labour costs continue to rise in China, fieldwork findings indicate that Chinese ICT firms are increasingly appointing local talent to mid-level managerial roles and, to a lesser degree, top executive positions. This trend suggests a growing diffusion of managerial expertise which can play a crucial role in strengthening these firms' competitive edge in the long run. At the same time, as latecomer firms from a rising global power, Chinese ICT corporations – most notably Huawei – have invested significant resources in capacity-building initiatives aimed at penetrating markets traditionally dominated by US and European firms. These initiatives have the potential to stimulate greater engagement with ICTs and enhance local stakeholders' familiarity with the technologies, processes, and standards that are increasingly shaping the global digital economy. In turn, this exposure can facilitate learning and drive innovation within the ICT sectors of host countries.

While Chinese ICT firms may introduce new technologies, protocols, and operational models, the extent to which these are embraced by host economies will vary depending on existing institutional frameworks, political and geopolitical preferences and domestic interests and digital visions. Examining the Soviet union's transfer of nuclear technology to Easter Europe during the Cold War using the concept of technopolitical regimes, Schmid (2011) argues that the Soviets sought to impose control through technical designs and management structures but ultimately failed due to pre-existing technical and organisational differences across states and shifting dynamics of cooperation. Early diffusion of Soviet nuclear technology was facilitated by its portrayal as politically neutral, but this effort was eventually undermined by growing local resistance (Schmid, 2011). In the case of Chinese digital firms, a key determinant in the extent of technological dependence would be the scope and effectiveness of the host country's industrial policies. Governments play a critical role in shaping the regulatory and policy environment, including decisions about which technologies to prioritise, what infrastructure to support, and how to balance foreign influence with domestic interests. China's ability to implement ambitious industrial policies, as discussed in Chapter 4, is underpinned by its vast market size and strong state capacity. Most developing countries are unable to reproduce the so-called Chinese economic miracle. Yet, this does not mean that smaller states, or those with less institutional capacity, should give up. What matters is not replicating China's model wholesale but identifying context-appropriate strategies that leverage existing capabilities while incrementally building new ones.

It is important to note that this study's findings are limited by the scope of the research and the fieldwork undertaken. This chapter has focused on specific types of knowledge spillovers and may have marginalised more tacit and informal channels of transmission, such as the interpersonal relationships between Chinese and local workers and managers. Another important limitation has to do with the restricted access to private tech MNCs (both Chinese and non-Chinese), which made it challenging to collect more high-level management data and systematically compare practices across firms. Moreover, one should consider the time- sensitive nature of knowledge spillovers. Technology transfers, especially those involving complex processes and advanced technologies, often require time before they manifest in tangible outcomes. The absorption of new knowledge, the development of local expertise, and the integration of cutting-edge technologies into local practices are gradual processes that can take decades to fully materialise. This extended timeline presents a challenge for PhD research, which is inherently limited by time and

resource constraints.

By highlighting the salience of power in technology transfer and connecting micro-processes with broader geopolitical struggles over technological hegemony, this chapter enables us to get a better understanding of Chinese development impact on host economies. The findings presented here provide further evidence that on-the-ground field-based research is critical for grasping the complex dynamics shaping the globalisation of Chinese digital capital (Li and Cheong, 2017; Agbebi, 2018, 2019; Gagliardone, 2019; Erie and Streinz, 2021; Tugendhat, 200, 2021). This chapter, and broader dissertation, further contribute to responding to the call made by Oakes (2021) to employ technopolitics to rethink the passive role assigned to infrastructures in a narrative that is primarily driven by geopolitical discourses and rather adopt an approach of the political as an effect of socio-technical configurations. The focus on the material aspect of technologies enables us to closely examine the unique characteristics of digital MNCs and the socio-technical linkages they diffuse. In this vein, technology transfers in the digital sphere should not be perceived as a one-way stream, from foreign digital MNCs to host economies, but also from host economies to MNCs through the collection, storage and processing of digital data. Drawing on this project's extensive fieldwork, the following chapter zooms in on the crucial question of how Chinese-built digital projects are reshaping the global distribution of data ownership and how these infrastructural endeavours on the ground are redrawing emerging data governance frameworks.

CHAPTER 7

Reproducing Beijing's Data Governance Regime? Data Localisation and Infrastructural Control

In 2017, an Economist article asserted that "the world's most valuable resource is no longer oil, but data" (The Economist, 2017). While economic value has historically been closely associated with the transformation of raw materials into goods and services, in the digital age, a key trend driving value creation is the monetisation of the rapidly expanding volume of data (Panday and Malcolm, 2018; Mazzucato, 2019). Digital data refers to the vast amount of information generated and stored in digital formats, including text, images, videos, audio files, social media interactions, online transactions, and much more. As people, businesses, organisations, and governments use the internet and connected devices they generate data, which in turn becomes a critical asset for those who hold control over it.

Control over data conveys considerable economic, social and political power. Conversely, unequal control over it is increasingly understood as a ubiquitous form of digital inequality and a key challenge for economic development, national sovereignty, and collective self-determination (Mann, 2018; Zuboff, 2019; Cinnamon, 2020; Fischer, 2022). Chinese political leaders understood the significance of data early on. The country counts some of the world's most stringent policies for the localisation of domestic data within its territory. Article 37 of China's 2017 Cybersecurity Law introduced the principle that "Personal information and important data collected and generated by critical information infrastructure operators in the PRC must be stored domestically" (CCP, 2017). Data localisation –referring to the diverse regulations that restrict the cross-border flow of data (Burman and Sharma, 2021) – functions as a form of digital industrial policy. The idea is that by requiring data generated within a country to be stored, processed, or managed domestically, governments can exercise greater strategic control over this resource while seeking to move up digital value chains. In line with this approach, the CCP officially recognised data as a factor of production alongside land, labour, capital, and technology (CCP, 2020).

The success of the Chinese digital model in achieving the double aim of economic development and strengthened data sovereignty has inspired other developing countries. In recent years, several governments have introduced data localisation policies. As of July 2023, it was estimated that roughly 36 African governments adopted data regimes that subject data to contractual safeguards, prior authorisation, or mandatory localisation (Babalola, 2024). Countries like Egypt, South Africa, Tunisia, Algeria, Kenya, and Zimbabwe have all adopted conditional data flow regimes with the aim to advance cyber sovereignty and promote economic development (Kugler, 2021). Yet, a major challenge for developing countries in attempting to localise their data is the lack of adequate digital infrastructure such as data centres – instrumental for storing and processing data (WDR, 2021). China has emerged as a pivotal partner for BRI countries seeking to localise a larger share of their digital data within national borders. Chinese technology firms have secured significant contracts to construct data centres for governments and large state-owned enterprises across the Global South, reinforcing their role in supporting these localisation efforts (Erie and Streinz, 2021; Olander, 2022).

Data is becoming a crucial resource for businesses and economies. With Chinese tech firms constructing much of the infrastructure to host it, we must interrogate how this expansion may affect global data inequalities. This chapter examines the final set of empirical sub questions posed in this thesis: Are Chinese-built data centres transforming the global imbalance in data control, where access to and governance of digital data is largely dominated by a handful of firms based in rich countries? Additionally, are these infrastructural projects, diffusing China's data governance regime, i.e. Chinese technopolitical regime in data management? What are the implications of these emerging data governance regimes for digital development in host economies? In this regard, this chapter contributes to further answering this dissertation's central research question which asks whether the influx of Chinese digital capital to host developing countries creates new opportunities for technological upgrading and structural transformation or conversely, hinders the acquisition of technological capabilities and constrains broader economic change.

To address these questions, I investigate how digital data is collected, processed, and managed in two Huawei-built data centres located in Egypt and Algeria. In Egypt, I focus on Huawei's contract with the National Research Centre (NRC), the country's largest

research institution, while in Algeria, I examine Huawei's collaboration with Sonatrach, the state-owned energy firm.[23] Both countries have adopted data governance frameworks that emphasise data localisation to enhance digital sovereignty and promote digital development.

The chapter finds that these two North African countries have engaged in *superficial* data localisation efforts, whereby data in strategic sectors is localised within national borders but is still processed by foreign multinationals. Even though Sonatrach and the NRC took the initial step of localising their data by constructing, owning and running their own data centres, these initiatives were quickly abandoned in favour of solutions deemed to be more efficient that ultimately outsourced the management and expansion of their respective data centres to Huawei. Control over infrastructure and the data it hosts remain in the hands of the Chinese tech giant, limiting opportunities for technological learning and upgrading. While emerging data governance frameworks in Algeria and Egypt are failing to achieve their dual objectives of data sovereignty and economic development, both are still able to use the emerging data regimes to expand their surveillance capabilities and reach over their populations.

If ongoing efforts to build digital infrastructure and localise data are steps in the right direction, leveraging the full developmental power of data and ensuring data sovereignty requires not just territorial localisation but also effective control over the corporations that build, operate, and maintain the underpinning infrastructure, regardless of the corporations' country of origin. Contrary to the idealised narrative surrounding China's digital partnership with African countries, imbued with talks on digital sovereignty, Chinese firms, much like their Western counterparts, are emerging as custodians of locally generated data, carrying profound implications for the future of African knowledge economies. Ultimately, digital sovereignty without infrastructural control is – to invoke Whewell's metaphor, later deployed by Chang (2010) in development economics – "Hamlet without the Prince of Denmark"; it lacks its essence and will remain elusive without the development of endogenous technological capacities.

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[23] At the time of fieldwork, ZTE had no active presence in the provision of cloud services in either Algeria or Egypt.

This chapter draws on the fieldwork undertaken for this dissertation, which includes interviews with Huawei engineers and managers, representatives of Western ICT firms, ICT experts, researchers, representatives from international development organisations, and government officials in Algeria and Egypt. It also incorporates a comprehensive document analysis of laws regulating data flows, cybersecurity, and privacy, alongside other legislative texts shaping broader data governance frameworks. These documents, sourced in Arabic, French, and Chinese, were collected and examined in detail. Additionally, secondary sources such as media coverage, press releases, statements from technology firms and state agencies, as well as reports from Egyptian and Algerian ministries, were analysed to support the chapter's findings. Data analysis was conducted using content analysis, as outlined in Chapter 3.

Conceptually, this chapter aims to enhance our understanding of data governance by emphasising its link to physical infrastructure and highlighting the power imbalances in digital infrastructure control. Understanding how digital infrastructure shapes data governance frameworks requires moving beyond conventional analyses that treat infrastructure provision and regulatory frameworks as separate domains. Following the analytical framework outlined in Chapter 2, this chapter understands data governance as arising not only from formal legal instruments – laws, regulations, and bilateral agreements – but also from the material infrastructure that enables data storage, processing, and transfer. In this sense, infrastructure is not merely a passive conduit for implementing pre-existing governance rules; rather, it actively *shapes* governance possibilities by establishing technical parameters, embedding standards and operational protocols, determining technological stacks and future regulatory choices (Hughes, 1993; Edwards and Hecht, 2010). The analysis in this chapter shifts beyond the conventional focus on virtual digital platforms – such as websites and apps – which dominate existing discussions on data capture and inequality (Gillespie, 2018; Zuboff, 2019; Couldry and Mejias, 2019; Fisher and Streinz, 2021; Mann and Iazzolino, 2021). Instead, it examines the underlying physical infrastructure: data centres. Control over physical digital infrastructure confers the technical capacity to access, analyse, and extract insights from data, rendering infrastructure providers central to debates on data inequalities (Fischer, 2022). Viewed through this lens, the interplay between data and its infrastructural foundations becomes crucial to understanding evolving governance frameworks and their developmental implications.

The first section examines competing data governance frameworks promoted by major economies and presents the rationale for data localisation. Section 2 examines data centres as foundational infrastructure for data localisation, highlighting their economic and technological significance. Section 3 presents the findings. It begins by examining the emerging data governance frameworks in Algeria and Egypt, before zooming in on the Huawei-built data centres in each country to uncover the sinews of power embedded in digital infrastructure. Section 4 builds on these findings to explore the extent to which these centres have contributed to the diffusion of China's digital technopolitical regime in the two host countries. Section 5 concludes by summarising the findings and providing policy recommendations to avoid the reproduction and entrenchment of data inequality.

7.1 Competing data governance frameworks and value capture

7.1.1 The case for data localisation

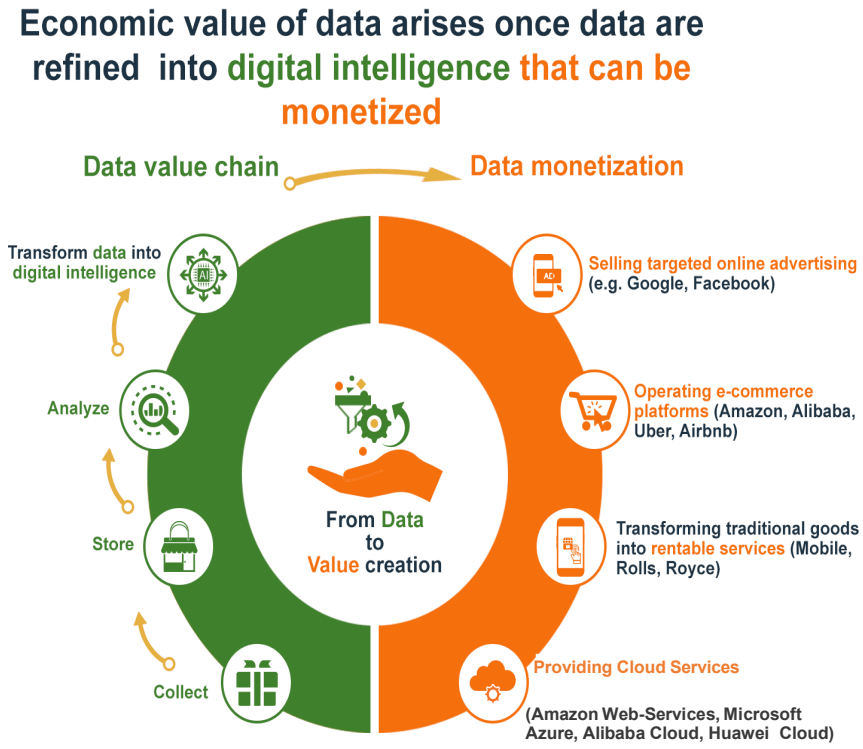
Over the past two decades, competing data governance frameworks have arisen across the world, with data localisation becoming a particularly contentious issue in trade deals and international organisations (Gurumurthy et al., 2017; Azmeh et al., 2020). In the early days of the internet, the free flow of data across borders was the default policy. This was largely the consequence of the unregulated state of the open, global network that constituted the internet (Meltzer and Lovelock, 2018). But as data traffic grew from about 100 gigabytes per day in 1992 to an estimated 150,700 gigabytes per second in 2022 (WDR, 2021), countries started to raise concerns about the free movement of data. Such concerns included national security risks associated with data storage on foreign servers, forfeiting potential economic gains from data exploitation to foreign businesses, and fear of infringement on citizens' privacy rights (Panday and Malcome, 2018; Burman and Sharma, 2021).

Countries with widely varying income levels have begun to implement data localisation policies. In response, the US, whose firms have long dominated the digital economy, has actively lobbied against measures that restrict data flows, arguing that they go against how the internet *should* work (Mansell, 2014; Azmeh et al., 2019). Based on neo-classical trade theory, the theoretical tradition mobilised to justify free data flows, the internet's borderless nature is conceptualised as having enabled the development of the digital economy and revolutionary technical innovations (Ahmed and Chander, 2015). Free data flows promote

individual rights by enabling users to engage in unrestricted information exchange, allowing ideas to flow across the world. By interrupting the global flow of data, localisation requirements reduce efficiency and the innovation potential offered by the digital economy (Chander and Le, 2014; Cory et al., 2022). Proponents of this view have warned against data localisation policies leading to the "Balkanisation" of the internet without the presumed gains (Hill, 2012; Fraser, 2016).

These approaches have tended to depoliticise discussions around data governance and have concealed some of the socio-technical practices and politics surrounding data collection and processing. Seen through the theoretical lens of this dissertation - which understands economic development as structural transformation – I seek to interrogate where data accumulates, between whom it flows, *whose* learning and innovation are being supported and ultimately who benefits (Taylor and Broeders, 2015; Mann, 2018). On a more fundamental level, if data is thought to be as valuable as oil, how can it make economic sense for it to flow freely from one country to another? In today's data-driven economy, companies see data as a lucrative asset, crucial for generating profits. Companies, especially those with leading technological advantages, use data analytics to extract valuable insights from large datasets, enabling them to map out markets, make better-informed decisions, understand customer behaviour, and adjust operations accordingly (Nield, 2017; Christl et al., 2017). With continuous advances in AI and machine learning, firms and countries that have control over vast data pools may be better positioned to reap the benefits of the so-called digital revolution (Panday and Malcolm, 2018).

Figure 7. 1 - Economic value of data



***Source**:* Adapted by the author from UNCTAD (2019, p. 24)

Policies that favour the extraction of data out of countries in order to provide a larger pool of datasets to dominant tech firms do nothing to promote the development of the societies from which the data was generated in the first place (Taylor and Broeders, 2015; Mann, 2018; Fisher and Streinz, 2021). By advocating the free flow of data, global trade laws maintain an unequal status quo, restricting states' ability to exercise control over their own data and foreclosing potential pathways towards learning and extracting value from data. US-based firms derive great commercial advantage from access to big data. In 2019, it was estimated that US platforms represented 68% of the market capitalisation value of the world's 70 largest digital platforms (UNCTAD, 2019). As such, the US has pushed for a global data governance framework that reflects its own interests. This was candidly recognised by former president Barack Obama who stated during an interview with the tech site *Re-code:*

> "We have owned the internet. Our companies have created it, expanded it, and perfected it in ways that they can't compete. And oftentimes what is portrayed as high-minded positions on issues is just designed to carve out some of their commercial interests."
>
> (Cited in Farrell, 2015)

In the face of the US dominance over the sector, countries across the globe are increasingly crafting regulatory frameworks to not only protect citizens' privacy and national security, but also to advance their domestic ICT industries (Foster and Azmeh, 2019).

Data localisation regimes vary by degrees of restrictions. These can broadly be categorised as soft and hard requirements (Chander and Le, 2014). Soft localisation requires some form of local storage. However, it can allow data to be transferred and processed outside national borders under some conditions. The European Union's General Data Protection Regulations (GDPR), adopted in 2018 fits this category. The GDPR does not ban the movement of European personal data outside the EU but only permits it to flow to states that the European Commission labels "adequate", that is states that provide similar levels of data protection as that of the EU (Hoofnagle et al., 2019). The EU's adequacy assessments of third countries' data protection regimes seek to advance its interests, most significantly by creating the incentive for other countries to model data protection laws after the GDPR in order to trade data with EU firms, in effect, expanding the GDPR's *de facto* jurisdictional reach.

In contrast, under hard localisation regimes, multiple and overlapping conditions must be met, including security standards, government approval and strict requirements on consent. China's approach to data localisation belongs to this category. The country has a number of laws governing its data flows: The Cybersecurity Law, Data Security Law (DSL), and Personal Information Protection Law (PIPL) (Creemers, 2021). A norm of "cyber sovereignty" (网络主权 - wǎngluò zhǔquán), has been embedded into national jurisdiction over the internet. It is central to China's data governance regime and shapes how Chinese citizens engage with the outside world and vice versa.

Table 7.1 - Leading Data Governance Regimes

	US	EU	China
Localisation Strategy	Free data flows[24]	Conditional data transfers - Data flow falls under restrictions.	Strict data localisation in strategic sectors.
Focus of Data strategy	Market centred. Limited set of obligations, unless related to national security.	Individual centred, privacy is paramount.	State centred. National sovereignty is paramount.
Sectors	Critical information for operational security and national defence.	All personal information.	Covers all sectors. Applies to critical information infrastructure and "important" personal information of any natural person collected or produced by public communication and information services, transport, energy, finance, or the government.

The PRC's data governance regime is primarily guided by the dual objectives of safeguarding national security and promoting economic growth. Accordingly, data generated from Chinese government communications, information systems, energy, water, transport, finance, health care and other public services must be stored and localised within China's territory (SCMP 2021). In scientific research, the Chinese government has issued a decree stating that all scientific data generated by organisations, groups and individuals in China must be submitted to government-sanctioned data centres before publication (Normile, 2018). In other sectors, companies must undergo tight security assessments and obtain necessary approvals from relevant authorities before transferring data outside of China. Crucially, beyond localising data domestically, the types of infrastructure that store and process data are also strictly regulated. China's National Security Law limits

[24] The US increasingly applies free data flow selectively, often conditional on whether countries rely on US-based ICT infrastructure or are considered strategic allies. However, these shifts do not represent a full-scale reversal of Washington's longstanding position, which has historically favoured data openness in ways that benefit its dominant technology firms. Rather, they signal a more targeted recalibration driven by geopolitical concerns.

operations and maintenance of "Critical Internet Infrastructure" to its territory as a matter of national and cyber security (Panday and Malcome, 2018, p. 514).

In sum, over the past two decades, diverging data governance regimes have emerged reflecting varying interests and priorities. The US, home to leading tech companies, has generally favoured a market-based system and promotes free data transfers. In contrast, countries and regions lagging behind have instead adopted and encouraged strategies that strengthen their control over their data The EU's data protection laws prioritise individuals' privacy rights at the core of their framework. Beijing's data governance regime strictly regulates data flows entering and leaving its territory in the name of cyber sovereignty and economic development, a model that many developing countries envy and attempt to copy.

Interestingly, the rise of Chinese tech giants has prompted a shift in the US' longstanding support for the free flow of data. In 2023, under President Biden, national security concerns surrounding TikTok led to the implementation of data localisation measures through an initiative known as *Project Texas* (Farhat, 2023). This arrangement places TikTok's US user data under the control of the US' Oracle and a newly established, government-supervised entity called US Data Security (USDS). USDS is responsible for overseeing key data governance functions – including engineering, compliance, legal, and privacy – effectively bringing TikTok's American operations under state-mediated oversight through a complex bureaucratic and technical framework. Although still unclear, the new Trump administration – which returned to power in January 2025 under the "America First" slogan – is expected to place further restrictions on cross-border data transfers. Such measures are likely to disproportionately affect countries that do not depend on US-based technology and cloud service providers (Kilic, 2025).

7.1.2 The internationalisation of China's data governance regime

China is arguably the world's most vocal advocate for data localisation, contending that this approach will enable developing countries to fare better in the global digital economy. As part of its innovation agenda, Beijing has become more proactive when it comes to shaping global digital technology standards, and governance frameworks. To do so, it has leveraged the role of its firms in building the digital infrastructure used by millions across the world (Pusceddu, 2020). To encourage BRI countries to adopt its data security standards and

practices, Beijing launched the Global Initiative on Data Security in September 2020. This initiative calls on nations to enhance their sovereignty, jurisdiction, and rights over data management (PRC, 2020).

At the Fourth United Nations World Data Forum held in April 2023 in Hangzhou, Chinese representatives did not shy away from promoting the country's data governance framework for sustainable development (Xinhua, 2023). The Chinese hosts emphasised that the country's development trajectory was enabled by the creation of a sophisticated system for collecting, analysing, and utilising data to address poverty at the national, provincial, and household levels (Mok, 2023). They argued that this approach has enabled China to identify persistent structural issues, allocate resources efficiently and monitor progress. The same representatives also stressed how the country was able to transform economic and social governance in the country through leveraging digital technologies in sectors like e-commerce, mobile payments, online education and telemedicine (Mok, 2023).

Chinese political leaders recognised early that winning the competition for AI leadership required the compilation and processing of large-scale datasets. With nearly 20% of the world's population, China boasts the largest digital market globally, providing it with a significant comparative advantage in the size of its data pools (McKinsey, 2017). The country aims to establish a "complete AI ecosystem" and has prioritised AI and quantum computing as critical components of national security (Huang and Mayer, 2023). As the leadership drives efforts to transform China into a digital great power, scholars have argued that the country's relatively limited concern for individual privacy, especially compared to the EU's GDPR, has provided Chinese firms with commercial advantages, strengthening their competitive edge and facilitating China's emergence as an AI superpower (Mazurek and Małagocka, 2019; Zeng, 2020).

A strand of the literature suggests that the globalisation of China's digital industry, accompanied by substantial investments in digital infrastructure, is likely to accelerate the adoption of China's data governance framework abroad. Erie and Streinz (2021) explain China's influence on other countries' data strategies in terms of a "Beijing effect". They theorise three mechanisms: First, China *unintentionally* diffuses its data governance model as foreign governments *willingly* mimic its approach in order to realise their own data sovereignty and rapid digital development (Erie and Streinz, 2021). Contrary to the US and,

to a lesser extent, the EU, China has refrained from using international law to export its data governance model (Gao, 2021). More often than not, leaders in developing countries, especially those with authoritarian political configurations, willingly choose to adopt the Chinese model, albeit with varying degrees of success.

Second, the "Beijing effect" manifests through the growing influence of Chinese tech firms in international digital technology standard-setting bodies. Chinese digital corporations, and Huawei in particular, have taken the lead in creating the international 5G standard, bolstered by the "Made in China 2025" initiative, which seeks to secure the nation's independence in advanced technologies (Triolo and Sherlock, 2020). Huawei has been particularly dynamic in international bodies, most notably, with its "New IP" Protocol proposed at the International Telecommunications Union (ITU) and in its attempts to steer the development of AI facial recognition standards (Hoffmann et al., 2020; Baron and Whitaker, 2021).

Finally, and most pertinent to this chapter's research questions, through the DSR, Chinese companies are supplying the infrastructure that underpins emerging data governance regimes. Unlike the EU and the US, which tend to use legal instruments to promote their data governance models abroad, China has primarily relied on the provision of cost-competitive digital infrastructure to other developing countries in order to diffuse its data governance regime, as discussed in Chapter 5. Such efforts can be seen as part of the broader objectives of the DSR, which seeks to position China's vision at the heart of a new global digital order. Through the supply of digital infrastructure to host countries along the BRI, Chinese tech firms are providing the material conditions under which these countries transition towards digitally mediated economies and societies.

The three mechanisms described by Erie and Streinz (2021) go a long way in describing how China influences other countries' digital strategies. However, there remains limited research on the concrete impact of the "Beijing Effect" on third countries, particularly in relation to the negotiations, decision-making processes, and broader implications between local actors and Chinese tech corporations (Gagliardone, 2019; Oreglia et al., 2021; Vila Seoane and Álvarez Velasco, 2024). After briefly defining the role of data centres in digital development and their contribution to more sovereign data governance models, the remainder of this chapter examines how data localisation initiatives are shaped by negotiations between Chinese tech firms and domestic actors in the distinct political

economies of Egypt and Algeria, emphasising the agency of domestic actors in these processes.

7.2 Data centres as localisation infrastructure

Data centres constitute an essential infrastructure in data localisation efforts. A data centre is a physical space within a building, or a group of buildings that contain the servers used to store the digital information produced by different types of organisations (Kant, 2009). Their interiors are filled with multiple rows of computer servers, and vast quantities of cables and switches, all of which rely on substantial amounts of electrical power. Poetically referred to by Google as the place "where the internet lives" (Google, 2025), data centres are responsible for the crucial tasks of storing, managing, processing, and distributing large amounts of data and applications needed for the operations of businesses, agencies, and institutions. Often data centres combine on-premises physical servers with virtual networks, which are known as the cloud and that support applications and workloads across pools of physical and cloud infrastructure.

Major inequalities exist in the global distribution of data centres. As of 2022, the African continent counted only 84 colocation data centres[24] in 13 countries, compared to 1257 centres in 23 Western European countries and 2163 centres in North America.[25] As it stands, most of the continent's data is stored and processed in European data centres. What would happen if Ireland or the Netherlands, the two European countries that host the largest volumes of data for many African countries, were to suddenly cut off access? Although extreme, this scenario is not far-fetched considering the vast amounts of energy data centres consume, due to their need to power servers, storage devices, and cooling systems continuously (Katal et al., 2023). If such a scenario was to occur, millions of African individuals, firms and organisations would lose their valuable data overnight. A 2020 market research study projected that revenue in the African data centre market would grow at an annual rate exceeding 12% between 2019 and 2025 (ReportLinker, 2020). By 2025, the total investment in data centre infrastructure is expected to be around USD 7 billion. Egypt, along with South Africa, Kenya, Morocco and

[24] A colocation data centre is a data centre where multiple organisations share a data centre space)
[25] Data Centre Map, available at: https://www.datacentermap.com/datacenters/

Nigeria, are driving this growth (ReportLinker, 2020). These expected growth rates will still fall short of the continent's needs if countries are to pursue greater data localisation.[26]

As infrastructure that facilitates the storage and processing of vast amounts of digitised information, data centres have the potential to stimulate economic development. First, they can generate substantial backward and forward linkages (Hirschman, 1977) and can enable a wide range of industries to function and innovate. Backward linkages include industries such as construction, utilities, and technology equipment providers (ie. cabling, wiring, routes, switchers, etc.). Data centres also boost demand for software development, incentivising firms and start-ups that develop management software, virtualisation tools, security solutions, and other software used to operate data centres. In this sense, data localisation requirements operate like local content policies, that foster the growth of domestic industries, by supporting local technology companies and related industries in the supply chain (Ferracane and González, 2024). Forward linkages include virtually all the industries and sectors that rely on data centre services to operate and grow. Downstream industries encompass a diverse range, including e-commerce, social media platforms, financial institutions, and agri-tech enterprises, each potentially benefiting from the geographic proximity of data centres.

Second, data centres create demand for a diverse range of technical and non-technical skills, encouraging investment in education and workforce development. Research suggests that their presence can promote educational initiatives, particularly in technology-related fields (Saunavaara et al., 2022; Mullin, 2023), while also bolstering the wider ICT ecosystem. Moreover, data centres provide high-quality employment opportunities for IT professionals, software developers, engineers, facility managers, and security personnel, supporting local job creation, capital accumulation, and skill development (Mullin, 2023).

Third, when data is stored locally, it removes the need for expensive international capacity and can dramatically reduce costs. Localisation also reduces latency issues as content is physically closer to the end user, with fewer hops and less congestion (Burman and Sharma, 2021). Finally, data centres can stimulate innovation in the local digital ecosystem. As infrastructure that boosts storage capacity and computational power, data centres allow more advanced analytics,

[26] This surge in digital infrastructure comes at a time when the continent continues to face severe electricity shortages. According to the Africa Data Centres Association, over 1,000 MW of additional power capacity, equating to hundreds of new generation facilities, will be required by 2030 merely to support planned data centre development.

machine learning, and AI applications, all of which can help local developers gain critical insights, make predictions, and drive innovation in areas such as healthcare, energy, finance, scientific research, and manufacturing, among others (Mavani et al., 2024).

While US data centre and cloud service providers such as Amazon's AWS, Microsoft Azure, and Google Cloud continue to dominate the global market, Chinese companies like Alibaba and Huawei are rapidly expanding their footprint in the cloud computing sector across the Global South. Huawei has notably established itself as a preferred provider of cloud services to government agencies, public institutions, and state-owned enterprises in developing countries. Beyond the price-competitiveness of its cloud services, the Shenzhen-based firm comes with access to loans as explained earlier. Furthermore, the Chinese tech firm has labelled itself, albeit informally, as the mediator that can help reproduce China's praised data governance model.

A striking example is Senegal's cooperation with China for the localisation of its government data. In 2021, President Macky Sall instructed his government to migrate all state data and platforms stored abroad to a Huawei-built data centre located in Dakar, with the aim of achieving greater data sovereignty (Journal de l'Economie, 2021). The data centre was financed through a 46 billion CFA francs (78 million USD) Chinese loan (Van der Made, 2021). Some analysts enthusiastically hailed the initiative as the first time an African country was fully replicating the Chinese data governance model by requiring all of its servers to be located within the country's borders and providing the state with full access to the information (Olander, 2022).

Yet, several countries on the African continent had already begun localising their data through strategic partnerships with Chinese technology firms. Algeria and Egypt, Beijing's closest allies in North Africa, have entered into high-level agreements with Chinese companies to develop and expand their data infrastructure. In Algeria, key ministries such as Energy, Finance, and Education signed agreements with Huawei to construct state-of-the-art data centres (El Kadi, 2022). Similarly, Egypt formalised its collaboration with Chinese ICT giants in April 2019 through a memorandum of understanding, aiming to strengthen cooperation in areas such as artificial intelligence, cloud computing, and surveillance technologies (Egypt Independent, 2019). So far, little is known about these data centres, the countries' emerging data governance frameworks and their economic implications. Are such data localisation initiatives allowing

local governments to harness the economic value of data? More fundamentally, how – if at all – does the physical infrastructure provided by Chinese tech firms, such as data centres, influence data governance frameworks in host countries?

7.3 Findings: Data localisation without infrastructural control

To answer these questions, this section explores two hallmark Huawei-built data centres in Algeria and Egypt, one supplied to a business, Algeria's Sonatrach and one to a public institution, Egypt's National Research Centre (NRC). This analysis focuses on the technical, regulatory, and political dimensions of these complex artefacts that capture, aggregate, standardise, transfer, and process data for a variety of purposes. By "technical dimensions", I refer to various components of the digital infrastructure including hardware and software, localised or decentralised storage facilities, as well as the networking and cloud computing capabilities. By "regulatory dimensions", I refer to the assemblage of laws, regulations and institutions that govern data-related activities. These include both formal and informal institutions, such as social practices or community norms that deliberately or inadvertently form part of data infrastructure and its governance. By "political dimensions", I refer to both state and corporate actors and interrogate how power bargains between both domestic and global actors shape decisions about data localisation and which entities control data infrastructures and gain from them. These three dimensions illuminate the power dynamics underlying digital infrastructure. They also highlight the connection between data and its underlying infrastructure, which is, as I argue, crucial for understanding governance frameworks and their developmental implications.

7.3.1 Algeria

Algeria's emerging data governance framework

The Algerian government has been attempting to move from being oil-powered to digitally powered. As discussed in Chapter 4, after the 2014 drop in oil prices, Bouteflika's government showed interest in promoting digital transformation as part of its broader economic development plans (Ramdani and Boudinar, 2021). Such a desire entailed improving internet connectivity but also ensuring more data sovereignty through data localisation in strategic sectors. As a country with a strong sense of nationalism rooted in its colonial, and decolonial history, data sovereignty became a central policy objective (APS, 2021b).

