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Does Trade Explain Europe's Rise? Geography, Market Size and Economic Development

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Abstract

This paper tests whether the so-called 'reach of the market' helps to explain 'why Europe' and 'why north-western Europe'. By looking at grain markets from the late seventeenth to the early twentieth century, this study concludes that the process of commodity market integration pre-dated the take-off in the late eighteenth or early nineteenth century, so it was neither a concomitant nor an effect of the Industrial Revolution, but indeed a plausible determinant for the rise of Europe. When looking at differences within Europe, it finds that in terms of economic integration, there were two distinct zones in early modern Europe – landlocked and lowland Europe. In the latter, markets clearly extended to much bigger geographical areas before the arrival of steam transportation and the creation of extensive road networks, which can be explained by physical geography that had endowed lowland Europe with easier and cheaper transportation.

Introduction

The idea that the reach of the market is associated through the division of labour with the level of economic development, and that the expansion of markets, that is, the process of market integration, leads to economic growth, has made Adam Smith one of the best known economists of all time. It has also become one of the most popular

explanations for economic development since Smith first asserted that connection more than 200 years ago.

In a nutshell, the logic of the argument runs as follows. When, for some reason, market areas expand and formerly separated markets become part of one single market, their integration turns them into a single operating entity. This generates a territorial expansion of the division of labour, inducing a re-allocation of resources within regions or national economies, leading to an increasing division of labour. Through the specialisation of skills, this will eventually improve the general productivity and thus induce economic growth.[1]

But through other channels than the pooling and accumulation of skills, market integration can lead to further economic gains. Among these are increased information flows that encourage technological spillovers and diffusions[2], enhanced competition, and increasing returns to scale.[3]

Intuitively, this notion of Smithian, or trade-led growth more generally is certainly very persuasive, so it is understandable that it has been hugely popular in academia and politics alike. And if economic development is in the eyes of many so inextricably linked to the extent of the market, surely we also know exactly just how big the markets for the various production factors and the various products have extended at most times in history, and where and how this impacted on economic progress. Well, not quite. The *empirical evidence* on when and how markets became integrated, and on whether, when, and under what

[1] Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations*; see for instance Kelly, 'The Dynamics of Smithian Growth' for an overview and an application to economic history.
[2] See for instance Keller, 'Are International R&D Spillovers Trade-related?'; Coe and Helpman, 'International R&D Spillovers'.
[3] Krugman and Venables, 'Globalisation and the Inequality of Nations'; Romer, 'Increasing Returns and Long-Run Growth'.

circumstances expanding markets promoted economic growth, is actually amazingly thin and often remains ambiguous.[4]

Empirical studies on the link between trade and economic growth have nearly exclusively concentrated on the post-World War II period, which is understandable, as good macroeconomic data only becomes available in this period.[5] But is the trade-led growth hypothesis also supported by pre-World War II evidence? Does it, most importantly, stand up to the ultimate test, that is, does it help to explain the most fundamental growth story in the history of mankind, namely the Industrial Revolution? Does market integration help to explain why it was Europe that led the economic development in the world and industrialised first? Does it give us a clue about why, within Europe, it was its North-western part that spearheaded the 'rise of Europe'? Fact is: we do not really know.

Surely, processes of economic change of such a monumental scale can hardly have mono-causal explanations. Indeed, standard accounts include among the prerequisites and concomitants of the Industrial Revolution commercial, institutional, social, intellectual, scientific, financial, agricultural, and political changes. While some economic historians see these factors as a 'seamless web of historical change', economist seeking to explain the phenomenon might call this a prototypical endogeneity problem, where a whole array of variables are mutually influencing each other and changing simultaneously in the process.[6]

In this 'web' of factors, priorities and weights are assigned very differently, with trade and commercialisation, geography, colonialism,

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[4] See for instance McMahon and Squire, *Explaining growth*.
[5] See for instance Frankel and Romer, 'Does Trade Cause Growth' or Dinoupoulos and Segerstrom, 'A Theory of North-South Trade and Globalisation'. Acemoglu and his co-authors are a notable exception here; but they work with very few and shaky data points. Acemoglu ***et al***., 'The Colonial Origins of Comparative Development' and 'The Rise of Europe'.
[6] Quote from Cameron, *A Concise Economic History of the World*, p. 167.

religion, institutions, human capital and coal among the most popular contenders for being key determinants for historical change. While some view markets as quite irrelevant for the process, overall, trade and increasing markets and the ensuing process of commercialisation are among the factors most often credited with being important driving forces for this 'rise of Europe'. Yet even in these accounts, there is profound disagreement about the extent of trade and about how and indeed when it actually impacted on European economic development. So the assessments about the role of market integration on Europe's industrialisation range from negligible to central. [7]

The plausibility of whether trade-led growth played a crucial role for the Industrial Revolution in Europe hinges on whether Europe experienced a process of market integration prior to, or at least accompanying, its economic 'take off' in the late eighteenth century. Unfortunately, there is little agreement about when the process of European market integration began, about the extent of trade and market integration at various points in early modern Europe, or about the comparative levels of economic integration Europe had reached relative to the rest of the world. This uncertainty about whether the preconditions for trade-led growth were met explains why the assessments about the importance of market integration for the rise of Europe contrast so starkly.

This piece of research wants to do away with that uncertainty. It tries to overcome some of the problems of the market integration literature that leave us with this unclear picture and tries to sketch the reach of the market and the process of market integration in Europe from

[7] For some classical accounts on the Industrial Revolution and the 'rise of Europe', see Ashton, *The Industrial Revolution*; Landes, *The Unbound Prometheus* and *The Wealth and Poverty of Nations*; Mokyr, *The British Industrial Revolution*. For works that see some very clear key determinants, see for instance: religion: Weber, *The Protestant ethic and the spirit of capitalism*; geography: Diamond, *Guns, Germs, and Steel*; coal and colonialism: Pomeranz, *The Great Divergence*; institutions: North and Thomas, *The Rise of the Western World*; knowledge and human capital: Mokyr, 'The Intellectual Origins of Modern Economic Growth'.

well before until well after the start of the Industrial Revolution. By doing this, it tries to determine whether, in light of evidence from the most decisive shift in economic development, the trade-led hypothesis that features so prominently in the growth literature remains plausible. The aim here is not to supplant the existing explanations of the Industrial Revolution, but to ascertain whether and how one particular growth factor that appears in many explanations – the so-called 'reach of the market' – has contributed to this rise. In other words: Does market integration help to explain 'why Europe' and 'why north-western Europe'? Has market integration proceeded the take-off, has it been a concomitant or was it merely a consequence of it, as the mainstream opinion – the 'Big Bang assumption' – has it?

The investigation starts with an overview of the literature on potential links between market expansion and the rise of Europe, and shows the huge existing discrepancies when assessing the importance of trade as a growth factor. Thereafter, we look at how some crucial shortcomings of the market integration literature, which to large degree generate these uncertainties, can be overcome and what historical evidence has been gathered to do so. The two following sections describe the new approaches and the quantitative results they yield. Section six provides some historical narrative and the logic behind the results obtained and section seven concludes.

1. Trade Expansion and the Rise of Europe

As stated above, the plausibility of whether Smithian, or trade-led growth more generally played a crucial role for the Industrial Revolution in Europe hinges on whether Europe experienced a process of market integration prior to, or at least accompanying, its economic 'take off' in the late eighteenth century. A number of empirical studies indeed do find

evidence that this was the case, pointing to the eighteenth century as a period of increasing market integration.[8] Consistent with these findings, it is argued that market integration was one of the key driving factors for structural change and economic growth in early modern Europe. Since technological change remained fairly limited in this period, it was the process of market expansion, facilitated by more efficient institutions and followed by an increasingly interregional and international division of labour, which is seen as the key to increases in productivity in the period before the Industrial Revolution.[9]

Not so, argues another body of literature, simply because European markets became integrated much earlier. According to Gregory Clark, English markets were well developed by the 1500s, while Abel and Achilles date the emergence of well developed markets to the sixteenth and early-seventeenth centuries. So why did Europe not take off then but only centuries later? Surely, neither can integrated markets explain the rise of Europe in the eighteenth century, nor can the slow growth in the centuries before be blamed on poorly developed markets. We must look elsewhere for the causes of modern economic growth.[10]

Wrong again, is the view of more recent authors. Market integration can indeed not have been central for explaining the Industrial Revolution, not because well developed markets developed much earlier, but because they only emerged after 1800, when the Industrial Revolution was already well under way. Focusing on long-distance trade, both intra-European and intercontinental, they conclude that trade in early modern

[8] Persson, *Grain Markets in Europe*; Unger, 'Integration of Baltic and Low Countries Grain Markets, 1400-1800'; Allen and Unger, 'The Depth and Breadth of the Market for Polish Grain 1500-1800'.
[9] De Vries and van der Woude, *The First Modern Economy*; Persson, *Pre-industrial Economic Growth, social organisation and technological progress in Europe*; Wrigley, *Continuity, Chance and Change*.
[10] Clark 'Markets and Economic Growth'; Abel, *Agricultural fluctuations in Europe*; Achilles, *Getreidepreise und Getreidehandelsbeziehungen europäischer Räume im 16. und 17. Jahrhundert*.

times was characterised by the exchange of non-competing goods of a low bulk-to-value ratio. The surge in trade before 1800 did therefore not result in an integration of markets, hence no re-allocation of resources and specialisation ensued. The decisive break with the past arguably occurred with a 'Big Bang' in the nineteenth century, when the steamship and the railways lowered transport costs to such an extent that a very broad range of commodities, including bulky goods like primary products, began to be traded internationally on a large scale. Before the second quarter of the nineteenth century, there was no widespread and sustained process or market integration. Starting in the 1820s, however, there was a rapid integration of markets, both within Europe as well as internationally. This first wave of globalisation had a dramatic impact on the worldwide division of labour and sharply increased productivity and rates of economic growth. In these accounts, which have become the dominating position, the decades from the 1830s onwards are seen as the first and typical era of Smithian growth.[11]

On top of the various explanations about how – or indeed how not – trade *directly* impacted on European economic development through market integration and Smith's 'invisible hand', there is an array of literature about trade-led growth that worked *indirectly* through channels

[11] O'Rourke and Williamson, 'When did Globalisation Begin?', 'After Columbus', 'From Malthus to Ohlin'; Findlay and O'Rourke, 'Commodity Market Integration, 1500-2000'; Özmucur and Pamuk, 'Did European commodity prices converge before 1800?'. A very different kind of rebuttal of the centrality of market integration for European industrialisation has recently been provided by the comparative analyses of Carol Shuie and Wolfgang Keller. Their quantitative evidence suggests that the markets in eighteenth-century Europe actually were pretty well integrated. However, they find that the degree of market integration was actually comparable in advanced parts of China, namely the Yangtze Valley. And since in China no Industrial Revolution ensued, markets cannot be the explanation of the rise of Europe. They may be a necessary condition, but not a sufficient one for economic development. Shuie and Keller, 'Markets in China and Europe', 2004 and 2007 versions. Shiue and Keller's paper has so far remained the only quantitative piece of research to claim that other regions of the world may have had as integrated markets as Europe on the eve of the Industrial Revolution. A more recent study comparing Europe with India, the other of the 'big two' in Asia, concludes that markets were significantly more integrated in Europe compared to India: Studer, 'India and the Great Divergence'.

other than proper market integration. Most authors stressing the indirect consequence of trade accept the argument that the extent of trade and market integration has not been big enough to enable large scale specialisation and the reallocation of resources in early modern Europe. Yet they argue that the observed increases in specific trading areas and the concentration of activities and gains had nevertheless the power to induce the 'rise of Europe'.