Successive governments in Algiers enacted laws restricting data flows. These requirements are scattered across several legislative texts including the 2018 data protection law, the e-commerce law and article 10 of the Post and Electronic Communications Regulatory Authority (ARPCE) directive on cloud computing (E5, E6). Law No. 18-07 on data protection passed in 2018, is the most comprehensive piece of legislation governing the country's data. It is largely inspired by the EU's GDPR as well as the French data protection law that preceded the GDPR (Journal Officiel Algérien, 2018). Algeria has a strong incentive to adopt a GDPR-like data framework as the EU remains Algeria's first trading partner. Complying with GDPR standards is necessary for doing business with EU-based firms. Algeria therefore aligns with Anu Bradford's "Brussels Effect" hypothesis, which posits that companies and countries gravitate towards European law even when they are not legally required to do so (Bradford, 2020).

Algeria's data law remains vague and ambiguous. Notably, article 44 of the data protection law prohibits any transfer of personal data to a foreign state when it is likely to harm public security or the country's vital interests (Journal Officiel Algérien, 2018). The law fails to provide details on what may constitute "public security" or "vital interests". Although Law No. 18-07 has officially entered into force after being published in the Official Journal in 2018. As of October 2024, firms and institutions were unable to fully execute it as the national data protection authority, which would govern data flows, has yet to be created (E5). According to interviewed experts, its creation has stalled due to the 2019 popular uprising that toppled former president Bouteflika and led to the dissolution of several institutions including parliament (E2, E5). As it stands, the country's data governance framework operates in a grey area; the policies are in place but there are no enforcement bodies.

In an attempt to control the data generated within Algerian territory, the authorities-have imposed data requirements on companies and organisations in sectors deemed to be strategic. Data generated from government ministries and agencies, and the banking and energy sectors must be hosted on Algerian territory (E2, S7). Moreover, the National Telecommunications Regulatory Agency (NTRA) requires service providers commercialising the national domain name ".dz" to set up and maintain a secure Domain Name System (DNS) service platform made up of at least two DNS servers, including at least one server hosted in Algeria (S7).

In order to justify data localisation, the state has highlighted the security risks associated with free data flows. During an interview conducted with Algeria's minister of the knowledge

economy as part of my fieldwork in November 2021, the minister voiced concern about the country's over-reliance on servers based abroad to store the bulk of its data, viewing foreign storage as a serious security threat. He emphasised the need for his government to accelerate the construction of data centres to localise strategic data domestically (G1). In a statement released subsequently to the Algerian Council of Ministers, in June 2023, President Abdelmadjid Tebboune ordered the government to raise cybersecurity to the status of a national sovereignty issue, calling for greater control over the country's digital sphere (APS, 2023). Algeria has been systematically ranked by the Global Security Index (GSI) among the countries with the most vulnerable digital systems (GSI, 2023).

Beyond the imperative of protecting national data from foreign cybersecurity breaches, Algeria's ruling elite have pursued greater data localisation to enhance their access to citizens' information for surveillance purposes. This approach is underpinned by the principle that data is subject to the jurisdiction of the country where it is stored and processed. Yet, Algeria's data protection laws are weak and rife with loopholes, leaving personal data highly susceptible to misuse. Growing evidence suggests that such data is being utilised to reinforce the state's repressive capabilities (Bhalla, 2021; Jones, 2022). The emerging data framework is caught between, on the one hand, the ambition to mimic GDPR-like norms to send reassuring signals to foreign partners about personal data protection, and on the other hand, a palpable desire from powerholders to keep unfettered access to citizen's data in the name of national security. Within the country's ruling elite, among which the army is the most powerful organisation, arguments justifying breaches of data privacy draw on the nation's decades-long fight against terrorism in the 1990s and its enduring consequences (Martinez, 2000; Roberts, 2003).

However, as of 2023, the share of localised data in the country remains small. Although Algerian authorities had set an ambitious target to achieve a data localisation rate of 50% by 2024, industry experts interviewed noted that the country was unlikely to meet this goal. This shortfall is largely attributed to the lack of infrastructure that adheres to international norms and standards for data storage (E5, E6, S1, S4, S7). In 2017, the government had already launched a policy to create a state-owned cloud and data centre infrastructure (Octenium, 2017), but the initiative quickly unravelled as the minister of telecommunication who had initiated the project, Houda-Imane Faraoun, was indicted two years later on corruption charges (APS, 2021c).

Later, the strategy shifted towards supporting domestic private actors to invest in cloud development and data centres (E5). Nonetheless, local capital largely has shied away from the sector. Fieldwork interviews with local data centre providers, including ICOSNET, Algeria's largest data centre constructor, revealed two major factors hindering local firms. First, the lack of long-term visibility for local actors, acts as a disincentive to invest in what is a capital-intensive activity. As it stands, Algerian companies offering Cloud services operate under an authorisation regime that delivers a maximum of 7 years-long authorisations, subject to renewal (S2, S5, S7). Several actors have seen their accreditation removed without justification. Such removal was often done to make space for entrepreneurs connected to powerful army generals in place of those without political connections or with backing from less influential clans within the regime (S5). One interviewee commented:

> "The regulator can withdraw these authorisations without any explanation. In this situation, how can we reassure our customers, that we can reliably host their data in the medium and long term?" (S5).

This uncertain legal framework has severely constrained the capacity of home-grown actors to capture bigger shares of the domestic market and inhibited the growth of data centres in the country.

The second major hindrance is the difficulty that Algerian firms face in obtaining international standard certification. Several interviewees complained that it was extremely costly for them to get international certification, such as the "Uptime Tier 3 design" - an endorsement that attests that the firm meets international standards for safely storing and processing data (S2, S3, S5, S7). Without such certification, companies and institutions seeking to construct or expand data centres are unlikely to trust Algerian cloud providers. To ease the certification barrier, Algeria's minister of Posts and Telecommunications, Karim Bibi Triki, announced at the *Rakmana* innovation and start-up forum organised by the Algerian Group of Digital Actors (GAAN) in 2022, that the state is planning to partially subsidise international certification for promising firms interested in operating domestic data centres and a locally based Cloud (Indjazat, 2021). At the time of writing, however, the minister's announced policy, akin to an industrial policy supporting national firms, had not yet been put into place. In a context where local firms struggle to benefit from data localisation due to political, regulatory, and financial

constraints, foreign operators like Huawei, as the following illustrates, are seizing significant shares of Algeria's data centre market, including in the most vital sectors.

Huawei's data centre provision for Sonatrach

Sonatrach is Algeria's national state-owned oil and gas company. The name "Sonatrach" is an abbreviation of the French for "National Company for Research, Production, Transport, Transformation, and Commercialisation of Hydrocarbons". Established in 1963, a year after the country's independence, Sonatrach is one of the largest energy companies in Africa (Entelis, 1999). The company is responsible for exploring, producing, refining, and marketing oil and natural gas resources within Algeria and internationally (Layachi, 2021) and is a major player in the global natural gas market, exporting liquefied natural gas to various countries. In 2021, it was ranked as the seventh-largest gas company in the world. Given that hydrocarbons represent about 88% of Algeria's export earnings (OEC, 2024), Sonatrach plays a vital role in Algeria's economy and has a substantial impact on Algeria's development trajectory.

As a large energy firm, Sonatrach generates several terabytes of data annually from its transactions and daily operations. At the start of the ICT revolution in the 1990s, when there was little awareness about the strategic value of data, Sonatrach stored most of its data on foreign servers located in Europe and the US (E6). Starting in the early 2010s, with firms across the developing world gaining awareness about the security risks and economic losses associated with foreign data storage, Sonatrach started progressively repatriating its data to Algerian soil (E2). Former IT managers at Sonatrach explained that under the presidency of Mohamed Meziane, Sonatrach engaged in an ambitious digital transformation that sought to leverage digital technologies for its development (E2). As such, the energy company built its own data storing facility made of five data centres, accessible to its 10 key functional departments and 200 subsidiaries (E2, Internal Audit Documents (IDS) on Sonatrach's digital transformation).

However, with digital technologies becoming ubiquitous in Sonatrach's activities, the amount of data generated by the firm rapidly exceeded the firm's storing and processing capacity. Sonatrach's five data centres, although large, functioned in silo from one another, causing serious operational constraints for the storage and processing of the company's data (E5, IDS). For instance, if one data centre became overloaded, data could not be automatically distributed

to another one of its data centres. The fragmented architecture of Sonatrach's digital infrastructure made data processing complicated. It also rendered the rollout of new software costly and technically challenging. With several subsidies and divisions, data had to be manually transferred using Excel spreadsheets or other time-consuming means (S2, S7). This cumbersome process reduced possibilities for remote data access, resulting in data silos and information asymmetries within the firm. Furthermore, according to Huawei's own assessment before striking a partnership with Sonatrach, the company's infrastructure was riddled with inefficiencies and interoperability issues as its hardware had been supplied by various technology vendors (Huawei, 2019). The wide range of hardware and software generated data under different forms and standards. As a result, the management team struggled to process and monitor data, leading to low operational efficiency and limited capacity to utilise data (Huawei, 2019).

With this assessment in mind, Sonatrach, under the leadership of Amine Mazouzi, decided to abandon the plan to develop its own data infrastructure through in-house IT capacities and turned instead towards third-party cloud service provision. Sonatrach selected Huawei to assist it in pursuing its data localisation operation (Farhi, 2019). This choice was based on the Chinese firm's attractive prices and its favourable reputation as a supplier of Cloud services. The Huawei-Sonatrach agreement followed an official visit to China by Algerian Prime Minister Abdelmalek Sellal during which an agreement on expanding and deepening cooperation between Algiers and Beijing was inked (Haddouche, 2020). At that time, Algiers was trying to attract some of China's appealing BRI infrastructure projects, which it ultimately achieved by securing a loan agreement worth $3.3 billion US dollars for the construction of a commercial port at El Hamdania, Cherchell on the Western Mediterranean (Africanews, 2016).

Both the NRC and Huawei defended the agreement as essential for enhancing operational efficiency. In a press release published after the agreement was inked, Huawei Enterprise, the division of the company in charge of building and managing data centre and Cloud services, explained that it sought to tackle the inefficiencies of Sonatrach's data infrastructure through three phases of strategy (Huawei, 2019). First, Huawei would sell its Cloud Stack solution to Sonatrach, a full-stack hybrid cloud solution that integrates all IT resources into one platform. This solution was deployed to centralise the management of multiple data centres and centralise all servers under one Cloud service (Huawei 2019). Second, Sonatrach would acquire Huawei's Enterprise Resource Planning (ERP) system to be deployed on the cloud Stack platform. This

service would smooth and homogenise the management of multiple departments and subsidiaries. According to the tech giant, the system can improve the "effectiveness of the group's operation management" by supporting data sharing between upstream and downstream activities (Huawei, 2019).

Finally, the Sonatrach-Huawei partnership would involve the implementation of advanced AI-powered sensors, and big data analysis tools to improve oil field operations**.** While refineries have long been challenging to manage as vast, outdoor environments with a myriad of mobile machinery, the Huawei statement explained that the development of AI-empowered tracking devices would enable the energy firm to better track its field operations, and to increase its efficiency and productivity. According to Huawei's press release on the partnership, the oil industry's development depends on "efficient IT systems with robust data management and analysis capabilities" (Huawei, 2019). A McKinsey report suggested that the use of advanced digital technologies to optimise drilling and production could lead to $250 billions of value creation for the global oil and gas upstream operations by 2030 (McKinsey, 2020). With hopes for increased value generation, and "transform data resources into data assets" (Huawei, 2019), Sonatrach gave up on its in-house data centre and embraced Huawei's cloud.

If one is to perceive data as more valuable than oil in today's knowledge economy, then multiple issues arise from the Huawei-Sonatrach partnership. By fully relying on Huawei's cloud system, connected devices and AI-powered analytical software, Sonatrach has devolved power over its data to the Chinese firm. The idiosyncratic nature of data infrastructure means that service provision in this sphere can generate instances of data capture (Soghoian, 2009; Ngila, 2022). When IT hardware is sold, leased, or provided as a service to another party following a contractual agreement, the customer exercises control from that point onwards over all or some parts of the hardware. Yet, the firm that designs the software that operates the data management platform will continue to exercise full control over how data is processed and analysed, and what types of insights and level of access is given to the users, and so on, even after selling the service to a customer. Producers of integrated systems combining hardware and software maintain even greater control over customers' data (Yoo and Blanchette, 2015).

The growing use of sensors for data collection by third-party actors can result in a loss of control over one's data, with significant implications for data inequality. Huawei, like its competitors, has invested heavily in technologies that employ detailed data to provide

ostensibly useful insights to oil firms (e.g., on how to detect and manage new oil fields) (Ma, 2018). In practice, the technopolitics of these devices mean that oil firms that want to benefit from data-driven insights for exploration and management have to rely on tech corporations, which dictate the terms of service due to asymmetries in technical capacities. Moreover, tech firms have intentionally limited the interoperability of sensors embedded in mining equipment in order to maintain business deals over time, entrenching control in the long run through technological dependencies (Fisher and Streinz, 2021). Such dependencies can occur through different channels. For instance, sensors are often linked to specific data management platforms that come with strict proprietary rights making it difficult for customers to shift to other providers.

The ubiquity of these technologies coupled with increasing computational power means that territorial data localisation alone cannot guarantee the security and development of such initiatives. With local Cloud providers excluded from the picture, the deal offered by Huawei for localising Sonatrach's data has concentrated data in a single Cloud system. This concentration, justified by the two parties under the efficiency imperative, limits local learning and upgrading and risks trapping the energy company into a long-term dependency. These dynamics reflect wider transformations in how Cloud and data centre infrastructures are being designed and delivered globally. As an engineer working for a Chinese tech firm explained:

> "Data centre design has changed quite a bit in recent years. The way the Cloud solution is built, hardware and software tightly integrated, isn't just technical. It's designed so the manufacturer stays involved in operating the data centre over the long run. But it's not just the Chinese, it's the way Cloud solutions operate now." (W10)

It is important to note that the Huawei-Sonatrach partnership was signed during the final years of Bouteflika's presidency, a period, as discussed in Chapter 4, marked by a heavy reliance on hydrocarbon exports, pervasive corruption and diminished commitment to structural change (Marwan, 2019; Kilavuz and Grenwal, 2020). Although many of the policymakers involved in the Huawei-Sonatrach deal were later sent to jail for public fund mismanagement, the outsourcing of Sonatrach's data storage and processing was ongoing into 2025.

In sum, Algeria's emerging data governance system seems to replicate some of the authoritarian features of China's own data framework but shorn of its developmental aspects. Despite an initial push for data localisation through the consolidation of domestic capabilities, Sonatrach devolved control over critical data infrastructure to Huawei when the first technical constraints arose. With the ever-expanding scope, and speed of data generation, the creation of sprawling data infrastructure – extracting, processing, and standardising data – the Huawei-Sonatrach deal will bear serious implications for the firm, and the country's economy, for many years to come.

7.3.2 Egypt

Egypt's emerging data governance framework

Egypt launched a far-reaching regulatory reform programme to strengthen control over its data and accelerate its digital transformation. In 2020, the country adopted its first data protection law, the Personal Data Protection Law (PDPL) (ILO, 2020). The PDPL specifies several rules and restrictions regulating the collection and processing of citizens' and residents' personal data. Prior to the PDPL, Egypt suffered from a patchy legal framework that involved no less than 55 laws and regulations covering matters such as data protection, licensing, intellectual property rights, cybercrime, and financial transactions.

The PDPL introduces obligations on both domestic and foreign data controllers and processors that handle the personal data of Egyptians. Under the law, no personal information can be collected, processed, or disclosed unless there exists a legal basis to do so (PDPL, 2020). Foreign companies processing data in Egypt are required to partner with local representatives. The law states that: "All controllers and processors in Egypt must appoint a Data Protection Officer who is an Egyptian resident" (PDPL, 2020). The law also imposes a licensing, permit and security accreditation framework for data processing, data control, dealing with sensitive data, electronic marketing, and cross-border transfer of data. While the PDPL does not entail strict data localisation requirements like those applied in China, it mentions the need for a licence authorising data transfer outside of the country. However, interviews with Egyptian data centre firms indicated that the country was moving towards a full localisation of data in strategic sectors such as government, energy, and finance (S9, S11, S12).

Many of the provisions under Egypt's data governance framework are modelled on the EU's GDPR. Under Article 3 of the PDPL, key features of the GDPR are replicated such as the requirement for data processing to be transparent, ethical and lawful (PDPL, 2020). Like the GDPR, the general rule of thumb is that data must be transferred to a jurisdiction that offers at least an equivalent level of protection to that provided under Egyptian law. Similarly to Algeria, the adoption of a GDPR-like framework made economic sense to Egyptian authorities as it facilitates integration into global trade and investment networks (Bradford, 2020).

The ratification of Egypt's data protection law mirrors the country's economic-political imperatives. The Covid-19 pandemic accelerated the shift toward digitalisation by making internet access essential for maintaining economic activity and social interaction (Wade and Shan, 2020). As such, data regulation became more salient. At the same time, as Egypt's economy remained heavily dependent on foreign capital inflows, the military regime under the presidency of al-Sisi was keen to counter the significant balance of payments deficit by creating a more welcoming data governance framework. The idea was that a data framework similar to the GDPR would reassure foreign investors by setting clear parameters for companies looking to capitalise on the growth of the digital economy (E12).

In addition to serving as a signal to foreign actors, the government aimed to utilise the data governance law as a digital industrial policy, positioning Egypt to harness data as a driver of development. In a public statement, Egypt's Minister of Communications and Information Technology (MCIT), Amr Talaat, emphasised that the law would support his ministry's efforts to expand the industry of data centres and create a safe environment for the circulation of information in cyberspace (Flinders, 2020). As data centres have traditionally been scarce, the lion's share of the country's data is currently stored in European and American data centres (E12, E15). With the new law, the government seeks to promote the take-off of the data centre industry, described by the MCIT as one of the most promising industries (MCIT, 2022).

However, data localisation efforts preceded the new data law by several years. Egypt's ICT2030 agenda, issued in 2015, stressed the need to localise a greater share of data domestically and to significantly boost the number of data centres on its territory (MCIT, 2015). The country has long aimed to become a "Suez Canal" for data traffic, seeking to attract multinational firms to set up data centres to store both domestically and internationally generated data. In order to attract them, the Egyptian government has advertised its distinguished position on the global

marine cable map; Egypt links Europe, Asia and Africa together, representing a key passage for international data traffic (MCIT, 2022).

Unlike Algeria, Egypt counts several certified data centre providers. Firms like Mideast Communication Systems-MCS and EGID, are leading data centre constructors with several years of experience (S16, E15). Yet, these firms have been absent from government-led data localisation initiatives, which have been dominated by foreign players. According to interviewed representatives from Egypt's National Telecommunication Regulation Authority (NTRA), local firms lack the "business drive" and "economic case" that would allow them to take a greater role in domestic data centre provision (G7). In contrast, the firms themselves complain that public bids from state institutions and state-owned firms come with unnecessarily high requirements that *de facto* leads to their exclusion (S9, S15). Only large foreign tech firms with advanced capabilities and deep pockets can meet bidding requirements.

On the political front, the introduction of Egypt's data law has sparked controversy, particularly among civil society groups, who question the motivations behind its enactment. Whereas the GDPR prioritises the protection of European citizens' privacy as its primary objective, safeguarding privacy has not traditionally been a priority for Egypt's ruling elite. Analysts and human rights activists have argued that Egypt's data protection laws have largely been driven by the regime's aim to gain greater access to the data generated by individuals, public institutions, and businesses in Egypt, and stress that the PDPL may actually undermine its own purpose (Fatafa, 2020). As noted earlier, data localisation ensures that data is governed by the legal jurisdiction of the country in which it is stored and processed. However, the PDPL exempts major state organisations from provisions to respect data privacy. These include the Central Bank of Egypt (CBE) and national security authorities (Fatafa, 2020) such as the President, the Ministry of Defence, the Ministry of Interior, and the General Intelligence Services.

Although the adoption of GDPR-like data frameworks may be seen as institutional mimicry, signalling to the EU and other international investors that Egypt upholds high standards of data privacy, the country's fragmented data governance framework includes several ambiguous laws that infringe on citizens' privacy and impose excessive criminal sanctions across various aspects of cyberspace regulation. The PDPL is enforced in parallel with Egypt's much-contested cybercrime law, which entered into force in 2018 (E10). It substantially resembles

China's own in the sense that it infringes on citizens' rights in the name of national security. It is estimated that over the past few years, Cairo has blocked access to hundreds of websites, most of them belonging to media organisations. Thus, the nascent framework may allow law enforcement authorities to use data regulation to preserve and consolidate the incumbent's political power. In the meantime, as the following case will illustrate, data in strategic sectors, albeit increasingly localised, remains under the control of foreign firms, limiting the developmental opportunities of data localisation.

Egypt's National Research Centre (NRC)

Founded in 1956, shortly after Egypt's nationalist Gamal Abdel Nasser came to power, the NRC aims to foster basic and applied scientific research, particularly in industry, agriculture, public health and other strategic sectors of the national economy (NRC, 2023). Today, the NRC is the largest research institution in Egypt as well as the rest of the Middle East and North Africa, with a research staff of about 4800 scientists, representing approximately 60% of Egypt's researchers affiliated to the ministry of scientific research (NRC, 2023). The National Research Centre consists of 109 departments and 14 institutes including the Research Institute of Ophthalmology, the Central Institute for Minerals Research, and the Electronic Research Institute, as well as the Institute of Petroleum Research. The NRC defines its role as promoting scientific research aligning with Egypt's main production and service sectors and future strategic fields (NRC, 2023).

Previously the NRC's data, spanning from emails to scientific work, was scattered on servers across the world. In 2016, against the backdrop of a global wave for data localisation, the NRC engaged in data localisation efforts. Similarly to Sonatrach, the NRC began by building its own data servers for storage and cloud computing (S13). Citing cyber security and data privacy concerns, the research organisation acquired a large in-house data centre scattered across 16 different buildings throughout its campus, located in Cairo (Huawei, 2021). A team of 11 engineers oversaw the operations and management of the different data storage units (Huawei, 2021). The NRC's localisation was the first such initiative in Egypt among research organisations and was largely seen as an example to reproduce.

Nonetheless, the running costs of the data centre were high, and the NRC struggled to keep top-notch Egyptian engineers. Interviewed managers at the NRC explained how costly it was

for the centre to maintain talent, even with salaries higher than the average for a public research organisation, qualified engineers were quickly poached by the large tech multinationals present in the country (S13, S14). At the same time, running the physical infrastructure incurred several expenses including those linked to maintenance, troubleshooting and power consumption. With limited resources, the in-house IT team at the NRC had to perform onsite maintenance and troubleshooting by hand, travelling between different office buildings to ensure the smooth operation of these equipment rooms (Huawei, 2021). In the words of the NRC's data centre manager: "Manual operation and maintenance, plus the scattered layout of the equipment rooms, severely restricted our operation and maintenance efficiency" (Huawei, 2021).

As the amount of data accumulated, it became apparent that the centre's existing infrastructure could not scale up, so the centre's management decided to outsource its data storage and processing. In 2017, the NRC signed a cooperation agreement with Huawei to help establish a new, centralised data centre (Refaat, 2020). The NRC's IT Manager explained that they had chosen Huawei due to the technological sophistication of its data centres, which took up little physical space compared to other models, and which were sold at prices unmatched by any other provider (Huawei, 2021).

This partnership must be contextualised within the broader political transformation going on in Egypt at the time. After the 2013 military coup that brought General Abdel Fattah Al Sisi to power, and the Rabaa massacre of anti-coup demonstrators on 14 August 2013,[27] the US suspended its military aid to Egypt (Labott, 2013). Consequently, the Egyptian regime shifted towards closer ties with Beijing and Moscow (Hassanein, 2019). In 2015, President Al Sisi went on a four-day state visit to Beijing, during which he met with high-level representatives from Huawei, including the tech firm's Chairwoman Sun Yafang (Huawei, 2015). At the meeting, Sisi called on Huawei to increase its presence in Egypt to support its digital transformation, stating:

> "As the situation becomes stable and our economy recovers, I trust that Huawei will contribute more to boosting the nation's communications network coverage and increase ICT adoption by our government and public services."
>
> (al-Sisi, cited in Huawei, 2015)

[27] According to Egypt's National Council for Human Rights, the crackdown caused 632 deaths in one day.

A few months after the visit, the NRC announced its partnership with the Chinese tech giant. At the heart of Huawei's selling strategy was a promise to boost the operational efficiency of the NRC's data infrastructure. Its statement on the partnership claimed its equipment was efficiency-enhancing and would "make O&M [operation and management] simpler for the centre's staff, lowering skill requirements and helping to ensure stable services" (Huawei, 2017b). The statement added that: "realistically speaking, most research institutions in Egypt aren't in a position to invest either a large amount of physical space or labour costs to construct and maintain data centres" (Huawei, 2017b). As such, the tech firm sold the NRC its fully modular and pre-integrated FusionModule2000 Smart Modular Data Centre, a novel type of data centre which use AI and IoT solutions. This next generation data centre integrates all parameters from power, cooling, racks, and cabling, to data processing and analytical software. Concurrently, the NRC's own efforts to rely on Egyptian engineers and capabilities in the early stages of its data localisation plan were side-lined and criticised for resulting in poor management and wobbly safety and reliability.

The NRC-Huawei partnership was touted in Egyptian government circles and in the media, hailed as a benchmark for the scientific community. In the eyes of the Chinese firm, in turn, it was claimed as a 'success story' (Huawei, 2017b). Yet, if the initial intent was to ensure greater security over data while benefiting from the economic spillovers of localisation, the centralisation of data in an all-encompassing hardware and software infrastructure constructed and managed by a foreign actor does little to meet these goals. The Huawei-built data centre for the NRC, like those built by other tech firms are *by design* meant to keep the equipment provider involved in operations, thereby reducing the learning opportunities for domestic firms. Furthermore, integrated data processing systems allow firms to continuously access their clients' data. Several interviews with Egyptian engineers working for Huawei Enterprise indicated that by running the data infrastructure, Huawei was able to maintain continuous access to the data stored in the infrastructure (W14, W17, W18, W19). The continuous intervention of the equipment provider is neither incidental nor coincidental, but rather a product of deliberate material choices embedded in the technical artefacts.

While control over infrastructure is rarely exercised by a single actor (in this case, the NRC has preserved some of its in-house IT capabilities and still technically owns the data centre), control over key segments such as a particular protocol, application, or operating system can allow firms to secure and leverage control over data. To be clear, the NRC's plan to localise its

data is a step in the right direction. But the over-reliance on a foreign firm with a significantly better understanding of the underpinning infrastructure poses both economic and security threats. A new hire at Huawei's main Cairo office explained that Cloud providers retain access to their customers' data:

> "It's not just about fixing things when there's a problem on the cloud. I also access data from the servers, clean it up, and run some basic analysis to identify patterns or trends. Then we share that with clients so they can make better decisions based on what the data is saying." (W24)

To be clear, this does not suggest that ICT OEMs are inherently predisposed to extract or monetise data. There is no evidence that Huawei directly exploits data from organisations such as the NRC or Sonatrach. However, the growing role of technology firms in storing and managing the data of strategic institutions and corporations affords them significant long-term advantages. These stem from their control over the critical infrastructure that supports data management systems, servers, cloud platforms, and proprietary software. For instance, beyond the organisational control exercised through integrated service provision, Huawei embeds proprietary technical standards within its systems that deepen forms of lock-in. Its CloudStack platform, like those of competitors, operates on proprietary architectures that determine how data is formatted, stored, and transferred. Although many providers claim compliance with open-source frameworks such as OpenStack, they often incorporate proprietary extensions and modifications that diverge from standard distributions (W26, C3). Marketed as performance or security enhancements, these customisations create vendor-specific ecosystems that impede migration to alternative providers (Opara-Martins et al., 2016).

Huawei's ManageOne platform illustrates how such control operates in practice. Using AI-driven automation for resource allocation, fault detection, and predictive maintenance, it defines decision-making parameters through Huawei's own algorithms. Institutions like Sonatrach and the NRC, despite formally owning their data centres, depend on Huawei's proprietary systems to interpret and manage operational data. Similar dependencies arise through Huawei's FusionSphere platform, whose proprietary APIs govern resource management, data processing, and security functions (Huawei, 2024). While resembling industry standards, differences in parameter structures, authentication methods, and data formats often obstruct interoperability with non-Huawei systems. Through these proprietary standards, ICT firms determine access conditions and data architectures, effectively binding third parties to their technologies for interoperability, security, and scalability (Fisher and Streinz, 2021).

These interoperability challenges are not unique to Chinese providers. Western cloud platforms, including Amazon Web Services, Microsoft Azure, and Google Cloud, employ comparable strategies of proprietary extension and strategic incompatibility. The resulting 'cloud lock-in' has been well documented, even among organisations in advanced economies with significant IT expertise (Opara-Martins et al., 2016; Ramalingam and Mohan, 2021). In contexts where data protection and interoperability regulations remain underdeveloped, such as in North Africa, these corporations have strategically used cryptographic and proprietary design choices to capture markets. Ultimately, the issue extends beyond any specific firm or nationality. It reflects the extractive dynamics of digital capitalism, a data-driven economic order dominated by a few global corporations whose proprietary infrastructures entrench asymmetries of control and reproduce path-dependent structures (Schiller, 2014; Zuboff, 2019).

In brief, in Egypt, like in Algeria, data localisation efforts are expanding the state's surveillance capacities but without generating many increased economic opportunities for local actors and institutions. In both countries, the pursuit of greater efficiency undermined the developmental potential of data localisation. My findings reveal that despite initial attempts to own and run their respective digital infrastructure, Sonatrach and the NRC rapidly abandoned this path in favour of becoming an intermediary of locally generated data. With more technological capacity to process data, tech giants like Huawei can exploit the benefits of Algeria and Egyptian data at the expense of local economies and societies. In this sense, the Algerian and Egyptian governments' double objective of advancing data sovereignty and economic development through data localisation seems compromised within their emerging data governance frameworks.

7.4 Digital infrastructure and the diffusion of China's digital technopolitical regime

Under the banner of improved connectivity, Chinese firms – as providers of digital infrastructure – may be strengthening their privileged positions to access, harness, and profit from data generated in host countries. Scholars of digital systems have often used the term 'data colonialism' to highlight the uneven power relations that enable the corporation to control and process data at the expense of others (Thatcher et al., 2016; Couldry and Mejias, 2019; Mumford, 2022). The term "digital colonialism" extends the scope to other dimensions of the digital, such as control over hardware and infrastructure that underpin the use of the internet (Kwet, 2019; Young, 2019; Mouton and Burns, 2019). In this vein, some have suggested that the scramble for Africa's data is taking place in the Cloud, arguing that the continent's over-

dependence on foreign Cloud services is a breeding ground for data colonialism (Ngila, 2022).

Looking at the evidence emerging from the data localisation plans explored above, the frame of colonialism, or neo-colonialism, seems to lack analytical usefulness. Although terms like "scramble," "hegemony," and "empire" have been used to describe both digital technologies and China in Africa more generally – maybe because they speak to many people's preconceptions – the use of such terms, as argued by Lee (2018), present considerable definitional, empirical, and historical problems when deployed analytically and not just for political effect. The countries dispatching global tech giants in North Africa are not engaged in military occupation nor dispatching chartered corporations with exclusive trading rights. These terms divert attention from what is really happening on the ground; a fierce expansion of digital capitalism, of which Chinese players are relatively new entrants, attempting to capture market share. Importantly, host countries exercise agency in shaping their digital infrastructure. As the two examples of Sonatrach and the NRC illustrate, it was at the bequest of the Algerian energy firm and the Egyptian research centre that Huawei took over their respective data infrastructure. While the ownership of the data centres remains in the hands of the two North African parties, asymmetries in technical knowledge and capabilities, risk consolidating and deepening data inequalities over time.

Instead of asking whether China's digital engagement with other developing countries is evidence of colonialism, it might be more productive to ask whether Chinese-built data infrastructure is diffusing China's data governance regime in host countries. Do the material artefacts constitute a distinct technopolitical regime, reflecting Chinese standards, norms, and values? This chapter's findings suggest that the emerging data governance framework in Algeria and Egypt are not replicating the single data regime found in China but are instead made up of a patchwork of laws and jurisdictions reflecting the various technologies that constitute their technological stacks and their domestic political economies. Drawing on both the EU and China's regulatory regimes, the two countries have adopted restrictions on free data flows. But the localisation of data ensures that data generated within national borders falls squarely under local jurisdiction. This shift grants governments the ability to exert greater control over citizens, firms and organisations' data. In parallel with China, North African countries have carved out significant exceptions with respect to data privacy laws in order to strengthen and expand state surveillance capacities.

In this regard, this chapter's findings corroborate those of Erie and Streinz (2021) in relation to Chinese-built smart cities in Pakistan. The authors argue that there is no evidence of China imposing its digital model on Pakistan. Rather, it is Pakistan's heavy demand for Chinese-built and operated digital infrastructure, combined with its lack of a robust legal framework, that fosters a convergence in data governance approaches between the two countries (Erie and Streinz, 2021, p. 80). The cases of Pakistan, Algeria and Egypt show that key features of the local political economies, such as strong militaries, façade party democratic systems, civil society movements, and Muslim-dominated populations at least complicate the transposition of China's data governance regime. Going beyond the digital world, these findings mirror resistance to technopolitical regimes in other sectors.

Although no Chinese digital technopolitical regime is being forced upon host countries, the two countries may face serious data sovereignty concerns. While the Algerian and Egyptian police, military, and intelligence services are attempting to expand their intelligence-gathering capacities through cyber policies similar to those of China, they may be simultaneously subordinating themselves to an even greater data-gathering operation orchestrated by China's superior surveillance system (Huang and Tsai, 2022; Hicks, 2022). Since the vast bulk of infrastructure built along the new silk road is financed through loans provided by China's main development financers some have suggested that loans granted to expand surveillance infrastructure are reversing the ancient adage of "heaven is high, and the emperor is far away" (Qian, 2019), deepening the surveillance capacity of the Chinese state (Stevens, 2019).