A first variant of a trade induced, but non-Smithian, growth explanation is indeed very 'un-Smithian': Instead of the *invisible hand*, it is indeed a very *visible hand* that brings about an international division of labour by force. At the core of this position is the international Atlantic trade, in particular on the so-called 'triangular trade' between Europe (largely Britain), Africa and the New World. According to this position, it was the profits from the slave trade, which grew to major proportions in the eighteenth century with the expansion of sugar, tobacco and cotton cultivation on slave plantations in the New World, together with the rise of a new division of labour which spurred the Industrial Revolution. The outcome of that process was that the British specialised in capital intensive and labour-saving production, while the slaves of the New World were forced into delivering the complementary labour-intensive production side. Thanks to the handsome profits of the Atlantic trade, Britain also had the necessary capital to pursue this capital-intensive specialisation route, while the New World at the same time increased the British selling market and with it the demand for the new British manufactured products.[12]

[12] Williams, *Capitalism and Slavery*, gave rise to this line of arguments; for a current overview of the debate surrounding the Williams thesis, see Morgan, *Slavery, Atlantic Trade and the British Economy 1660-1800*. For some very influential work focussing on colonialism and world trade: Frank, *World accumulation, 1492 – 1789,* Wallerstein, *The Modern World-System*.

Daron Acemoglu and his co-authors have recently added another explanation of how the increasing Atlantic trade induced economic growth in Europe in a non-Smithian way. Focussing on the period 1500 to 1850, they agree that the rise in overseas trade after Columbus was most likely not 'large enough to have been *directly* responsible for the process of growth in Europe'.[13] However, they contend that the rise of the Atlantic trade played a central role in the rise of Europe through indirect channels influencing institutional developments. In countries with easy access to the Atlantic and with non-absolutist initial institutions – England and the Netherlands, basically – the surging Atlantic trade generated large and concentrated profits for merchants. This thus strengthened commercial interests and increased their political power while it had a constraining effect on the power of monarchs. This shift of power away from the monarchy is believed to have induced significant institutional reforms in favour of institutions that were conducive to growth, as they guaranteed private property and personal freedom, the rule of law and the prevention of excessive spending by the crown. 'With their newly gained property rights, English and Dutch merchants nations invested more, traded more and spurred economic growth'.[14]

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[13] Acemoglu et al., 'The Rise of Europe', p. 550; emphasis added. Partly in reaction to the Williams thesis just mentioned, Engerman, 'The Slave Trade and British Capital Formation' and O'Brien, 'European Economic Development' showed that the profits from the slave trade only played a modest part in the capital accumulation in Europe. In *Africans and the Industrial Revolution in England* Inikori revised these estimates upwards, but there is some agreement that the direct gains from the Atlantic trade were relatively rather limited. Also, it is accepted wisdom that maritime overseas trade only represented a small share of total trade in Europe, as inter-European land transport dominated trade. See, for instance, Irwin, „Comment on 'Commodity Market Integration, 1500-2000'".

[14] Acemoglu *et al*., 'The Rise of Europe', p. 572. The linkage between trade and institutions for explaining the rise of Europe is by no means new, but it is an updated variant of the arguments of North and Thomas' *The Rise of the Western World* and of North and Weingast's 'Constitutions and Commitment'. However, the causations proposed by Acemoglu now run the other way round, from trade to institutional change, while in the earlier formulation better property rights and more liberty were the prime movers and led to more trade and growth. Yet since in Acemoglu's argument the

The most recent explanation about how increased trade created the Industrial Revolution without a proper integration of markets comes from Robert Allen. In his account, England's commercial success during its imperial expansion in the seventeenth and eighteenth centuries enriched England and turned London into the trading centre of the world. This created a unique structure of wages and prices that set Britain apart from the rest of the world. In particular, wages rose above the levels enjoyed in any other country, while the price of energy, thanks to Britain's natural endowment in coal, remained low at the same time. This peculiar price and wage environment created the incentive to substitute capital and energy for labour. Hence it was in England where it paid for inventors to invent machines that did exactly that, and it was in England where it paid for entrepreneurs to apply this knowledge and for investors to provide the money necessary to do so. Consequently, these machines (such as the steam engine) were invented and put into use in England, and mechanisation and industrialisation got under way.[15]

To sum up, this body of literature about the connection between increasing trade and the rise of Europe, there is indeed little agreement about when the process of European market integration began, about the extent of trade and market integration at various points in early modern Europe. As scant and ambiguous quantitative evidence leaves large room for manoeuvre, it is hardly astonishing that there are also completely diverging views on the importance of the expansion of trade for the rise of Europe, either as a direct force through the integration of markets and the ensuing re-allocation of resources or indirectly through other channels.

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development depends on non-absolutist 'initial' institutions, the new version of the institutional argument is really only marginally different.

[15] Allen, *The British Industrial Revolution in Global Perspective.* This list of attempts to explain the rise of Europe or England with the commercial expansion is by no means exhaustive, but focussed on important and distinct contributions.

2. Analysing Market Integration in Europe

It will be argued here that this inconclusive picture regarding the reach of the market over time is due to several consistent shortcomings in the market integration literature, which can be corrected for.

The first of these deficiencies of market integration studies for the pre-World War I period is the segregation of research in terms of *time span* the various studies cover. The main dividing line is 1800, as most studies either focus on the early modern period or on the nineteenth century. That is particularly bothering with the present research question in mind, as Europe's rise is dated broadly around that time, so that these market integration studies either have their end or starting point around the time of the take-off.

To some degree, this dividing line stems from the different sets of qualities needed to study pre-1800 and post-1800 market integration. The nineteenth century has certainly attracted by far the most attention, and this is certainly due to the availability of data. The abundance and quality of economic data that was collected in the nineteenth century, both by the authorities as well as private businessmen, is unprecedented in history. For earlier periods, records of prices or other variables are much scarcer and have rarely been published. Consequently, good data for quantitative studies on earlier periods is not just less abundant and often of inferior quality, but normally also much more scattered and it is much harder to gain access to such sources. No wonder that researchers with good quantitative of econometric skills – the 'data people' – focus on the nineteenth century, while more traditional historians work on the early modern period, where qualitative accounts and a sound knowledge of archives and sources are much more important.[16] Unfortunately, given

[16] An example of the former are Jacks, 'Intra- and International Commodity Market Integration', or O'Rourke and Williamson, 'When did Globalisation Begin?'; examples of the latter are Unger, 'Integration of Baltic and Low Countries Grain Markets, 1400-

the varying abundance and quality of the data and the different analytical tools used in their research, direct comparisons of pre- and post-1800 studies are far from straightforward, thereby blurring the picture about the evolution of markets.

Another problem in the existing literature is its heavy *geographical bias*. Within Europe, special attention has been paid to the first movers – England and the Netherlands – as well as to a particular mode of transportation, namely maritime or coastal trade, and particular trade routes. Taken together, one may speak of a strong bias towards lowland Europe and trading centres, including, apart from England and the Netherlands, also the Baltic States, the German and Belgian lowlands.[17] This incidentally also applies to studies that attempt to span 'Europe' as a whole.[18] Overland trade in more landlocked territories of Europe has attracted relatively little research. With respect to intercontinental trade, special attention has in particular been paid to the so-called 'Atlantic trade', that is to trade flows and market integration between Western Europe and the Americas.[19]

Yet, despite the aspiration of 'European' or 'global' coverage of some of these studies, maritime and coastal trade was in all probability only a relatively small share of both total world trade and total European trade. Local, regional and interregional trade were far more important in terms of volumes. Accordingly, sea transport was by no means the

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1800' or Abel, *Agricultural fluctuations in Europe*, and Braudel and Spooner, *'Prices in Europe from 1450 to 1750'.*

[17] Unger, 'Integration of Baltic and Low Countries'; Allen and Unger, 'The Depth and Breadth of the Market for Polish Grain 1500-1800'; Jacks, 'Market Integration in the North and Baltic Seas'; Kopsidis, 'Market integration and agricultural development'.

[18] Shiue and Keller, 'Markets in China and Europe'.

[19] O'Rourke and Williamson, 'When did Globalisation Begin?', 'After Columbus', and 'From Malthus to Ohlin'; Acemoglu et al., 'The Rise of Europe'; Jacks, 'Intra- and International Commodity Market Integration', 'What drove nineteenth century commodity market integration', 'Commodity Market Integration in the Long-Run'; Persson, 'Mind theGap'.

dominant mode of transportation, because the lion's share of commodities was transported overland or on inland waterways.[20]

A third shortcoming is the bias in terms of *distance.* So far, most studies describing 'European market integration' have focused on trade over long or very long distances[21], while only few quantitative studies on regional and interregional market integration exist to date.[22] Accordingly, a synthesis combining the regional, national and international levels is still lacking. This is paramount when assessing the overall history of market development, as there may be significant differences in terms of timing, extent and trends of market integration on the different spatial scales. And as today's generalisations about the course of European market integration largely stem from research on long-distance trade, the current picture may not only be incomplete but grossly misleading. One may say that this shortcoming is linguistic, as in these studies 'European market integration' – i.e. the formation of an all-European market – is mostly not differentiated from 'market integration in Europe', i.e. from the process of market expansion on a regional or interregional scale.

Finally, the studies attempting to provide a 'European' picture of market integration are still based on relatively *small databases*. The efforts to broaden the quantitative evidence is still very much an ongoing project, so that most studies that include the pre-1800 period are normally based on the a sample of markets of 5-15 markets, which in an all-

[20] Irwin, "'Comment on 'Commodity Market Integration'".
[21] See for instance Persson, *Grain Markets in Europe*; Özmucur and Pamuk, 'Did European commodity prices converge before 1800?' or again Shiue and Keller's 'Markets in China and Europe'.
[22] Some notable exceptions are Kopsidis, 'Market integration and agricultural development' and 'The creation of a Westphalian rye market', Brandenberger, *Ausbruch der ‚Malthusianischen Falle'*, Göttmann, *Getreidemarkt am Bodensee*, Vögele, *Getreidemärkte am Bodensee*.

European context is not very large and may neither be terribly representative nor reliable.[23]

Taken together, these limitations and biases in the current market integration literature are such that some generalisations may not only be incomplete, but actually misleading or plain wrong in some respects. To overcome these main deficiencies of the field, a new database of historical evidence has been compiled and analysed with these problems in mind.

Thus, here the dividing line of 1800 is avoided by covering the *time period* from 1650-1914 and only including very long data series that can be uniformly analysed over the whole period. Like that, all claims can be verified, namely whether market integration preceded, accompanied or followed the take-off. Also, notwithstanding the debate about the dividing line of 1800, most scholars would agree that the reach of the market in 1650 was, in all parts of the world, local or regional. Also, nobody would disagree that by World War I, there were global markets for most commodities as well as for capital and to a lesser degree, labour. Consequently, the period examined here spans the most dramatic period of market expansion in world history in its entirety, as most parts of the world witnessed in its course a shift from a regional to a global reach of markets.

Second, the *geographical bias* which favoured maritime and coastal trade, and featured a predominance of north-western Europe or prominent trade routes, is overcome. The sample of markets used for the present investigation is geographically much more evenly distributed across the continent (see Figure 1). In particular, the new database

[23] See for instance Shiue and Keller, 'Markets in China and Europe'; Persson, *Grain Markets in Europe*; and Özmucur and Pamuk, 'Did European commodity prices converge before 1800?'

includes many markets in the interior of Europe, a region that had previously been neglected.[24]

Third, instead of exclusively focussing on long-distance trade, market integration on *all distance ranges* shall be investigated, which ought to give us a much more complete picture of the expansion of market areas.

Finally, the new database not only covers a longer time period and features a more balanced set of markets in terms of geography and distance, but it is also substantially bigger than in most previous studies. This newly collected database consists of commodity, more specifically grain, prices. These annual average prices for calendar years are for wheat, or in some cases for spelt, which is a special type of wheat that was, especially in the early modern period, the predominant grain in parts of Europe's interior. In total, this *extended* grain price *data base* for the market towns shown in Figure 1 includes price series for 45 markets across Europe, encompassing the period from 1650 to 1914. The average number of years a price series continuously covers is 145, the minimum number and maximum numbers being 47 and 264, respectively.

When compiling the database, many of these price series were taken from the secondary literature and, thanks to recent scholarship, many are even available online and in standardised form that makes them comparable internationally.[25] Considerably less data was readily

[24] One qualification to be made here is that the Mediterranean region has been excluded from this study for various reasons. First, this region is not central to the study of Europe's rise, as the Mediterranean has been lagging behind in terms of development. Also, consistent long-term series covering both the eighteenth and the nineteenth century are hard to come by. Judging from some limited preliminary analysis done with some available series, this area might have been a distinct trading area, and the interpretation appears less clear than for the rest of Europe. Surely, the Mediterranean is a promising topic for further research.

[25] Many series are nowadays available both in original units and currencies as well as in standardised form, mostly expressed in grams of silver per litre or kilogram. The richest online sources of standardised grain price series are the Allen-Unger database at http://www2.history.ubc.ca/unger/htm_files/new_grain.htm and David Jacks' data sets at http://www.sfu.ca/~djacks/data/data.html. Consequently, all other, non-

available for regions in the interior of Europe, however, so that many new price series have been collected from archives and old statistical journals to complement the more readily available series. For more detailed information about sources, coverage and conversions of all price series used, please consult the appendix.

Figure 1: Market Towns Included in the New European Database

It becomes clear from the database compiled for the study that this investigation follows the tradition of narrowing down the study of market integration to the study of commodity markets, and more specifically, to grain markets. Inference about the extent of the market at any point in time as well as the process of market integration or disintegration will be made from the comparative study of grain prices. This choice of focus can firstly be justified by the dominant position of grain in consumption and trade in the pre-twentieth-century world. This pre-eminence of grain is

standardised grain price series used have also been converted into grams of silver per kilogram, using recent literature on the silver content and exchange rates of currencies. For more information, please consult the appendix.

manifest in the availability of data; it is for that period the good for which by far the most and best data is available. Any attempt to span an equal range of time and space for any good other than grain is virtually impossible to date.

Apart from its dominant position, grain is for another reason arguably the most suitable good for assessing the course of commodity market integration. In terms of 'transport suitability' it could be called an intermediate good. It has on the one hand a high bulk-to-value ratio, meaning that transport costs and capacities are central to the extent of grain markets. Once grain markets become integrated, the markets for most other goods will also be integrated, as most of them are easier and cheaper to transport. When trying to assess the scope for a large scale reallocation of production factors to allow for specialisation through market integration, this condition must be met. However, such a condition does not hold for goods with a very low bulk-to-value ratio, such as spices or fine cloth. Consequently, the markets for such goods have in some cases been integrated for centuries, even when the markets for most goods remained completely fragmented. Clearly, telling the story of the fine cloth market will not be representative for the more general picture and will not be useful when gauging the possibility of Smithian growth. On the other hand, though, some goods, eggs for example, will never be traded over longer distances, since they are inherently difficult, hence expensive, to transport. Grain, as an intermediate case, makes for a good proxy for inferences about the overall process of expanding markets and the reach of an integrated market enabling large scale geographical reallocation and specialisation.

3. Using Factor Analysis to Study European Market Integration

To remind the reader, the aim of the present contribution is to assess whether market integration helps to explain 'why Europe', and 'why north-western Europe in particular. In the present analysis, we therefore want to simultaneously look at these two research questions – but how can this be done? Clearly, and 'all Europe' analysis, the most popular way of dealing with this broad research question, will not provide the desired answers. So should we try out the second predominant mode of analysis – a country-wise investigation? Certainly, this is quite a meaningful observation unit, as several relevant factors like trade policy, currencies, legal systems or measurement units are often determined by national borders. But then national borders over the 250+ years under study are not constant but changing considerably. Also, when splitting up the European database into many different country sub-samples, we are once more faced with the problem of very small sample sizes. What is more, there are other potential categorisations that do not follow national borders, such as special trade routes or geographical features – which may well be more important dividing lines in early modern Europe than national borders. Thus, a novel approach is required. The solution proposed here about how to break up the newly compiled database is to let the data speak for itself.

One way to attempt this is to use factor analysis, which is a popular analytical technique to detect structure in the relationship between variables, that is, to classify variables. Factor analysis is commonly used for data sets with many variables in order to uncover latent structures, with which the essential information of the data set can be expressed with a few variables – called factors. The basic principle of this technique is that is does not assume any dependent variable, but instead looks at the co-movement of individual variables. Simultaneous movement (correlation) of variables is taken as evidence of an underlying factor

shaping both variables. In the case of two variables, a new variable (factor) is then created, which is a linear combination of the two variables. When extending this procedure to multiple variables, the computations become more involved, but the basic principle of expressing two or more variables by a single factor remains the same.[26]

In the present case, the variables are the time series of grain prices from cities all across Europe. Applying factor analysis, we are trying to detect underlying structures in European grain markets. In particular, we are trying to uncover groups of markets where prices behave similarly and to interpret what factors might account for such patterns, such as national borders, special trade routes, trade policies, or geography. To do this, the data set described above is used, but all price series have been differenced to avoid spurious correlation. This is central for factor analysis, where co-movement is at the centre of the analysis. If levels were used, some detected co-movement between variables would be spurious because of simultaneously rising price levels. Consequently, inferences would be mistaken and the newly constructed factors would be fundamentally flawed.

Moving to the actual estimation, we face the choice of various variations of factor analysis. The most popular among these is Principal Component Analysis (PCA), especially when the research purpose is trying to reduce the information in many measured variables into a smaller set of components. What PCA basically does is to seek linear combinations of variables such that the maximum variance is extracted from the variables. It then removes this variance and seeks a second linear combination which explains the maximum proportion of the remaining variance and so on. PCA therefore extracts uncorrelated (orthogonal) components in order of their importance for explaining the

[26] For introductions to factor analysis, see Lawley and Maxwell, *Factor analysis as a statistical method*; Dunteman, *Principal component analysis*.

total variance in the data set. How many factors (components) we want to extract is an arbitrary decision. Note that as we extract consecutive factors, they account for less and less variability. This is demonstrated in Table 1, where 25 components have been extracted from a sample of 25 wheat price series from 25 European cities. This sample is for early modern Europe and covers the years from about 1650 to about 1770, while most series only start in 1700.[27]

Table 1: Total Variance Explained in Early modern European grain prices

Component	**Initial Eigenvalues**		
	Total	% of Variance	Cumulative %
1	10.63	42.52	42.52
2	5.30	21.22	63.73
3	3.48	13.93	77.66
4	2.09	8.35	86.01
5	1.45	5.78	91.79
6	1.22	4.86	96.65
7	0.84	3.35	100.00
8	0.00	0.00	100.00
…	…	…	…
25	0.00	0.00	100.00

Extraction method: Principal Component Analysis.
Sources: see appendix

For each of the 25 components extracted by PCA, we see how much of the total variation in the data set they individually and collectively explain. The components are ordered according to the importance, with component 1 alone explaining 42% of the variation, and the first two already roughly two-thirds of the total variance. Note that the 'total value'

[27] SPSS has been used throughout all estimations concerned with PCA. For a guide about how to use factor analysis in SPSS, see Norušis, *SPSS 13.0 Statistical Procedures Companion*. The reason that only 25 markets out of the total of 45 have been used for the PCA is that only series that cover big part of the pre-take off years (prior to1770) and that do not have holes have been used.

of the eigenvalue is just another way of expressing how much of the variance in all variables is accounted for by one component. The bigger the eigenvalue, the more one factor contributes to the explanation of the variance.

Even though there are no clear rules of how many components to extract and interpret, there are some guidelines. One of them looks at the total variance explained and suggests that, depending on the researcher's emphasis on parsimony, enough factors should be kept to account for about 50% to 90% of the variation. The Kaiser criterion proposes to retain all components with an eigenvalue in excess of 1, while other researchers prefer to plot the eigenvalues in so-called 'scree plots' (we will see one of them later on) and cut where the eigenvalues seem to level off. Regardless of the guidelines used, most often only the first two or three components are retained, whose dimensions of meaning are readily comprehensible. We will do the same here, keeping the two most important components only, which together account for nearly two-thirds of the variation in the data.

The next step in PCA is to look at how our individual variables relate to the newly constructed components in order to know the meaning of the components, that is, whether and how we can interpret them in a meaningful manner. In SPSS, which had been used for all PCA analysis, the relevant output in this respect is the component matrix. It shows 'factor loadings', also called component loadings in PCA, which are the correlation coefficients between the variables (rows) and the components (columns). In the present case, the analysis is, as mentioned, restricted to the two most important components. The results are shown in Table 2, where we see how the individual price series from markets all across Europe relate to these two principal components extracted by PCA from the whole data set.

Table 2: Component Matrix for Early Modern Europe

Market Town	Component	
	1	2
D_Lucerne	0.44	0.03
D_Bern	0.75	-0.28
D_Munich	0.94	0.20
D_Vienna	0.38	-0.33
D_Ueberlingen	0.99	-0.04
D_Schafhausen	0.97	-0.11
D_Zurich	0.94	-0.17
D_Appenzell	0.93	-0.23
D_Strasbourg	0.85	-0.16
D_Augsburg	0.98	-0.19
D_Frankfurt	0.87	-0.08
D_Grenoble	0.83	0.18
D_Hamburg	0.31	0.57

Market Town	Component	
	1	2
D_Amsterdam	-0.18	0.72
D_Gdansk	-0.64	0.62
D_Boulogne	0.32	0.81
D_Exeter	0.37	0.66
D_Windsor	0.45	0.68
D_Utrecht	-0.45	0.53
D_Eton	0.44	0.73
D_Winchester	0.44	0.70
D_Berlin	0.27	0.51
D_Rennes	-0.51	0.47
D_Toulouse	0.09	0.47
D_Madrid	-0.38	-0.30