The danger of relying on Chinese surveillance technologies for Algeria and Egypt's own cyber sovereignty has been somewhat inadvertently concealed by China's vigorous advocacy for data sovereignty in various global digital technology standard-setting bodies and governance institutions. Yet, an investigation published by Le Monde showed that confidential data from the Chinese-built African Union headquarters was being diverted every night from Addis Ababa to Shanghai (Le Monde, 2018). Huawei had provided the telecommunications infrastructure, including servers and IT systems, as part of China's broader support for the project. Of course, China is by no means the only power involved in using the internet for spying. The US has long used its dominant position in global digital infrastructure to gather intelligence. Classified documents leaked by former National Security Agency (NSA) contractor Edward Snowden exposed how US intelligence agencies conducted mass surveillance on a global scale, accessing the communications and data of millions of individuals worldwide. Crucially, this was done in close collaboration with major US technology firms

such as Google, Microsoft, Apple, and Facebook, which were compelled – sometimes unknowingly, sometimes under legal pressure – to share user data through programmes like PRISM (Hayden, 2013).

Recognising the risks of excessive reliance on foreign data infrastructure providers, several developing nations are increasingly adopting data localisation strategies that prioritise domestic actors. India serves as a notable example of this shift. The country has implemented stringent data governance frameworks to restrict the unrestricted flow of data across borders while simultaneously introducing local content requirements to bolster its domestic data centre providers. In 2024, the Reserve Bank of India (RBI) announced an initiative to offer affordable local cloud data storage solutions to Indian financial institutions. This programme aims to reduce dependency on foreign cloud service providers, thereby fostering the growth of indigenous cloud infrastructure. As part of this effort, the RBI has invited only local IT companies with prior experience in developing cloud-related solutions to bid for the project (The Economic Times, 2024). In parallel, India's Ministry of Electronics and Information Technology (MeitY) has launched the "GI Cloud" initiative, commonly referred to as "MeghRaj," to accelerate the delivery of e-governance services across the country. This programme actively promotes the use of local cloud infrastructure, thereby incentivising the development of domestic data centre providers (MeitY, 2024). However, these types of industrial policies may be difficult for smaller developing nations, which often lack the economies of scale necessary to sustain competitive domestic data infrastructure. For these countries, collaboration within regional blocs could present a viable solution, as will be further explored in the conclusion of this thesis.

Eventually, data sovereignty will remain elusive without endogenous technological capabilities. The power to govern data effectively is dependent on controlling relevant digital infrastructure, much of which is increasingly being supplied by Chinese technology companies, which may (or may not) be working under the influence of the CCP. As such, even though some countries may feel the need to adopt data governance frameworks that are more "closed" by promoting territorial data localisation, they remain "open" to the control of big corporate actors and surveillance systems. The ability of governments to leverage the ever-growing power of large tech firms whether Chinese or not depends on their capacity to strengthen domestic political, technological, and financial resources for building resilient and developmental digital systems.

7.5 Conclusion

This chapter examined two Huawei-built data centres in Algeria and Egypt with an eye to better understand the emerging data governance regimes in the two countries. The two case studies reveal that the initial ambition to localise data through on-premises servers was dropped by both Sonatrach and the NRC, in favour of Huawei cloud services for data storage and processing. Ongoing data localisation efforts are only *superficially* enabling the domestic storing of data while the processing is still controlled by foreign firms. This form of data localisation is depriving domestic Cloud actors of significant learning and upgrading opportunities. However, while emerging data governance frameworks fail to achieve the dual objectives of data sovereignty and economic development, they are expanding the surveillance capabilities and reach of both states.

Dominant understandings of digital sovereignty continue to privilege dominant actors, who exploit them to perpetuate asymmetrical power dynamics with the Global South. The frameworks promoted by China may be misleading, fostering an illusion of sovereignty while failing to disrupt entrenched cycles of dependency. Reclaiming infrastructural control and building technological capabilities is necessary to avoid the reproduction and entrenchment of data inequality. To limit the dependency on data infrastructure controlled by large corporate entities, developing countries need to resist the temptation of adopting wholesale top-down data centre packages that suppress the developmental spillovers from data localisation as well as sovereignty. To realise these goals, laws regulating the international political economy must enable states to experiment with digital development policies without being overly constrained by restrictive trade policies. Naturally, such industrial policies will not always succeed. But, as data infrastructure is being built at a fast pace and on a massive scale, seizing control of this task is crucial for confronting data inequality.

CHAPTER 8

Conclusion

Chinese ICT firms have increasingly taken centre stage in global digital capitalism. Beijing's flagship development strategy, the Belt and Road Initiative (BRI), along with its digital component, the Digital Silk Road (DSR), encompass a wide range of infrastructure projects, including fibre optic cables, 4G and 5G networks, and data centres. Such infrastructure projects can theoretically have significant developmental spillovers for host economies. While few topics in recent years have sparked as much media and policy attention as the globalisation of China's digital industry, the discourse has largely centred on the perceived threats posed by China's rise to US dominance in the digital sphere. Much less attention has been paid to what China's increased digital presence in developing countries could signify for global digital inequalities and development.

This thesis has investigated the central question of whether Chinese digital capital creates new channels for technological upgrading and structural transformation or conversely hinders the development of technological capabilities and limits broader economic change in host developing countries. This research deployed a multi-dimensional political-economy framework that combines insights from heterodox approaches to economic development – to understand the effect that foreign firms have on technological upgrading and to trace the occurrence of spillovers – with insights from technopolitics – to analyse the norms and standards conveyed through built digital systems and the way in which technological regimes are negotiated between global and local actors. On this basis, I traced three key channels for technological upgrading and structural change: (1) ICT infrastructure and connectivity, (2) technology transfers, and (3) data governance frameworks.

Using a mix of research methods ranging from regression analysis, documentary research to fieldwork interviews in Egypt and Algeria, the dissertation shows that while the globalisation of China's ICT firms has contributed to bridging the digital divide and has created some instances of managerial knowledge spillovers, it does not substantially contribute to consolidating technological capabilities nor boosting productivity in the domestic ICT industries. Its impact on structural change is thus limited. Fieldwork findings in the two North

African countries reveal that the operations of the two Chinese firms, like those of Western competitors, impeded local actors from expanding their share of domestic markets and consolidating their capabilities. Both governments appeared to prioritise *efficiency* and immediate access to cutting-edge infrastructure, rather than investments in long term learning and upgrading. This emphasis on short-term gains came at the expense of supporting local firms to grow and participate more substantively in the domestic ICT ecosystem.

The research shows that what could at first seem like developmental linkages emerging from Chinese ICT corporations are in fact linkages that mainly diffuse Chinese infrastructure, hardware, software, training and processes, and which uphold norms and standards that shape, both *intentionally* and *unintentionally*, a distinct technopolitical regime. Throughout these empirical chapters, I have shown how Chinese digital corporations are disseminating *de facto* standards from the ground up, via the construction of cost competitive digital infrastructure, the roll out of training and knowledge transfer programmes, and the diffusion of data governance frameworks, which are collectively reconfiguring ICT ecosystems. In the current context of heightened geopolitical tensions and increasingly bifurcated digital systems, developing countries face greater pressure as dominant actors expand their regulatory influence with the aim of consolidating extra-territorial economic and political power.

This conclusion starts by summarising the findings from the empirical chapters and weaving them together to provide a holistic answer to the thesis' central research question. It then provides a discussion of what the rise of a Chinese digital technopolitical regime, with distinct norms and standards, means for digital development in the Global South. I argue that the rise of a Chinese digital technopolitical regime, competing with the US hegemonic regime, has the potential to create developmental opportunities by increasing the bargaining power of countries in the Global South. However, without pro-active industrial policies that promote strategic autonomy, countries may end up being trapped in a new layer of dependency. I suggest some policies in this vein and conclude by highlighting areas for further research.

8.1 Summary of empirical findings

After introducing the three ICT ecosystems and examining their evolution, political economies, and stages of digital development in Chapter 4, this dissertation developed a series of empirical arguments that address each of its sub-questions and contribute to answering the overarching research question. Below is a summary of the key empirical findings.

First, the thesis has sought to evaluate the tangible impacts of the globalisation of China's ICT industry on digital connectivity and its implications for the digital systems of host economies. Chapter 5 examined this hypothesis using a dataset I developed, which includes data from 132 countries spanning the years 2008 to 2022. A propensity score reweighting Difference-in-Differences (DiD) regression approach was employed to establish the causal relationship between participation in the BRI and internet access rates. I accounted for country-specific and temporal variations, incorporating a carefully selected set of control variables grounded in relevant theoretical frameworks. The analysis reveals that BRI countries experience a 2.82 percentage point increase in internet access compared to non-BRI countries, even after controlling for other relevant variables. This effect is statistically significant at the 0.1% level ($p < 0.001$). Robustness is confirmed through parallel trend validation, alternative model specifications, time-lag sensitivity analysis, and incorporation of supplementary control variables. At first glance, a 2.82 percentage point rise might appear small, but its impact is far from trivial. In a country of 50 million, that increase would mean around 1.4 million more people coming online. These findings underscore the role of the BRI in narrowing the digital infrastructure gap and advancing global connectivity, a process largely driven by China's development finance and the cost competitiveness of its ICT infrastructure.

Moving beyond macro quantitative analysis, the second section of Chapter 5 goes further to investigate the grounded effect of expanded Chinese ICT infrastructure on domestic digital systems in North Africa, taking the case study of Algeria's deployment of its Fibre to the Home (FTTH) project with Huawei and ZTE. The case study shows that collaboration between Algeria and the two Chinese ICT giants has enabled the rapid rollout of digital infrastructure, considerably enhancing the scope and quality of connectivity across the country. At the same time, however, the decision to designate these two Chinese firms as the primary providers raises concerns about potential dependency within Algeria's ICT industry. Reliance on a limited pool of suppliers not only restricts development pathways for local ICT firms but also narrows the country's future technological choices. Thus, the growing role of Chinese ICT firms in developing infrastructure beyond China's borders has positively contributed to expanding internet access, representing a step forward in narrowing the digital divide. However, the deployment of Chinese technologies and standards are simultaneously transforming global ICT supply chains and reshaping digital ecosystems in host countries in ways that potentially hinder the development of local ICT actors.

Second, this dissertation evaluated the role of Chinese ICT corporations in facilitating technology transfer. In this vein, Chapter 6 examined three different types of linkages: horizontal linkages, vertical linkages, and linkages with local universities, emerging between Huawei and ZTE and the Egyptian and Algerian economies. Drawing on the conceptual framework developed in this dissertation; the analysis extends beyond merely identifying the *presence* or *absence* of linkages. It examines the quality of these connections and their deeper effects – what linkages *do* on the ground, *how* they work and for *whom.* This chapter, which builds on extensive interviews with a variety of stakeholders, reveals that, despite localising activities that appear developmental and theoretically capable of generating productivity spillovers, the two Chinese technology firms offered limited productive linkages that could drive technological upgrading domestically. Instead, the technologies disseminated by Chinese digital corporations – from the codes and hardware underpinning network infrastructures to the expertise embedded in training programmes for local employees, suppliers, and students – are reshaping ICT ecosystems in ways that make the adoption of Chinese firms' products, processes, and standards increasingly pervasive.

The comparison between tech firms headquartered in different countries shows that keeping a tight rein over intellectual property is by no means associated only with Chinese investors. In Algeria and Egypt, both Chinese and non-Chinese corporations are found to limit knowledge transfer *by design* to protect their technological edge. Without effective technology and skill transfers that could ultimately usher in technological upgrading, the globalisation of Chinese ICT corporations may only strengthen the global position of Chinese tech multinationals while exacerbating cross-country inequalities. This being said, fieldwork findings also indicate that with rising labour costs in China, Huawei and ZTE are increasingly localising mid-level managerial roles and, to a growing extent, top-level leadership positions. Fieldwork findings indicate increasing instances of managerial spillovers. Discussions on knowledge spillovers from MNCs have largely neglected the transfer of managerial expertise. Yet, changes in management practices can drastically enhance firms' competitive performance. Concurrently, as latecomer firms dispatched from a developing country, Chinese ICT corporations, and Huawei in particular, have devoted substantial resources to capacity-building efforts to capture markets that were historically dominated by US and European firms. These efforts bear the promise to foster interest in ICTs, and help local stakeholders become familiar with technologies, processes, and standards that are increasingly becoming dominant in the global

digital economy. This exposure, in the long run, can help learning and innovation within the ICT industries of host countries.

Third, the thesis examined the effect of Chinese-built data centres on the global inequality in data control and asked whether these infrastructural projects are diffusing China's data governance regime. To explore these questions, Chapter 7 analyses how digital data is collected, processed, and managed in two Huawei-built data centres. In Egypt, I focus on Huawei's contract with the National Research Centre (NRC), the country's largest research institution, and in Algeria, I look at Huawei's data centre for Sonatrach, the state-owned energy firm. The chapter finds that both Algeria and Egypt have pursued *superficial* data localisation efforts. In these cases, data from strategic sectors is stored within national borders but continues to be processed by foreign multinational corporations. While Algeria's Sonatrach and Egypt's NRC initially took steps to localise their data by constructing, owning, and operating their own data centres, these initiatives were swiftly abandoned in favour of solutions that were more *efficient* in the short-term, which outsourced the management and expansion of these facilities to Huawei. Consequently, control over the infrastructure and the data it hosts remains firmly in the hands of the Chinese technology giant. Although the emerging data governance frameworks in the two North African countries have fallen short of their stated objectives of achieving data sovereignty and fostering economic development, state organisations in both countries have leveraged these frameworks to enhance their surveillance capabilities and extend their reach over their populations.

Although current initiatives to construct digital infrastructure and localise data represent progress, unlocking the full developmental potential of data necessitates more than just territorial localisation. It requires meaningful control over the entities responsible for building, operating, and maintaining the critical infrastructure, irrespective of their country of origin. Digital sovereignty, as promoted by China internationally, appears to depart from the approach China adopted domestically as it lacks systemic critique of the dependency structures inherent to digital capitalism. Instead, it utilises the rhetoric of national control over the digital sphere primarily as a façade. The prevailing narrative that portrays China's digital collaboration with African nations as a vehicle for achieving digital sovereignty fails to recognise a critical reality: Chinese firms, much like their Western equivalents, are positioning themselves as key gatekeepers of locally produced data. This development has far-reaching implications for the trajectory of African knowledge economies. If governments do not invest in building

indigenous technological capabilities, aspirations for genuine digital sovereignty and sustained economic development will remain unattainable.

Overall, when analysing insights from the empirical chapters, this dissertation finds that the role of Chinese firms in fostering technological upgrading in host developing countries is at best *mixed*. Chinese ICT firms such as Huawei and ZTE have made substantial contributions to bridging the digital divide in many host countries. Emerging evidence from Algeria and Egypt also indicates the presence of some managerial skills spillovers and capacity-building initiatives that are introducing new expertise and fostering innovation within the local ICT environment. Moreover, the push for increased data localisation in strategic sectors represents, from the heterodox lens of this thesis, a crucial first step toward achieving greater economic sovereignty and equitable control over digital data.

But despite their substantial presence, fieldwork findings in Algeria and Egypt reveal that the operations of Huawei and ZTE impeded local actors from expanding their share of domestic markets and consolidating their capabilities. As discussed in Chapters 5, 6 and 7, Algeria and Egypt's heavy reliance on foreign firms to deliver critical ICT infrastructure relegated local actors to subordinate roles, restricting their opportunities for technological learning – a key pathway for building capabilities. The two North African countries' prioritisation of immediate infrastructural access over long-term technological upgrading undermines the development of indigenous technological capabilities in the long run.

The research shows that what might initially seem like developmental connections promoting domestic capabilities are, in fact, linkages diffusing – through fibre optic cables, data centres, antennas, and routers, as well as the implementation of training and knowledge transfer programmes and data governance frameworks – new norms, protocols, and standards that reconfigure local ICT ecosystems and integrate them into distinct technopolitical regimes. Amid escalating geopolitical tensions and the growing fragmentation of digital ecosystems, developing countries are under increasing pressure from dominant global powers aiming to expand their regulatory influence. This strategy enables these actors to reinforce their extraterritorial economic and political control, further entrenching local ICT stakeholders in dependent roles defined and dominated by foreign technology corporations.

The notion of a Chinese technopolitical regime does not imply a centrally orchestrated state strategy aimed at imposing Chinese standards on host economies. Fieldwork data suggests that

the activities of Huawei and ZTE – encompassing infrastructure development, knowledge transfer initiatives, and data localisation efforts – were primarily driven by commercial imperatives and domestic demand in the two North African countries. While the Chinese state, through initiatives such as the BRI and the DSR, has facilitated the global expansion of Chinese tech firms, their strategies were shaped far more by profit maximisation than by Beijing's geopolitical objectives. Rather than a top-down imposition of a coherent digital model, the effect of China's technopolitical regime in third countries is better understood as a negotiated process, materialising through the interaction of Chinese technologies and standards with local development priorities, regulatory frameworks, and pre-existing technological stacks. As argued by Oakes:

> "China's infrastructure projects tend to take on a life of their own and produce unanticipated political effects. Understanding this involves grounded, place-specific, and contextual analysis that reveals the many social, political, and technological connections and relations that are set in motion by Chinese investments and activities."
>
> (Oakes, 2024, pp. 85-86)

This thesis offers an original conceptual contribution at the intersection of development studies, Science and Technology Studies (STS), and the political economy of global digital capitalism. It advances a conceptual framework that helps unpack how the developmental effects of foreign multinational corporations in the digital sector arise not only from economic linkages or policy incentives, but also from the technological regimes within which these actors operate. By foregrounding infrastructure, technology transfer, and data governance as interconnected sites of power and capability formation, the framework reconceptualises technological upgrading as a socio-technical process shaped by competing global technopolitical regimes and their embedded technology stacks – the technical architectures, standards, and organisational routines that underpin digital systems. Crucially, this approach provides a theoretical lens for analysing how developmental outcomes are co-produced through interactions between global technological forces and local political economies, rather than determined unilaterally by either external actors or domestic policies. It reveals that the politics of development in the digital age operate not only through formal diplomatic channels, trade negotiations, and global regulations, but also through the material infrastructures, operational practices, and governance architectures that are embedded within everyday technological systems.

In this way, the framework offers analytical tools to trace the micro-foundations of technological dependence and autonomy, linking ground-level socio-technical configurations to macro-level questions of structural transformation and digital sovereignty. It also allows the analysis to move beyond conventional firm- or value-chain-centred analyses by locating development outcomes within the broader struggle over who defines and controls the infrastructures of connectivity. By reframing technology spillover not as a discrete transaction but as an ongoing process of regime alignment and institutional reconfiguration, the framework offers analytical tools for understanding how power operates through seemingly technical choices about hardware, software, and standards. In this sense, technological upgrading is recast as a process of selective integration into different technopolitical regimes.

At present, it seems clear that countries looking to develop digital economies are faced with a dilemma. On the one hand, the absence of essential physical or digital infrastructure – coupled with the substantial costs of establishing it domestically – often compels nations to depend on the infrastructure provided by leading global technology firms. This reliance is driven by the principle of market efficiency, with most governments, international organisations, and consultancies operating under the assumption that acquiring the latest technology as swiftly as possible is crucial to avoid falling behind. On the other hand, digital infrastructures inherently shape ICT ecosystems in ways that lock countries into the continued use and consumption of vendors' proprietary equipment and technologies. Addressing digital inequality and striving to strengthen domestic technological capabilities inevitably compel governments to navigate competing values, interests, and visions. As emphasised throughout this dissertation, achieving technological upgrading and structural transformation necessitates the development of advanced human capabilities and the establishment of control over data infrastructure. These infrastructures are neither passive nor static; instead, they are inherently political and dynamic.

8.2 Competing digital technopolitical regimes and opportunities for developing countries

This section discusses the findings in the context of intensifying geopolitical competition between the two dominant technopolitical regimes. As competition in global digital capitalism increasingly centres on recruiting nations into one technological regime or another, we must ask whether the rivalry between these competing regimes opens up new developmental prospects for these nations? In answering this question, one ought to first assess the existing avenues for technological upgrading for developing countries within the long- established unipolar digital landscape, predominantly shaped and led by the US. Since the Advanced Research Projects Agency Network [ARPANET], funded by the US Department of Defence, first launched the protocol suite TCP/IP in 1983, which became the foundation of the modern internet (Hafner and Lyon, 1998), the US has enjoyed dominance over the digital domain.

The US-led international standardisation process produced the protocol stack that shaped the internet through a completely new set of standard bodies such as the Internet Engineering Task Force (IETF), Internet Corporation for Assigned Names and Numbers (ICANN), among others (Russell, 2014). This standardisation allowed Washington and its technology giants to dictate the terms of global connectivity, interoperability, and innovation. By controlling these critical standards, the US ensured that its technological framework remained central to the global digital ecosystem, compelling other countries and companies to align with US-defined norms to participate in the internet's growth. This control has provided the US with a strategic edge, allowing it to maintain its hegemonic position in the digital sphere for decades (Mueller, 2010). Through this dominance, the US has been able to steer the evolution of digital technologies while safeguarding its geopolitical and economic interests.

As discussed in Chapter 7, the US-designed internet system has upheld the value of "openness". Openness allowed for the internet to be promoted as a freedom-generating technology, while also being acknowledged as a US enterprise (Abbate, 1999; Russell, 2014). The architecture of the internet was designed by the US to promote democracy and the open market, in the context of neoliberal globalisation. Advocates for the open internet mobilise arguments about the nature of the network to advance their agenda. But while in the early 1990s, US leaders promoted the internet as "global information infrastructure", throughout the 2000s, the critical

infrastructure making up the internet became centralised under the tight control of a handful of US-based MNCs. The democratic ideal of open networks and markets came to hide the reality that more technologically advanced actors, from wealthy economies, were able to exploit internet infrastructure to their advantage. As put by Maxigas and Ten Oever: "The internet has been a fundamental material infrastructure for funnelling profits from the semi-peripheries to the core economies" (Maxigas and Ten Oever, 2023, p. 275). Silicon Valley corporations like Google, Microsoft, and Amazon, developed platforms that became central to the global digital economy, data exchange, and commerce. These firms played a key role in standardising and regulating the internet in ways that entrenched US control over much of the global digital platform's infrastructure (Srnicek, 2016; Smyrnaios and Karatzogianni, 2018).

The US technopolitical regime, which consolidates wealth and power within a limited number of tech giants, has arguably constrained the developmental space available to third countries in the digital sphere. Varoufakis (2024) contends that leading technology companies have created platforms akin to feudal fiefdoms. On these platforms, users provide data and content, comparable to the labour of medieval serfs, without receiving direct compensation. This user-generated data is subsequently monetised by tech giants, enabling them to extract rents and consolidate their power. Varoufakis further argues that digital platforms have diverged from conventional capitalist profit-making models, embracing what he terms *techno-feudalism*, a system in which tech firms operate as modern-day feudal lords. For low- and middle-income countries, which generate vast amounts of data, the economic advantages derived from this data extraction are rarely redistributed within these nations. The near-monopolistic dominance of digital ecosystems by a handful of US based corporations has erected substantial barriers to entry for underfunded local startups and smaller enterprises in developing regions (Fisher and Streinz, 2022). The dominance of these tech giants creates an uneven playing field where local firms struggle to scale or innovate due to limited access to data and markets. The algorithms, platforms, and ecosystems controlled by these corporations often privilege their own services, products, and monetisation models, further excluding smaller players.

At the same time, the US did not show much appetite in investing in hard ICT infrastructure – the cables, wires, routers and switches that enable connectivity – in developing countries (Winseck, 2019). The US regime reflects the broader neoliberal paradigm, which emphasise the importance of market-driven solutions and private-sector leadership over direct state investment in infrastructure. Similarly, and despite grand claims about the seemingly

transformative role of digital connectivity for economic development, institutions under the influence of the US such as the IMF and the World Bank, largely refrained from financing large-scale backbone ICT infrastructure projects (Dreher et al., 2022). Instead, Bretton Woods institutions focused on fostering market reforms, privatisation, and structural adjustments (See Mkandawire and Soludo, 2003; Chang, 2002 for a detailed discussion). Without substantial investments in the physical infrastructure that supports connectivity, capital-scarce developing countries faced slower internet speeds, higher costs of access, and limited broadband coverage, perpetuating ICT infrastructural inequalities.

The historical irony is that the doctrine of openness, globalisation and free market, originally designed to serve the interests of the US, has facilitated China's technological ascent. Yet, for developing countries, which do not have China's unique endowments, the US's digital techno political regime resulted in a hegemonic regime that adversely integrated smaller actors and economies and largely reproduced the unequal global division of labour (Murphy and Carmody, 2015; Kleibert and Mann, 2020). The globalised US internet regime failed to address the digital infrastructural gap while promoting the expansion of its platforms as extractive pipes for siphoning profits from user data, advertising revenues, and digital services back to the US, leaving little room for equitable economic benefits in the Global South (Ortiz-Freuler, 2023).

China's technopolitical regime departs from the US regime in several ways. The sociotechnical imaginaries, infrastructural norms, and values embedded in Chinese infrastructure contrast with the "open" paradigm that defines the US model. China's own regime prioritises concepts such as national security, data sovereignty, industrial capacity, and infrastructural building, inspired by China's own development playbook. As detailed in Chapter 4, these norms have been shaped by China's history of state-led industrialisation, emphasising self-reliance, indigenous innovation, and control over critical sectors. In this regard, the rise of a competing technopolitical regime, challenging the US hegemonic position, may offer promising avenues to developing countries seeking to leverage digital technologies for upgrading and moving up the economic transformation ladder. If there is no evidence that China is actively imposing its digital model on other countries – as argued in this dissertation and supported by other studies (Gagliardone, 2019; He, 2024; Oreglia and Zhang, 2024) – then its influence may be indirect. Developing countries may be voluntarily emulating China's approach because it has successfully achieved digital transformation while maintaining political control and stability, as suggested by Erie and Streinz (2021).

Building on the previous point, China's technopolitical regime places the state at the core of data governance, distinguishing it from the market-driven US model. Beijing's approach is defined by strong state oversight, where the government has a say over data flows and processing. This model aligns with China's broader strategy of embedding digital transformation within state-driven economic planning and national security priorities. This approach could in theory empower countries in the Global South with a history of colonial subjugation, seeking to have greater sovereignty over domestically generated data and increasing their ability to extract economic value from it (Fischer, 2022). This research found that China's engagement primarily facilitated superficial forms of data localisation, nonetheless, digital development and sovereignty in governance should not be understood as fixed, binary attributes but rather as dynamic and relative parameters that exist along a spectrum. They function as a "discursive practice" that shapes policy narratives and regulatory frameworks (Pohle and Thiel, 2021). The increasing recognition of the principle that strategic data should be stored and processed domestically may, over time, contribute to the strengthening of national data ecosystems, enhancing local capacities for data processing and domestic value capture.

Finally, and central to this thesis, unlike the US and EU who have largely adopted a top-down standardisation approach, focusing on international standard-setting bodies, China appears to be favouring a ground-up approach centred around infrastructural power (Rossiter, 2016; Erie and Streinz, 2021). As shown throughout this thesis, the cost-competitiveness of Chinese firms enables them to expand in developing markets and boost their technological influence through the dissemination of technical artefacts, processes, and standards embedded in physical components, training programmes and governance models. This dissertation echoes the findings of Rühlig and Brink (2021) who find that China is promoting its technical standards in BRI countries through package deals that encompass financing, design, and construction of railway infrastructure and telecom networks, that require the use of Chinese standards. The authors argue that with the BRI, China aims to internationalise its domestic technical standards "outside existing institutional frameworks" (Rühlig and Brink, 2021, p. 1197). Through this *de facto* standardisation approach Beijing can bypass traditional institutional mechanisms where it is underrepresented, allowing it to shape global technology landscapes by embedding its standards into the physical infrastructure it provides.

China's representation in secretariat roles across ISO and IEC technical committees is growing, though it still lags behind established powers in the transatlantic region (Rühlig, 2023). Chinese representatives are increasingly taking on leadership roles at the highest levels of these organisations. For instance, Zhang Xiaogang served as the first Chinese president of the International Organisation for Standardisation (ISO) from 2015 to 2018, and Shu Yinbiao began his tenure as president of the International Electrotechnical Commission (IEC) in 2020. Similarly, as mentioned earlier, Zhao Houlin held the position of General Secretary at the International Telecommunication Union (ITU) from 2015 until 2023. However, according to insiders, Chinese standard setters, being relatively new to these international communities of practice, still encounter challenges in navigating the complexities of global standardisation processes (Seaman, 2020). Consequently, China has been capitalising on its competitive advantage in delivering cost-effective ICT infrastructure to the Global South as a strategy to promote its domestic technical standards as *de facto* international norms.

If *de facto* standards on the ground are not legally binding, they hold enormously powerful implications in practice. The most obvious one is that the globalisation of China's digital firms and standards may create a new layer of technological dependence. As highlighted throughout the thesis, standards can lock customers into relying on products from a single supplier, particularly in the context of ICT components, where both hardware and software rely on established technical standards for maintenance and interoperability with other systems (Brunsson et al., 2012; Opra-Martins et al., 2016). For example, Apple's iOS operating system requires regular updates that only Apple can provide. To maintain their technological dominance, Western companies have long employed this strategy, and China has begun to follow suit. China's approach to standardisation across multiple sectors acts as a strategic method to block international competitors and secure long-term market dominance (Rühlig and Brink, 2021). Requiring compliance with specific technical standards that only Chinese companies meet effectively eliminates competitors whose products are incompatible. Huppenbauer (2023) explores this dynamic by analysing China's international standardisation efforts in autonomous driving, demonstrating how technical processes can be used to redefine political spaces to align with national interest.

In recent years, US actions targeting Chinese technologies and standards have further reduced interoperability within the global digital economy (Schneider-Petsinger et al., 2019). A prominent example is the US sanctions on Huawei, which disrupted the functionality of the

Android operating system on Huawei devices, compelling the Shenzhen-based company to develop its own operating system, Harmony OS (CNN Business, 2024). In the context of increasingly bifurcated digital systems, the absence of interoperability and economies of scale may hinder low- and middle-income countries from seamlessly integrating into global digital infrastructures and value chains, thereby reducing their competitiveness in global markets. This fragmentation risks creating digital silos or what Peck and Phillips (2020) have described as digital "fiefdoms", controlled by two mutually exclusive powers, exacerbating existing digital divides.

Over time, countries that become overly dependent on Chinese technological standards may face restricted access to a broader array of technologies from other regions. When countries become locked into a specific technological regime, transitioning to alternative systems or upgrading to emerging global standards in the future may become prohibitively expensive and inefficient. As Winner (1986) observed, technological innovations function much like fundamental laws or legislative frameworks, shaping societies and establishing the parameters for action. Their influence extends across generations, defining structural constraints and possibilities that shape long-term social, economic, and political trajectories. Thus, heavily aligning with one technopolitical regime could limit strategic autonomy and reduce pathways for future digital development.

However, this does not mean that developing countries are unable to move to more technologically sophisticated activities or capture greater value within the global digital economy, notwithstanding dominant technological constellations. In many ways, the rise of an alternative regime challenging the US hegemonic position, disrupts the status quo and creates new economic channels and avenues for developing countries. The growing competition between these two global powers, arguably provides developing countries with more bargaining power and a wider array of options for digital development. As I have argued, the impact of China's globalising ICT industry and the rivalry it has generated cannot be assumed based on preconceived ideas. Instead, only a deeper empirical engagement with the idiosyncratic contexts of different countries can reveal how these competing technological actors are shaping digital transitions and influencing development trajectories.

In light of China's rapid expansion in the global ICT market, the US sought to expand its influence by offering technology, loans, and capacity-building programmes aimed at

countering China's growing footprint. For instance, the US' bipartisan *Better Utilisation of Investments Leading to Development* (BUILD) Act, enacted under the first Trump administration, restructured US development finance mechanisms (Savoy, 2021). It established the US International Development Finance Corporation (DFC) to mobilise private capital for infrastructure and digital connectivity projects in emerging markets. Similarly, *Prosper Africa*, introduced in 2019, sought to deepen US-Africa trade and investment ties, with a focus on expanding infrastructure and supporting African businesses in integrating into global supply chains (Usman and Auth, 2022). Beyond the US, Western allies in the G7 launched the *Partnership for Global Infrastructure and Investment* (PGII) in 2022 as a direct response to China's BRI, aiming to provide a Western-led alternative for infrastructure financing in developing countries (Wintour, 2022). These initiatives collectively reflect Western countries' broader efforts to position themselves as key partners in the digital transformation of developing countries.

The return of the Trump administration in January 2025 has cast uncertainty over the continuity of these efforts. Early policy decisions suggest a sharp retrenchment, with proposed cuts to USAID and several development initiatives across the Global South (McCoy, 2025). This shift signals a de-prioritisation of development engagement in favour of a more transactional or security-driven foreign policy approach. Yet, despite this rollback, the strategic competition with China continues to shape US engagement abroad, albeit through different channels, such as export controls, tech alliances, and bilateral pressure. For developing countries that can skilfully navigate the rivalry, leveraging it to secure investment, negotiate better terms, or diversify partnerships, stand to benefit from the broader reconfiguration of global digital capitalism.

One of the most tangible benefits for developing countries is the ability to negotiate better terms for digital infrastructure projects. For instance, countries can negotiate lower borrowing costs, as the availability of multiple lenders – including Chinese policy banks, the US' DFC, and European development agencies – gives them leverage to secure more favourable interest rates and repayment conditions. Moreover, fearing to lose ground European firms and development agencies have ramped up their emphasis on technology transfers and capacity building initiatives (Lau and Cokelaere, 2021). Access to multiple sources of expertise and training programmes can consolidate domestic capabilities and boost local absorptive capacity. With China's BRI offering, developing countries now have more leverage in deciding which model

aligns better with their long-term goals. The variety of digital systems and providers creates an environment where governments in developing countries pragmatically engage with, and attract interest from, a wide range of stakeholders and partners, including but not limited to Chinese entities, in their pursuit of digital transformation. This dynamic within the global political economy provides political elites in these countries with a limited yet meaningful degree of "agency of choice". Ultimately, the developmental outcomes of this rivalry will largely depend on factors such as market size, local skills, the capabilities of domestic firms and economies, as well as broader political economy dynamics.