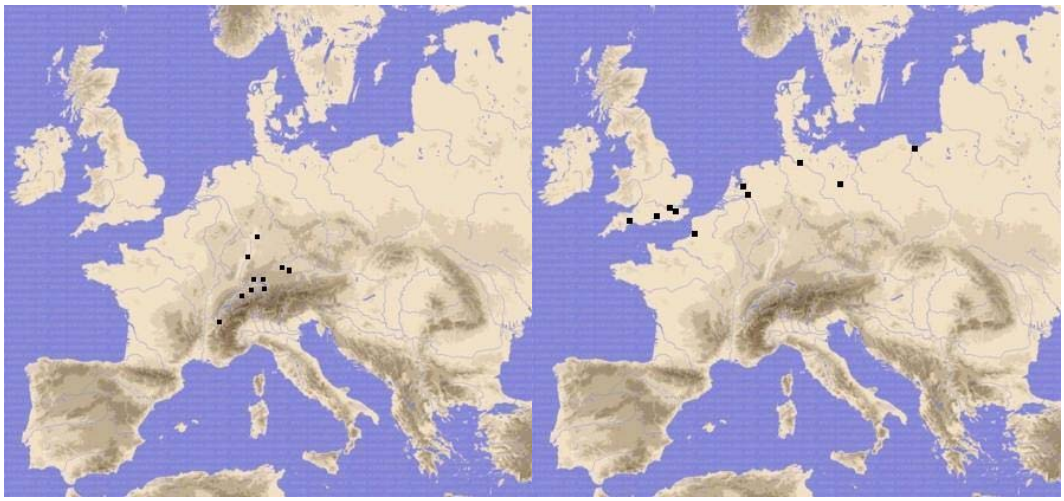
Sources: see appendix

When trying to make sense of what the newly constructed component might represent, we look at which variables are closely associated with the components. As with the number of components to retain, there is no clear criterion as to what actually represents a strong association between a variable and a component. That decision is arbitrary to some degree, though guidelines of ‘strong’ or ‘substantial’ connections often range from factor loadings in excess of 0.4 to factor loadings in excess to 0.6. In order to get a preliminary idea, the variables have been highlighted according to a middle estimate of 0.5. Of the 25 variables, 10 variables have a factor loading of > 0.5 for component 1, that is, they are strongly correlated with component 1. At the same time, they are not strongly correlated with component 2. Roughly the other half of the variables, again 10 cities, show the mirror image, as they are strongly associated with component 2, but not with component 1. A few variables are not strongly associated with either of the two components,

like Vienna and Madrid, while Rennes and Toulouse only fall a bit short of the 0.5 threshold for component 2, and Lucerne only a bit short of the threshold for component 1.

We now want to further examine what underlying structures these two principal components are picking up, that is, we want to try to label the two principal components that split our sample of 25 markets in nearly two halves. Since our variables are grain price series of different cities, our observational units are geographic in nature, so that a good option to make sense of the factors loading is to visualise them on a map. Consequently, two maps have been drawn (Figure 2), the first showing the locations of cities with a factor loading exceeding 0.5 for component 1, and the second showing all the cities with a factor loading of higher than 0.5 for component 2.

Figure 2: Visualising the Principal Components of Early Modern Europe



Factor loadings of >0.5 for component 1 Factor loadings of >0.5 for component 2

The results are unequivocal in that they postulate two zones in the grain markets of early modern Europe. All variables (cities) which are strongly associated with component 1 are situated in the interior of

Europe, while all variables strongly correlated with component 2 are either on the coast or in the plains with ready access to the sea. With good reason we can label component 1 ‘landlocked Europe’ and component 2 ‘lowland Europe’. It therefore appears that physical geography is not only an important dimension to add, but that is actually the most characteristic feature of grain markets in early modern Europe. Most variation in prices across Europe is explained by the fact that price movements are similar within lowland Europe and within landlocked Europe. However, there is no connection between prices from the zones, that is, these are two very distinct and separated price regimes.[28]

[28] This notion is actually not a new one, but has been proposed before. For the early modern period, William Abel found that grain prices rose in times of dearth much higher in the interior parts of Europe, stretching from Lemberg in the east all the way to Orléans in the west. In coastal areas, including their immediate hinterlands, running from Gdansk in the east to London, and even going into the Mediterranean, prices were generally lower and price increases in times of crises much lower. From this he concluded that up to the late eighteenth century, the European grain markets consisted of two basic zones, coastal Europe and inland Europe. His explanation for this was the much better trade opportunities in coastal Europe, where the availability of cheap water transportation greatly increased the scope for arbitrage between regions of high and low prices, or between regions of deficient and abundant harvests. Achilles and later Allen and Unger broadly corroborated Abel’s findings also for the general level of integration that included not only years of crises. The tentative results of all these studies are, however, hardly present in today’s literature on European market integration, and newer studies such as David Jack’s ‘Commodity Market Integration in the Long-Run’ actually reject the idea of physical geography playing a central part in the history of European market integration. The absence of these early studies from today’s literature may partly be explained by their limitations. First, they are mostly restricted to a relatively small number of markets, or cover only limited time periods, so that generalisations for larger parts of Europe remained more speculative, while the trends in market segregation and integration over time could not be followed. Also, it remains unclear exactly where the dividing line between the two zones should be set. Second, they suffer from some clear methodological shortcomings. As most of these works are slightly dated, they often use fairly simple methods like comparing average price levels and one-year deviations to derive their results. When more systematic measures are used, like correlation analysis, they suffer from the fact that the problem of spurious correlation in the presence of non-stationary data had at the time of their publication not yet become an issue in econometrics. Consequently, when Abel as well as Allen and Unger found high correlations for the sixteenth and eighteenth centuries, they were not aware that these co-movements of prices could to a good extent be spurious as they could simply be generated by the fact that these were periods of generally rising prices. Abel, *Massenarmut und Hungerkrisen im vorindustriellen Deutschland*, pp. 38-39, 47. Achilles, *Getreidepreise und Getreidehandelsbeziehungen europäischer Räume im 16. und 17. Jahrhundert*, pp. 5-

Five cities do, however, not quite fit the pattern. Two of them, Vienna and Madrid, show low factor loadings for both principal components. Both these markets are located in the interior, but they are rather distant from the bulk of the other landlocked markets. So distance is one additional factor we will have to take into account while we proceed. Lucerne is a third variant whose factor loading does not exceed the threshold for any component. However, it falls only slightly short of the 0.5 threshold for component 1, and this is also where it should belong according to its landlocked location. Finally, also Toulouse and Rennes only slightly miss the threshold, this time for component 2, which would again be where they belong according to their geographic position.

What explains this pattern that splits Europe into two? Three basic options seem possible. The first relates to trade activities and market structures: All landlocked cities show similar price movements because they form some sort of an integrated market, and the same applies for lowland Europe. However, grain is not traded across these zones, or is traded only at a relatively low level. This hypothesis basically contends two well-integrated European markets, which, however, remained separated from each other. A point to be mentioned here is that in the present sample the landlocked markets are geographically much closer together than the lowland markets (see Figure 2). Distance is certainly an issue, and we have mentioned before that Madrid and Vienna, which are the two interior markets farthest away from the bulk of landlocked markets, do not show a substantial connection to the landlocked component.

A second possible explanation for two separate zones is that similar weather conditions across fairly large regions are causing prices to move similarly. While this definitely looks like a good option for the

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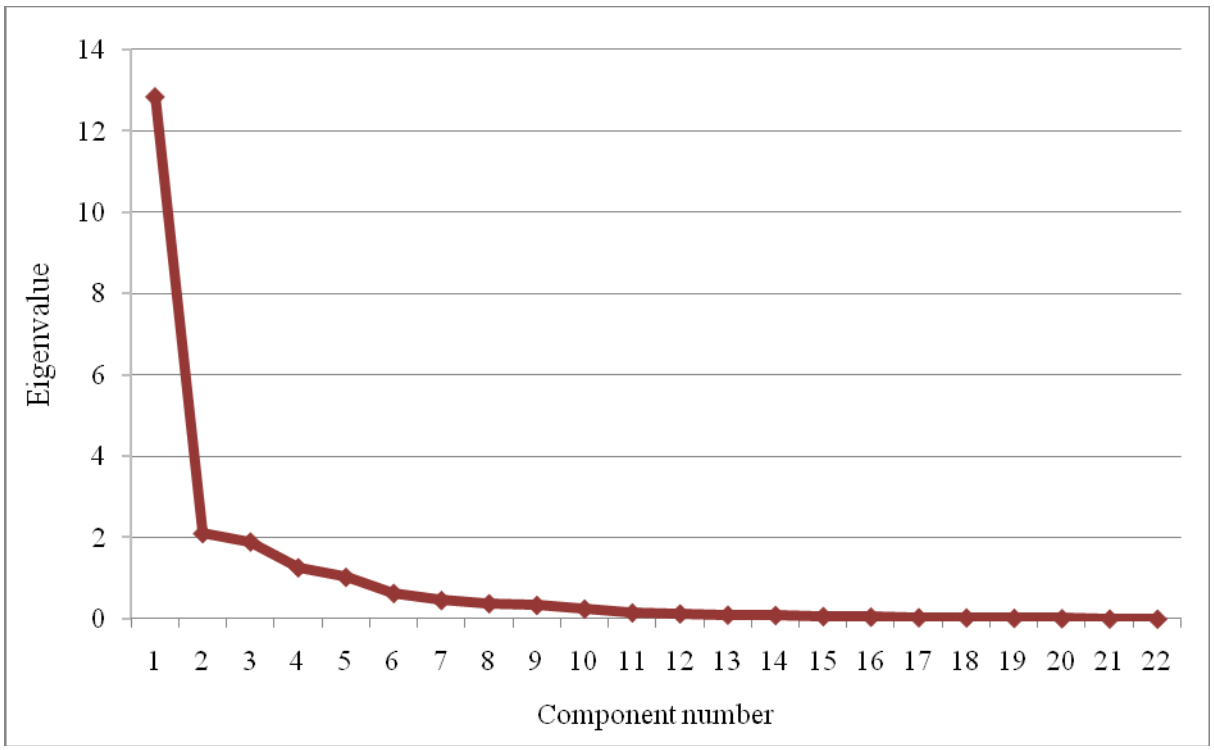
10, 33-34, 83-87, 114; Allen and Unger, ‘The Depth and Breadth of the Market for Polish Grain 1500-1800’.

landlocked parts where markets are fairly close to each other, it appears like a less powerful explanation for lowland Europe, where even very distant markets show co-movements. While in particular temperature patterns do show very large scale geographical patters, rainfall patterns in Europe normally vary more across distance than such an interpretation would suggest.

A third possibility again relates to market integration, but this time to an absolute extent of integration in the two zones. It is well-known that food prices in integrated markets behave differently than prices in localised, un-integrated markets. Given the possibility of arbitrage in the former, volatility and seasonal differences are less in integrated markets, as imports or exports help to dampen local demand or supply shocks. As a consequence, the two zones may represent different stages of market integration, with one zone showing a price pattern more typical of an integrated market and the other zones price behaviour more characteristic in segmented markets.

One first hint about how to explain this picture is given when repeating the exercise with nineteenth-century data. The data set is now slightly different, long series with no holes were not available for all markets for the nineteenth century. However, the 22 markets in the new sample, which cover the years 1800-1914, still extend over a similarly wide geographical range. Now, instead of a table listing all components and their explanatory power (as done in Table 1), for this later sample the same information is depicted in a *scree plot*, which shows the eigenvalues of all the 22 components extracted (Figure 3).

Figure 3: Eigenvalues of Components of Nineteenth-Century Sample



Compared to the PCA for early modern Europe (pre-1770), this scree plot for the nineteenth century shows one striking difference: an absolutely dominant component. With an eigenvalue of nearly 13, the first component itself explains nearly 60% of the total variance. Already the second component explains relatively little. Certainly, if we wanted a parsimonious model and judged on the basis of the scree plot, we would only retain one component, as it really looks like the one important underlying pattern of the whole data set. Such a suggestion is corroborated when looking at the component matrix for the first two components. Nearly all variables – 20 out of 22 – are strongly associated (factor loading > 0.5) with component one. Meanwhile, only two variables show a strong connection to component 2, namely two Polish markets. So already component two seems to pick up only a side issue in the data set.