8.3 Digital industrial policy in an era of tech wars

Moving forward, governments across the Global South tasked with managing the transition towards increasingly digitally mediated economies and societies must navigate global tensions and leverage their policy space to carve out industrial policies that promote domestic capabilities and innovation. Such policies require a delicate balance between attracting foreign investment and cultivating homegrown technological capabilities. To do so, governments must establish frameworks that incentivise knowledge transfer, foster collaboration between local firms and multinational corporations, and protect national interests through robust data governance regulations. The crux would be in balancing immediate infrastructural needs with long term strategies to build thriving, inclusive, and independent digital economies.

Amid escalating geopolitical tensions, developing countries must prioritise the cultivation of strategic autonomy, that is the ability for countries to make and implement decisions independently, without excessive reliance on external powers, particularly in critical sectors such as defence, technology, and the digital economy. It encompasses the capacity to safeguard national interests, reduce vulnerabilities to external pressures, and maintain control over key infrastructures and resources. Various policy instruments and regulatory frameworks can be deployed to bolster strategic autonomy in the digital sector while simultaneously nurturing dynamic and self-sustaining digital economies.

First, leaders in developing countries must prioritise technological diversification by avoiding dependence on a single provider and instead adopting a multi-vendor approach. This strategy mitigates the risks of technological lock-in, where reliance on a single supplier restricts future choices and increases vulnerability to price manipulation, sanctions, and geopolitical pressures

from the two dominant digital powers (Jura et al., 2024). By fostering competition among multiple vendors, governments can negotiate better terms, lower costs, and enhance the quality of digital infrastructure. This diversification allows developing countries to maintain a degree of autonomy, ensuring that digital choices are driven primarily by developmental priorities rather than geopolitical alignments (Soulé, 2024).

Second, a fundamental step in fostering resilient and dynamic digital economies is investing in domestic capability development. This entails ensuring that foreign firms establish meaningful linkages with the local economy and actively contribute to knowledge and technology transfer. For horizontal linkages, as the wage premiums offered by MNCs were found to hinder labour turnover, strengthening horizontal linkages may require host governments to introduce financial incentives to help local private and public tech firms align with the salaries and remuneration packages offered by tech MNCs. Such policies would promote labour turnover and poaching, especially of managers, a mechanism long recognised as powerful in promoting domestic innovation and increasing productivity (Beaudry and Francois, 2010; Fu, 2012). Learning from China's own development experience, policies could ensure that emerging tech champions have sufficient financial resources to hire top talents and adopt cutting-edge technical and managerial practices.

To promote vertical linkages – and backward linkages in particular – policies should seek to include local firms in large ICT infrastructure projects to boost learning from foreign digital firms. One way of achieving this would be by requiring consortium bidding between local and foreign firms. Tender winners would have to divide the tasks between them with well-defined compensations for each party and clearly set terms for technology transfers. Furthermore, while joint venture requirements, when feasible, have proven to be powerful vehicles for technology transfer, the case of Huawei's factory in Algiers indicates that without broader local content requirements, these are unlikely to yield noteworthy learning opportunities.

Third, enhancing digital skills is essential for strengthening domestic digital economies and enabling them to seize emerging opportunities arising from tech rivalries. Investing in digital skills development needs to go beyond basic digital literacy to ensure training programmes equip students and workers with advanced competencies such as data processing, coding, software development, and AI applications. This could help countries move from thin ICT integration, a superficial or minimal adoption of digital technologies, often focused on basic infrastructure without substantial local economic transformation, to thicker or deeper

integration of new ICTs associated with improvements in productivity and competitiveness (Murphy and Carmody, 2015).

Importantly, university curricula should avoid excessive reliance on ICT corporate training and ensure that educational content remains broad, adaptable, and system-agnostic. If university-industry linkages can provide valuable insights, curricula should prioritise foundational knowledge, critical thinking, and cross-platform competencies to equip students with the flexibility to work across different technologies and evolving digital ecosystems. Policies should support universities to improve their internal scientific base, develop indigenous R&D capabilities and adopt programmes that are in phase with technological innovations, rather than leaving them to become fighting grounds between large foreign tech firms. Beyond formal education, vocational training and continuous learning programmes are crucial for reskilling workers in rapidly evolving digital industries. This includes offering courses, boot camps, and certification programmes in software development, cloud computing, and data analytics. Brazil's SENAI (National Service for Industrial Training) provides a strong model for industry-aligned digital skills development (Oliveira et al., 2021). Designed in close collaboration with industry, SENAI's curriculums adapt quickly to technological trends and employer needs, ensuring learners gain immediately relevant and applied technical expertise.

While upgrading skills is essential to capturing greater value from the digital economy, it must be embedded within a broader strategy for industrial development and skills enhancement. Industrial policies should not be confined to the digital economy as a standalone sector but should be integrated across key industries. In many African countries, for instance, agriculture employs the largest workforce and accounts for the highest share of GDP. A well-designed digital industrial policy would focus on enhancing capabilities within this sector, leveraging both digital and traditional technologies (Mann and Iazzolino, 2021). Without such capabilities, countries risk becoming passive consumers of imported technologies rather than active participants in shaping the digital economy. Strengthening domestic capabilities also enhances a country's bargaining power in global value chains, allowing it to retain greater value within its borders. These investments must go beyond narrow, short-term objectives and prioritise long-term structural transformation.

Finally, the ability to implement industrial policies will vary across countries, depending on their economic and geopolitical positioning. Smaller economies, particularly developing or

landlocked nations, may have limited individual leverage but can benefit significantly from regional integration. By pooling resources, harmonising regulations, and strengthening collective bargaining power, regional blocks can better navigate and respond to pressures from dominant technological regimes. For instance, a larger, unified market would strengthen African countries' bargaining power with multinational digital corporations, reducing their vulnerability in bilateral negotiations and enabling more equitable agreements. Initiatives like the African Continental Free Trade Area (AfCFTA) and the proposed Digital Single Market (DSM) for Africa, targeted for full implementation by 2030, represent significant steps in this direction (Fafunwa and Odufuwa, 2022). These efforts aim to bolster digital trade and services across member states. Harmonising policies on data flows, cybersecurity, and industrial strategies with a regional outlook can empower governments to build resilient, innovative digital economies that drive job creation and long-term inclusive economic growth. At the same time, robust competition policies are essential to regulate dominant players in both the tech sector and broader markets, ensuring that the digitised collection and use of market data do not lead to unfair advantages for large firms.

In any case, governments across the Global South would be wise to assert, where possible, the freedom to experiment with diverse industrial policies—especially in light of the limited empirical evidence on optimal pathways to digital development amidst intensifying tech rivalries, fierce market competition, and the path dependencies embedded in digital infrastructures. After all, as Hirschman reminds us, “development is essentially the record of how one thing leads to another” (Hirschman, 1977, p. 169). Embracing this approach could allow for iterative learning and adaptation, enabling governments to tailor their strategies to the rapidly evolving global digital economy.

8.4 Future research

This thesis lays the groundwork for further research in several key areas. Perhaps the most immediate avenue for future research would be to expand the analysis beyond Algeria and Egypt to examine how Chinese digital capital is reshaping the ICT sectors of countries with different political economies. By broadening the empirical scope to diverse political and economic contexts, future studies could provide a more comprehensive understanding of the role of Chinese firms in global digital transformations. Adopting the technopolitics lens provides analytical tools to move beyond both abstract macro-geopolitical accounts and depoliticised narratives. This perspective enables a more nuanced examination of socio-

technical linkages and power dynamics at the ground level. Here, and as highlighted by Heeks et al. (2024), there is a notable need of more Southern voices in studies investigating the globalisation of China's digital industry and its effects. This could help increase primary research that draws directly on evidence from Global South stakeholders, and a greater focus on individual countries' agency. Such research would also contribute to broader debates on the relationship between foreign digital investments, state capacity, and the possibilities for alternative development pathways.

The focus of this study was on the mechanisms of standard diffusion on the ground. But more research is needed on China's role in shaping formal standard-setting processes within international institutions such as the ITU and other key regulatory bodies. Understanding the interplay between China's bottom-up and top-down strategies in standard diffusion. How do infrastructure projects on the ground contribute to Beijing's broader agenda in international standard-setting institutions? To what extent does the widespread adoption of Chinese-built ICT infrastructure create incentives for countries to align with Chinese-backed standards at the global level? This research would provide valuable insights into the evolving geopolitics of technology and the shifting dynamics of digital standard- setting in an era of intensified global competition.

Furthermore, it would be important to assess the impact of US-imposed export bans on technological components, not only on China but also on third countries, particularly in the context of efforts to prevent Beijing from circumventing these restrictions. Empirical research could provide valuable insights into how these sanctions are restructuring GVCs, particularly in the semiconductor and AI industries. By mapping shifts in production networks, investment patterns, and supply chain dependencies, scholars could assess the extent to which firms in third countries are repositioning themselves in response to these restrictions. This includes examining whether certain states are emerging as alternative manufacturing or research hubs, benefiting from the fragmentation of pre-existing technological hierarchies. The reconfiguration of supply chains and trade relationships could create new avenues for industrial upgrading, technological spillovers, and local capacity-building. This investigation could help us shed light on the development prospects that may arise for third countries as a result of export bans, tariffs and mounting technological competition.

Relating to this, the growing digital rivalry between China and the US has significant implications for the green transition. As the digital economy expands, so too does its

environmental footprint, from the energy-intensive data centres, and the increasing demand for rare earth minerals used in ICT hardware. Moreover, the efforts by the US and EU to curb China's rise as a leading digital and green power have led to high tariffs on Chinese electric vehicle (EV) production, and smart grid development. Further research is needed to explore how the geopolitical competition is accelerating or hindering the adoption of cleaner technologies, particularly in developing countries that are sites of both resource extraction and digital infrastructure deployment.

At the time of writing this dissertation's conclusion in January 2025, Deepseek, a Chinese AI company went live, creating a watershed moment and calling into question whether American firms would dominate the booming AI market, as many had assumed. DeepSeek's models are said to be as capable as those from OpenAI, ChatGPT parent firm, but at a radically lower cost. Forced to work under the US ban on advanced NVIDIA chips, the Chinese AI firm developed its model using fewer chips than its rivals. This raised questions over a multibillion-dollar AI spending spree by US companies, leading experts to describe the advent of Deepseek as akin to a "Sputnik moment" in the AI race (Milmo et al., 2025).

This development is particularly significant given that AI has long been seen as an inherently capital-intensive field; one reliant on cutting-edge semiconductors, immense computing power, and vast financial resources. As a result, AI research and deployment were largely assumed to be the preserve of wealthy nations and a handful of dominant tech firms. By showing that advanced AI can be developed without exclusive access to the most sophisticated chips or proprietary models, DeepSeek has helped pave the way for a more democratised form of AI innovation. Crucially, by open-sourcing its code, it has created opportunities for firms in developing countries to build AI applications tailored to their own economic and social contexts. Future research could examine how Chinese AI models are lowering barriers to entry for developers in the Global South, and how this may drive the emergence of industry-specific, locally adapted AI solutions. Such developments could boost productivity and enable developing countries to move from passive users of AI to active innovators. Studying how these firms adapt and refine open-source models for local needs may offer insight into their capacity to create competitive applications with regional or even global reach. This, in turn, raises important questions about whether open-source AI can disrupt existing innovation hierarchies and support technological catch-up in the Global South.

Bibliography

Abbate, J. (1999). *Inventing the internet*. MIT Press.

Abdel Ghafar, A., & Jacobs, A. (2019). *Beijing calling: Assessing China's growing footprint in North Africa*. Brookings Institution. https://www.brookings.edu/research/beijing-calling-assessing-chinas-growing-footprint-in-north-africa/

Abdulla, R. A. (2007). *The internet in the Arab world: Egypt and beyond*. Peter Lang.

Adams, W. C. (2015). Conducting semi-structured interviews. In *Handbook of practical program evaluation* (pp. 492–505). John Wiley & Sons. https://doi.org/10.1002/9781119171386.ch19

Adly, A. (2021). Authoritarian restitution in bad economic times: Egypt and the crisis of global neoliberalism. *Geoforum*, *124*, 290–299. https://doi.org/10.1016/j.geoforum.2020.01.001

AfricaNews. (2016, January 20). Algeria and China sign $3.3 billion port deal. *Africanews*. https://www.africanews.com/2016/01/20/algeria-and-china-sign-33-billion-port-deal/

AFTE. (2018, June 20). Egyptian Parliament approves cybercrime law legalizing the blocking of websites and full surveillance of Egyptians. *Association of Freedom of Thought and Expression*. https://afteegypt.org/en/advocacy-en/joint-statements-en/2018/06/20/15358-afteegypt.html

Agarwala, N., & Chaudhary, R. D. (2021). 'Made in China 2025': Poised for success? *India Quarterly*, *77*(3), 424–461. https://doi.org/10.1177/09749284211027250

Agbebi, M. (2018). China in Africa's telecom sector: Opportunities for human capital development? A case of Huawei in Nigeria. *Human Resource Development International*, *21*(5), 532–551. https://doi.org/10.1080/13678868.2018.1512232

Agbebi, M. (2019). Exploring the human capital development dimensions of Chinese investments in Africa: Opportunities, implications and directions for further research. *Journal of Asian and African Studies*, *54*(2), 189–210. https://doi.org/10.1177/0021909618801381

Agence Ecofin. (2018). Telecom annonce le lancement de la fibre optique à domicile. *Agence Ecofin*. https://www.agenceecofin.com/operateur/3101-53922-algerie-telecom-annonce-le-lancement-de-la-fibre-optique-a-domicile

Agence Ecofin. (2019a, August 9). Telecom Egypt signs new deal with Huawei, ZTE and China Telecom. *Ecofin Agency*. https://www.ecofinagency.com/telecom/0908-40385-telecom-egypt-signs-new-deal-with-huawei-zte-and-china-telecom

Agence Ecofin. (2019b, January 28). L'Algérie abrite la toute première usine africaine de Huawei, opérationnelle depuis le 22 janvier 2019. *Agence Ecofin*. https://www.agenceecofin.com/investissement/2801-63550-l-algerie-abrite-la-toute-premiere-usine-africaine-de-huawei-operationnelle-depuis-le-22-janvier-2019

Ahmaid, I. (2021). *What stands behind the balanced ratio of male/female students in the Algerian STEM education despite the country's low gender equity?* [Master's thesis, University of Agder]. UiA Brage. https://uia.brage.unit.no/uia-xmlui/handle/11250/2828260

Ahmed, U., & Chander, A. (2015). *Information goes global: Protecting privacy, security, and the new economy in a world of cross-border data flows* (SSRN Scholarly Paper No. 2731888). https://papers.ssrn.com/abstract=2731888

Ahram. (2022, August 17). China's Oppo to establish mobile phone factory in Egypt. *Ahram Online*. https://english.ahram.org.eg/NewsContent/3/1239/476012/Business/Tech/China%E2%80%99s-Oppo-to-establish-mobile-phone-factory-in-.aspx

Aissaoui, A. (2001). *Algeria: The political economy of oil and gas* (1st ed.). Oxford University Press.

Aitken, B. J., & Harrison, A. E. (1999). Do domestic firms benefit from direct foreign investment? Evidence from Venezuela. *American Economic Review*, *89*(3), 605–618. https://doi.org/10.1257/aer.89.3.605

Akamatsu, K. (1962). A historical pattern of economic growth in developing countries. *The Developing Economies*, *1*(s1), 3–25. https://doi.org/10.1111/j.1746-1049.1962.tb01020.x

Aker, J. C., & Mbiti, I. M. (2010). Mobile phones and economic development in Africa. *Journal of Economic Perspectives*, *24*(3), 207–232. https://doi.org/10.1257/jep.24.3.207
Algerie360. (2017). Parrainé par Houda-Imane Faraoun, un gros contrat Algérie-Télécom-Huawei suscite de fortes suspicions. *Algerie360*. https://www.algerie360.com/parraine-par-houda-imane-faraoun-un-gros-contrat-algerie-telecom-huawei-suscite-de-fortes-suspicions/
Al-Sisi, A. F. (2014, September 16). President Abdel Fattah Al-Sisi to Daily News Egypt: Egypt's blueprint for stability, investment and growth. *Daily News Egypt*. http://www.dailynewsegypt.com/2014/09/16/egypts-blueprint-stability-investment-growth-president-abdel-fattah-el-sisi/
Amanor, K. S., & Chichava, S. (2016). South–South cooperation, agribusiness, and African agricultural development: Brazil and China in Ghana and Mozambique. *World Development*, *81*, 13–23. https://doi.org/10.1016/j.worlddev.2015.11.021
Amendolagine, V., Boly, A., Coniglio, N. D., Prota, F., & Seric, A. (2013). FDI and local linkages in developing countries: Evidence from Sub-Saharan Africa. *World Development*, *50*, 41–56. https://doi.org/10.1016/j.worlddev.2013.05.001
Amsden, A. (2001). *The rise of "the rest": Challenges to the West from late-industrializing economies*. Oxford University Press. https://oxford.universitypressscholarship.com/view/10.1093/0195139690.001.0001/acprof-9780195139693
Amsden, A. H. (1989). *Asia's next giant: South Korea and late industrialization*. Oxford University Press.
Amsden, A. H. (1990). Third World industrialization: 'Global Fordism' or a new model? *New Left Review*, *I/182*, 5–31.
Amsden, A. H., & Hikino, T. (1993). Borrowing technology or innovating: An exploration of the two paths to industrial development. In R. Thomson (Ed.), *Learning and technological change* (pp. 243–266). Palgrave Macmillan UK. https://doi.org/10.1007/978-1-349-22855-3_13
Anand, N., Gupta, A., & Appel, H. (Eds.). (2018). *The promise of infrastructure*. Duke University Press.
Antwi-Boateng, O. (2017). New world order neo-colonialism: A contextual comparison of contemporary China and European colonization in Africa. *The Journal of Pan African Studies*, *10*(2), 177–195.
Aoude, I. G. (1994). From national bourgeois development to "infitah": Egypt 1952-1992. *Arab Studies Quarterly*, *16*(4), 1–23.
APS. (2021a). L'augmentation du débit Internet minimum réalisée grâce à d'énormes investissements [The increase in minimum Internet speed achieved thanks to massive investments.]. *Algérie Presse Service*.
APS. (2021b). L'Algérie déterminée à défendre sa souveraineté numérique [*Algeria determined to defend its digital sovereignty.* Algérie Presse Service]. *Algérie Presse Service*. https://www.aps.dz/algerie/126093-contenus-mediatiques-attentatoires-aux-interets-nationaux-l-algerie-determinee-a-defendre-sa-souverainete-numerique
APS. (2021c). Former minister Houda Faraoun sentenced to 3 years in prison [Former minister Houda Faraoun sentenced to 3 years in prison]. *Algérie Presse Service. Algérie Presse Service*. https://www.aps.dz/en/algeria/41287-former-minister-houda-faraoun-sentenced-to-3-years-in-prison
APS. (2023). Communiqué du Conseil des ministres [Council of Ministers communiqué]. *Algérie Presse Service*. https://www.aps.dz/algerie/156869-communique-du-conseil-des-ministres
Arabeche, Z. (2022). The actions carried out by the Cyberparc incubator of Sidi Abdellah during the period of 2010–2020: State of play and perspectives. *Economics and Business*, *36*(1), 17–33. https://doi.org/10.2478/eb-2022-0002
Arsel, M., Adaman, F., & Saad-Filho, A. (2021). Authoritarian developmentalism: The latest stage of neoliberalism? *Geoforum*, *124*, 261–266. https://doi.org/10.1016/j.geoforum.2021.05.003
Arsène, S. (2015). Internet domain names in China: Articulating local control with global connectivity. *China Perspectives*, *2015*(4), 25–34.

Arthur, W. B. (1989). Competing technologies, increasing returns, and lock-in by historical events. *The Economic Journal*, *99*(394), 116–131.
Atkinson, R. D. (2020). *How China's mercantilist policies have undermined global innovation in the telecom equipment industry*. Information Technology and Innovation Foundation. https://itif.org/publications/2020/06/22/how-chinas-mercantilist-policies-have-undermined-global-innovation-telecom/
Aubert, J.-E., & Reiffers, J.-L. (2003). *Knowledge economies in the Middle East and North Africa: Toward new development strategies*. World Bank Publications.
Auffray, C., & Fu, X. (2015). Chinese MNEs and managerial knowledge transfer in Africa: The case of the construction sector in Ghana. *Journal of Chinese Economic and Business Studies*, *13*(4), 285–310. https://doi.org/10.1080/14765284.2015.1092415
Austin, G. (2008). The 'reversal of fortune' thesis and the compression of history: Perspectives from African and comparative economic history. *Journal of International Development*, *20*(8), 996–1027. https://doi.org/10.1002/jid.1510
Avgerou, C. (2002). *Information systems and global diversity*. Oxford University Press.
Azmeh, S., & Elshennawy, A. (2020). *North Africa's export economies and structural fragility: The limits of development through European value chains* (Paper No. 42). LSE Middle East Centre. http://www.lse.ac.uk/middle-east-centre/publications/paper-series
Azmeh, S., Foster, C., & Echavarri, J. (2020). The international trade regime and the quest for free digital trade. *International Studies Review*, *22*(3), 671–692. https://doi.org/10.1093/isr/viz033
Baah, A. Y., & Jauch, H. (2009). *Chinese investments in Africa: A labour perspective*. African Labour Research Network.
Babalola, O. (2024). Transborder flow of personal data (TDF) in Africa: Stocktaking the ills and gains of a divergently regulated business mechanism. *Computer Law & Security Review*, *52*, 105940.
Bacha, R., & Gasmi, F. (2022). *The broadband diffusion process and its determinants in Algeria: A simultaneous estimation*. Toulouse School of Economics. https://publications.ut-capitole.fr/id/eprint/44430/
Badran, A. (2012). The rationale behind the creation and diffusion of independent regulatory agencies: The case of the telecommunications sector in Egypt. *International Journal of Public Administration*, *35*(3), 204–213. https://doi.org/10.1080/01900692.2012.638521
Banga, K., Harbansh, P., & Singh, S. (2023). Digital de-industrialization, global value chains, and structural transformation: Empirical evidence from low- and middle-income countries. WIDER Working Paper 2023/65. Helsinki: UNU-WIDER. https://doi.org/10.35188/UNU-WIDER/2023/373-4
Baldakova, O., & Oreglia, E. (2025). Beyond geopolitics: Agency and modularity in mobile telecommunications in Kazakhstan. *Telecommunications Policy*, *49*(2), 102878. https://doi.org/10.1016/j.telpol.2024.102878
Baldwin, R. (2019). *The great convergence: Information technology and the new globalization* (Reprint ed.). Harvard University Press.
Baniya, S., Rocha, N., & Ruta, M. (2020). Trade effects of the New Silk Road: A gravity analysis. *Journal of Development Economics*, *146*, 102467.
Baron, J., & Kanevskaia Whitaker, O. (2021). *Global competition for leadership positions in standards development organizations* (SSRN Scholarly Paper No. 3818143). https://doi.org/10.2139/ssrn.3818143
Barrett, C. B., & Carter, M. R. (2010). The power and pitfalls of experiments in development economics: Some non-random reflections. *Applied Economic Perspectives and Policy*, *32*(4), 515–548. https://doi.org/10.1093/aepp/ppq023
Barzic, G. (2019, May 7). Europe's 5G to cost $62 billion more if Chinese vendors banned-telcos. *Reuters*. https://www.reuters.com/article/us-europe-telecoms-huawei-costs/europes-5g-to-cost-62-billion-more-if-chinese-vendors-banned-telcos-idUSKCN1T80XL
Baum, R. (2019). *China's four modernizations: The new technological revolution*. Routledge.
Bayliss, K., & Van Waeyenberge, E. (2017). Unpacking the public private partnership revival. *The Journal of Development Studies*, *54*(4), 577–593. https://doi.org/10.1080/00220388.2017.1303671
BBC. (2018, August 18). Egypt internet: Sisi ratifies law tightening control over websites. *BBC News*. https://www.bbc.com/news/world-middle-east-45237171

Beattie, A. (2019, June 18). Technology: How the US, EU and China compete to set industry standards. *Financial Times*. https://www.ft.com/content/0c91b884-92bb-11e9-aea1-2b1d33ac3271

Beaudry, P., & Francois, P. (2010). Managerial skills acquisition and the theory of economic development. *The Review of Economic Studies*, *77*(1), 90–126. https://doi.org/10.1111/j.1467-937X.2009.00571.x

Belloumi, M., & Touati, K. (2022). Do FDI inflows and ICT affect economic growth? An evidence from Arab countries. *Sustainability*, *14*(10), 6293. https://doi.org/10.3390/su14106293

Beladi, R. (2023, March 15). Algeria: The abolition of the 49/51% law alone is not sufficient to attract significant investment. *International Supermarket News*. https://internationalsupermarketnews.com/algeria-the-abolition-of-the-49-51-law-alone-is-not-sufficient-to-attract-significant-investment/

Bennoune, M. (2002). *The making of contemporary Algeria, 1830-1987* (Vol. 19). Cambridge University Press.

Bernard, M., & Ravenhill, J. (1995). Beyond product cycles and flying geese: Regionalization, hierarchy, and the industrialization of East Asia. *World Politics*, *47*(2), 171–209.

Bertot, J. C., Jaeger, P. T., & Grimes, J. M. (2010). Using ICTs to create a culture of transparency: E-government and social media as openness and anti-corruption tools for societies. *Government Information Quarterly*, *27*(3), 264–271. https://doi.org/10.1016/j.giq.2010.03.001

Bhalla, N. (2021, February 1). 'Digital authoritarianism' threatening basic rights in Africa, study says. *Reuters*. https://www.reuters.com/article/us-rights-privacy-africa-trfn-idUSKBN2AW0YS

Biernacki, P., & Waldorf, D. (1981). Snowball sampling: Problems and techniques of chain referral sampling. *Sociological Methods & Research*, *10*(2), 141–163. https://doi.org/10.1177/004912418101000205

Bircan, Ç., & De Haas, R. (2020). The limits of lending? Banks and technology adoption across Russia. *Review of Financial Studies*, *33*(2), 536–609.

Blalock, G., & Gertler, P. J. (2008). Welfare gains from foreign direct investment through technology transfer to local suppliers. *Journal of International Economics*, *74*(2), 402–421. https://doi.org/10.1016/j.jinteco.2007.05.011

Blanchette, J., & Hillman, J. E. (2020, April 8). *China's Digital Silk Road after the coronavirus*. Center for Strategic and International Studies. https://www.csis.org/analysis/chinas-digital-silk-road-after-coronavirus

Blomstrom, M., & Kokko, A. (2001). Foreign direct investment and spillovers of technology. *International Journal of Technology Management*, *22*(5–6), 435–454. https://doi.org/10.1504/IJTM.2001.002972

Borgman, C. L. (2007). *Scholarship in the digital age: Information, infrastructure, and the internet*. MIT Press.

Bou Nassif, H. (2017). Coups and nascent democracies: The military and Egypt's failed consolidation. *Democratization*, *24*(1), 157–174. https://doi.org/10.1080/13510347.2016.1142533

Bouchikhi, F., & Zine, B. (2017). *Higher education in Algeria: Achievements and challenges-1963 to 2017*. UBT International Conference. https://knowledgecenter.ubt-uni.net/conference/2017/all-events/115/

Bradford, A. (2020). *The Brussels effect: How the European Union rules the world*. Oxford University Press. https://scholarship.law.columbia.edu/books/232

Brautigam, D. (1993). South-south technology transfer: The case of China's Kpatawee rice project in Liberia. *World Development*, *21*(12), 1989–2001. https://doi.org/10.1016/0305-750X(93)90071-G

Brautigam, D. (2009). *The dragon's gift: The real story of China in Africa*. Oxford University Press.

Brautigam, D. (2011). Aid 'with Chinese characteristics': Chinese foreign aid and development finance meet the OECD-DAC aid regime. *Journal of International Development*, *23*(5), 752–764. https://doi.org/10.1002/jid.1798

Brautigam, D. (2015). *Will Africa feed China?* Oxford University Press.

Brautigam, D., & Tang, X. (2011). African Shenzhen: China's special economic zones in Africa. *The Journal of Modern African Studies*, *49*(1), 27–54. https://doi.org/10.1017/S0022278X10000649

Brautigam, D., Weis, T., & Tang, X. (2018). Latent advantage, complex challenges: Industrial policy and Chinese linkages in Ethiopia's leather sector. *China Economic Review*, *48*, 158–169. https://doi.org/10.1016/j.chieco.2016.06.006

Breznitz, D., & Murphree, M. (2012). *Shaking grounds? Technology standards in China*. National Academy of Sciences. https://sites.nationalacademies.org/cs/groups/pgasite/documents/webpage/pga_072292.pdf

Brunsson, N., Rasche, A., & Seidl, D. (2012). The dynamics of standardization: Three perspectives on standards in organization studies. *Organization Studies*, *33*(5–6), 613–632. https://doi.org/10.1177/0170840612450120

Buckley, P. J. (2020). China's Belt and Road Initiative and the COVID-19 crisis. *Journal of International Business Policy*, *3*(3), 311–314. https://doi.org/10.1057/s42214-020-00063-9

Buckley, R. P., & Zhou, W. (2013). Navigating adroitly: China's interaction with the global trade, investment, and financial regimes. *East Asia Law Review*, *9*(1), 1–41.

Burman, A., & Sharma, U. (2021). *How would data localization benefit India?* Carnegie India.

Burns, R. (2015). Rethinking big data in digital humanitarianism: Practices, epistemologies, and social relations. *GeoJournal*, *80*(4), 477–490.

Cabling. (2013). Huawei advances embedded OTDR design. *Cabling Installation & Maintenance*. https://www.cablinginstall.com/design-install/article/16474484/huawei-advances-embedded-otdr-design

Calabrese, L., & Tang, X. (2020). *Africa's economic transformation: The role of Chinese investment* (Synthesis Report). Overseas Development Institute. https://odi.org/documents/7926/DEGRP-Africas-economic-transformation-the-role-of-Chinese-investment-Synthesis-report.pdf

Camba, A., Lim, G., & Gallagher, K. (2022). Leading sector and dual economy: How Indonesia and Malaysia mobilised Chinese capital in mineral processing. *Third World Quarterly*, *43*(10), 2375–2395. https://doi.org/10.1080/01436597.2022.2093180

Carmody, P. (2013). A knowledge economy or an information society in Africa? Thintegration and the mobile phone revolution. *Information Technology for Development*, *19*(1), 24–39. https://doi.org/10.1080/02681102.2012.719859

Carmody, P. (2024). 'Digital provide' or product consumption diffusion cycle? The diffusion impact and potential of digital technology in the Global South. *Information Technology for Development*, 1–14. https://doi.org/10.1080/02681102.2024.2368539

Carmody, P., & Wainwright, J. (2022). Contradiction and restructuring in the Belt and Road Initiative: Reflections on China's pause in the 'Go world'. *Third World Quarterly*, *43*(12), 2830–2851. https://doi.org/10.1080/01436597.2022.2110058

Carmody, P., Taylor, I., & Zajontz, T. (2021). China's spatial fix and 'debt diplomacy' in Africa: Constraining belt or road to economic transformation? *Canadian Journal of African Studies*, *55*(3), 444–464. https://doi.org/10.1080/00083968.2020.1868014

Castells, M., & Himanen, P. (2014). *Reconceptualizing development in the global information age*. Oxford University Press.

CCCPC. (2016). *The 13th Five-Year Plan for Economic and Social Development of the People's Republic of China—2016–2020*. National Development and Reform Commission. https://en.ndrc.gov.cn/newsrelease_8232/201612/P020191101481868235378.pdf

CCP. (2017). *Cybersecurity Law of the People's Republic of China* (English Translation). International Association of Privacy Professionals. https://iapp.org/resources/article/cybersecurity-law-of-the-peoples-republic-of-china-english-translation/

CCP. (2020, April 9). Opinions of the Central Committee of the Communist Party of China and the State Council on improving the market-based allocation mechanism of production factors [中共中央 国务院关于构建更加完善的要素市场化配置体制机制的意见]. *The State Council of the People's Republic of China*. http://www.gov.cn/zhengce/2020-04/09/content_5500622.htm

CDB News. (2017, March 9). The 3rd investing in Africa forum wrapping up in Dakar—CDB investing and financing more than USD 50 billion in Africa. *China Development Bank*. http://www.cdb.com.cn/English/xwzx_715/khdt/201803/t20180309_4998.html

CEIC. (2024). *Egypt teledensity: Fixed line, 1960–2024*. CEIC Data. https://www.ceicdata.com/en/indicator/egypt/teledensity-fixed-line

CGTN. (2019, May 17). ITU secretary-general: BRI helps narrow world digital divide. *China Global Television Network*. https://news.cgtn.com/news/3d3d674e31597a4d34457a6333566d54/index.html

Chalk, W. (2019, July 2). China's digital imperialism: Shaping the global internet. *The China Project*. https://thechinaproject.com/2019/07/02/chinas-digital-imperialism-shaping-the-global-internet/

Chan, G. (2022). *China's digital silk road: Setting standards, powering growth*. Edward Elgar Publishing.

Chan, J. H. (2019, November 14). All may not be smooth along China's digital silk road. *Lowy Institute*. https://www.lowyinstitute.org/the-interpreter/all-may-not-be-smooth-along-china-s-digital-silk-road

Chander, A., & Le, U. P. (2014). *Breaking the web: Data localization vs. the global internet* (SSRN Scholarly Paper No. 2407858). https://papers.ssrn.com/abstract=2407858

Chang, H.-J. (1993). The political economy of industrial policy in Korea. *Cambridge Journal of Economics*, *17*(2), 131–157. https://doi.org/10.1093/oxfordjournals.cje.a035227

Chang, H.-J. (2002). *Kicking away the ladder: Development strategy in historical perspective* (1st ed.). Anthem Press.

Chang, H.-J. (2010). Hamlet without the Prince of Denmark: How development has disappeared from today's 'development' discourse. In S. Khan & J. Christiansen (Eds.), *Towards new developmentalism: Market as means rather than master* (pp. 47–59). Routledge.

Chao, L. (2009, March 17). China's telecom-gear makers, once laggards at home, pass foreign rivals. *Wall Street Journal*. https://www.wsj.com/articles/SB123932068946706913

Chatwin, J. (2024). *The southern tour: Deng Xiaoping and the fight for China's future*. Bloomsbury Publishing.

Chaudhuri, A., Flamm, K. S., & Horrigan, J. (2005). An analysis of the determinants of internet access. *Telecommunications Policy*, *29*(9), 731–755. https://doi.org/10.1016/j.telpol.2005.07.001

Chen, B.-M. (2021). *Digital Leninism: The complex, dangerous relationship between tech giants and the Chinese Communist Party*. Center for International Private Enterprise. https://www.cipe.org/resources/digital-leninism-the-complex-dangerous-relationship-between-tech-giants-and-the-chinese-communist-party/

Chen, J. (2018). Strategic synergy between Egypt "Vision 2030" and China's "Belt and Road" initiative. *Outlines of Global Transformations: Politics, Economics, Law*, *11*(5), 219–235.

Chen, X., Fang, H., Liu, Y., & Zhang, Y. (2022). Does Chinese policy banks' overseas lending favor Belt Road Initiative countries? *International Studies of Economics*, *17*(4), 430–458. https://doi.org/10.1002/ise3.8

Chen, Y., & Landry, D. (2018). Capturing the rains: Comparing Chinese and World Bank hydropower projects in Cameroon and pathways for South-South and North South technology transfer. *Energy Policy*, *115*, 561–571.

Cheng, J., & Zeng, J. (2024). "Digital Silk Road" as a slogan instead of a grand strategy. *Journal of Contemporary China*. https://www.tandfonline.com/doi/abs/10.1080/10670564.2023.2222269

Chenley, C. (2019). *China's digital aid: The risks and rewards*. Council on Foreign Relations. https://www.cfr.org/china-digital-silk-road

Chhetri, P., Gekara, V., Li, S., & Lee, J. Y. (2020). Changing global production network and its implication on Belt and Road Initiative. *Journal of International Logistics and Trade*, *18*(1), 13–14. http://dx.doi.org/10.24006/jilt.2020.18.1.013

Chin, G. T., & Gallagher, K. P. (2019). Coordinated credit spaces: The globalization of Chinese development finance. *Development and Change*, *50*(1), 245–274. https://doi.org/10.1111/dech.12470

China Foreign Exchange Trade System. (2023). *New version of the China Interbank Bond Market handbook (2023)*. https://iftp.chinamoney.com.cn/english/svcnrl/20231110/2750976.html

Christl, W., Kopp, K., & Riechert, P. U. (2017). *Corporate surveillance in everyday life*. Cracked Labs.

Chung, P. (2017). *Building global capitalism: Militarization, standardization, and US-South Korean relations, 1950-present* [Doctoral dissertation, Brown University]. https://doi.org/10.7301/Z0PR7TDT

Cinnamon, J. (2020). Data inequalities and why they matter for development. *Information Technology for Development*, *26*(2), 214–233. https://doi.org/10.1080/02681102.2019.1650244

Clarke, G. R. G., & Wallsten, S. J. (2006). Has the Internet increased trade? Developed and developing country evidence. *Economic Inquiry*, *44*(3), 465–484. https://doi.org/10.1093/ei/cbj026

Clinton, H. (2010, January 21). *Remarks on internet freedom*. U.S. Department of State. https://2009-2017.state.gov/secretary/20092013clinton/rm/2010/01/135519.htm

CNN Business. (2024, June 24). Huawei Harmony OS: Flashpoint in US-China tech rivalry is again a force to reckon with. *CNN*. https://edition.cnn.com/2024/06/24/tech/china-huawei-harmony-os-growth-intl-hnk/index.html

Cobo, M. O., & Levano, R. I. J. (2023). Gender digital divide in migratory contexts: The case of Peruvian migrant women in Italy and Spain. *Journal of Education Culture and Society*, *14*(1), 575–596.

Coe, N. M., & Yeung, H. W.-C. (2015). *Global production networks: Theorizing economic development in an interconnected world*. Oxford University Press.

Cohen, W. M., & Levinthal, D. A. (2000). Absorptive capacity: A new perspective on learning and innovation. In *Strategic learning in a knowledge economy*. Routledge.

Condor. (2014). *Condor, an Algerian high-tech giant in the making*. https://www.condor-tunisie.tn/en/condor-electronics-en/news/264-condor-an-algerian-high-tech-giant-in-the-making

Connecting Africa. (2018, October 22). Huawei helps Telecom Egypt secure a $200M loan to fund 4G rollout. *Connecting Africa*. http://www.connectingafrica.com/author.asp?section_id=530&doc_id=743459

Cooksley, J., da Silva Curiel, A., Stephens, P., Boland, L., Jason, S., Sun, W., & Sweeting, M. (2003). *ALSAT-1 first year in orbit*. https://digitalcommons.usu.edu/smallsat/2003/All2003/38/

Cory, N., Dascoli, L., & Clay, I. (2022). *The cost of data localization policies in Bangladesh, Hong Kong, Indonesia, Pakistan, and Vietnam*. Information Technology and Innovation Foundation. https://itif.org/publications/2022/12/12/the-cost-of-data-localization-policies-in-bangladesh-hong-kong-indonesia-pakistan-and-vietnam/

Couldry, N., & Mejias, U. A. (2019). Data colonialism: Rethinking big data's relation to the contemporary subject. *Television & New Media*, *20*(4), 336–349. https://doi.org/10.1177/1527476418796632

Creemers, R. (2020). China's conception of cyber sovereignty. In *Governing cyberspace: Behavior, power and diplomacy* (pp. 107–145).

Creemers, R. (2021). *China's emerging data protection framework* (SSRN Scholarly Paper No. 3964684). https://doi.org/10.2139/ssrn.3964684

Crespo, N., & Fontoura, M. P. (2007). Determinant factors of FDI spillovers–what do we really know? *World Development*, *35*(3), 410–425.

Custer, S., Horigoshi, A., & Marshall, K. (2024). *BRI from the ground up: Leaders from 129 countries evaluate a decade of Beijing's signature initiative*. AidData. https://docs.aiddata.org/reports/bri-from-the-ground-up/full-report.html

Dabrowski, M., & Dominguez, J. (2021, June). *The socio-economic consequences of COVID-19 in the Middle East and North Africa*. Bruegel. https://www.bruegel.org/2021/06/the-socio-economic-consequences-of-covid-19-in-the-middle-east-and-north-africa/

Dahshan, M. E. (2015). The Egyptian economy. *Adelphi Series*, *55*(453–454), 201–218. https://doi.org/10.1080/19445571.2015.1131437

Dai, X. (2022). The BRI and China's soft power strategy: Implications of the Digital Silk Road for South Asia. In B. Chakma & X. Dai (Eds.), *The Belt and Road Initiative and the politics of connectivity: Sino-Indian rivalry in the 21st century* (pp. 57–75). Springer Nature. https://doi.org/10.1007/978-981-19-2864-2_3

Datareportal. (2022). *Digital 2022: Algeria*. DataReportal – Global Digital Insights. https://datareportal.com/reports/digital-2022-algeria

Davies, M., Edinger, H., Tay, N., & Naidu, S. (2008). *How China delivers development assistance to Africa*. Centre for Chinese Studies of Stellenbosch University.

DeNardis, L. (2009). Protocol Politics: The Globalization of Internet Governance. MIT Press.

De Seta, G. (2023). China's digital infrastructure: Networks, systems, standards. *Global Media and China*, *8*(3), 245–253. https://doi.org/10.1177/20594364231202203

De Soyres, F., Mulabdic, A., Murray, S., Rocha, N., & Ruta, M. (2019). How much will the Belt and Road Initiative reduce trade costs? *International Economics*, *159*, 151–164.

DEBI. (2022). *Digital Egypt Builders Initiative*. https://debi.gov.eg/

Del Giudice, M., Scuotto, V., Garcia-Perez, A., & Petruzzelli, A. M. (2019). Shifting wealth II in Chinese economy: The effect of the horizontal technology spillover for SMEs for international growth. *Technological Forecasting and Social Change*, *145*, 307–316.

Delimatsis, P. (2015). *The law, economics and politics of international standardisation*. Cambridge University Press.

Deloitte. (2014). *Economic and social benefits of expanding internet access*. https://www2.deloitte.com/content/dam/Deloitte/no/Documents/technology-media-telecommunications/uk-tmt-value-of-connectivity.pdf

Djazairess. (2019, May 18). Huawei se lance dans le 'Made in bladi'. *Djazairess*. https://www.djazairess.com/fr/lexpression/308334

Drahokoupil, J., McCaleb, A., Pawlicki, P., & Szunomár, Á. (2017). Chapter 11: Huawei in Europe: Strategic integration of local capabilities in a global production network. In *Global value chains after the COVID-19 crisis*. https://www.etui.org/sites/default/files/Chapter%2011_0.pdf

Dreher, A., Fuchs, A., Parks, B., Strange, A., & Tierney, M. J. (2022). *Banking on Beijing: The aims and impacts of China's overseas development program*. Cambridge University Press.

Driouchi, A. (2014). Rents from natural resources and relations to knowledge economy in Arab countries. In *Knowledge-based economic policy development in the Arab world* (pp. 313–334). IGI Global. https://doi.org/10.4018/978-1-4666-5210-1.ch013

Drisko, J. W., & Maschi, T. (2015). *Content analysis*. Oxford University Press.

Ecomnews Med. (2024, October 20). Algérie: Le ministère de la Poste et des Télécommunications a annoncé que le nombre de foyers connectés à la fibre optique à domicile (FTTH) a atteint 1,5 million soit une croissance de 2730 %. *Ecomnews Med*. https://www.ecomnewsmed.com/2024/10/20/algerie-le-ministere-de-la-poste-et-des-telecommunications-a-annonce-que-le-nombre-de-foyers-connectes-a-la-fibre-optique-a-domicile-ftth-a-atteint-15-million-soit-une-croissance-de-2730/

Edwards, P. N., & Hecht, G. (2010). History and the technopolitics of identity: The case of apartheid South Africa. *Journal of Southern African Studies*, *36*(3), 619–639. https://doi.org/10.1080/03057070.2010.507568

Edwards, P., Jackson, S., Bowker, G., & Knobel, C. (2009). *Understanding infrastructure: Dynamics, tensions, and design*.

Eguegu, O. (2022). The Digital Silk Road: Connecting Africa with new norms of digital development. *Asia Policy*, *17*(3), 30–39.

Egypt Business. (2023). *Mobile phone industry in Egypt*. https://www.egypt-business.com/paper/details/2336-mobile-phone-industry-in-egypt/429618
Egypt Independent. (2019, March 27). Egypt, Huawei sign MoU for cloud computing, AI networks. *Egypt Independent*. https://egyptindependent.com/egypt-huawei-sign-mou-for-cloud-computing-ai-networks/
Egypt Today. (2021, September 22). Egypt's SICO plans to produce more than 2M devices, export to Africa. *Egypt Today*. https://www.egypttoday.com/Article/3/108560/Egypt-s-SICO-plans-to-produce-more-than-2M-devices
Ejaz, K. (2019). Neo-imperialism: A case study of China Pakistan Economic Corridor. *Journal of Politics and International Studies*, *5*, 85–96.
El Kadi, T. H. (2022, April 14). How Huawei's localization in North Africa delivered mixed returns. *Carnegie Endowment for International Peace*. https://carnegieendowment.org/2022/04/14/how-huawei-s-localization-in-north-africa-delivered-mixed-returns-pub-86889
Elyachar, J. (2012). Before (and after) neoliberalism: Tacit knowledge, secrets of the trade, and the public sector in Egypt. *Cultural Anthropology*, *27*(1), 76–96. https://doi.org/10.1111/j.1548-1360.2012.01127.x
Engel, E. M., Fischer, R. D., & Galetovic, A. (2010). The economics of infrastructure finance: Public-private partnerships versus public provision. *EIB Papers*, *15*(1), 40–69.
Ensafi, R., Winter, P., Mueen, A., & Crandall, J. R. (2015). Analyzing the Great Firewall of China over space and time. *Proceedings on Privacy Enhancing Technologies*, *2015*(1), 61–76. https://petsymposium.org/popets/2015/popets-2015-0005.php
Entelis, J. P. (1999). Sonatrach: The political economy of an Algerian state institution. *Middle East Journal*, *53*(1), 9–27.
Erie, M. S., & Streinz, T. (2021). The Beijing effect: China's digital silk road as transnational data governance. *New York University Journal of International Law and Politics*, *54*(1), 1–92.
Ernst, D. (2011). *Indigenous innovation and globalization: The challenge for China's standardization strategy*. East-West Center. https://www.eastwestcenter.org/sites/default/files/private/ernstindigenousinnovation.pdf
Ernst, D., & Kim, L. (2002). Global production networks, knowledge diffusion, and local capability formation. *Research Policy*, *31*(8), 1417–1429. https://doi.org/10.1016/S0048-7333(02)00072-0
Fafunwa, T., & Odufuwa, F. (2022). African micro, small, and medium enterprises need to digitally transform to benefit from the Africa Continental Free Trade Area (AfCFTA). In *Africa–Europe cooperation and digital transformation*. Routledge.
Fahim, Y., & Sami, N. (2011). Adequacy, efficiency and equity of higher education financing: The case of Egypt. *PROSPECTS*, *41*(1), 47–67. https://doi.org/10.1007/s11125-011-9182-x
Fairfield, T., & Charman, A. (2019). A dialogue with the data: The Bayesian foundations of iterative research in qualitative social science. *Perspectives on Politics*, *17*(1), 154–167. https://doi.org/10.1017/S1537592718002177
Fan, J. P., Morck, R., Xu, L. C., & Yeung, B. (2009). Institutions and foreign direct investment: China versus the rest of the world. *World Development*, *37*(4), 852–865.
Fardella, E., & Prodi, G. (2017). The Belt and Road Initiative impact on Europe: An Italian perspective. *China & World Economy*, *25*(5), 125–138. https://doi.org/10.1111/cwe.12217
Farhat, K. (2023, March 9). TikTok's Project Texas: The wrong template for tomorrow's digital economy. *Internet Governance Project*. https://www.internetgovernance.org/2023/03/09/tiktoks-project-texas-the-wrong-template-for-tomorrows-digital-economy/
Farhi, S. (2019, April 21). Sonatrach et Huawei ou l'autre scandale de l'ère Bouteflika. *L'Express DZ*. https://www.express-dz.com/2019/04/21/sonatrach-et-huawei-ou-lautre-sacandale-de-lere-bouteflika/
Faris, D. (2013). *Dissent and revolution in a digital age*. I.B. Tauris.
Farrell, H. (2015, February 17). Obama says that Europeans are using privacy rules to protect their firms against U.S. competition. Is he right? *Washington Post*.

https://www.washingtonpost.com/news/monkey-cage/wp/2015/02/17/obama-says-that-europeans-are-using-privacy-rules-to-protect-their-firms-against-u-s-competition-is-he-right/
Fatafa, M. (2020, August 10). Egypt's new data protection law: Data protection or data control? *Access Now*. https://www.accessnow.org/egypts-new-data-protection-law-data-protection-or-data-control/
Ferracane, M. F., & González, S. (2024). *Data localisation: Global trends* (Working Paper). European University Institute. https://cadmus.eui.eu/handle/1814/77051
Fewsmith, J. (2004). Promoting the scientific development concept. *China Leadership Monitor*, *11*(30), 1–10.
Fischer, D. (2022). The digital sovereignty trick: Why the sovereignty discourse fails to address the structural dependencies of digital capitalism in the global south. *Zeitschrift für Politikwissenschaft*, *32*(2), 383–402. https://doi.org/10.1007/s41358-022-00316-4
Fisher, A., & Streinz, T. (2021). Confronting data inequality. *Columbia Journal of Transnational Law*, *60*(3), 829–956.
Flinders, K. (2020, September 1). Egypt's datacentre plans take key step forward. *Computer Weekly*. https://www.computerweekly.com/news/252487199/Egypts-datacentre-plans-take-key-step-forward
Fong, M. W. L. (2009). Digital divide between urban and rural regions in China. *The Electronic Journal of Information Systems in Developing Countries*, *36*(1), 1–12. https://doi.org/10.1002/j.1681-4835.2009.tb00253.x
Foster, C., & Azmeh, S. (2019). Latecomer economies and national digital policy: An industrial policy perspective. *The Journal of Development Studies*, *56*(7), 1247–1262. https://doi.org/10.1080/00220388.2019.1677886
Foster, C., Graham, M., Mann, L., Waema, T., & Friederici, N. (2018). Digital control in value chains: Challenges of connectivity for East African firms. *Economic Geography*, *94*(1), 68–86. https://doi.org/10.1080/00130095.2017.1350104
Franceschini, I., & Loubere, N. (2022). *Global China as method*. Cambridge University Press. https://doi.org/10.1017/9781108999472
Fraser, E. (2016). Data localisation and the balkanisation of the internet. *SCRIPTed: A Journal of Law, Technology and Society*, *13*(3), 359–373.
French, H. W. (2015). *China's second continent: How a million migrants are building a new empire in Africa* (Reprint ed.). Random House.
Freund, C., & Weinhold, D. (2002). The internet and international trade in services. *American Economic Review*, *92*(2), 236–240. https://doi.org/10.1257/000282802320189320
Friederici, N., Ojanperä, S., & Graham, M. (2017). The impact of connectivity in Africa: Grand visions and the mirage of inclusive digital development. *The Electronic Journal of Information Systems in Developing Countries*, *79*(1), 1–20. https://doi.org/10.1002/j.1681-4835.2017.tb00578.x
FTTH Council. (2024). *2024 FTTH market panorama—Report by country*. https://www.ftthcouncil.eu/resources/all-publications-and-assets/2154/2024-ftth-market-panorama-report-by-country
Fu, X. (2015). *China's path to innovation*. Cambridge University Press.
Fu, X. (2011). Foreign direct investment and managerial knowledge spillovers through the diffusion of management practices. *Journal of Management Studies*, *49*(5), 970–999. https://doi.org/10.1111/j.1467-6486.2011.01036.x
Fu, X., & Gong, Y. (2011). Indigenous and foreign innovation efforts and drivers of technological upgrading: Evidence from China. *World Development*, *39*(7), 1213–1225. https://doi.org/10.1016/j.worlddev.2010.05.010
Fu, X., & Zhang, J. (2011). Technology transfer, indigenous innovation and leapfrogging in green technology: The solar-PV industry in China and India. *Journal of Chinese Economic and Business Studies*, *9*(4), 329–347. https://doi.org/10.1080/14765284.2011.618590
Fu, X., Pietrobelli, C., & Soete, L. (2011). The role of foreign technology and indigenous innovation in the emerging economies: Technological change and catching up. *World Development*, *39*(7), 1204–1212. https://doi.org/10.1016/j.worlddev.2010.05.009

Furuholt, B., & Kristiansen, S. (2007). A rural-urban digital divide? *The Electronic Journal of Information Systems in Developing Countries*, *31*(1), 1–15. https://doi.org/10.1002/j.1681-4835.2007.tb00215.x
GAFI. (2017). *Law No. 72 of 2017 promulgating the investment law*. https://www.gafi.gov.eg/english/startabusiness/laws-and-regulations/publishingimages/pages/businesslaws/investment%20law%20english%20ban.pdf
Gagliardone, I. (2010). *Development and destabilization: The selective adoption of ICTs in Ethiopia* [Doctoral dissertation, University of Oxford].
Gagliardone, I. (2014). Technopolitics, nation building, and the development of ICT in Ethiopia. *Information Technologies and International Development*, *10*(1), 1–14.
Gagliardone, I. (2019). *China, Africa, and the future of the internet: New media, new politics* (1st ed.). Zed Books.
Gao, H. S. (2021). Data regulation with Chinese characteristics. In M. Burri (Ed.), *Big data and global trade law* (pp. 245–267). Cambridge University Press. https://doi.org/10.1017/9781108919234.017
Gao, Y. (2014). An emerging giant of science: Achievements and challenges of STEM education in China. In *The age of STEM*. Routledge.
Gereffi, G. (2015). Global value chains in a post-Washington Consensus world. In *Global value chains and global production networks*. Routledge.
Gereffi, G. (2019). Economic upgrading in global value chains. In *Handbook on global value chains* (pp. 240–254). Edward Elgar Publishing. https://www.elgaronline.com/edcollchap/edcoll/9781788113762/9781788113762.00022.xml
Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy*, *12*(1), 78–104. https://doi.org/10.1080/09692290500049805
Gerschenkron, A. (1962). *Economic backwardness in historical perspective*. Harvard University Press.
Ghanem, D. (2022). *Understanding the persistence of competitive authoritarianism in Algeria*. Springer International Publishing. https://doi.org/10.1007/978-3-031-05102-9
Gholami, R., Lee, S.-Y. T., & Heshmati, A. (2005). *The causal relationship between ICT and FDI*. WIDER Research Paper. https://www.econstor.eu/handle/10419/63535
Ghoneim, A. (2011). Unexploited potential: The case of Egypt. In A. G. Goswami, A. Mattoo, & S. Sáez (Eds.), *Exporting services: A developing country perspective*. The World Bank.
Ghosh, S. (2016). How important is mobile telephony for economic growth? Evidence from MENA countries. *Information and Management*, *18*(3), 6–25. https://doi.org/10.1108/info-11-2015-0061
Gillespie, T. (2018). *Custodians of the internet: Platforms, content moderation, and the hidden decisions that shape social media*. Yale University Press.
Girma, S. (2005). Absorptive capacity and productivity spillovers from FDI: A threshold regression analysis. *Oxford Bulletin of Economics and Statistics*, *67*(3), 281–306. https://doi.org/10.1111/j.1468-0084.2005.00120.x
Glass, A. J., & Saggi, K. (2002). Multinational firms and technology transfer. *The Scandinavian Journal of Economics*, *104*(4), 495–513. https://doi.org/10.1111/1467-9442.00298
Globerman, S. (1979). Foreign direct investment and 'spillover' efficiency benefits in Canadian manufacturing industries. *The Canadian Journal of Economics*, *12*(1), 42–56. https://doi.org/10.2307/134570
Göll, E., & Zwiers, J. (2018). *Technological trends in the MENA region: The cases of digitalization and information and communications technology (ICT)* (Working Paper No. 23). Stiftung Wissenschaft und Politik.
Gonzalez-Vicente, R. (2012). Mapping Chinese mining investment in Latin America: Politics or market? *The China Quarterly*, *209*, 35–58. https://doi.org/10.1017/S0305741011001470
Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of Econometrics*, *225*(2), 254–277.
Goodman, D. (1994). *Deng Xiaoping and the Chinese revolution: A political biography*. Routledge. https://doi.org/10.4324/9780203035214

Google. (2025). *Where the internet lives podcast series*. Google Data Centers. https://datacenters.google/discover-more/podcast

Gottschalk, R. (2019). *Financing regional digital infrastructures in the south: Development banks, funds and other policy options*. United Nations University Institute for Natural Resources in Africa. https://doi.org/10.18356/f09505cc-en

Graham, S., & Marvin, S. (2001). *Splintering urbanism: Networked infrastructures, technological mobilities and the urban condition*. Routledge.

Graham, M., & Mann, L. (2013). Imagining a Silicon Savannah? Technological and conceptual connectivity in Kenya's BPO and software development sectors. *The Electronic Journal of Information Systems in Developing Countries*, *56*(1), 1–19. https://doi.org/10.1002/j.1681-4835.2013.tb00396.x

Graham, M., Hjorth, I., & Lehdonvirta, V. (2017). Digital labour and development: Impacts of global digital labour platforms and the gig economy on worker livelihoods. *Transfer: European Review of Labour and Research*, *23*(2), 135–162. https://doi.org/10.1177/1024258916687250

Greene, P., & Triolo, R. (2020, May 8). Will China control the global internet via its Digital Silk Road? *Carnegie Endowment for International Peace*. https://carnegieendowment.org/2020/05/08/will-china-control-global-internet-via-its-digital-silk-road-pub-81857

Greenstein, S. (2021). Digital infrastructure. In E. L. Glaeser & J. M. Poterba (Eds.), *Economic analysis and infrastructure investment* (pp. 409–452). University of Chicago Press. https://doi.org/10.7208/chicago/9780226800615-011

Greeven, M. J. (2007). The new great leap: The rise of China's ICT industry. In *The Chinese economy in the 21st century* (pp. 71–112). Edward Elgar Publishing. https://www.elgaronline.com/edcollchap/book/9781782543411/book-part-9781782543411-11.xml

Grimes, S., & Yang, C. (2018). From foreign technology dependence towards greater innovation autonomy: China's integration into the information and communications technology (ICT) global value chain (GVC). *Area Development and Policy*, *3*(1), 132–148. https://doi.org/10.1080/23792949.2017.1305870

Gruber, H., & Koutroumpis, P. (2011). Mobile telecommunications and the impact on economic development. *Economic Policy*, *26*(67), 387–426.

GSI. (2023). *Global cybersecurity index*. International Telecommunication Union. https://www.itu.int:443/en/ITU-D/Cybersecurity/Pages/global-cybersecurity-index.aspx

Gu, J., & Carey, J. (2019). China's development finance and African infrastructure development. In *China-Africa and economic transformation* (pp. 147–172). Oxford University Press.

Guimon, J., Chaminade, C., Maggi, C., & Salazar-Elena, J. C. (2018). Policies to attract R&D-related FDI in small emerging countries: Aligning incentives with local linkages and absorptive capacities in Chile. *Journal of International Management*, *24*(2), 165–178. https://doi.org/10.1016/j.intman.2017.09.005

Gurumurthy, A., Chami, N., Bharthur, D., & Singh, P. J. (2019). *Tackling online inequality: Making digital platforms work for inclusive development* (Final technical report). International Development Research Centre. http://hdl.handle.net/10625/59174

Gurumurthy, A., Vasudevan, A., & Chami, N. (2017). *The grand myth of cross-border data flows in trade deals* (SSRN Scholarly Paper No. 3875222). https://papers.ssrn.com/abstract=3875222

Gyu, L. D. (2021, March 15). The Belt and Road Initiative after COVID: The rise of health and digital silk roads [Issue brief]. *Centre for Regional Studies*. https://en.asaninst.org/contents/the-belt-and-road-initiative-after-covid-the-rise-of-health-and-digital-silk-roads/

Haddad, M., & Harrison, A. (1993). Are there positive spillovers from direct foreign investment? Evidence from panel data for Morocco. *Journal of Development Economics*, *42*(1), 51–74. https://doi.org/10.1016/0304-3878(93)90072-U

Haddouche, H. (2020, July 15). Chine-Algérie : Les espoirs déçus du partenariat économique. *Middle East Eye édition française*. https://www.middleeasteye.net/fr/decryptages/chine-algerie-economie-investissements
Hafner, K., & Lyon, M. (1998). *Where wizards stay up late: The origins of the internet* (Reprint ed.). Simon & Schuster.
Hall, D. (2015). *Why public-private partnerships don't work: The many advantages of the public alternative*. Public Services International Research Unit.
Halpern, L., & Murakozy, B. (2007). Does distance matter in spillover? *Economics of Transition*, *15*(4), 781–805. https://doi.org/10.1111/j.1468-0351.2007.00308.x
Halverson, K. (2004). China's WTO accession: Economic, legal, and political implications. *Boston College International and Comparative Law Review*, *27*(2), 319–370.
Hamza, A., Hussain, M. Z., Hasan, M. Z., Nosheen, S., Siddiqui, A. A., & Qureshi, A. M. (2023). Futuristic fiber: Bringing the future home with FTTH. *2023 25th International Multitopic Conference (INMIC)*, 1–6. https://doi.org/10.1109/INMIC60434.2023.10466188
Hamza, K. (2016). Smart city implementation framework for developing countries: The case of Egypt. In J. R. Gil-Garcia, T. A. Pardo, & T. Nam (Eds.), *Smarter as the new urban agenda* (Vol. 11, pp. 171–187). Springer International Publishing. https://doi.org/10.1007/978-3-319-17620-8_9
Handy, H. (2001). *Monetary policy and financial sector reform in Egypt: The record and the challenges ahead* (Working Paper No. 51). Egyptian Center for Economic Studies. https://eces.org.eg/wp-content/uploads/2023/07/Monetary-Policy-and-Financial-Sector-Reform-in-Egypt-The-Record-and-the-Challenges-Ahead-WP-51-January-2001.pdf
Hanieh, A. (2011). Beyond Mubarak: Reframing the "politics" and "economics" of Egypt's uprising. *Studies in Political Economy*, *87*(1), 7–27. https://doi.org/10.1080/19187033.2011.11675018
Hanieh, A. (2015). Re-scaling Egypt's political economy: Neoliberalism and the transformation of the regional space. In *Revolutionary Egypt*. Routledge.
Haouas, A., & Lin, J. Y. (2024). The failure of Algeria's industrialization strategy, 1967–1989: A new structural economics perspective. *Revista de Historia Industrial—Industrial History Review*, *33*(90), 11–40.
Hargittai, E., & Hinnant, A. (2008). Digital inequality: Differences in young adults' use of the internet. *Communication Research*, *35*(5), 602–621. https://doi.org/10.1177/0093650208321782
Hart-Landsberg, M. (2013). *Capitalist globalization: Consequences, resistance, and alternatives*. NYU Press.
Harvey, D. (1982). *The limits to capital*. Verso Books.
Harwit, E. (2007). Building China's telecommunications network: Industrial policy and the role of Chinese state-owned, foreign and private domestic enterprises. *The China Quarterly*, *190*, 311–332.
Hassanein, H. (2019). *Egypt takes another step toward China* (Policy Watch No. 3168). The Washington Institute. https://www.washingtoninstitute.org/policy-analysis/egypt-takes-another-step-toward-china
Hauge, J. (2023). *The future of the factory: How megatrends are changing industrialization*. Oxford University Press.
Hayden, M. V. (2013). Beyond Snowden: An NSA reality check. *World Affairs*, *176*(4), 13–23.
HBS. (2023). *Naguib Sawiris—Creating emerging markets*. Harvard Business School. https://www.hbs.edu/creating-emerging-markets/interviews/Pages/profile.aspx?profile=nsawiris
He, A. (2022). *The digital Silk Road and China's influence on standard setting* (Working Paper No. 264). Centre for International Governance Innovation. https://www.econstor.eu/handle/10419/299736
He, Y. (2024). Chinese digital platform companies' expansion in the Belt and Road countries. *The Information Society*, *40*(5), 1–24. https://doi.org/10.1080/01972243.2024.2317058
Hecht, G. (1998). *The radiance of France: Nuclear power and national identity after World War II*. MIT Press.