A map (Figure 4) visualising the cities with a factor loading exceeding 0.5 for the dominant component 1 very nicely wraps up the fundamental difference of nineteenth-century European grain markets when compared to the early modern picture (Figure 1). There is now one absolutely dominating component comprising the whole continent, and the clear separation of landlocked and lowland Europe that was so characteristic for early modern Europe is wholly absent. Surely, there is but one clear explanation for this: fuelled by a transport revolution and helped by more liberal policies, the whole of Europe now forms one single market. While weather patterns remain a possible explanation for the existence of the two Europes in the early modern era, they are surely not of any help for explaining the changes from the early period to the late period, as large spatial weather patterns do not normally change dramatically over such short time spans as a century.

Figure 4: Visualising the Principal Component in Nineteenth-Century Europe

Factor loadings of >0.5 for component 1

Consequently, Principal Component Analysis corroborates earlier findings that the emergence of a pan-European market was a nineteenth-

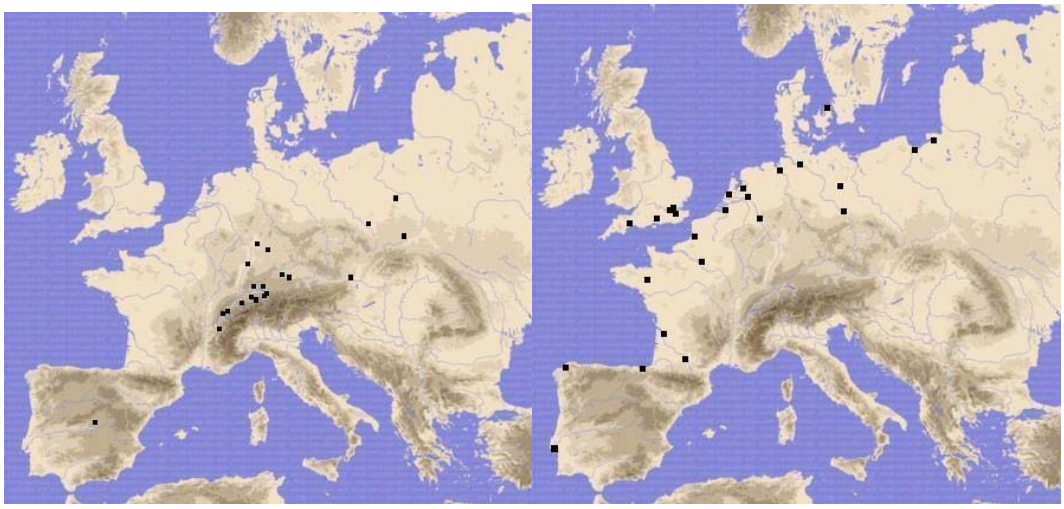
century phenomenon, as it was at this time when the two hitherto separated Europes became integrated *together*. What factor analysis cannot reveal, however, is the level and trends of market integration *within* both landlocked and lowland Europe – which is essential when answering ‘why Europe’ and ‘why north-western Europe’.

4. Measuring Market Integration in the Two Europes

By separately analysing the two European sub-samples, we want to determine whether geography not only split early modern European grain markets into two segregated zones, but whether it also resulted in distinct levels and trends of market integration within these zones. Hence traditional dimensions of market integrations such as national borders, trade policies or wars are ignored here, as we purely look at how geography and distance shaped the process of economic integration in Europe.

We now turn to the analysis of this new data set, trying to gauge the level and process of market integration for both ‘Europes’. To do this, we now work with the whole dataset presented in Figure 1. However, all 45 markets in this sample are now categorised either as a ‘landlocked’ or a ‘lowland’ market according to physical geography, which reproduces the spatial pattern that came out from the factor analysis performed above. As Figure 5 depicts, this produces a sub-sample of 20 landlocked markets that are located far from any coast and, as the dark colouring of the map indicates, often in rather hilly or even mountainous territory. The remaining 25 lowland markets are located either directly on the coast or are situated in plains characterised by low altitude and inclination and, in most cases, ready access to the sea via large navigable rivers.

Figure 5: The ‘Two Europes’: Landlocked and Lowland Europe



‘Landlocked Europe’ sample of 20 markets ‘Lowland Europe’ sample of 25 markets

To infer the state of market integration and the processes of integration or disintegration over time from these price series, we resort to the most popular analytical tools used in that respect, namely correlation analysis, price convergence, and price volatility. The logic for applying these tools is basically the ‘law of one price’, which states that in perfectly integrated markets, where trade participants in two markets share the same information and transport costs become small, price differentials between these markets offer opportunities for arbitrage up to the point that prices are either the same in the two markets or reach a stable ratio where the difference in price equals transport costs. As a consequence, the two price series are expected in the long-run to show a linear relationship, while small local price shocks, which temporarily create disequilibria in this stable relationship, are quickly corrected for by arbitrage. Testing to what extent the newly compiled grain prices show these characteristics therefore serves as the basic means for gauging the extent of grain market integration at any point in time. Rather than picking one particular indicator, we will be using various indicators to do so, as

every analytical tool has its weaknesses, so that applying several will enhance the reliability of the analysis.

Co-Movement of Prices

We begin by scrutinising the first characteristic of prices in integrated markets, which is whether they show a stable linear long-term relationship. To do so, we use *correlation analysis* to measure the strength or degree of linear association between price series in different markets. Correlation coefficients indicate the quality of the binary relationship, because the higher the coefficient, the stronger the association between the variables. Hence higher coefficients suggest a more integrated market, and they are expected to decrease with the distance between two markets as transport costs rise. To avoid any problems arising from spurious correlation, all price series have been differenced for the analysis.

The results of the correlation analysis for the two Europes are presented in Tables 3 and 4, and they have been grouped and aggregated into time periods and according to the distance between the two markets. Combining the price series of the markets in each sub-sample with each other, a total of 866 binary relations (correlations) were examined in total, of which 349 for landlocked Europe (Table 3) and 517 for lowland Europe (Table 4). The exact numbers of correlations examined for each time period in lowland and landlocked Europe are given in brackets.

Table 3: Correlations in landlocked Europe

	1700-1750 [n = 58]	**1750-1790** [n = 100]	**1790-1820** [n = 64]	**1825-1860** [n = 90]	**1870-1914** [n = 37]
35-70 km	0.76 (0.08)		0.80 (0.07)	0.79 (0.16)	
70-150 km	0.54 (0.20)	0.62 (0.15)	0.71 (0.19)	0.83 (0.18)	
150-300 km	0.37 (0.18)	0.48 (0.15)	0.67 (0.13)	0.71 (0.19)	0.76 (0.10)
300-600 km	0.30 (0.20)	0.42 (0.17)	0.50 (0.32)	0.68 (0.24)	0.79 (0.11)
600-1000 km	0.22 (0.19)	0.22 (0.24)	0.34 (0.28)	0.27 (0.15)	0.74 (0.15)
1000-1500 km	0.15 (0.10)	0.06 (0.28)	0.38 (0.18)	0.34 (0.12)	0.72 (0.15)
>1500 km	-0.04 (0.10)	-0.19 (0.14)		0.34 (0.09)	0.79 (0.08)

n: total number of market pairs examined; the average correlation coefficient reported for the different distance ranges and time periods are simple arithmetic averages of the relevant binary correlation coefficients; the standard deviations of the correlation coefficients are given in parenthesis. Distance ranges with n≤3 are not reported. To reiterate: for all correlations, differenced series have been used.

Table 4: Correlations in lowland Europe

	1700-1750 [n = 91]	**1750-1790** [n = 186]	**1790-1820** [n = 145]	**1825-1860** [n = 52]	**1870-1914** [n = 43]
35-70 km					
70-150 km	0.88 (0.08)	0.75 (0.16)	0.77 (0.08)		
150-300 km	0.73 (0.10)	0.71 (0.12)	0.68 (0.18)	0.81 (0.15)	0.80 (0.16)
300-600 km	0.34 (0.24)	0.37 (0.28)	0.58 (0.17)	0.84 (0.08)	0.79 (0.12)
600-1000 km	0.36 (0.28)	0.34 (0.27)	0.45 (0.15)	0.83 (0.06)	0.82 (0.16)
1000-1500 km	0.27 (0.20)	0.16 (0.25)	0.32 (0.19)	0.70 (0.19)	0.70 (0.13)
>1500 km	0.24 (0.25)	0.11 (0.20)	0.21 (0.17)	0.46 (0.25)	0.69 (0.09)

n: total number of market pairs examined; the average correlation coefficient reported for the different distance ranges and time periods are simple arithmetic averages of the relevant binary correlation coefficients; the standard deviations of the correlation coefficients are given in parenthesis. Distance ranges with n≤3 are not reported. To reiterate: for all correlations, differenced series have been used.

Let us first look briefly at the common features of both regions. First, distance is confirmed as the basic determinant for the extent of integration in the pre-railway period: nearly uniformly in all time periods, bar the late nineteenth century, correlations fall with increasing distance. Also, correlation coefficients increase over time, suggesting a gradual process of market integration over the eighteenth and nineteenth

centuries. Regional markets, on the one hand, were already closely integrated by the early eighteenth century in both of the two regions. Long-distance markets, on the other hand, only became closely linked in the course of the nineteenth century, thereby creating an overarching European market by the late nineteenth century. In the period from 1700 to 1914, both regions witnessed the most fundamental expansion of market areas in history, starting from a regional level, then moving to an interregional, and finally to a Europe-wide (and global) level. This already highlights one central finding, namely that there was no ‘Big Bang” in terms of integration, neither in the very late eighteenth nor in the early nineteenth century.

So much for the common features of the two Europes; now we want to move on to describing their differences, which we set out to explore in this section – and which are indeed quite distinct, judging from correlation analysis.

First, while local and regional markets were already well integrated in both areas in the first half of the eighteenth century, lowland Europe’s markets clearly extended much further, i.e. the position of the lowland line in Figure 6 is positioned markedly and consistently over the landlocked line. In lowland Europe, markets up to a distance range of 300 km appear very closely connected, with average correlation coefficient exceeding 0.7. In landlocked Europe, only markets up to a distance of 70 km are that closely linked, while for markets further apart than 150 km, correlation coefficients drop below 0.5.