Hecht, G. (2001). Technology, politics, and national identity in France. In M. Allen & G. Hecht (Eds.), *Technologies of power: Essays in honor of Thomas Parke Hughes and Agatha Chipley Hughes* (pp. 253–294). MIT Press.
Heeks, R. (2022). Digital inequality beyond the digital divide: Conceptualizing adverse digital incorporation in the global South. *Information Technology for Development*, *28*(4), 688–704. https://doi.org/10.1080/02681102.2022.2068492
Heeks, R., Ospina, A. V., Foster, C., Gao, P., Han, X., Jepson, N., Schindler, S., & Zhou, Q. (2024). China's digital expansion in the Global South: Systematic literature review and future research agenda. *The Information Society*, *40*(4), 1–27. https://doi.org/10.1080/01972243.2024.2315875
Heidenreich, M. (2012). *Innovation and institutional embeddedness of multinational companies*. Edward Elgar Publishing.
Helft, M., & Barboza, D. (2010, March 23). Google shuts China site in dispute over censorship. *The New York Times*. https://www.nytimes.com/2010/03/23/technology/23google.html
Henderson, J., Dicken, P., Hess, M., Coe, N., & Yeung, H. W.-C. (2002). Global production networks and the analysis of economic development. *Review of International Political Economy*, *9*(3), 436–464. https://doi.org/10.1080/09692290210150842
Hernandez, K. (2019). *Achieving complex development goals along China's Digital Silk Road*. Institute of Development Studies. https://opendocs.ids.ac.uk/opendocs/handle/20.500.12413/14396
Hicks, J. (2022). *Export of digital surveillance technologies from China to developing countries* (IDS Working Paper). Institute of Development Studies. https://opendocs.ids.ac.uk/opendocs/bitstream/handle/20.500.12413/17644/1190_Digital_Surveillance.pdf?sequence=1
Hill, J. F. (2012). A balkanized internet? The uncertain future of global internet standards. *Georgetown Journal of International Affairs*, *13*(2), 49–58.
Hiller, H. H., & Diluzio, L. (2004). The interviewee and the research interview: Analysing a neglected dimension in research. *Canadian Review of Sociology*, *41*(1), 1–26. https://doi.org/10.1111/j.1755-618X.2004.tb02167.x
Hillman, J. E. (2021). *The Digital Silk Road: China's quest to wire the world and win the future*. Harper Business.
Hindman, D. B. (2000). The rural-urban digital divide. *Journalism & Mass Communication Quarterly*, *77*(3), 549–560. https://doi.org/10.1177/107769900007700306
Hirschman, A. O. (1958). *The strategy of economic development*. Yale University Press.
Hirschman, A. O. (1977). A generalized linkage approach to development, with special reference to staples. *Economic Development and Cultural Change*, *25*(Supplement), 67–98.
Hjort, J., & Poulsen, J. (2019). The arrival of fast internet and employment in Africa. *American Economic Review*, *109*(3), 1032–1079. https://doi.org/10.1257/aer.20161385
Ho, C.-Y., Narins, T. P., & Sung, W. (2023). Developing information and communication technology with the Belt and Road Initiative and the Digital Silk Road. *Telecommunications Policy*, *47*(10), 102672. https://doi.org/10.1016/j.telpol.2023.102672
Hoffmann, S., Lazanski, D., & Taylor, E. (2020). Standardising the splinternet: How China's technical standards could fragment the internet. *Journal of Cyber Policy*, *5*(2), 239–264.
Hong, Y. (2008). Distinctive characteristics of China's path of ICT development: A critical analysis of Chinese developmental strategies in light of the Eastern Asian model. *International Journal of Communication*, *2*, 304–319.
Hong, Y. (2013). Repurposing telecoms for capital in China. *Asian Survey*, *53*(2), 319–347. https://doi.org/10.1525/as.2013.53.2.319
Hong, Y. (2017a). *Networking China: The digital transformation of the Chinese economy*. University of Illinois Press. https://www.jstor.org/stable/10.5406/j.ctt1kc6hhz
Hong, Y. (2017b). *Pivot to internet plus: Molding China's digital economy for economic restructuring?* (SSRN Scholarly Paper No. 2943609). https://papers.ssrn.com/abstract=2943609

Hong, Y., Bar, F., & An, Z. (2012). Chinese telecommunications on the threshold of convergence: Contexts, possibilities, and limitations of forging a domestic demand-based growth model. *Telecommunications Policy*, *36*(10), 914–928. https://doi.org/10.1016/j.telpol.2012.07.013

Hoofnagle, C. J., van der Sloot, B., & Borgesius, F. Z. (2019). The European Union general data protection regulation: What it is and what it means. *Information & Communications Technology Law*, *28*(1), 65–98. https://doi.org/10.1080/13600834.2019.1573501

Huang, J., & Tsai, K. S. (2022). Securing authoritarian capitalism in the digital age: The political economy of surveillance in China. *The China Journal*, *88*, 2–28. https://doi.org/10.1086/720144

Huang, Y. (2016). Understanding China's Belt & Road Initiative: Motivation, framework and assessment. *China Economic Review*, *40*, 314–321. https://doi.org/10.1016/j.chieco.2016.07.007

Huang, Y., & Mayer, M. (2023). Power in the age of datafication: Exploring China's global data power. *Journal of Chinese Political Science*, *28*(1), 25–49. https://doi.org/10.1007/s11366-022-09816-0

Huawei. (2015, September 3). Egyptian President Sisi meets Huawei Chairwoman Sun Yafang in Beijing. *Huawei Press Center*. https://www.huawei.com/it/news/2015/09/hw_452940

Huawei. (2017a, December 19). Huawei announces new OpenLab in Cairo to build ICT ecosystem in Northern Africa. *Huawei Press Center*. https://www.huawei.com/en/news/2017/12/Huawei-New-OpenLab-Cairo

Huawei. (2017b). *Entering a new digital era for scientific research in Egypt*. Huawei Digital Power. https://digitalpower.huawei.com/en/data-center-facility/success_stories/detail/32.html

Huawei. (2021). *Interview with Mohamed Gamal, Data Centre Manager at NRC* [Video]. Facebook.https://www.facebook.com/HuaweiEnterprise/photos/a.482770781790140/4248021491931698/

Huawei. (2024). FusionSphere platform. Huawei Enterprise Support. https://support.huawei.com/enterprise/en/cloud-computing/fusionsphere-platform-pid-22418531

Hughes, T. P. (1993). *Networks of power: Electrification in Western society, 1880-1930* (Rev. ed.).Johns Hopkins University Press.

Huppenbauer, N. (2023). Connectivity, centrality, and adaptation: The coproduction of political space in China's standardization of autonomous driving technologies. *Global Media and China*, *8*(3), 414–430. https://doi.org/10.1177/20594364231198289

ICA. (2018). *Infrastructure financing trends in Africa—2017*. Infrastructure Consortium for Africa. https://www.icafrica.org/fileadmin/documents/IFT_2016/Infrastructure_Financing_Trends_2017.pdf

IDRC. (1999). *African connection, AISI, ECA, ACACIA and the IDRC*. International Development Research Centre. https://idl-bnc-idrc.dspacedirect.org/bitstream/10625/32502/1/117161.pdf

Ikram, K. (2007). *The Egyptian economy, 1952-2000: Performance policies and issues*. Routledge. https://doi.org/10.4324/9780203014462

ILO. (2020). *Egypt—Law 151/2020 on the protection of personal data*. International Labour Organization. https://www.ilo.org/dyn/natlex/natlex4.detail?p_lang=en&p_isn=111246&p_count=7&p_classification=01

ILO. (2024). *Global employment trends for youth 2024: Middle East and North Africa*. International Labour Organization. https://www.ilo.org/media/583631/download

Imbens, G. W. (2004). Nonparametric estimation of average treatment effects under exogeneity: A review. *The Review of Economics and Statistics*, *86*(1), 4–29. https://doi.org/10.1162/003465304323023651

Indjazat. (2021). Karim Bibi Triki au Forum Rakmana : « Le numérique offre des opportunités énormes aux investisseurs ». *Indjazat.com*. https://www.indjazat.com/karim-bibi-triki-au-forum-rakmana-le-numerique-offre-des-opportunites-enormes-aux-investisseurs/

Iršová, Z., & Havránek, T. (2013). Determinants of horizontal spillovers from FDI: Evidence from a large meta-analysis. *World Development*, *42*, 1–15. https://doi.org/10.1016/j.worlddev.2012.07.001

ITIDA. (2024). *Egypt's thriving ICT sector*. Information Technology Industry Development

Agency. https://www.itida.gov.eg

ITMAG. (2018, January 31). Lancement de la FTTH par Algérie Télécom: Jusqu'à 100 Mb/s pour les résidentiels. *ITMAG*. https://www.itmag.dz/2018/01/31/lancement-de-la-ftth-par-algerie-telecom-jusqua-100-mb-s-pour-les-residentiels/

Ito, A., Lim, G., & Yarim, M. (Forthcoming). Digital China effect: The Belt and Road Initiative and cyber protectionism in emerging countries. *East Asian Economic Association 2024 Conference Proceedings*. http://eaea2024.econ.tu.ac.th/ProgramSchedule.php

ITU. (2024). *ICT price baskets (IPB)*. International Telecommunication Union. https://www.itu.int:443/en/ITU-D/Statistics/Dashboards/Pages/IPB.aspx

Ivarsson, I., & Alvstam, C. G. (2005). The effect of spatial proximity on technology transfer from TNCs to local suppliers in developing countries: The case of AB Volvo in Asia and Latin America. *Economic Geography*, *81*(1), 83–111. https://doi.org/10.1111/j.1944-8287.2005.tb00256.x

Javorcik, B. S. (2004). Does foreign direct investment increase the productivity of domestic firms? In search of spillovers through backward linkages. *American Economic Review*, *94*(3), 605–627. https://doi.org/10.1257/0002828041464605

Jenkins, R. (2022). *How China is reshaping the global economy: Development impacts in Africa and Latin America* (2nd ed.). Oxford University Press.

Jennings, R. (2024, December 9). China's next-gen BeiDou satellite system to ramp up rivalry with US-based GPS. *South China Morning Post*. https://www.scmp.com/economy/china-economy/article/3288672/chinas-next-gen-beidou-satellite-system-ramp-rivalry-us-based-gps

Jerven, M. (2011). The quest for the African dummy: Explaining African post-colonial economic performance revisited. *Journal of International Development*, *23*(2), 288–307. https://doi.org/10.1002/jid.1603

Jiang, H., Gao, S., Zhao, S., & Chen, H. (2020). Competition of technology standards in Industry 4.0: An innovation ecosystem perspective. *Systems Research and Behavioral Science*, *37*(4), 772–783. https://doi.org/10.1002/sres.2718

Jiuzhou, D. (2021). China–Egypt relations during the BRI era and beyond. In *Routledge handbook on China–Middle East relations* (pp. 126–136). Routledge. https://www.taylorfrancis.com/chapters/edit/10.4324/9781003034520-11/china%E2%80%93egypt-relations-bri-era-beyond-duan-jiuzhou

Jones, M. O. (2022). *Digital authoritarianism in the Middle East: Deception, disinformation and social media*. C Hurst & Co Publishers Ltd.

Journal de l'Economie. (2021, July). Huawei livre un data center au Sénégal et renforce son maillage en Afrique. *Journal de l'Economie*. https://www.journaldeleconomie.com/2021/07/huawei-livre-un-data-center-au-senegal.html

Journal Officiel Algérien. (2018). *Loi n° 18-07 du 25 Ramadhan 1439 correspondant au 10 juin 2018 relative à la protection des personnes physiques dans le traitement des données à caractère personnel*. https://www.joradp.dz/FTP/jo-francais/2018/F2018034.pdf

Jovchelovitch, S., & Bauer, M. W. (2000). *Narrative interviewing*. LSE Research Online. http://eprints.lse.ac.uk/2633

Joya, A. (2017). Neoliberalism, the state and economic policy outcomes in the post-Arab uprisings: The case of Egypt. *Mediterranean Politics*, *22*(3), 339–361. https://doi.org/10.1080/13629395.2016.1219182

Joya, A. (2018). The military and the state in Egypt: Class formation in the post-Arab uprisings. *British Journal of Middle Eastern Studies*, *47*(5), 681–701. https://doi.org/10.1080/13530194.2018.1509692

Jura, J., Kopiński, D., Polus, A., & Tycholiz, W. (2024). Examining shifts in the Angola–China relations in the post-Dos Santos era. *African Affairs*, adae005. https://doi.org/10.1093/afraf/adae005

Justia Law. (2003). *Cisco Systems, Inc. v. Huawei Technologies, Co., Ltd.*, 266 F. Supp. 2d 551 (E.D. Tex. 2003). https://law.justia.com/cases/federal/district-courts/FSupp2/266/551/2516657/

Kabeer, N. (2019). Randomized control trials and qualitative evaluations of a multifaceted programme for women in extreme poverty: Empirical findings and methodological

reflections. *Journal of Human Development and Capabilities*, *20*(2), 197–217. https://doi.org/10.1080/19452829.2018.1536696
Kamakura, W. A., & Wedel, M. (1997). Statistical data fusion for cross-tabulation. *Journal of Marketing Research*, *34*(4), 485–498. https://doi.org/10.1177/002224379703400406
Kamel, S. (2007). *Evolution of mobile technology in Egypt*. IGI Global. https://www.irma-international.org/viewtitle/32466/?isxn=9781616921255
Kamel, S. (2010). Information and communication technology for development: Empowering Egypt's youth. In *Knowledge management and innovation: A business competitive edge perspective—Proceedings of the 15th International Business Information Management Association Conference* (Vol. 2, p. 941).
Kampini, T., & Kalepa, J. (2024). China–Africa collaboration in agriculture and food security: Prospects and challenges. In *China-Africa science, technology and innovation collaboration* (pp. 157–175). Springer.
Kant, K. (2009). Data center evolution: A tutorial on state of the art, issues, and challenges. *Computer Networks*, *53*(17), 2939–2965. https://doi.org/10.1016/j.comnet.2009.10.004
Kaplinsky, R. (2005). *Globalization, poverty and inequality: Between a rock and a hard place*. Polity Press.
Kaplinsky, R. (2015). Global value chains in manufacturing industry: Where they came from, where they are going and why this is important. In *Routledge handbook of industry and development*. Routledge.
Karpova, O., & Mayburov, I. (2019). Implementation of the E-Customs project in Russia and the Golden Customs project in China: Opportunities for cooperation and coordination. *Public Administration Issues*, *6*, 82–100.
Katal, A., Dahiya, S., & Choudhury, T. (2023). Energy efficiency in cloud computing data centers: A survey on software technologies. *Cluster Computing*, *26*(3), 1845–1875. https://doi.org/10.1007/s10586-022-03713-0
Katz, R., & Callorda, F. (2018). Accelerating the development of Latin American digital ecosystem and implications for broadband policy. *Telecommunications Policy*, *42*(9), 661–681. https://doi.org/10.1016/j.telpol.2017.11.002
Kernen, A., & Lam, K. N. (2014). Workforce localization among Chinese state-owned enterprises (SOEs) in Ghana. *Journal of Contemporary China*, *23*(90), 1053–1072. https://doi.org/10.1080/10670564.2014.898894
Khan, M. (2000). Rents, efficiency and growth. In *Rents, rent-seeking and economic development: Theory and evidence in Asia*. Cambridge University Press. https://eprints.soas.ac.uk/9842/1/Rents_Efficiency_and_Growth.pdf
Khelfaoui, H. (2007). Stratégies individuelles et collectives d'intégration des TIC en Algérie. In *Le Maghreb dans l'économie numérique* (p. 71).
Kilavuz, T., & Grenwal, S. (2020, February 24). Algerians have been protesting for a year. Here's what you need to know. *Brookings*. https://www.brookings.edu/articles/algerians-have-been-protesting-for-a-year-heres-what-you-need-to-know/
Kilic, B. (2025, January 23). On digital trade: Will Trump 2.0 continue to break from neoliberalism? *Centre for International Governance Innovation*. https://www.cigionline.org/articles/on-digital-trade-will-trump-20-continue-to-break-from-neoliberalism/
Kim, M., Lee, H., & Kwak, J. (2020). The changing patterns of China's international standardization in ICT under techno-nationalism: A reflection through 5G standardization. *International Journal of Information Management*, *54*, 102145.
King, K. (2013). *China's aid and soft power in Africa*. Boydell & Brewer. https://boydellandbrewer.com/9781847010650/chinas-aid-and-soft-power-in-africa/
Kira, B., Sinha, V., & Srinivasan, S. (2021). Regulating digital ecosystems: Bridging the gap between competition policy and data protection. *Industrial and Corporate Change*, *30*(5), 1337–1360. https://doi.org/10.1093/icc/dtab053
Kirchherr, J., & Matthews, N. (2018). Technology transfer in the hydropower industry: An analysis of Chinese dam developers' undertakings in Europe and Latin America. *Energy Policy*, *113*, 546–558. https://doi.org/10.1016/j.enpol.2017.11.043

Kleibert, J. M., & Mann, L. (2020). Capturing value amidst constant global restructuring? Information-technology-enabled services in India, the Philippines and Kenya. *The European Journal of Development Research*, *32*(4), 1057–1079. https://doi.org/10.1057/s41287-020-00256-1

Kneller, R., & Pisu, M. (2007). Industrial linkages and export spillovers from FDI. *The World Economy*, *30*(1), 105–134. https://doi.org/10.1111/j.1467-9701.2007.00874.x

Kohli, A. (2004). *State-directed development: Political power and industrialization in the global periphery*. Cambridge University Press.

Kokko, A., Tansini, R., & Zejan, M. C. (1996). Local technological capability and productivity spillovers from FDI in the Uruguayan manufacturing sector. *The Journal of Development Studies*, *32*(4), 602–611. https://doi.org/10.1080/00220389608422430

Kopinski, D., Carmody, P., & Taylor, I. (2024). *The political economy of Chinese FDI and spillover effects in Africa*. Springer Nature.

Kouladoum, J.-C. (2023). Digital infrastructural development and inclusive growth in Sub-Saharan Africa. *Journal of Social and Economic Development*, *25*(2), 403–427. https://doi.org/10.1007/s40847-023-00240-5

Krueger, A. (1998). Why trade liberalisation is good for growth. *The Economic Journal*, *108*(450), 1513–1522. https://doi.org/10.1111/1468-0297.00358

Krueger, A. (1990). Government failures in development. *Journal of Economic Perspectives*, *4*(3), 9–23. https://doi.org/10.1257/jep.4.3.9

Kubny, J., & Voss, H. (2014). Benefitting from Chinese FDI? An assessment of vertical linkages with Vietnamese manufacturing firms. *International Business Review*, *23*(4), 731–740. https://doi.org/10.1016/j.ibusrev.2013.11.002

Kugler, K. (2021). *The impact of data localisation laws on trade in Africa*. Mandela Institute, University of the Witwatersrand. https://www.wits.ac.za/media/wits-university/faculties-and-schools/commerce-law-and-management/research-entities/mandela-institute/documents/research-publications/PB%2008%20Data%20localisation%20laws%20and%20trade.pdf

Kurban, C., Peña-López, I., & Haberer, M. (2017). What is technopolitics? A conceptual schema for understanding politics in the digital age. *IDP Revista de Internet, Derecho y Política*, *24*, 3–20. https://doi.org/10.7238/idp.v0i24.3061

Kurlantzick, J. (2020, December 23). China's Digital Silk Road Initiative: A boon for developing countries or a danger to freedom? *The Diplomat*. https://thediplomat.com/2020/12/chinas-digital-silk-road-initiative-a-boon-for-developing-countries-or-a-danger-to-freedom/

Kwet, M. (2019). Digital colonialism: US empire and the new imperialism in the Global South. *Race & Class*, *60*(4), 3–26. https://doi.org/10.1177/0306396818823172

Labott, E. (2013, October 9). U.S. suspends significant military aid to Egypt. *CNN*. https://www.cnn.com/2013/10/09/world/meast/us-egypt-aid/index.html

Lal, D. (2000). *The poverty of 'development economics'*. MIT Press.

Lall, S. (1992). Technological capabilities and industrialization. *World Development*, *20*(2), 165–186. https://doi.org/10.1016/0305-750X(92)90097-F

Lall, S. (1996). *Learning from the Asian tigers: Studies in technology and industrial policy*. Palgrave Macmillan.

Lall, S., & Narula, R. (2004). Foreign direct investment and its role in economic development: Do we need a new agenda? *European Journal of Development Research*, *16*(3), 447–464. https://doi.org/10.1080/0957881042000266589

Lamont, M., & Swidler, A. (2014). Methodological pluralism and the possibilities and limits of interviewing. *Qualitative Sociology*, *37*(2), 153–171. https://doi.org/10.1007/s11133-014-9274-z

Lampert, B., & Mohan, G. (2014). Sino-African encounters in Ghana and Nigeria: From conflict to conviviality and mutual benefit. *Journal of Current Chinese Affairs*, *43*(1), 9–39. https://doi.org/10.1177/186810261404300102

Landry, D. (2024). More problems more money? Does China lend more to African countries with higher credit risk levels? *Global Studies Quarterly*, *4*(2), ksae017. https://doi.org/10.1093/isagsq/ksae017

Langley, P., & Leyshon, A. (2021). The platform political economy of FinTech: Reintermediation, consolidation and capitalisation. *New Political Economy*, *26*(3), 376–388. https://doi.org/10.1080/13563467.2020.1766432
Laouisset, D. E. (2021). Algeria imports substitution policy: The case of the pharmaceutical industry. *Les Cahiers du Cread*, *37*(1), 31–56.
Larios-Hernandez, G. J. (2024). Alibaba in Mexico: Adapting the digital villages model to Latin America. *The Information Society*, *40*(2), 120–135. https://doi.org/10.1080/01972243.2024.2315878
Larkin, B. (2013). The politics and poetics of infrastructure. *Annual Review of Anthropology*, *42*(1), 327–343. https://doi.org/10.1146/annurev-anthro-092412-155522
Larsen, M. M., Mkalama, B., & Mol, M. J. (2023). Outsourcing in Africa: How do the interactions between providers, multinationals, and the state lead to the evolution of the BPO industry? *Journal of International Business Policy*, *6*(4), 432–452. https://doi.org/10.1057/s42214-023-00166-z
Lau, S., & Cokelaere, H. (2021, December 1). EU launches 'Global Gateway' to counter China's Belt and Road. *POLITICO*. https://www.politico.eu/article/eu-launches-global-gateway-to-counter-chinas-belt-and-road/
Lauridsen, L. S. (2010). Strategic industrial policy and latecomer development: The what, the why and the how. *Forum for Development Studies*, *37*(1), 7–32. https://doi.org/10.1080/08039410903558244
Lawless, R., & Findlay, A. (1984). Algeria: The contradictions of rapid industrialisation. In *North Africa: Contemporary politics and economic development*. Routledge.
Layachi, O. B. (2021). The role of international arbitration in resolving oil disputes with foreign investment companies: Case study of the National Company for Research, Production, Transport, Transformation and Marketing of Fuels (Sonatrach). *PalArch's Journal of Vertebrate Palaeontology*, *18*(1), 1–15.
Le Maistre, R. (2018, October 22). Huawei helps Telecom Egypt secure a $200M loan to fund 4G rollout. *Connecting Africa*. http://www.connectingafrica.com/author.asp?section_id=530&doc_id=743459
Le Monde. (2018, January 26). Addis-Abeba, le siège de l'Union africaine espionné par Pékin. *Le Monde*. https://www.lemonde.fr/afrique/article/2018/01/26/a-addis-abeba-le-siege-de-l-union-africaine-espionne-par-les-chinois_5247521_3212.html
Lean, C. S. (2001). Empirical tests to discern linkages between construction and other economic sectors in Singapore. *Construction Management and Economics*, *19*(4), 355–363. https://doi.org/10.1080/01446190010022686
Lee, C. K. (2018). *The specter of global China: Politics, labor, and foreign investment in Africa*. University of Chicago Press.
Lee, H., & Oh, S. (2006). A standards war waged by a developing country: Understanding international standard setting from the actor-network perspective. *The Journal of Strategic Information Systems*, *15*(3), 177–195. https://doi.org/10.1016/j.jsis.2005.10.002
Lee, J.-W., & Gray, K. (2016). Neo-colonialism in South–South relations? The case of China and North Korea. *Development and Change*, *47*(2), 293–316. https://doi.org/10.1111/dech.12223
Lee, S., Brown, J. S., & Lee, S. (2011). A cross-country analysis of fixed broadband deployment: Examination of adoption factors and network effect. *Journalism & Mass Communication Quarterly*, *88*(3), 580–596. https://doi.org/10.1177/107769901108800307
Lemoine, F., & Ünal-Kesenci, D. (2004). Assembly trade and technology transfer: The case of China. *World Development*, *32*(5), 829–850. https://doi.org/10.1016/j.worlddev.2004.01.001
Lewis, W. A. (1954). *Economic development with unlimited supplies of labour*. The Manchester School. http://la.utexas.edu/users/hcleaver/368/368lewistable.pdf
Li, H., & Todo, Y. (2025). *The direct and indirect effects of the Belt and Road Initiative on exports to China*. Research Institute for Economy, Trade and Industry. https://www.rieti.go.jp/jp/publications/dp/25e038.pdf
Li, R., & Cheong, K.-C. (2017). Huawei and ZTE in Malaysia: The localisation of Chinese transnational enterprises. *Journal of Contemporary Asia*, *47*(5), 752–773. https://doi.org/10.1080/00472336.2017.1346697

Li, X., Li, J., Yuan, C., Guo, S., & Wang, Z. (2023). *Development practice of digital business environment in China* (1st ed.). Springer.
Lin-Liu, J. (2003). Huawei-Cisco tests China's respect for property rights. *IEEE Spectrum*, *40*(8), 10–12. https://doi.org/10.1109/MSPEC.2003.1222038
Lin, J. Y. (2011). New structural economics: A framework for rethinking development. *The World Bank Research Observer*, *26*(2), 193–221. https://doi.org/10.1093/wbro/lkr007
Lin, J. Y., Cai, F., & Li, Z. (2003). *The China miracle: Development strategy and economic reform* (Rev. ed.). The Chinese University of Hong Kong Press. https://doi.org/10.2307/j.ctv1fj84hd
Lin, J., & Chang, H.-J. (2009). Should industrial policy in developing countries conform to comparative advantage or defy it? A debate between Justin Lin and Ha-Joon Chang. *Development Policy Review*, *27*(5), 483–502. https://doi.org/10.1111/j.1467-7679.2009.00456.x
Lin, L., & Wang, S. (2022). China's higher education policy change from 211 project and 985 project to the double-first-class plan: Applying Kingdon's multiple streams framework. *Higher Education Policy*, *35*(4), 808–832.
Liu, H. (2024). The Chinese strategic mind at work: The case of Huawei. In *Chinese strategic thinking on competitive dynamics in innovation* (Chapter 6). Edward Elgar Publishing. https://www.elgaronline.com/monochap/book/9781803927305/book-part-9781803927305-14.xml
Liu, W., & Dunford, M. (2016). Inclusive globalization: Unpacking China's Belt and Road Initiative. *Area Development and Policy*, *1*(3), 323–340. https://doi.org/10.1080/23792949.2016.1232598
Liu, X., & Cheng, P. (2011). *Is China's indigenous innovation strategy compatible with globalization?* University of Hawai'i at Mānoa. http://hdl.handle.net/10125/22292
Liu, X., Wang, C., & Wei, Y. (2009). Do local manufacturing firms benefit from transactional linkages with multinational enterprises in China? *Journal of International Business Studies*, *40*(7), 1113–1130. https://doi.org/10.1057/jibs.2008.97
Liu, Z. (2009). Foreign direct investment and technology spillovers: Theory and evidence. *Journal of Development Economics*, *85*(1), 176–193. https://doi.org/10.1016/j.jdeveco.2006.07.001
Lou, X. (2019). Building China-Latin America digital silk road: Challenges and roadmap. *China International Studies*, *77*, 48–67.
Lumumba-Kasongo, T. (2011). China-Africa relations: A neo-imperialism or a neo-colonialism? A reflection. *African and Asian Studies*, *10*(2–3), 234–266. https://doi.org/10.1163/156921011X587040
Luo, Z., Wan, G., Wang, C., & Zhang, X. (2022). The distributive impacts of the Belt and Road Initiative. *Journal of Economic Surveys*, *36*(3), 586–604. https://doi.org/10.1111/joes.12436
Ma, M. (2018). *Activating intelligence with IoT cloud and AI*. Huawei. https://www.huawei.com/en/huaweitech/publication/86/activating-intelligence-with-iot-cloud-ai
Mackinnon, A. (2019, March 19). For Africa, Chinese-built internet is better than no internet at all. *Foreign Policy*. https://foreignpolicy.com/2019/03/19/for-africa-chinese-built-internet-is-better-than-no-internet-at-all/
Macrotrends. (2024). *Crude oil prices—Historical chart*. https://www.macrotrends.net/1369/crude-oil-price-history-chart
Madon, S., & Krishna, S. (Eds.). (2017). *The digital challenge: Information technology in the development context* (Routledge Revivals). Routledge.
Magaldi, D., & Berler, M. (2020). Semi-structured interviews. In V. Zeigler-Hill & T. K. Shackelford (Eds.), *Encyclopedia of personality and individual differences* (pp. 4825–4830). Springer International Publishing. https://doi.org/10.1007/978-3-319-24612-3_857
Maghreb Emergent. (2024). Réalisation d'un Data center : Le contrat avec Huawei se négociera directement avec le Haut-commissariat à la numérisation. *Maghreb Émergent*. https://maghrebemergent.net/realisation-dun-data-center-le-contrat-avec-huawei-se-negociera-directement-avec-le-haut-commissariat-a-la-numerisation/

Majerowicz, E., & de Carvalho, M. H. (2024). China's expansion into Brazilian digital surveillance markets. *The Information Society*, *40*(2), 168–185. https://doi.org/10.1080/01972243.2024.2315880
Malena, J. (2021). *The extension of the Digital Silk Road to Latin America: Advantages and potential risks*. Brazilian Center for International Relations.
Malerba, F., & Nelson, R. (2011). Learning and catching up in different sectoral systems: Evidence from six industries. *Industrial and Corporate Change*, *20*(6), 1645–1675. https://doi.org/10.1093/icc/dtr062
Mann, L. (2018). Left to other peoples' devices? A political economy perspective on the big data revolution in development. *Development and Change*, *49*(1), 3–36. https://doi.org/10.1111/dech.12347
Mann, L., & Iazzolino, G. (2019). *See, nudge, control and profit: Digital platforms as privatized epistemic infrastructures*. ICT for Change.
Mann, L., & Iazzolino, G. (2021). From development state to corporate leviathan: Historicizing the infrastructural performativity of digital platforms within Kenyan agriculture. *Development and Change*, *52*(4), 829–854. https://doi.org/10.1111/dech.12671
Mann, M. (2012). *The sources of social power: A history of power from the beginning to AD 1760* (2nd ed.). Cambridge University Press. [Original work published 1986]
Mansell, R. (2014). Power and interests in information and communication and development: Exogenous and endogenous discourses in contention. *Journal of International Development*, *26*(1), 109–127. https://doi.org/10.1002/jid.1805
Markusen, J., & Venables, A. (1999). Foreign direct investment as a catalyst for industrial development. *European Economic Review*, *43*(2), 335–356.
Marti, M. E. (2002). *China and the legacy of Deng Xiaoping: From Communist revolution to capitalist evolution*. Potomac Books.
Martinez, L. (2000). *The Algerian civil war, 1990-1998*. Columbia University Press.
Marwan, A. (2019, September 4). The uncertain future of Algeria's anti-corruption battles. *The Washington Institute*. https://www.washingtoninstitute.org/policy-analysis/uncertain-future-algerias-anti-corruption-battles
Mathews, J. A., & Cho, D. S. (2000). *Tiger technology: The creation of a semiconductor industry in East Asia* (1st ed.). Cambridge University Press.
Mattli, W., & Büthe, T. (2003). Setting international standards: Technological rationality or primacy of power? *World Politics*, *56*(1), 1–42.
Mavani, C., Mistry, H. K., Patel, R., & Goswami, A. (2024). Artificial intelligence (AI) based data center networking. *International Journal on Recent and Innovation Trends in Computing and Communication*, *12*(2), 508–518.
Maxigas, & Ten Oever, N. (2023). Geopolitics in the infrastructural ideology of 5G. *Global Media and China*, *8*(3), 298–315. https://doi.org/10.1177/20594364231193950
Mazurek, G., & Małagocka, K. (2019). Perception of privacy and data protection in the context of the development of artificial intelligence. *Journal of Management Analytics*, *6*(4), 344–364. https://doi.org/10.1080/23270012.2019.1671243
Mazzoleni, R., & Nelson, R. R. (1998). Economic theories about the benefits and costs of patents. *Journal of Economic Issues*, *32*(4), 1031–1052.
Mazzucato, M. (2013). *The entrepreneurial state: Debunking public vs. private sector myths* (1st ed.). Anthem Press.
Mazzucato, M. (2019). *Preventing digital feudalism*. Project Syndicate. https://www.bresserpereira.org.br/terceiros/2019/outubro/19.10-Digital-Feudalism.pdf
McCoy, A. (2025, January 27). President Trump is demolishing America's global soft power. *The Nation*. https://www.thenation.com/?post_type=article&p=558356
McGregor, G. (2022, December 14). China emerges as lead funder for Egypt's new administrative city. *Al-Monitor*. https://www.al-monitor.com/originals/2022/12/china-emerges-lead-funder-egypts-new-administrative-city
MCIT. (2005). *Yearbook 2005*. Ministry of Communications and Information Technology. https://mcit.gov.eg/Upcont/Documents/Publications_22102019000_MCIT_Yearbook_2005.pdf

MCIT. (2006). *Yearbook 2006*. Ministry of Communications and Information Technology. https://mcit.gov.eg/Upcont/Documents/MCITYearbook2006.pdf
MCIT. (2015). *Egypt's ICT 2030 strategy*. Ministry of Communications and Information Technology. https://mcit.gov.eg/en/ICT_Strategy
MCIT. (2016). *Egypt's ICT 2030 strategy*. Ministry of Communications and Information Technology. https://mcit.gov.eg/en/ICT_Strategy
MCIT. (2022, October 24). ICT minister opens Future of Data Centers Summit 2022. *Ministry of Communications and Information Technology*. https://mcit.gov.eg/en/Media_Center/Press_Room/Press_Releases/66213
MCIT. (2023). *MCIT achievements in 10 years*. Ministry of Communications and Information Technology.
McKinsey. (2017). *Digital globalization: The new era of global flows*. https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/digital-globalization-the-new-era-of-global-flows
McKinsey. (2020). *Oil and gas technology: Connectivity for higher performance*. https://www.mckinsey.com/industries/oil-and-gas/our-insights/how-tapping-connectivity-in-oil-and-gas-can-fuel-higher-performance
Meagher, K. (2021). Informality and the infrastructures of inclusion: An introduction. *Development and Change*, *52*(4), 729–755. https://doi.org/10.1111/dech.12672
Meddah, A., & Charef, L. (2022). E-CRM in algerian telecommunication sector: Website evaluation case study: Mobile network operators in Algeria (Djezzy Ooredoo and Mobilis). *Les Cahiers du Mecas*, *18*(2), 92–106.
Meity. (2024). *GI Cloud (MeghRaj)*. Ministry of Electronics and Information Technology, Government of India. https://www.meity.gov.in/content/gi-cloud-meghraj
Meltzer, J. P., & Lovelock, P. (2018). *Regulating for a digital economy—Understanding the importance of cross-border data flows in Asia* (SSRN Scholarly Paper No. 3164401). https://papers.ssrn.com/abstract=3164401
MFA. (2009). *Premier Wen Jiabao talks with trainees of Huawei Training Center in Egypt*. Ministry of Foreign Affairs of the People's Republic of China. https://www.mfa.gov.cn/ce/cedk/eng/TourChina/t626256.htm
Miao, W., & Lei, W. (2016). Policy review: The Cyberspace Administration of China. *Global Media and Communication*, *12*(3), 337–340. https://doi.org/10.1177/1742766516680879
Miller, C. (2022). *Chip war: The fight for the world's most critical technology*. Simon & Schuster.
Milmo, D., Hawkins, A., Booth, R., & Kollewe, J. (2025, January 27). 'Sputnik moment': $1tn wiped off US stocks after Chinese firm unveils AI chatbot. *The Guardian*. https://www.theguardian.com/business/2025/jan/27/tech-shares-asia-europe-fall-china-ai-deepseek
Minagawa, T., Trott, P., & Hoecht, A. (2007). Counterfeit, imitation, reverse engineering and learning: Reflections from Chinese manufacturing firms. *R&D Management*, *37*(5), 455–467. https://doi.org/10.1111/j.1467-9310.2007.00488.x
Mingas, M. (2020, September 1). Egypt awards spectrum worth $1.1 billion to boost mobile services. *Capacity Media*. https://www.capacitymedia.com/article/29otcq7s58uymwyai1m2o/news/egypt-awards-spectrum-worth-1-1-billion-to-boost-mobile-services
Minges, M. (2015). *Exploring the relationship between broadband and economic growth*. World Bank.
Mishra, V. N. (1988). China's four modernisations: Historical perspective. *Proceedings of the Indian History Congress*, *49*, 575–578.
Mitchell, T. (1999). No factories, no problems: The logic of neo-liberalism in Egypt. *Review of African Political Economy*, *26*(82), 455–468. https://doi.org/10.1080/03056249908704412
Mitchell, T. (2002). *Rule of experts: Egypt, technopolitics, modernity*. University of California Press.
Mitra, R. M. (2013). *The information technology and business process outsourcing industry: Diversity and challenges in Asia* (Asian Development Bank Economics Working Paper Series No. 365). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2321535