A second feature that sets the two Europes apart is rather different trends in the eighteenth century. While lowland Europe starts at a considerably higher level of integration at the beginning of the century, progress over the eighteenth century is only modest. In the interior, however, the eighteenth century is a period of expanding markets: in Table 3, the coefficients for all distance ranges increase gradually from

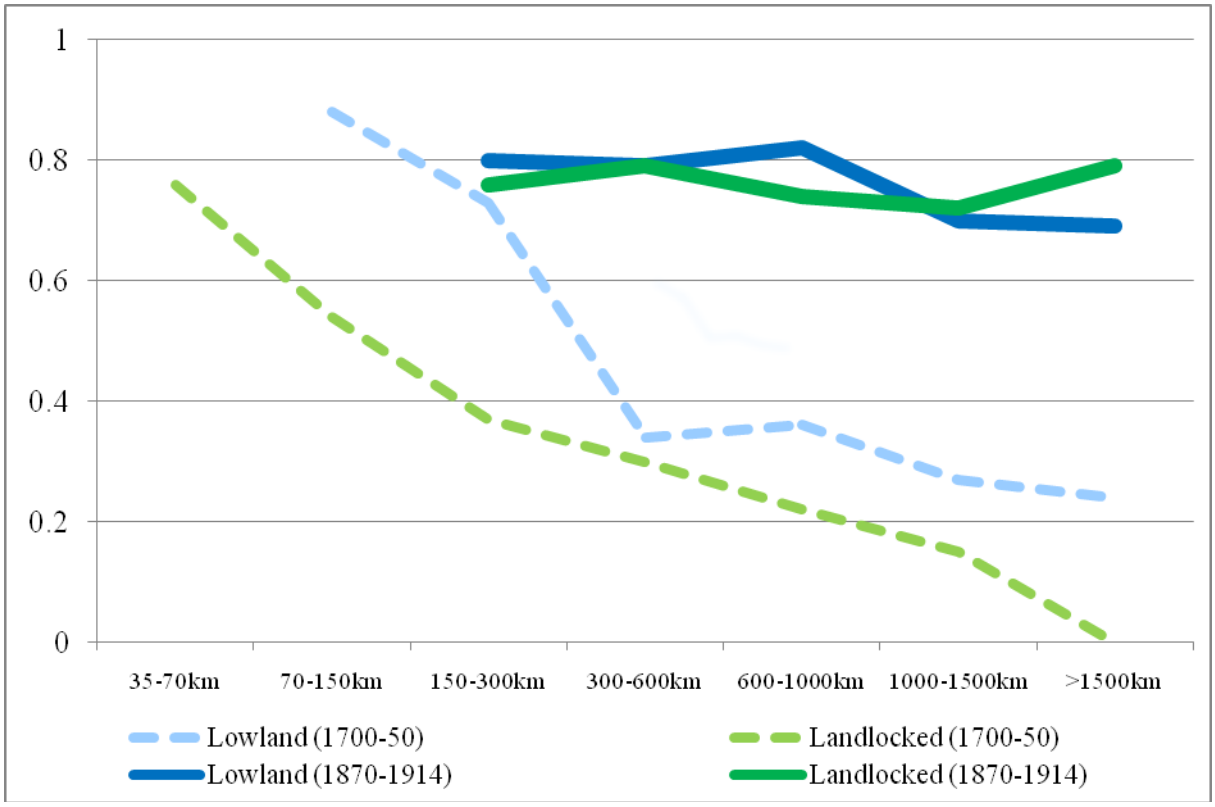
the first time period (1700-1750) to the third period (1790-1820). By the turn of the nineteenth century, the reach of well integrated market areas extends at least up to 300km. The degrees of integration of interregional markets (150-300km) did by then nearly reach the level in lowland Europe. While coefficients for all distance ranges are still higher in lowland Europe, the eighteenth century clearly saw a good deal of convergence. This catch-up process continues in the nineteenth century, so that by the end of the century, the differences in market integration between lowland and landlocked Europe have all but disappeared, as Figure 6 nicely illustrates.

A third dividing line is the greater heterogeneity in lowland Europe during the eighteenth century. This can be seen by the much higher standard deviations for longer distances in the lowland sample. This means, on the one hand, that distance does not explain everything, but that other determinants were important for the degree of connection between two markets, especially for lowland Europe. What these aggregated coefficients therefore hide is that for some city pairs, coefficients were considerably higher than the averages. Above average correlations for longer distances (>300 km) were in particular found for special trade routes, namely between cities in Eastern Prussia and Poland and the Netherlands.

A final clear dividing line between the two Europes can be drawn for the integration of long-distance markets (over 1000 km). While in both parts long-distance markets remain fragmented throughout the eighteenth century, their integration in lowland Europe is to a good degree already accomplished by the middle of the century (1825-1860). That is not true at all for landlocked Europe, where the integration of long-distance markets was clearly only achieved in the second half of the century. It is therefore only lowland Europe that fits the consensus in the literature that the decisive period for market integration in Europe was the second

quarter of the nineteenth century. Landlocked Europe does not fit this stylised consensus as there, long-distance markets really only became integrated in the late nineteenth century. However, by the late nineteenth century, distance really is 'dead" all over Europe, a fact that is nicely illustrated by the flat correlation lines for that period shown in Figure 6.

Figure 6: Two Europes, Catch-up and the Death of Distance



Sources: See appendix

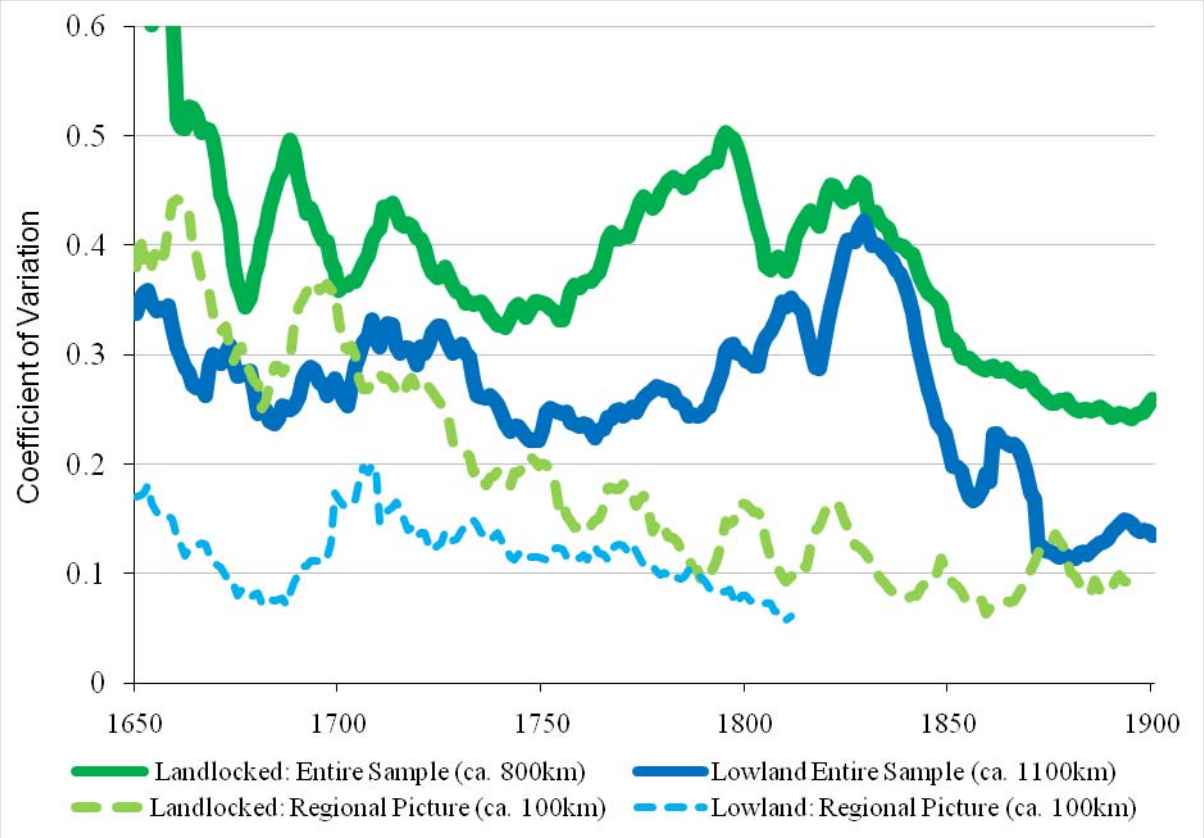
Price Convergence

Based on the law of one price, commodity price convergence is considered a reliable indicator for expanding markets. Therefore price dispersion, as measured by the coefficient of variation, has been calculated for both the entire landlocked and lowland Europe samples ('entire samples'). The results are shown in Figure 7, for which centred 11-year moving averages have been used.

The central conclusion from this exercise is that it corroborates earlier studies which found that price convergence across Europe, or indeed across continents, really only happened some time after the Napoleonic Wars had ended.[29] Although there was a sustained fall in the second half of the seventeenth century, in particular in Europe's interior, the big picture before the 1820s for long distance trade is one of stagnation. On the other hand, price convergence comes to a halt after around 1870, when prices even slightly diverge. Also this finding is very much in line with conventional wisdom, as the late nineteenth century saw, in some parts of Europe, the stepping up of trade barriers in reaction to the so-called 'grain invasion' from abroad.[30] Another conclusion arising from the entire sub-sample results depicted in Figure 7 is that price dispersion in lowland Europe was considerably lower at all times, which again underlines the systematic differences between the two Europes.

[29] O'Rourke and Williamson, 'When did globalisation begin?'; Findlay and O'Rourke, 'Commodity Market Integration, 1500-2000'.
[30] O'Rourke, 'The European Grain Invasion'.

Figure 7: Price Dispersion and Price Convergence, 1650-1900



Sources: See appendix

However, in some respects this comparison is flawed, as the two sub-samples are not directly comparable. In particular, the average distance between two markets, which is slightly changing over time, stands at between 700 and 900 km for landlocked Europe and at between 900 and1200 km for lowland Europe. Consequently, average distances at all times are about 200-300 km larger in lowland Europe compared to landlocked Europe (see also Figure 5 for a graphic illustration). Since distance has over and over been confirmed as central for transport costs and, hence, integration, one would want to adjust for differences in distance between the samples. However, to actually do so would necessitate a lot of very tentative assumptions, since we would have to assume some average transport costs, as well as their changes over

time. What is clear, however, irrespective of the assumptions, is that such a correction to hold distances constant would substantially increase the price dispersion in landlocked Europe compared to lowland Europe. In other words, the sub-sample lines in Figure 7 understate the true extent of the differences between the two Europes in terms of price dispersion.

As outlined, these findings for the 'entire samples' are capturing the process of price convergence between very distant markets. Therefore, what we have been describing so far is the integration of long-distance markets, so that these lines try to measure the same as the correlation coefficients for very large distances. The findings yielded by both techniques, correlation analysis and price convergence, are broadly matching, in that both confirm earlier studies that long distances markets only became integrated in the period after, say, 1820. The 'Big Bang' conclusion does seem to hold for long-distance trade.

However, – and this has been stated before – this macro view, which is shaping the conventional wisdom about market integration these days, completely misses the process of regional and interregional integration.[31] Correlation analysis suggested that the actual integration process started earlier, following the logic of gradual market expansion, starting from a local level at some point in the early modern era and finally reaching long-distance trade in the nineteenth century. Such an interpretation is confirmed for price convergence on a regional level, as depicted by the dotted lines in Figure 7, which show the price convergence process, in both landlocked and lowland Europe, between markets that are on average approximately 100 km apart from each other. Clearly, the eighteenth century now appears as a very dynamic period, by the end of which prices across these cities have nearly converged. Once

[31] The macro studies shaping the present scholarly opinion include Jacks, 'Intra- and International Commodity Market Integration in the Atlantic Economy, 1800-1913'; O'Rourke and Williamson, 'When did globalisation begin'; Federico and Persson, 'Market integration and convergence in the world wheat market, 1800-2000'.