Mkandawire, T. (2001). Thinking about developmental states in Africa. *Cambridge Journal of Economics*, *25*(3), 289–314. https://doi.org/10.1093/cje/25.3.289
Mkandawire, T. (2005). Maladjusted African economies and globalisation. *Africa Development*, *30*(1), 1–33.
Mkandawire, P. T., & Soludo, C. C. (2003). *African voices on structural adjustment: A companion to our continent, our future*. International Development Research Centre.
Moghaddam, F., Walker, B., & Harre, R. (2003). Culture distance, abstraction and the advantages of mixed-methods. In *Handbook of mixed methods in social & behavioural research*. SAGE.
Mok, A. (2023, April 24). Data for all: Why China's approach to data governance matters. *CGTN*. https://news.cgtn.com/news/2023-04-24/Data-for-all-Why-China-s-approach-to-data-governance-matters-1jgjDicFBsI/index.html
Molla, A., & Heeks, R. (2007). Exploring e-commerce benefits for businesses in a developing country. *The Information Society*, *23*(2), 95–108. https://doi.org/10.1080/01972240701224028
Moreira, M. (2007). Fear of China: Is there a future for manufacturing in Latin America? *World Development*, *35*(3), 355–376. https://doi.org/10.1016/j.worlddev.2006.11.001
Morocco World News. (2011, October). The reasons for the delay of the Algerian internet. *Morocco World News*. https://www.moroccoworldnews.com/2011/10/10984/the-reasons-for-the-delay-of-the-algerian-internet
Mouton, M., & Burns, R. (2021). (Digital) neo-colonialism in the smart city. *Regional Studies*, *55*(12), 1890–1901. https://doi.org/10.1080/00343404.2021.1915974
Mu, Q., & Lee, K. (2005). Knowledge diffusion, market segmentation and technological catch-up: The case of the telecommunication industry in China. *Research Policy*, *34*(6), 759–783. https://doi.org/10.1016/J.RESPOL.2005.02.007
Mueller, M. L. (2011). China and global internet governance: A tiger by the tail. In *Global governance of the internet: Principles and norms in dispute* (pp. 174–204). MIT Press. https://direct.mit.edu/books/oa-edited-volume/2190/chapter-abstract/4728273
Mukiri-Smith, H., Mann, L., & Azmeh, S. (2022). A DC state of mind? A review of the World Development Report 2021: Data for better lives. *Development & Change*, *53*(6), 1336–1353.
Mullin, J. (2023, Q2). Virginia's data centers and economic development. *Econ Focus*, *27*(2). https://www.richmondfed.org/publications/research/econ_focus/2023/q2_feature2
Mumford, D. (2022). Data colonialism: Compelling and useful, but whither epistemes? *Information, Communication & Society*, *25*(10), 1511–1516. https://doi.org/10.1080/1369118X.2021.1986103
Murphy, J. T., & Carmody, P. (2015). *Africa's information revolution: Technical regimes and production networks in South Africa and Tanzania* (1st ed.). Wiley-Blackwell.
Musiani, F. (2013). Network architecture as internet governance. Internet Policy Review, 2(4). https://doi.org/10.14763/2013.4.208
Myrdal, G. (1957). *Economic theory and under-developed regions*. Duckworth. http://revistas.bancomext.gob.mx/rce/magazines/567/12/RCE11.pdf
Nadvi, K. (2008). Global standards, global governance and the organization of global value chains. *Journal of Economic Geography*, *8*(3), 323–343. https://doi.org/10.1093/jeg/lbn003
Nahla, N. (2023). University-company collaboration: What are the obstacles in Algeria? *SocioEconomic Challenges*, *7*(1), 59–64. https://doi.org/10.21272/sec.7(1).59-64.2023
Naughton, B. (2017). Supply-side structural reform: Policymakers look for a way out. *China Leadership Monitor*, *49*, 1–13.
Naughton, B. (2020). Chinese industrial policy and the digital silk road. *Asia Policy*, *15*(1), 23–40.
NBS. (2024). *National Bureau of Statistics data*. National Bureau of Statistics of China. https://data.stats.gov.cn/english/
Ndemo, B., & Weiss, T. (2017). Making sense of Africa's emerging digital transformation and its many futures. *Africa Journal of Management*, *3*(3–4), 328–347. https://doi.org/10.1080/23322373.2017.1400260
NDRC. (2015). *Action plan for harmonisation of standards along the Belt and Road (2015–2017)*. National Development and Reform Commission. http://www.yidaiyilu.gov.cn/wcm.files/upload/CMSydylgw/201702/201702150616033.pdf
Ngila, F. (2022, August 17). The scramble for Africa's data is taking place on the cloud. *Quartz*. https://qz.com/the-scramble-for-africas-data-is-taking-place-on-the-cl-1849444808

Ngwenyama, O., & Morawczynski, O. (2009). Factors affecting ICT expansion in emerging economies: An analysis of ICT infrastructure expansion in five Latin American countries. *Information Technology for Development*, *15*(4), 237–258. https://doi.org/10.1002/itdj.20128
Nield, D. (2017, May 29). All the sensors in your smartphone, and how they work. *Gizmodo Australia*.
Ning, L., & Wang, F. (2018). Does FDI bring environmental knowledge spillovers to developing countries? The role of the local industrial structure. *Environmental and Resource Economics*, *71*(2), 381–405. https://doi.org/10.1007/s10640-017-0159-y
Noone, G. (2022, May 19). How Huawei is winning over the global south. *Tech Monitor*. https://www.techmonitor.ai/future-of-telecoms/why-huawei-is-winning-over-the-global-south
Normile, D. (2018, March 16). China asserts firm grip on research data. *Science*. https://www.science.org/content/article/china-asserts-firm-grip-research-data
North, D. (1990). Institutions and their consequences for economic performance. In *The limits of rationality* (pp. 383–401). University of Chicago Press.
Northey, J. A. (2021). The Algerian hirak: Citizenship, non-violence, and the new movement for democracy. In *The condition of democracy*. Routledge.
Noumba, P. (2004). *A policy note on telecommunications reform in Algeria* (Policy Research Working Paper No. 3339). World Bank. https://documents1.worldbank.org/curated/ar/102191468768542092/pdf/wps3339.pdf
Noumoff, S. J. (2003). The Chinese strategy of technology self-sufficiency. *China Report*, *39*(2), 157–196. https://doi.org/10.1177/000944550303900201
NRC. (2023). *National Research Centre—About us*. National Research Centre. https://www.nrc.sci.eg/about-us
Oakes, T. (2021). The Belt and Road as method: Geopolitics, technopolitics and power through an infrastructure lens. *Asia Pacific Viewpoint*, *62*(3), 281–285. https://doi.org/10.1111/apv.12319
Oakes, T. (2024). *Global China & infrastructure power: The technopolitics of the 'China model' of development*. Georgetown University. https://repository.library.georgetown.edu/bitstream/handle/10822/1088865/Oakes_Global%20China_2024.pdf?sequence=1
Ockwell, D. G., Watson, J., MacKerron, G., Pal, P., & Yamin, F. (2008). Key policy considerations for facilitating low carbon technology transfer to developing countries. *Energy Policy*, *36*(11), 4104–4115.
Octenium. (2017, December 13). Algérie | Projet de construction d'un Datacenter. *Blog Octenium*. https://blog.octenium.com/algerie-construction-datacenter/
OEC. (2024). *Exports, imports, and trade partners*. OEC - The Observatory of Economic Complexity. https://oec.world/en/profile/country/dza
OECD. (2023). *New tertiary graduates in science, technology, engineering and mathematics as a share of new graduates* [Dataset]. OECD Going Digital. https://goingdigital.oecd.org/en/indicator/43
Olander, E. (2022, July 22). The powerful symbolism of the Huawei-built data center deal in Senegal. *The China Global South Project*. https://chinaglobalsouth.com/analysis/the-powerful-symbolism-of-the-huawei-data-center-deal-in-senegal/
Oliveira, G. A., Trentin, M. G., Setti, D., & de Lima, J. D. (2021). The path towards Industry 4.0 for Brazilian SMEs. In *Industry 4.0 in SMEs across the globe* (pp. 141–154). CRC Press. https://www.taylorfrancis.com/chapters/edit/10.1201/9781003165880-11/path-towards-industry-4-0-brazilian-smes-gilson-adamczuk-oliveira-marcelo-gon%C3%A7alves-trentin-dalmarino-setti-jose-donizetti-de-lima
Omdia. (2023). *Africa broadband outlook 2023*. Informa Tech. https://omdia.tech.informa.com/-/media/tech/omdia/marketing/commissioned-research/pdfs/africa-broadband-outlook-2023.pdf
Onwuegbuzie, A. J., & Leech, N. L. (2005). On becoming a pragmatic researcher: The importance of combining quantitative and qualitative research methodologies. *International Journal of Social Research Methodology*, *8*(5), 375–387. https://doi.org/10.1080/13645570500402447

Opara-Martins, J., Sahandi, R., & Tian, F. (2016). Critical analysis of vendor lock-in and its impact on cloud computing migration: A business perspective. *Journal of Cloud Computing*, *5*(1), 4. https://doi.org/10.1186/s13677-016-0054-z

Oqubay, A., & Lin, J. Y. (2019). *China-Africa and an economic transformation*. Oxford University Press. https://doi.org/10.1093/oso/9780198830504.001.0001

Oreglia, E., & Zheng, W. (2024). The Digital Silk Road between national rhetoric and provincial ambitions. *The China Quarterly*, 1–13. https://doi.org/10.1017/S0305741024000936

Oreglia, E., Ren, H., & Liao, C.-C. (2021). The puzzle of the Digital Silk Road. In *Digital Silk Road in Central Asia: Present and future* (p. 136). Davis Center for Russian and Eurasian Studies, Harvard University. https://daviscenter.fas.harvard.edu/sites/default/files/files/2021-06/Digital_Silk_Road_Report.pdf

Ortiz-Freuler, J. (2023). The weaponization of private corporate infrastructure: Internet fragmentation and coercive diplomacy in the 21st century. *Global Media and China*, *8*(1), 6–23. https://doi.org/10.1177/20594364221139729

Otero-Iglesias, M. (2019, February 21). Europe is not behind China and the US in 5G technology. *Elcano Royal Institute*. https://www.realinstitutoelcano.org/en/commentaries/europe-is-not-behind-china-and-the-us-in-5g-technology/

Ould Khettab, D. (2020, October 8). Algeria: Never-ending battle with Sawiris' Orascom finally concludes. *The Africa Report*. https://www.theafricareport.com/44515/algeria-never-ending-battle-with-sawiris-orascom-finally-concudes/

Overholt, W. H. (2010). China in the global financial crisis: Rising influence, rising challenges. *The Washington Quarterly*, *33*(1), 21–34. https://doi.org/10.1080/01636600903418652

Oya, C., & Schaefer, F. (2019). *Chinese firms and employment dynamics in Africa: A comparative analysis* (Working Paper). SOAS University of London.

Pack, H. (2006). Econometric versus case study approaches to technology transfer. In B. Hoekman & B. S. Javorcik (Eds.), *Global integration and technology transfer* (pp. 29–50). World Bank.

Page, J. (1994). The East Asian miracle: Four lessons for development policy. *NBER Macroeconomics Annual*, *9*, 219–269. https://doi.org/10.1086/654251

Page, J. (2000). Getting ready for globalization: A new privatization strategy for the MENA region? In *State-owned enterprises in the Middle East and North Africa*. Routledge.

Pairault, T. (2017). La Chine au Maghreb : De l'esprit de Bandung à l'esprit du capitalisme. *Revue de la Régulation*, *21*. https://doi.org/10.4000/regulation.12230

Pairault, T., & Talahite, F. (2014). *China-Algeria, a unique relationship in Africa* [Post-Print]. HAL. https://econpapers.repec.org/paper/haljournl/halshs-00980942.htm

Palacio Ludeña, M. G. (2021). Falling through the cracks: Digital infrastructures of social protection in Ecuador. *Development and Change*, *52*(4), 805–828. https://doi.org/10.1111/dech.12664

Panday, J., & Malcolm, J. (2018). The political economy of data localization. *Partecipazione e Conflitto*, *11*(2), 511–527.

Park, J. (2022, February 23). Breaking the internet: China-US competition over technology standards. *The Diplomat*. https://thediplomat.com/2022/02/breaking-the-internet-china-us-competition-over-technology-standards/

Park, S. R., Choi, D. Y., & Hong, P. (2015). Club convergence and factors of digital divide across countries. *Technological Forecasting and Social Change*, *96*, 92–100. https://doi.org/10.1016/j.techfore.2015.02.011

PDPL. (2020). *Egypt's data protection law*. Privacy Laws. https://www.privacylaws.com/media/3263/egypt-data-protection-law-151-of-2020.pdf

Peck, J., & Phillips, R. (2020). The platform conjuncture. *Sociologica*, *14*(3), 39–58. https://doi.org/10.6092/issn.1971-8853/11613

Peltola, M., Xue, G., & Zheng, Y. (2021). *China-powered ICT infrastructure: Lessons from Tanzania and Cambodia*. South African Institute of International Affairs. https://saiia.org.za/research/china-powered-ict-infrastructure-lessons-from-tanzania-and-cambodia/

Perkmann, M., & Walsh, K. (2007). University–industry relationships and open innovation: Towards a research agenda. *International Journal of Management Reviews*, *9*(4), 259–280. https://doi.org/10.1111/j.1468-2370.2007.00225.x
Peyrat, O. (2012). Normes : Un outil caché de la stratégie économique chinoise. *Le Journal de l'École de Paris du Management*, *30*(1), 8–14. https://www.ecole.org/fr/seance/961-normes-un-outil-cache-de-la-strategie-economique-chinoise
Pietrobelli, C., & Rabellotti, R. (2011). Value chains meet innovation systems: Are there learning opportunities for developing countries? *World Development, 39*(7), 1261–1269. https://doi.org/10.1016/j.worlddev.2010.05.013
Pohle, J., & Thiel, T. (2021). Digital sovereignty. In B. Herlo, D. Irrgang, G. Joost, & A. Unteidig (Eds.), *Practicing sovereignty: Digital involvement in times of crises* (pp. 47–68). transcript Verlag. https://doi.org/10.1515/9783839457603-003
Pohlmann, T., Buggenhagen, M., & Richter, M. (2023). *Who is leading the 5G patent race?* LexisNexis IPlytics. https://files.lbr.cloud/public/2023-10/Who%20is%20leading%20the%205G%20patent%20race,%202023%20report%20by%20LexisNexis%C2%AE%20IPlytics.docx.pdf?VersionId=SXbB495AboU2B1A.pAJN.Atqh.t5eqH2
Pollock, N., & Williams, R. (2010). E-infrastructures: How do we know and understand them: Strategic ethnography and the biography of artefacts. *Computer Supported Cooperative Work*, *19*(6), 521–556. https://doi.org/10.1007/s10606-010-9129-4
PRC. (2020). *Quanqiu shuju anquan changyi* 全球数据安全倡议 [Global data security initiative]. Ministry of Foreign Affairs of the People's Republic of China. https://perma.cc/8SXK-9TWT
Prebisch, R. (1950). *The economic development of Latin America and its principal problems*. United Nations Economic Commission for Latin America and the Caribbean. http://econpapers.repec.org/paper/ecrcol093/29973.htm
Pusceddu, P. (2020). Hic sunt dracones? Mapping the legal framework of China's innovation policy: Standardization and IPRs. *IIC - International Review of Intellectual Property and Competition Law*, *51*(6), 645–671. https://doi.org/10.1007/s40319-020-00945-8
Qian, J. (2019, April 10). Feeling safe in the surveillance state [Opinion]. *The New York Times*. https://www.nytimes.com/2019/04/10/opinion/china-internet-surveillance.html
Rabhi, M. (2021, February 24). Huawei se lance dans l'assemblage de smartphones en Algérie. *Liberté*. https://www.liberte-algerie.com/actualite/huawei-se-lance-dans-lassemblage-de-smartphones-en-algerie-308006/print/1
Rahim, S., & Grau, G. (2024). *Building Egypt's AI future: Capacity-building, compute infrastructure, and domestic LLMs*. Oxford Insights. https://oxfordinsights.com/insights/building-egypts-ai-future/
Ramalingam, C., & Mohan, P. (2021). Addressing semantics standards for cloud portability and interoperability in multi cloud environment. Symmetry, 13(2), 317. https://doi.org/10.3390/sym13020317
Ramdani, L., & Boudinar, C. (2021). Human resources management in the era of digital transformation in Algeria: Challenges and issues. *2021 1st International Conference on Cyber Management and Engineering (CyMaEn)*, 1–4. https://doi.org/10.1109/CyMaEn50288.2021.9497296
Rao, S. S. (2005). Bridging digital divide: Efforts in India. *Telematics and Informatics*, *22*(4), 361–375. https://doi.org/10.1016/j.tele.2005.01.007
Rasmussen, T. (2014). Internet and the political public sphere. *Sociology Compass*, *8*(12), 1315–1329. https://doi.org/10.1111/soc4.12228
Rath, B. N. (2016). Does the digital divide across countries lead to convergence? New international evidence. *Economic Modelling*, *58*, 75–82. https://doi.org/10.1016/j.econmod.2016.05.020
Rath, B. N., Panda, B., & Akram, V. (2023). Convergence and determinants of ICT development in case of emerging market economies. *Telecommunications Policy*, *47*(2), 102464. https://doi.org/10.1016/j.telpol.2022.102464
Ray, R., Gallagher, K. P., Kring, W., Pitts, J., & Simmons, B. A. (2021). Geolocated dataset of Chinese overseas development finance. *Scientific Data*, *8*(1), 241. https://doi.org/10.1038/s41597-021-01021-7
Ray, R., Gallagher, K. P., & Chen, Y. (2023). *China's overseas development finance database*.

Boston University Global Development Policy Center
NTIC-DZ. (2020, February 26). Pourquoi le choix du FTTX de Huawei est judicieux pour l'Algérie. *Ntic-dz*. https://www.ntic-dz.com/pourquoi-le-choix-du-fttx-de-huawei-est-judicieux-pour-lalgerie/
Refaat, T. (2020, November 17). Huawei to provide Egypt's NRC with digital transformation solutions. *Sada Elbalad*. https://see.news/huawei-to-provide-egypts-nrc-with-digital-transformation-solutions
ReportLinker. (2020, August 4). The Africa data center market by revenue is expected to grow at a CAGR of over 12% during the period 2019–2025. *GlobeNewswire*. https://www.globenewswire.com/news-release/2020/08/04/2072600/0/en/The-Africa-data-center-market-by-revenue-is-expected-to-grow-at-a-CAGR-of-over-12-during-the-period-2019-2025.html
Reuters. (2010, October 4). Vimpelcom in $6.6 billion deal to buy Orascom, Wind. *Reuters*. https://www.reuters.com/article/markets/asia/vimpelcom-in-66-billion-deal-to-buy-orascom-wind-idUSTRE6934N0/
Reuters. (2020, April 17). U.S.'s Pompeo: Nations should rethink use of China's Huawei amid coronavirus. *Reuters*. https://www.reuters.com/article/technology/uss-pompeo-nations-should-rethink-use-of-chinas-huawei-amid-coronavirus-idUSKBN21Z20P/
Reynolds, B. L. (2014). *Chinese economic reform: How far, how fast?* Academic Press.
Rip, A., & Kemp, R. (1998). Technological change. In S. Rayner & E. L. Malone (Eds.), *Human choice and climate change: Vol. II, Resources and technology* (pp. 327–399). Battelle Press.
Rizk, N., & Kamel, S. (2013). ICT and building a knowledge-based society in Egypt. *International Journal of Knowledge Management*, *9*(1), 1–20.
Roberts, H. (2003). *The battlefield: Algeria 1988-2002: Studies in a broken polity*. Verso.
Robson, C., & McCartan, K. (2015). *Real world research*. Wiley.
Roccu, R. (2021). State–business relations in neoliberal Egypt: The global political economy of subordinate integration. In *Routledge handbook on contemporary Egypt*. Routledge.
Rodriguez-Clare, A. (1996). Multinationals, linkages, and economic development. *The American Economic Review*, *86*(4), 852–873.
Rodrik, D. (2009). Industrial policy: Don't ask why, ask how. *Middle East Development Journal*, *1*(1), 1–29. https://doi.org/10.1142/S1793812009000024
Rodrik, D. (2013a). *Structural change, fundamentals and growth: An overview*. Institute for Advanced Study.
Rodrik, D. (2013b). Unconditional convergence in manufacturing. *The Quarterly Journal of Economics*, *128*(1), 165–204.
Rojec, M., & Knell, M. (2018). Why is there a lack of evidence on knowledge spillovers from foreign direct investment? *Journal of Economic Surveys*, *32*(3), 579–612. https://doi.org/10.1111/joes.12207
Roller, L.-H., & Waverman, L. (2001). Telecommunications infrastructure and economic development: A simultaneous approach. *American Economic Review*, *91*(4), 909–923. https://doi.org/10.1257/aer.91.4.909
Rosenstein-Rodan, P. N. (1943). Problems of industrialisation of eastern and south-eastern Europe. *The Economic Journal*, *53*(210–211), 202–211.
Rossiter, N. (2016). *Software, infrastructure, labor: A media theory of logistical nightmares* (1st ed.). Routledge.
Rossotto, C. M., Sekkat, K., & Varoudakis, A. (2005). Opening up telecommunications to competition and MENA integration in the world economy. *Journal of International Development*, *17*(7), 931–955. https://doi.org/10.1002/jid.1185
Rühlig, T. (2023). Chinese influence through technical standardization power. *Journal of Contemporary China*, *32*(139), 54–72. https://doi.org/10.1080/10670564.2022.2052439
Rühlig, T. N., & Ten Brink, T. (2021). The externalization of China's technical standardization approach. *Development and Change*, *52*(5), 1196–1221. https://doi.org/10.1111/dech.12685
Russell, A. L. (2014). *Open standards and the digital age*. Cambridge University Press.
Rwehumbiza, D. A. (2021). Huawei's linkages with local firms in Tanzania: Idiosyncratic benefits and risks. *Global Business and Organizational Excellence*, *40*(3), 20–35. https://doi.org/10.1002/joe.22076

Gwelo, A. (2019). Principal components to overcome multicollinearity problem. *Oradea Journal of Business and Economics*, *4*(1), 79–91.
S&P Global. (2020, January 6). Algeria's new hydrocarbon law comes into force amid output slump. *S&P Global Commodity Insights*. https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/natural-gas/010620-algerias-new-hydrocarbon-law-comes-into-force-amid-output-slump
SAC. (2018). *Standards action plan for building the "Belt and Road" (2018–2020)*. Standardization Administration of China. http://www.sac.gov.cn/zt/ydyl/bzhyw/201801/t20180119_341413.htm
Saggi, K. (2002). Trade, foreign direct investment, and international technology transfer: A survey. *The World Bank Research Observer*, *17*(2), 191–235. https://doi.org/10.1093/wbro/17.2.191
SAIS-CARI. (2024). *Data*. Johns Hopkins School of Advanced International Studies China Africa Research Initiative. https://www.sais-cari.org/data
Saunavaara, J., Laine, A., & Salo, M. (2022). The Nordic societies and the development of the data centre industry: Digital transformation meets infrastructural and industrial inheritance. *Technology in Society*, *69*, 101931. https://doi.org/10.1016/j.techsoc.2022.101931
Savoy, C. M. (2021, March 15). *Mission creep at the Development Finance Corporation*. Center for Strategic and International Studies. https://www.csis.org/analysis/mission-creep-development-finance-corporation
Saxenian, A. (2007). *The new argonauts: Regional advantage in a global economy*. Harvard University Press.
Schiller, D. (2014). *Digital depression: Information technology and economic crisis* (1st ed.). University of Illinois Press.
Schindler, S., & Rolf, S. (2024). Geostrategic globalization: US–China rivalry, corporate strategy, and the new global economy. *Globalizations*, 1–18. https://doi.org/10.1080/14747731.2024.2434306
Schindler, S., Alami, I., DiCarlo, J., Jepson, N., Rolf, S., Bayırbağ, M. K., Cyuzuzo, L., DeBoom, M., Farahani, A. F., Liu, I. T., McNicol, H., Miao, J. T., Nock, P., Teri, G., Vila Seoane, M. F., Ward, K., Zajontz, T., & Zhao, Y. (2024). The Second Cold War: US-China competition for centrality in infrastructure, digital, production, and finance networks. *Geopolitics*, *29*(4), 1083–1120. https://doi.org/10.1080/14650045.2023.2253432
Schmid, S. D. (2011). Nuclear colonization? Soviet technopolitics in the Second World. In G. Hecht (Ed.), *Entangled geographies: Empire and technopolitics in the global Cold War* (pp. 125–154). MIT Press. https://doi.org/10.7551/mitpress/9780262515788.003.0006
Schneider-Petsinger, M., Wang, J., Jie, Y., & Crabtree, J. (2019). *US–China strategic competition: The quest for global technological leadership*. Chatham House. https://www.chathamhouse.org/sites/default/files/CHHJ7480-US-China-Competition-RP-WEB.pdf
Schreier, M. (2014). Qualitative content analysis. In U. Flick (Ed.), *The SAGE handbook of qualitative data analysis* (pp. 170–183). SAGE Publications. https://doi.org/10.4135/9781446282243.n12
Schuster, C. E. (2021). 'Risky data' for inclusive microinsurance infrastructures. *Development and Change*, *52*(4), 780–804. https://doi.org/10.1111/dech.12663
Schware, R. (2005). *E-development from excitement to effectiveness*. World Bank. https://doi.org/10.1596/0-8213-6442-1
SCMP. (2021, September 1). How China's new data laws will make cross-border business much harder. *South China Morning Post*. https://www.scmp.com/tech/policy/article/3147040/what-chinas-new-data-laws-are-and-their-impact-big-tech
Seaman, J. (2020). *China and the new geopolitics of technical standardization* (Notes de l'Ifri). Institut français des relations internationales.
Seawright, J., & Gerring, J. (2008). Case selection techniques in case study research: A menu of qualitative and quantitative options. *Political Research Quarterly*, *61*(2), 294–308. https://doi.org/10.1177/1065912907313077

Sekhon, J. S. (2004). Quality meets quantity: Case studies, conditional probability, and counterfactuals. *Perspectives on Politics*, *2*(2), 281–293. https://doi.org/10.1017/S1537592704040150

Selwyn, B., & Leyden, D. (2022). Oligopoly-driven development: The World Bank's Trading for Development in the Age of Global Value Chains in perspective. *Competition & Change*, *26*(2), 174–196. https://doi.org/10.1177/1024529421995351

Serafica, R. B., & Oren, Q. C. A. (2022). *Upgrading the ICT regulatory framework: Toward accelerated and inclusive digital connectivity* (Working Paper No. 2022–26). Philippine Institute for Development Studies. https://www.econstor.eu/handle/10419/284563

Seyoum, M., Wu, R., & Yang, L. (2015). Technology spillovers from Chinese outward direct investment: The case of Ethiopia. *China Economic Review*, *33*, 35–49. https://doi.org/10.1016/j.chieco.2015.01.005

Sheehan, M. (2018, December 19). How Google took on China—and lost. *MIT Technology Review*. https://www.technologyreview.com/2018/12/19/138307/how-google-took-on-china-and-lost/

Shen, H. (2017). *Across the great (fire) wall: China and the global internet* [Doctoral dissertation, University of Illinois]. Illinois Digital Environment for Access to Learning and Scholarship. https://www.ideals.illinois.edu/handle/2142/97589

Shen, H. (2018). Building a Digital Silk Road? Situating the internet in China's Belt and Road Initiative. *International Journal of Communication*, *12*, 2683–2701.

Shen, H., & He, Y. (2024). The geopolitics of infrastructuralized platforms: The case of Alibaba. In *The geopolitics of Chinese internets*. Routledge.

Sheng, L. (2022). Cyber-politics in U.S.–China relations: Big Tech and the trade war. In L. Sheng (Ed.), *Big Tech firms and international relations: The role of the nation-state in new forms of power* (pp. 43–70). Springer Nature. https://doi.org/10.1007/978-981-19-3682-1_2

Shenglin, B., Simonelli, F., Ruidong, Z., Bosc, R., & Wenwei, L. (2017). Digital infrastructure: Overcoming the digital divide in emerging economies. *G20 Insights*, *3*, 1–36.

Sioshansi, F. (2013). *Evolution of global electricity markets: New paradigms, new challenges, new approaches*. Academic Press.

Small, M. L. (2011). How to conduct a mixed methods study: Recent trends in a rapidly growing literature. *Annual Review of Sociology*, *37*, 57–86. https://doi.org/10.1146/annurev.soc.012809.102657

Smith, J., Cummins, C., & Krasodomski-Jones, A. (2021). *Why democracies should care about the wiring of the internet*. Demos.

Smyrnaios, N., & Karatzogianni, A. (2018). *Internet oligopoly: The corporate takeover of our digital world*. Emerald Group Publishing.

Sofrecom. (2022). *FTTH deployment challenges Africa*. Sofrecom. https://www.sofrecom.com/en/news-insights/ftth-deployment-challenges-africa.html

Soghoian, C. (2009). *Caught in the cloud: Privacy, encryption, and government back doors in the Web 2.0 era* (SSRN Scholarly Paper No. 1421553). https://papers.ssrn.com/abstract=1421553

Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, *70*(1), 65–94. https://doi.org/10.2307/1884513

Soulé, F. (2024). *Digital sovereignty in Africa: Moving beyond local data ownership* (CIGI Policy Brief No. 185). Centre for International Governance Innovation. https://www.cigionline.org/documents/2684/PB_no.185.pdf

Srnicek, N. (2016). *Platform capitalism* (1st ed.). Polity Press.

Stallings, B. (2020). *Dependency in the twenty-first century? The political economy of China-Latin America relations*. Cambridge University Press. https://doi.org/10.1017/9781108875141

Statcounter. (2024). *Mobile vendor market share*. StatCounter Global Stats. https://gs.statcounter.com/vendor-market-share/mobile/a2019

State Council. (2015). *Guowuyuan guanyu tuijin guoji channeng he zhuangbei zhizao hezuo de zhidao yijian* 国务院关于推进国际产能和装备制造合作的指导意见 [Guideline on boosting international cooperation in production capacity and equipment manufacturing] (No. 30). http://www.gov.cn/zhengce/content/2015-05/16/content_9771.htm

State Council. (2018). *Gongye he xinxihua bu guanyu gongye tongxinye biaozhunhua gongzuo fuwu yu "yidai yilu" jianshe de shishi yijian* 工业和信息化部关于工业通信业标准化工作服务于"一带一路"建设的实施意见 [Implementation opinions of Ministry of Industry and Information Technology on standardization work of industry and communication sector to serve the Belt and Road Initiative]. http://www.gov.cn/zhengce/zhengceku/2018-12/31/content_5442657.htm

Stevens, H. (2019, July 23). Digital infrastructure in the Chinese register. *Made in China Journal*. https://madeinchinajournal.com/2019/07/23/digital-infrastructure-in-the-chinese-register/

Stiglitz, J. E. (2017). *Globalization and its discontents revisited: Anti-globalization in the era of Trump* (1st ed.). Penguin.

Sum, N.-L. (2019). The intertwined geopolitics and geoeconomics of hopes/fears: China's triple economic bubbles and the 'One Belt One Road' imaginary. *Territory, Politics, Governance*, *7*(4), 528–552. https://doi.org/10.1080/21622671.2018.1523746

Sun, L. (1993). Funding telecom expansion. *China Business Review*, *20*(2), 46–49. https://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=01637169&asa=N&AN=9706171897&h=Cx%2BZ%2FwA7nsiHtLDYuvplDOFG0WnOk%2BxZ7IiEuQB8UtPnk%2FzpP2%2F1JhveqJH%2FNtxBPbmWdiOctfR6G3OTW6w0hA%3D%3D&crl=c

Sun, Y., & Grimes, S. (2018). *China and global value chains: Globalization and the information and communications technology sector*. Routledge. https://doi.org/10.4324/9781315267418

Švedkauskas, Ž. (2019). Three steps in ensuring digital security of Egyptian activists abroad. *IEMed Mediterranean Yearbook*, 280–284. https://www.iemed.org/publication/three-steps-in-ensuring-digital-security-of-egyptian-activists-abroad/

Swain, G. (2025, January 24). China launches $47B semiconductor fund to counter US supremacy. *Computerworld*. https://www.computerworld.com/article/2127689/china-launches-47b-semiconductor-fund-to-counter-us-supremacy.html

Szalavetz, A. (2020). Digital transformation – enabling factory economy actors' entrepreneurial integration in global value chains? *Post-Communist Economies*, *32*(6), 771–792. https://doi.org/10.1080/14631377.2020.1722588

Takii, S. (2005). Productivity spillovers and characteristics of foreign multinational plants in Indonesian manufacturing 1990-1995. *Journal of Development Economics*, *76*(2), 521–542.

Tan, Z. A. (2002). Product cycle theory and telecommunications industry—Foreign direct investment, government policy, and indigenous manufacturing in China. *Telecommunications Policy*, *26*(1–2), 17–30. https://doi.org/10.1016/S0308-5961(01)00051-9

Tang, X. (2016a). *Chinese investment in Ghana's manufacturing sector*. China Africa Research Initiative. http://www.sais-cari.org/publications

Tang, X. (2016b). Does Chinese employment benefit Africans? Investigating Chinese enterprises and their operations in Africa. *African Studies Quarterly*, *16*(3–4), 107–128.

Tang, X. (2019). *Chinese manufacturing investments and knowledge transfer: A report from Ethiopia* (SSRN Scholarly Paper No. 3711601). https://doi.org/10.2139/ssrn.3711601

Tang, X. (2021). Adaptation, innovation, and industrialization: The impact of Chinese investments on skill development in the Zambian and Malawian cotton sectors. *Journal of Chinese Economic and Business Studies*, *19*(4), 295–313. https://doi.org/10.1080/14765284.2021.1943734

Tansel, C. B. (2017). *States of discipline: Authoritarian neoliberalism and the contested reproduction of capitalist order*. Rowman & Littlefield.

Taylor, I., & Zajontz, T. (2020). In a fix: Africa's place in the Belt and Road Initiative and the reproduction of dependency. *South African Journal of International Affairs*, *27*(3), 277–295. https://doi.org/10.1080/10220461.2020.1830165

Taylor, L., & Broeders, D. (2015). In the name of development: Power, profit and the datafication of the global South. *Geoforum*, *64*, 229–237. https://doi.org/10.1016/j.geoforum.2015.07.002

Te Velde, D. W. (2002). *Government policies for inward foreign direct investment in developing countries: Implications for human capital formation and income inequality* (Working Paper No. 193). OECD Development Centre.
TechNode. (2023, March 13). Zhang Xin to head up China's semiconductor "Big Fund". *TechNode*. http://technode.com/2023/03/13/zhang-xin-to-head-up-chinas-semiconductor-big-fund/
Telecom Egypt. (2023). *Egypt's digital backbone*. Telecom Egypt. https://ir.te.eg/IRMedia/Financial_Information/2023/Financial_Informationf4203974-0282-4202-9cfc-6c58c420b91b.pdf
Thatcher, J., O'Sullivan, D., & Mahmoudi, D. (2016). Data colonialism through accumulation by dispossession: New metaphors for daily data. *Environment and Planning D: Society and Space*, *34*(6), 990–1006. https://doi.org/10.1177/0263775816633195
Tashakkori, A., & Teddlie, C. (2003). *Handbook of mixed methods in social and behavioral research*. SAGE Publications.
The Economic Times. (2024, November 26). RBI plans 2025 launch of cloud services, countering dominance of global firms. *The Economic Times*. https://economictimes.indiatimes.com/tech/technology/rbi-plans-2025-launch-of-cloud-services-countering-dominance-of-global-firms/articleshow/115405872.cms?from=mdr
The Economist. (2017, May 6). The world's most valuable resource is no longer oil, but data. *The Economist*. https://www.economist.com/leaders/2017/05/06/the-worlds-most-valuable-resource-is-no-longer-oil-but-data
The Economist. (2023, September 7). China's Belt and Road Initiative will keep testing the West. *The Economist*. https://www.economist.com/leaders/2023/09/07/chinas-belt-and-road-initiative-will-keep-testing-the-west
Thinyane, M., & Terzoli, A. (2009). Universal digital inclusion: Beyond connectivity, affordability and capability. *2009 ITU-T Kaleidoscope: Innovations for Digital Inclusions*, 1–8. https://ieeexplore.ieee.org/abstract/document/5338911
Eder, T., Arcesati, R., & Mardell, J. (2019). *Networking the "Belt and Road"—The future is digital*. Mercator Institute for China Studies. https://merics.org/en/tracker/networking-belt-and-road-future-digital
Thompson, E. R. (2002). Clustering of foreign direct investment and enhanced technology transfer: Evidence from Hong Kong garment firms in China. *World Development*, *30*(5), 873–889. https://doi.org/10.1016/S0305-750X(02)00009-8
Thun, E., & Sturgeon, T. (2019). When global technology meets local standards: Reassessing China's communications policy in the age of platform innovation. In L. Brandt & T. G. Rawski (Eds.), *Policy, regulation and innovation in China's electricity and telecom industries* (pp. 108–142). Cambridge University Press. https://doi.org/10.1017/9781108644402.005
TIEC. (2022). *InvestIT: Investment-readiness program for ICT startups in Egypt*. Technology Innovation and Entrepreneurship Center. https://tiec.gov.eg:443/English/Programs/Invest-IT/Pages/default.aspx
Tijssen, R. J. W., & Winnink, J. J. (2018). Capturing 'R&D excellence': Indicators, international statistics, and innovative universities. *Scientometrics*, *114*(2), 687–699. https://doi.org/10.1007/s11192-017-2602-9
Timotheou, S., Miliou, O., Dimitriadis, Y., Sobrino, S. V., Giannoutsou, N., Cachia, R., Monés, A. M., & Ioannou, A. (2023). Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review. *Education and Information Technologies*, *28*(6), 6695–6726. https://doi.org/10.1007/s10639-022-11431-8
Tlemcani, R., & Hansen, W. W. (1989). Development and the state in post-colonial Algeria. *Journal of Asian and African Studies*, *24*(1–2), 114–133.
Torres, A. P. S. (2018). China and Latin America, from neo-colonialism to interdependence? Brazil case. *Dimensión Empresarial*, *16*(1), 185–194.
Tradingeconomics. (2025). *Egypt—Manufacturing, value added (% of GDP)—2025 data 2026 forecast 1974-2023 historical*. Trading Economics. https://tradingeconomics.com/egypt/manufacturing-value-added-percent-of-gdp-wb-data.html

Triolo, P., & Sherlock, A. (2020, July 1). 'New infrastructure'—China's race for 5G and networked everything has a new catchphrase. *SupChina*. https://supchina.com/2020/07/01/new-infrastructure-chinas-race-for-5g-and-networked-everything-has-a-new-catchphrase/

Tsui, B. (2016). *Do Huawei's training programs and centers transfer skills to Africa?* (Policy Brief No. 14). China-Africa Research Initiative, Johns Hopkins SAIS.

Tugendhat, H. (2020). *How Huawei succeeds in Africa: Training and knowledge transfers in Kenya and Nigeria* (Working Paper No. 2020/31). China Africa Research Initiative, Johns Hopkins SAIS.

Tugendhat, H. (2021). Connection issues: A study on the limitations of knowledge transfer in Huawei's African training centres. *Journal of Chinese Economic and Business Studies*, *19*(4), 314–338. https://doi.org/10.1080/14765284.2021.1943194

Tugendhat, H., & Voo, J. (2021). *China's Digital Silk Road in Africa and the future of internet governance* (Working Paper). EconStor. https://www.econstor.eu/handle/10419/248178

Tull, D. M. (2006). China's engagement in Africa: Scope, significance and consequences. *The Journal of Modern African Studies*, *44*(3), 459–479. https://doi.org/10.1017/S0022278X06001856

UNCTAD. (2012). *Technology and innovation report 2012: Innovation, technology and south–south collaboration*. United Nations Conference on Trade and Development.

UNCTAD. (2019). *Digital economy report 2019*. United Nations Conference on Trade and Development. https://unctad.org/system/files/official-document/der2019_en.pdf

UNESCO. (2022). *Silk Roads exchange and the development of the medical sciences*. United Nations Educational, Scientific and Cultural Organization. https://en.unesco.org/silkroad/content/did-you-know-silk-roads-exchange-and-development-medical-sciences

USAID. (1992). *Country programme strategy 1992-1996 telecommunications*. United States Agency for International Development. https://pdf.usaid.gov/pdf_docs/PNACB032.pdf

Usman, Z., & Auth, K. (2022, May 12). The three issues that will make or break the Prosper Africa Initiative. *Carnegie Endowment for International Peace*. https://carnegieendowment.org/posts/2022/05/the-three-issues-that-will-make-or-break-the-prosper-africa-initiative?lang=en

Vaaland, T. I., & Ishengoma, E. (2016). University-industry linkages in developing countries: Perceived effect on innovation. *Education + Training*, *58*(9), 1014–1040. https://doi.org/10.1108/ET-07-2015-0067

Van Der Made, J. (2021, June 25). Senegal to move all government data to Huawei-run data center. *RFI*. https://www.rfi.fr/en/africa/20210625-senegal-to-move-all-government-data-to-huawei-run-data-center-china-africa-macky-sall-information-technology

Varoufakis, Y. (2024). *Technofeudalism: What killed capitalism* (Rev. ed.). Vintage.

Vemuri, V. K., & Siddiqi, S. (2009). Impact of commercialization of the internet on international trade: A panel study using the extended gravity model. *The International Trade Journal*, *23*(4), 458–484. https://doi.org/10.1080/08853900903223792

Vila Seoane, M., & Álvarez Velasco, C. (2024). The Chinese surveillance state in Latin America? Evidence from Argentina and Ecuador. *The Information Society*, *40*(2), 154–167. https://doi.org/10.1080/01972243.2024.2317057

Vincent, C. (2019, January 30). Condor Le smartphone qui vient du Sud. *Les Echos*. https://www.lesechos.fr/2019/01/condor-le-smartphone-qui-vient-du-sud-1021432

Vogel, E. F. (2011). *Deng Xiaoping and the transformation of China*. Harvard University Press. http://ebookcentral.proquest.com/lib/londonschoolecons/detail.action?docID=3300979

Wade, M., & Shan, J. (2020). Covid-19 has accelerated digital transformation but may have made it harder not easier. *MIS Quarterly Executive*, *19*(3), 213–220.

Wade, R. (1990). *Governing the market: Economic theory and the role of government in East Asian industrialization*. Princeton University Press.

Wade, R. (2003). Bridging the digital divide: New route to development or new form of dependency. *Global Governance*, *8*(4), 443–466.

Wade, R. (2017). *Is Trump wrong on trade? A partial defense based on production and employment* (Working Paper No. 79). London School of Economics and Political Science.

Wahab, S. A., Rose, R. C., & Osman, S. I. W. (2011). Defining the concepts of technology and technology transfer: A literature analysis. *International Business Research*, *5*(1), 61–71. https://doi.org/10.5539/ibr.v5n1p61

Wahdan, D., & Elshayal, T. (2024). Dissonant times: The land–infrastructure–finance nexus in post-Mubarak Egypt. In *The political economy of development in the Middle East* (Chapter 8). Bristol University Press. https://bristoluniversitypressdigital.com/edcollchap/book/9781529229745/ch008.xml

Wang, C. (2025). *China Belt and Road Initiative (BRI) investment report 2024*. Green Finance & Development Center. https://greenfdc.org/china-belt-and-road-initiative-bri-investment-report-2024/

Wang, Y. (2016a). Yidai yilu: Chongsu jingji quanqiuhua huayuquan 一带一路：重塑经济全球化话语权 [The Belt and Road Initiative: Restructuring the economic globalization]. *Red Flag Manuscript*, *21*, 12–14.

Wang, H. (2016b). *A deeper look at China's "going out" policy*. Centre for International Governance Innovation. https://www.cigionline.org/publications/deeper-look-chinas-going-out-policy/

Wang, P. (2017). China's accession to the WTO Government Procurement Agreement—Challenges and the way forward. In *Law and the market economy in China* (pp. 319–362). Routledge. https://www.taylorfrancis.com/chapters/edit/10.4324/9781315091969-11/china-accession-wto-government-procurement-agreement%E2%80%94challenges-way-forward-ping-wang

Wang, S., & Shen, G. (2021). The Belt and Road Initiative and globalization. In Y. Li & A. C. [Note: This reference appears incomplete in the original]

Wang, S., Zheng, Y., & Wang, Q. (2023). Technical standardization and total factor productivity in innovation-driven development: Evidence from China. *PLOS ONE*, *18*(10), e0287109. https://doi.org/10.1371/journal.pone.0287109

Waring, J. (2021, February 23). Huawei, ZTE boost global infrastructure market share. *Mobile World Live*. https://www.mobileworldlive.com/top-three/huawei-zte-boost-global-infrastructure-market-share/

Waterbury, J. (1985). The 'soft state' and the open door: Egypt's experience with economic liberalization, 1974-1984. *Comparative Politics*, *18*(1), 65–83. https://doi.org/10.2307/421658

WDR. (2021). *World Development Report 2021: Data for better lives*. World Bank. https://wdr2021.worldbank.org/the-report/

Weber, I. M. (2021). *How China escaped shock therapy: The market reform debate* (1st ed.). Routledge.

Weinbaum, M. G. (1985). Egypt's Infitah and the politics of US economic assistance. *Middle Eastern Studies*, *21*(2), 206–222. https://doi.org/10.1080/00263208508700624

Wen, Y. (2020). Huawei's expansion into the Global South: A path toward alternative globalization? In W. Zhang, I. Alon, & C. Lattemann (Eds.), *Huawei goes global: Volume I: Made in China for the world* (pp. 147–169). Springer International Publishing. https://doi.org/10.1007/978-3-030-47564-2_7

Werenfels, I. (2007). *Managing instability in Algeria* (1st ed.). Routledge.

West, D. M. (2015). *Digital divide: Improving internet access in the developing world through affordable services and diverse content*. Brookings Institution.

White, G. (2001). *A comparative political economy of Tunisia and Morocco: On the outside of Europe looking in*. State University of New York Press.

Whitfield, L. (2023). Markets, states or transnational networks? Explaining technology leverage by latecomer firms in industrializing countries. *The Journal of Development Studies*, *59*(10), 1508–1530. https://doi.org/10.1080/00220388.2023.2222209

Willis, M. J. (2022). *Algeria: Politics and society from the dark decade to the hirak*. Oxford University Press.

Winner, L. (1980). Do artifacts have politics? *Daedalus*, *109*(1), 121–136.

Winseck, D. (2019). Internet infrastructure and the persistent myth of U.S. hegemony. In B. Haggart [Note: This reference appears incomplete in the original]
Wintour, P. (2022, June 26). G7 relaunches funding programme for developing countries under new name. *The Guardian*. https://www.theguardian.com/world/2022/jun/26/g7-relaunches-funding-programme-developing-countries-global-investment-infrastructure-partnership
World Bank. (1999). *World development report 1998/99: Knowledge for development*. Oxford University Press. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/729771468328524815
World Bank. (2013). *Value for money analysis-practices and challenges: How governments choose when to use PPP to deliver public infrastructure and services*. World Bank. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/724231468331050325/value-for-money-analysis-practices-and-challenges-how-governments-choose-when-to-use-ppp-to-deliver-public-infrastructure-and-services
World Bank Data. (2025a). *Individuals using the internet (% of population)* [Dataset]. World Bank. https://data.worldbank.org/indicator/IT.NET.USER.ZS
World Bank Data. (2025b). *Research and development expenditure (% of GDP)* [Dataset]. World Bank. https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS
World Bank Data. (2025c). *Government expenditure on education, total (% of GDP)* [Dataset]. World Bank. https://data.worldbank.org/indicator/SE.XPD.TOTL.GD.ZS
Wu, M., & Han, X. (2022). Influence of economic openness on total factor productivity: Evidence from China's Belt and Road Initiative. *Sustainability*, *14*(20), 13375. https://doi.org/10.3390/su142013375
Wu, Y., Hu, C., & Shi, X. (2021). Heterogeneous effects of the Belt and Road Initiative on energy efficiency in participating countries. *Energies*, *14*(18), 5594. https://doi.org/10.3390/en14185594
Wübbeke, J., Meissner, M., Zenglein, M. J., Ives, J., & Conrad, B. (2016). *Made in China 2025* (Papers on China No. 2). Mercator Institute for China Studies.
Xinhua. (2002, November 18). Full text of Jiang Zemin's report at the 16th Party Congress. *China.org.cn*. http://www.china.org.cn/english/2002/Nov/49107.htm
Xinhua. (2023, April 25). UN World Data Forum 2023 to discuss data innovation. *Xinhua*. https://english.news.cn/20230425/0f46d64279c64d4ca848553076a569a6/c.html
Xinhua. (2024, August 30). China-Africa space cooperation benefits people across continent. *Xinhua*. https://english.news.cn/20240830/79f803e15a0e44eebee61c28eb1fefc1/c.html
Xu, C. (2011). The fundamental institutions of China's reforms and development. *Journal of Economic Literature*, *49*(4), 1076–1151. https://doi.org/10.1257/jel.49.4.1076
Yahiaoui, N. (2016). The e-government in Africa-challenges and implementation barriers: The case of Algeria. *Revue Algérienne des Politiques Publiques*, *12*(1), 78–95. https://platform.almanhal.com/Files/2/109557
Yao, X., Tan, A., & Suttmeier, R. (2009). Standards of power? Technology, institutions, and politics in the development of China's national standards strategy. *Geopolitics, History, and International Relations*, *1*(1), 46–84.
Yeung, Y., Lee, J., & Kee, G. (2009). China's special economic zones at 30. *Eurasian Geography and Economics*, *50*(2), 222–240. https://doi.org/10.2747/1539-7216.50.2.222
Yoo, C. S., & Blanchette, J.-F. (Eds.). (2015). Regulating the cloud: Policy for computing infrastructure. In *Regulating the cloud: Policy for computing infrastructure* (pp. 1–15). MIT Press. https://doi.org/10.7551/mitpress/9780262029407.002.0004
Young, J. C. (2019). The new knowledge politics of digital colonialism. *Environment and Planning A: Economy and Space*, *51*(7), 1424–1441. https://doi.org/10.1177/0308518X19858998
Young, S., & Lan, P. (1997). Technology transfer to China through foreign direct investment. *Regional Studies*, *31*(7), 669–679. https://doi.org/10.1080/00343409750130759
Yunnan, C., Yuan, S., Irene, U. U., Rex, Tang, X., & Deborah, B. (2016). *Learning from China? Manufacturing, investment, and technology transfer in Nigeria*. International Food Policy Research Institute.

Zajontz, T. (2020). The Chinese infrastructural fix in Africa: Lessons from the Sino-Zambian 'road bonanza'. *Oxford Development Studies*, *49*(3), 222–238. https://doi.org/10.1080/13600818.2020.1861230
Zavajil, M. (1995). Structural reform in Egypt. *Égypte/Monde Arabe*, *21*, 117–135. https://doi.org/10.4000/ema.392
Zeng, J. (2020). Artificial intelligence and China's authoritarian governance. *International Affairs*, *96*(6), 1441–1459. https://doi.org/10.1093/ia/iiaa172
Zenglein, M. J., & Holzmann, A. (2019). *Evolving made in China 2025* (MERICS Papers on China No. 8). Mercator Institute for China Studies.
Zenina, M. (2016, June 20). Algérie-La coupure d'internet a eu un impact réel sur les entreprises. *Maghreb Emergent*. https://maghrebemergent.net/algerie-la-coupure-d-internet-a-eu-un-impact-reel-sur-les-entreprises/
Zhan, A., & Tan, Z. (2010). Standardisation and innovation in China: TD-SCDMA standard as a case. *International Journal of Technology Management*, *51*(2/3/4), 453–473. https://doi.org/10.1504/IJTM.2010.033814
Zhang, A. H. (2024). *High wire: How China regulates big tech and governs its economy*. Oxford University Press.
Zhang, G., & Zhou, J. (2016). The effects of forward and reverse engineering on firm innovation performance in the stages of technology catch-up: An empirical study of China. *Technological Forecasting and Social Change*, *104*, 212–222.
Zhang, X., & Zheng, Y. (2012). *China's information and communications technology revolution*. Routledge.
Zhang, Z., Gao, Y., & Wei, T. (2022). The impact of trade barrier reductions on global value chains for agricultural products in China and countries along the 'belt and road'. *World Trade Review*, *21*(2), 224–248.
Zhao, K., & Xia, M. (2014). Forming interoperability through interorganizational systems standards. *Journal of Management Information Systems*, *30*(4), 269–298. https://doi.org/10.2753/MIS0742-1222300410
Zhao, L., & Wang, Y. (2009). China's pattern of trade and growth after WTO accession: Lessons for other developing countries. *Journal of Chinese Economic and Foreign Trade Studies*, *2*(3), 178–210. https://doi.org/10.1108/17544400910994751
Zhao, Y. (2010). China's pursuits of indigenous innovations in information technology developments: Hopes, follies and uncertainties. *Chinese Journal of Communication*, *3*(3), 266–289. https://doi.org/10.1080/17544750.2010.499628
Zhao, Y., & Schiller, D. (2001). Dances with wolves? China's integration into digital capitalism. *Info*, *3*(2), 137–151.
Zhou, Y., Kundu, T., & Goh, M. (2021). Multimodal transportation network centrality analysis for Belt and Road Initiative. *Transportation Research Part E: Logistics and Transportation Review*, *149*, 102292. https://doi.org/10.1016/j.tre.2021.102292
Zuboff, S. (2019). *The age of surveillance capitalism: The fight for a human future at the new frontier of power*. Profile Books.
Zúñiga, N., Burton, S. D., Blancato, F., & Carr, M. (2024). The geopolitics of technology standards: Historical context for US, EU and Chinese approaches. *International Affairs*, *100*(4), 1635–1652. https://doi.org/10.1093/ia/iiae124
Zyphur, M. J., & Pierides, D. C. (2020). Making quantitative research work: From positivist dogma to actual social scientific inquiry. *Journal of Business Ethics*, *167*(1), 49–62. https://doi.org/10.1007/s10551-019-04189-6

Appendix 1: BRI Membership Status by Country

Country	BRI Status	Year of Joining
Albania	Joined	2017
Algeria	Joined	2018
Angola	Joined	2018
Armenia	Joined	2015
Australia	Did not join	N/A
Austria	Joined	N/A
Azerbaijan	Joined	2015
Bahrain	Joined	2018
Bangladesh	Joined	2019
Barbados	Joined	2019
Belarus	Joined	2013
Belgium	Did not join	N/A
Belize	Did not join	N/A
Benin	Joined	2018
Bhutan	Did not join	N/A
Bolivia	Joined	2018
Bosnia and Herzegovina	Joined	2017
Botswana	Joined	2021
Brazil	Did not join	N/A
Brunei Darussalam	Joined	2018
Bulgaria	Joined	2015
Burkina Faso	Did not join	N/A
Cabo Verde	Joined	2018
Cambodia	Joined	2013
Cameroon	Joined	2015
Canada	Did not join	N/A
Chile	Joined	2018
Colombia	Did not join	N/A
Costa Rica	Joined	2018
Croatia	Joined	2017
Cyprus	Joined	2019
Czechia	Joined	2015
Côte d'Ivoire	Joined	2017
Dominica	Joined	2018
Dominican Republic	Joined	2019
Egypt	Joined	2016
El Salvador	Joined	2018
Estonia	Joined	2017
Eswatini	Did not join	N/A
Ethiopia	Joined	2018
Fiji	Joined	2018

Finland	Did not join	N/A
France	Did not join	N/A
Georgia	Joined	2016
Germany	Did not join	N/A
Ghana	Joined	2018
Greece	Joined	2018
Grenada	Joined	2018
Guyana	Joined	2018
Honduras	Joined	2023
Hungary	Joined	2015
Iceland	Did not join	N/A
India	Did not join	N/A
Indonesia	Joined	2015
Iran, Islamic Republic of	Joined	2018
Ireland	Did not join	N/A
Italy	Joined	2019
Jamaica	Joined	2019
Japan	Did not join	N/A
Jordan	Joined	2023
Kenya	Joined	2017
Korea, Republic of	Joined	2018
Laos	Joined	2018
Latvia	Joined	2016
Lebanon	Joined	2017
Lesotho	Joined	2019
Lithuania	Joined	2017
Luxembourg	Joined	2019
Madagascar	Joined	2017
Malaysia	Joined	2017
Maldives	Joined	2017
Mali	Joined	2019
Malta	Joined	2018
Mauritania	Joined	2018
Mauritius	Did not join	N/A
Mexico	Did not join	N/A
Moldova, Republic of	Joined	2013
Montenegro	Joined	2017
Morocco	Joined	2017
Mozambique	Joined	2018
Namibia	Joined	2018
Nepal	Joined	2017
Netherlands	Did not join	N/A
New Zealand	Joined	2017
Nicaragua	Joined	2022
Nigeria	Joined	2018
North Macedonia	Joined	2013
Norway	Did not join	N/A
Oman	Joined	2018

Pakistan	Joined	2013
Panama	Joined	2017
Papua New Guinea	Joined	2016
Paraguay	Did not join	N/A
Peru	Joined	2019
Philippines	Joined	2017
Poland	Joined	2015
Portugal	Joined	2018
Qatar	Joined	2019
Romania	Joined	2015
Russian Federation	Joined	2018
Rwanda	Joined	2018
Saint Lucia	Did not join	N/A
Saint Vincent and the Grenadines	Did not join	N/A
Samoa	Joined	2018
Sao Tome and Principe	Did not join	N/A
Saudi Arabia	Joined	2018
Senegal	Joined	2018
Serbia	Joined	2015
Seychelles	Joined	2018
Singapore	Joined	2018
Slovakia	Joined	2015
Slovenia	Joined	2017
South Africa	Joined	2015
Sri Lanka	Joined	2017
Suriname	Joined	2018
Sweden	Did not join	N/A
Switzerland	Did not join	N/A
Tanzania, United Republic of	Joined	2018
Thailand	Joined	2014
Togo	Joined	2018
Trinidad and Tobago	Joined	2018
Tunisia	Joined	2018
Turkey	Joined	2015
Uganda	Joined	2018
Ukraine	Joined	2017
United Arab Emirates	Joined	2018
United Kingdom	Did not join	N/A
United States	Did not join	N/A
Uruguay	Joined	2018
Vanuatu	Joined	2018
Viet Nam	Joined	2017
Zambia	Joined	2018

Appendix 2: List of Interviews

Affiliation	Code	Date	Place
Subcontractors[28], Suppliers, and Customers of Huawei and ZTE			
CEO of subcontracting firm for major ICT OEM	S1	17/10/2021	Algiers
CEO of subcontracting firm for major ICT OEM	S2	18/10/2021	Algiers
CEO of subcontracting firm for major ICT OEM	S3	22/10/2021	Algiers
CEO of subcontracting firm for major ICT OEM	S4	13/12/2021	Algiers
CEO of subcontracting firm for major ICT OEM	S5	20/12/2021	Algiers
Start-up	S6	09/12/2021	Algiers
CEO of subcontracting firm for major ICT OEM	S7	13/12/2021	Algiers
Mobile phone operator	S8	08/01/2022	Algiers
CEO of subcontracting firm for major ICT OEM	S9	02/03/2022	Cairo
Start-up	S10	02/03/2022	Cairo
Subcontractor to major ICT vendors	S11	15/03/2022	Cairo
Subcontractor to major ICT vendors	S12	28/06/2022	Cairo
Engineer at the NRC	S13	30/06/2022	Cairo
Engineer at the NRC	S14	13/06/2023	Cairo
CEO of subcontracting firm for major ICT OEM	S15	14/06/2023	Cairo
CEO of subcontracting firm to major ICT OEM	S16	11/06/2024	Algiers
Telecom operator	S17	02/10/2024	Algiers
Huawei and ZTE Engineers and Managers			
ICT engineer at ZTE	W1	28/10/2021	Algiers
ICT engineer at ZTE	W2	06/11/2021	Algiers

[28] While referred to as subcontractors here, many of these firms are, in fact, more than that. They offer services similar to those provided by large ICT OEMs, possess in-house capabilities, and actively pursue domestic, regional, and global markets. In contrast, subcontractors are typically domestic firms with their own operations, for whom subcontracting for OEMs is just one among several activities.

Engineer at Ooredoo with Huawei certification	W3	28/11/2021	Zoom call
Former Huawei engineer	W4	05/12/2021	Algiers
ICT Engineer at Huawei	W5	07/12/2021	Algiers
ZTE manager	W6	22/12/2021	Algiers
Assembly line manager at Afgotech (Algerian Huawei's partner for the factory)	W7	20/01/2022	Phone call
Former Huawei engineer who set up his own business	W8	03/01/2022	Algiers
Engineer at Huawei, the Oran Institute of Telecommunication	W9	06/01/2022	Zoom call
Engineer at ZTE	W10	18/01/2022	Algiers
Manager at Huawei Device – coordinator of phone manufacturing	W11	01/02/2022	Algiers
A senior manager at ZTE Egypt	W12	16/02/2022	Cairo
Junior network engineer at Huawei	W13	17/02/2022	Zoom call
Senior network engineer at Huawei	W14	21/02/2022	Cairo
Training and development manager at Huawei customer	W15	24/02/2022	Phone call
Huawei public relations manager	W16	27/02/2022	Zoom call
Telecom engineer at Huawei	W17	02/03/2022	Cairo
Telecom engineer at Huawei	W18	02/03/2022	Cairo
Telecom engineer at Huawei	W19	02/03/2022	Cairo
Computer engineer at ZTE Egypt	W20	04/03/2022	Phone call
Computer engineer at Huawei's OpenLab	W21	16/03/2022	Cairo
Senior network engineer at Huawei	W22	20/03/2022	Cairo
Director of operations at ZTE	W23	22/03/2022	Cairo
Former Computer Engineer at ZTE	W24	22/03/2022	Cairo
Computer Engineer at Huawei OpenLab	W25	22/03/2022	Cairo
Manager at Huawei Entreprise	W26	05/06/2023	Cairo
Computer Engineer at ZTE	W27	12/07/2024	Algiers
Former Engineer at Huawei	W28	23/09/2024	Algiers
Experts and Researchers			
Economic expert	E1	30/11/2021	Algiers
IT engineer and digital economy expert	E2	30/11/2021	Algiers
Professor of ICTs at the University of Bab Ezzouar	E3	17/11/2021	Algiers
Official responsible for the US-Algeria Trade Chamber	E4	20/11/2021	Algiers
Digital economy expert	E5	15/12/2021	Algiers
Digital economy Expert	E6	19/01/2022	Algiers
Professor of economic innovation at the University of Lille	E7	07/02/2022	Oran
Engineer in digital devices	E8	23/02/2022	Cairo
Researcher focusing on China-Egypt Relations	E9	27/02/2022	Zoom call
Professor of political economy at the American University in Cairo	E10	28/02/2022	Cairo

Professor of economics at the University of Cairo	E11	01/03/2022	Cairo
Senior digital development specialist at the World Bank	E12	10/03/2022	Cairo
Researcher focusing on foreign investments in Egypt	E13	02/07/2022	Cairo
Researcher focusing on ESG regulation	E14	04/07/2022	Cairo
Economic expert	E15	14/07/2023	Cairo
Professor of International Relations at American University in Cairo	E16	16/07/2023	Cairo
Researcher of Algerian Chinese Relations	E17	13/12/2023	Algiers
Development Economist who worked for the Algerian government in the 1980s	E18	02/07/2024	Algiers
Students and Instructors of Huawei and ZTE Training Programmes			
Senior official of the national institute of ICTs, Ucalypthus, Algiers	U1	07/12/2021	Algiers
Pedagogical coordinator at the national institute of ICTs, Ucalypthus, Algiers	U2	07/12/2021	Algiers
Student at the national institute of ICTs	U3	07/12/2021	Algiers
Student at the national institute of ICTs	U4	07/12/2021	Algiers
Student at the national institute of ICTs	U5	07/12/2021	Algiers
Student at the national institute of ICTs	U6	07/12/2021	Algiers
ICT student and coordinator of Huawei ICT academies at the University of Saad Dahleb, Blida	U7	12/21/2021	Zoom call
Senior official at the National School of Computer Science (ESI)	U8	27/12/2021	Algiers
University student and graduate of Huawei ICT Academy	U9	27/02/2022	Cairo
Huawei ICT Academy graduate	U10	09/03/2022	Cairo
Huawei ICT Academy graduate	U11	04/03/2022	Cairo
Huawei ICT Academy graduate	U12	12/03/2022	Cairo
ICT student – University of Alexandria	U13	10/04/2022	Zoom call
ICT student – University of Alexandria	U14	10/04/2022	Zoom call
Huawei programme Instructor	U15	02/07/2022	Cairo
Student in Computer Science and AI at ESI	U16	03/06/2024	Algiers
Professor of ICTs at the University of Bab Ezzouar	U17	16/09/2024	Algiers
Huawei programme Instructor	U18	15/10/2024	Zoom call
Engineers and Managers of Western Competitors			
Senior manager at Ericsson Algeria	C1	21/12/2021	Zoom call
Ericsson engineer	C2	23/12/2021	Algiers
Senior manager at Cisco Algeria	C3	17/01/2022	Algiers
Engineer at Ericsson	C4	29/01/2022	Zoom call
Foreign tech incubator	C5	28/02/2022	Cairo

Foreign tech incubator	C6	28/02/2022	Cairo
ICT engineer at Nokia	C7	08/03/2022	Cairo
Engineer at the Orange Innovation Lab	C8	08/03/2022	Cairo
Engineer at the Orange Innovation Lab	C9	08/03/2022	Cairo
Senior manager at the Orange Innovation Lab	C10	08/03/2022	Cairo
ICT engineer at Ericsson	C11	15/03/2022	Cairo
ICT engineer at Cisco	C12	12/05/2022	Zoom call
Manager at Nokia	C13	18/07/2023	Cairo
Computer Engineer at Nokia	C14	18/07/2023	Cairo
Senior manager at Ericson	C15	13/06/2024	Algiers
Engineer at Microsoft	C16	30/06/2024	Zoom call
Manager at Cisco	C17	28/09/2024	Algiers
Policymakers			
Algerian minister with responsibilities for the knowledge economy and start-ups	G1	28/11/2021	Algiers
Adviser to the Algerian minister of the knowledge economy	G2	28/11/2021	Algiers
Manager at the Egyptian Agency of Investment and Free Zones	G3	22/02/2022	Cairo
Policy Maker at ITIDA – Egyptian agency for informatics and telecommunication development	G4	01/03/2022	Phone call
Former finance minister of Egypt	G5	09/03/2022	Cairo
Former Egyptian ambassador	G6	30/06/2022	Cairo
Former Egyptian Minister of Trade	G7	18/07/2023	Cairo
Official in the ministry of the knowledge economy	G8	28/09/2024	Algiers