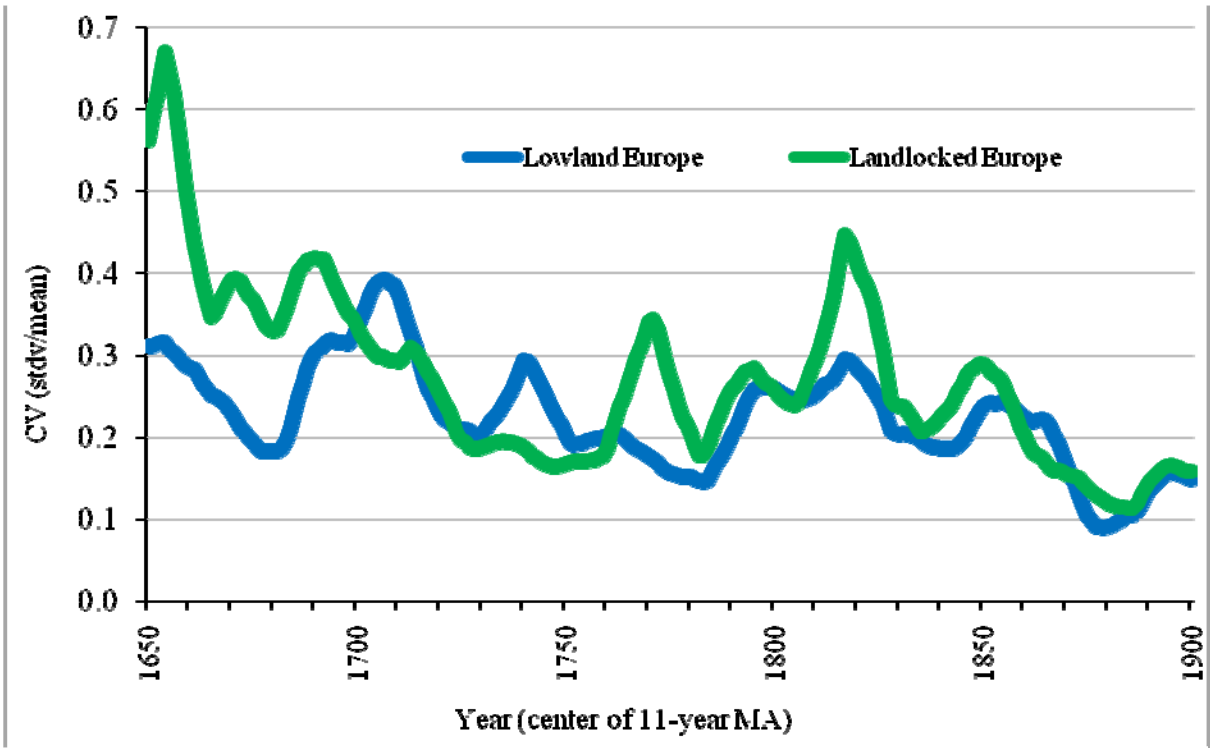
more, we find that the process of economic integration was much more gradual than conventional wisdom would have it. At the same time, Figure 7 also confirms two other earlier findings. First, price dispersion was considerably greater in landlocked Europe, pointing to a lower level of integration compared to the landlocked part. Second, distance is again confirmed as a central variable when looking at market integration, as price dispersion was a great deal higher over long distances compared to the regional level throughout the entire examination period.

Price Volatility

Let us finally look at an analytical method which is not directly dependent on distance. A decrease in the *single-market price volatility* is generally viewed as a concomitant of an expanding market. Price volatility is supposedly higher in fragmented markets compared with integrated markets, as in the latter case large variations in the local harvest (predominantly determined by local weather conditions) translate into only limited price shocks as they are dampened by the possibility of geographical arbitrage between surplus and deficient regions.[32] We measure price volatility in a market by the coefficient of variation, which is defined as the standard deviation divided by the mean, and the results for both European regions are shown in Figure 8.

[32] It needs to be mentioned that other factors than arbitrage can reduce price volatility; one factor could have been the reduction in the cost of storage. A decline in interest rates would encourage more people to store. Thus both geographical and inter-temporal arbitrage mattered.

Figure 8: Average Price Volatility in European Markets, 1650-1900



Sources: See appendix

In the seventeenth century, volatility levels were much higher in the interior than along the coasts.[33] However, again we find some convergence in the eighteenth century, when volatility levels in normal years look very similar in both regions. However, in times of the widespread harvest failures (in particular in 1770 and 1816) prices continued to increase much more in landlocked areas. Arguably lowland Europe's access to far more distant markets with less serious shortfalls meant that larger amounts of grain could be imported to dampen the supply-induced price shocks.

[33] This confirms Abel, who found that price rises in coastal towns were generally lower than price rises in inland towns. Abel, *Massenarmut und Hungerkrisen im vorindustriellen Deutschland*, pp. 38-39.

Another point about the bigger picture can be made when looking at the co-movement of volatilities. While up to the late eighteenth century, volatility levels behaved independently, they increasingly started moving similarly in both regions. This clearly suggests that the two Europes formed separate market areas in the eighteenth century. Thereafter, markets in both Europes became exposed to the same market forces, which is yet another proof of Europe-wide market integration by the nineteenth century, this time from a slightly different angle.

5. Explaining the Story of the Two Europes

The current findings suggest that physical geography was a crucial factor in determining the reach of the market in early modern Europe, and thereby support the strand of research that claim an important role for geographical variables for economic development.[34] Geography not only shaped the levels of integration, but also the trends. Is there a good narrative to support these conclusions and what is the link between geography and the reach of the market? That missing link is the availability of transportation.

Any production and exchange of goods through a market depends on the ability to transport goods from the producer to the market, and finally to the consumer. At any given time, the extent of the market and the degree of integration and specialisation therefore hinges on the performance of its transport environment – the capacity, cost, speed, and

[34] Well-known writings that stress the importance of geography (such as disease environment, natural resources, soil quality, abundant and well-spread rainfall, the absence of climatic extremes, and the presence of navigable rivers and access to the sea) are for example Sachs, 'Tropical Underdevelopment' and *The End of Poverty*, in particular chapters 3-4; Diamond, *Guns, Germs and Steel*; Landes, *The Wealth and Poverty of Nations*, ch. 1-2. Geography's importance as a central growth variable is, of course, a hotly debated topic and contested by authors who see the influence of geography as rather minor compared with factors such as institutions; see for instance Rodrik et al., 'Institutions Rule: The Primacy of Institutions over Geography and Integration in Economic Development'.

reach of transportation, as well as its stability, reliability, and regularity. Everything else equal, superior transport facilities increase the reach of the market, and therefore foster competition, increasing division of labour and regional specialisation, which all leads to both an intensifying and geographically more far-reaching trade in goods and services.[35]

Here, we have to restrict the description of the comparative picture of the transport environments in both regions to the bare minimum, highlighting the most crucial distinctive features. The two basic transport-related factors that can jointly explain the different *levels* of market integration in landlocked and lowland Europe are water transportation and inclination.

Let us start with water transportation. In the pre-railway era, transport on water was by far the cheapest and fastest. On the one hand, wind was the one main source of cheap non-human and non-animal energy in the pre-industrial transport environment, and was exploited by sailing ships. Therefore, sailing ships were the main means of long-distance transport. The other source was gravity that supported free energy for downstream river transport. But even upstream river transport was cheaper than overland transport, as the level of energy efficiency is better on water than overland. It is thus no wonder that estimated transport costs of maritime transport in early modern Europe range from 1.5 to 10 per cent of the costs of transporting the same goods overland, while for inland shipping the estimates range from 7 to 50 per cent of the cost.[36]

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[35] Szostak's *The Role of Transportation in the Industrial Revolution* is any extensive treatment of the connection between transportation and historical economic development. Further discussion of this issue can be found in Ville, *Transport and the Development of the European Economy*, especially at pp. 1-12. Sieferle and Breuninger's *Transportgeschichte im internationalen Vergleich*, pp. 5-41 provide some in-depth discussion of the link between transport and development.

[36] Weber*, Untiefen, Flut und Flauten*, pp. 97-105; Sieferle and Breuninger's *Transportgeschichte im internationalen Vergleich* Sieferle, pp. 12-17.

The European peninsula was naturally very suitable for coastal and maritime trade, as it offered plenty of access to the sea plenty. Compared with other coastal areas in the world, Europe's lands with access to the sea had even a special advantage for maritime shipping in that its coasts are jagged and in that it has several islands, so that it is endowed with an even longer coastline relative to its size than, say, India. In addition to their ready access to the sea, the plains of Europe – lowland Europe called here – from Prussia in the east to Bordeaux in the west, and in England, not only met the geographical requirements for inland navigation, but increasingly also the technological and financial ones, which were in many cases the real limiting factors for continuous and reliable – i.e. economically efficient – inland shipping. While some works to make rivers navigable are documented for the late Middle Ages, it was – as with the road network – the late seventeenth century, and in particular the eighteenth century that witnessed a clear break with the past and continuing improvements of inland waterways. All over Europe, from German lands, to the Low Countries, England, and France, dams and sluices were being built, river beds regulated, while newly-constructed towpaths also rendered upstream transport possible. To complement the natural waterways, in order to connect naturally navigable rivers or to increase density of the waterways more generally, artificial canals started to emerge simultaneously in many places.[37]

Elsewhere – in landlocked Europe in particular – the extent of inland waterways remained limited. It often had fewer navigable rivers, more inclination to overcome, while seasonally varying water levels, ice,

[37] However, pre-industrial technology in Europe was not able fully to tame many big naturally navigable rivers, while many grand projects of extensive river improvements and new canals were shipwrecked by the failure to raise the huge sums needed to carry them out. Thus the extent of artificial canals still remained limited outside England and the Low Countries, which were also the only countries to possess really dense networks of waterways by the late eighteenth century. By 1750, England had 2250 km of navigable inland waterways usable for the transport sector, which further increased to 6580 km by 1830; Duckham, *Canals and River Navigation*, pp. 109ff.

and frequent flooding remained serious obstacles until the nineteenth century, when technological solutions to these problems resulted in greatly increased the networks of continuous inland waterways that were at the same time much less dependent on seasons and the weather more generally.[38]

The second crucial edge lowland Europe had in terms of geographical endowment was its low level of inclination compared to the often hilly or mountainous territories of the interior. Even though already mentioned in connection with inland navigation, this factor weighs much more heavily when it comes to overland transport. The energy efficiency of animals and humans as bio-converters is rather low, estimated at 10-20 per cent, making the carrying of heavy goods a rather energy-consuming operation. Add the wasteful vertical dislocation of the load carried by draught animals and topographical obstacles posed by hills and mountains both for building roads and transporting goods and it becomes evident why flat territory makes the construction of a transport infrastructure as well as the transport itself so much easier and cheaper.[39]

To sum up, physical geographical endowed lowland Europe with both cheaper and much more widespread water transport as well as cheaper overland transport. An argument can therefore be made that physical geography divided early modern Europe generally into two transport regimes, thereby shaping the extent of economic integration in early modern Europe. It only seems logical that markets areas in lowland Europe should have been much greater, while the exchange of goods as

[38] For a short overview of inland navigation in pre-industrial Europe, see Weber, *Untiefen, Flut und Flauten*, pp. 55-75. Another very readable overview of European inland waterways is provided in Ville, *Transport and the Development of the European Economy*, pp. 30-47. Crompton, 'The tortoise and the economy' provides a discussion of the importance of inland waterways on European industrialisation.
[39] See for instance Sieferle and Breuninger's *Transportgeschichte im internationalen Vergleich*, pp. 10-17.

well as specialisation is expected to have been much more intense as a consequence.

When trying to explain the different *trends* in market integration in landlocked and lowland Europe observed in the previous sections, the history of transportation systems is again crucial. To start with, the general gradual expansion of market areas over the whole period, and gaining pace in the late eighteenth century, clearly fits the gradual improvement of the transport infrastructure. Also, the catch-up of landlocked Europe over the eighteenth century may illustrate that the intensification of road development in this period was much more crucial for the interior of Europe, simply because there no cheap alternative to road transport in the form of water transport was available. At least for the cities right on the coasts and alongside navigable rivers, road development had most probably far more modest effects on the level of market integration.[40] Similarly, the different transport environments can also give a hint as to why the timing of the integration of long-distance markets has varied for the two Europes. Steamships, which were predominantly used in lowland parts of Europe, came into widespread use already in the first half of the nineteenth century, and therefore supported an early expansion of markets. Extensive railway networks, on the other hand, were only completed in the second half of the century (with a few exceptions in lowland Europe). Consequently, landlocked Europe's integration into a pan-European grain market lagged behind, and long-distance markets only became integrated in the late nineteenth century.[41]

[40] A very good overview of overland transport in pre-railway Europe is also provided by Popplow, 'Europa auf Achse', pp. 87-156.
[41] A concise treatment of various aspects of the European railway network, including its extent and its financing as well as its debated impact on economic development and social savings is provided in Ville, *Transport and the Development of the European Economy*, pp. 114-7.

Finally, while the transport revolution in the nineteenth century made transport cheaper, faster, more regular, and more reliable all over Europe, one has to appreciate that this was particularly so for the interior territories, which had faced much more adverse conditions for transportation. Steam transport not only epitomised the process of economic development, it simultaneously ended an age-long transport advantage of lowland over landlocked Europe.

6. Conclusions

The results of the factor analysis are unequivocal in that propose a notion of two zones in the grain markets of early modern Europe. It appears that physical geography is not only an important dimension to add to the history of economic integration in Europe, but that it is actually the most characteristic feature of grain markets in early modern Europe. Most variation in prices across Europe is explained by the fact that price movements are similar within lowland Europe and within landlocked Europe. However, there is no connection between prices from these zones, that is, there are two very distinct and separated price regimes. As, by the nineteenth century, this pattern of a divided Europe is wholly absent, the standard view stating that the emergence of a pan-European market for bulky goods was a nineteenth- century phenomenon is corroborated. [42]

When moving to an in-depth analysis of both Europes to determine their respective paths of economic integration, the resulting picture is one of some common features and plenty of distinctive differences.

[42] Jacks, 'Intra- and International Commodity Market Integration in the Atlantic Economy, 1800-1913'; O'Rourke and Williamson, 'When did globalisation begin?'

As for the *common features* present in both landlocked and lowland Europe, distance is confirmed as the central determinant shaping the degree of integration. Also, both regions show a gradual expansion of markets over the whole time period from 1700 to 1914, with the effects that the cumulative expansion witnessed over this time period amounts to the most fundamental expansion of the market in history. In both Europes, the scope of integrated markets moved from a regional to a pan-European, even global, level over the eighteenth and nineteenth centuries.

This central finding on common levels and trends thus reject many popular positions in the literature. First, it rejects the 'Big Bang' hypothesis, arguably the dominating position in the market integration literature that contends a period of stagnation in the eighteenth century (or the entire early modern period), followed by a sudden expansion of the market at the turn of, or very early in, the nineteenth century.[43] Here we find that there was no 'Big Bang" in terms of integration, neither in the very late eighteenth nor in the early nineteenth century. However, the present results of a much more gradual expansion of markets also contradict claims that the eighteenth century saw 'the beginning of an all-European grain market', which sound overly optimistic.[44]

However, these new results find support in numerous studies focussing on regional or interregional markets structures. These works find that in eighteenth-century Europe, regional markets were well integrated and in many cases expanding.[45] All of this confirms the

[43] E.g. Clark, 'Markets and Economic Growth. The Grain Market of Medieval England'; O'Rourke and Williamson, 'When did globalisation begin?'
[44] Persson*, Grain Markets in Europe, 1500-1900*, p. 100. Braudel and Spooner's detected price convergence between very distant markets also appear rather on the optimistic side. Braudel and Spooner, 'Prices in Europe from 1450 to 1750', Figure 19.
[45] Grain was brought from the countryside to nearby towns. Many towns furthermore served depot functions, from where grain was, according to incentives, transported to and sold in other cities. See, for instance, Göttmann, *Getreidemarkt am Bodensee*; Giger-Eschke, *Kornmarktpolitik Zürichs im 18. Jahrhundert*; Brandenberger, *Ausbruch*

suspicion mentioned at the outset: The current consensus is indeed grossly misleading, as ‘European integration’ is not equal to ‘integration in Europe’.

Despite the common trajectories, the other major findings of this paper paint a picture of *fundamental differences* between landlocked and lowland Europe. In the early modern period, lowland Europe’s markets clearly extended to much bigger geographical areas: co-movement was stronger and shows close integration over longer distances than in landlocked Europe. Accordingly, price dispersion is much greater in the interior, as are volatility levels. The eighteenth century then brought about the beginning of the end of lowland Europe’s advantage, as market areas expanded substantially in the landlocked part, but only modestly in the lowland parts. On a regional and interregional scale, both increasing correlation coefficients and converging prices supported this picture of convergence. The general level of integration was still higher in lowland Europe by the turn of the nineteenth century, but the difference had been much reduced. The second quarter of the nineteenth century saw, however, a renewed divergence between the two regions, as in lowland parts integration in this period clearly broke out of the pre-modern ties, so that even very distant market were now connected, while prices between them converged. Landlocked Europe had to await the construction of a dense railway network in the second half of the century to experience the same acceleration of integration, which eventually resulted in the formation of a pan-European market.

Overall, the eighteenth and nineteenth centuries saw a convergence in terms of market integration between the two Europes. Starting from a very different state in the late seventeenth or early eighteenth century, the level of integration was nearly identical by the turn

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der ‚Malthusianischen Falle’. Versorgungslage und Wirtschaftsentwicklung im Staate Bern 1755-1797; O’Grada and Chevet, ‘Famine and Market in Ancien Régime France’.

of the twentieth century. Clearly, steam transportation and the creation of extensive road networks disposed of lowland Europe's advantage provided by a physical geography that had endowed it with easier and cheaper transportation. Thus this study adds physical geography to the list of determinants for market integration, and suggests that geography shaped the patterns and extent of economic integration probably more than any other factor.[46]

By now, the question about what explains the presence of two distinct price patterns in early modern Europe has also become much clearer. Three basic options seemed possible, the first being common weather patterns within landlocked and lowland Europe. Even though the climate argument cannot be completely rejected, it seems very implausible that it was a major cause for the distinct price patterns, as by the nineteenth century the price pattern across the whole of Europe are nearly uniform. A second hypothesis assumed that there were two Europes simply because they both formed some sort of trading areas, which were integrated within but did not trade across much. Such an explanation does have some merit, as especially popular trading routes such as the Baltic trade highlight. However, the main cause for trading within rather than across was not being part of one particular trading area, but rather distance. As highlighted by the analyses, distance was crucial in early modern Europe, so that landlocked cities traded with landlocked cities just because they were closer than lowland cities. The third explanation for the two market zones also relates to market integration, but this time to an absolute extent of integration in the two zones. And this

[46] This goes against a very recent study by David Jacks, in which physical geography was found not to have played an important role in the process of European integration, and, hence, development. The reason why Jacks does not find any important role for geography is most likely because his data only start at various points in the nineteenth century. As the present contribution makes clear, the importance of geography had by then already been much reduced. Jacks, 'Commodity Market Integration in the Long-Run'.

clearly emerges as the most powerful explanation, given our findings. As said before, food prices in integrated markets behave differently than prices in less integrated ones. Since the level of integration was considerably higher in the lowland part, its price pattern was more typical of an integrated market than the predominant pattern in the markets of the interior.

Finally, we want to return briefly to the bigger debate, which motivated this piece of research. Does the concept of Smithian or trade-led growth help to explain why it was Europe that led the economic development in the world and industrialised first? Does it give us a clue about why, within Europe, it was its North-western part that spearheaded the 'rise of Europe"?

Let us start with the first question: 'why Europe'? We mentioned that so far, the assessments about the role of market integration for Europe's industrialisation range from negligible to central, and that the plausibility of whether trade-led growth played a crucial role for the Industrial Revolution in Europe hinges on whether Europe experienced a process of market integration prior to, or at least accompanying, its economic 'take off' in the late eighteenth century. Well, this study concludes that market integration pre-dated the take-off in the late eighteenth or early nineteenth century, so it was neither a concomitant nor an effect of the Industrial Revolution.[47] It is thus a plausible determinant for the rise of Europe. This neither means that we should view market integration as a sufficient condition for the Industrial Revolution nor that these findings ought to supplant existing explanations of the Industrial Revolution. It simply puts market expansion on the table as one very plausible factor among other factors to explain the rise of Europe.

[47] The comparison of China and Europe concludes for instance that market integration was a concomitant of the take-off, not a cause of it. Shuie and Keller, 'Markets in China and Europe'.

Now to the second question: ‘why, within Europe, it was its North-western part that spearheaded the rise of Europe’? The conclusion from this investigation is: ‘Because of physical geography, which had endowed north-western Europe – more broadly called lowland Europe here – with easier and cheaper transportation.’

Hopefully, we have by now established that link between geography and economic integration. But how would the story about the subsequent link from bigger markets to economic growth look like? The speculative logic for such an argument could run as follows: Since lowland Europe had larger markets, it enjoyed more widespread and faster exchanges of goods and knowledge. This increased regional specialisation, and led to faster diffusion of knowledge and more spill-over effects, and hence resulted in a more productive economy, whose economic development must have outstripped that in landlocked Europe. Moreover, in accordance with newer research, the increased importance of trade and of profits thereof strengthened commercial interests and increased their political power while it had a constraining effect on the power of monarchs. This shift of power away from the monarchy induced significant institutional reforms in favour of institutions that were conducive to growth, as they guaranteed private property and personal freedom, the rule of law and the prevention of excessive spending by the crown. With their newly gained property rights, these merchants in lowland Europe invested more, traded more and spurred on economic growth.

The informed reader will be aware that the argument just outlined combined a Smithian-type and an institutional argument along the lines of North and Thomas and, more recently, Daron Acemoglu and his co-authors.[48] Compared with these popular accounts, the argument is

[48] Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations*, in particular book 1; North and Thomas, *The Rise of the Western World: A New Economic*

redirected here. In Acemoglu's account, the decisive geographic determinant for early economic development is access to the Atlantic, while the trade that arguably induced institutional change was the overseas trade with the colonies. Here, a similar argument can be made, in which the geographical determinant is not access to the Atlantic, but being part of lowland Europe more generally. And instead of colonial trade, it is the higher levels in intra-European trade that triggered institutional change and economic change. Given that maritime and coastal trade was in all probability only a relatively small share of both total world trade and total European trade, this seems quite reasonable. Thus, the big trade story ought not to be the centred on the Atlantic trade, but should instead focus on the intra-European trade on local, regional and interregional levels.

While the underlying logic in the two arguments is different, the predictions in both narratives would be very similar, namely that north-western Europe should, ultimately for geographical reasons leading to more trade, enjoy higher economic growth than other regions. While England and the Netherlands can quickly be named to supply empirical evidence for both narratives, a serious empirical study is more complicated in the present narrative. While estimates for production and growth are already crude at national levels, there are no estimates available for the categorisation proposed here. To compare production and growth rates in landlocked and lowland Europe would require entirely new research. However, as the present investigation suggests, it might be a promising area for new research.

History; Acemoglu et al., 'The Rise of Europe: Atlantic Trade, Institutional Change and Economic Growth'.

Appendix:

Sources Of Grain Prices

The list below shows all the sources used for the analysis, grouped into the two sub-samples 'lowland' and 'landlocked' Europe. The cities, which are included in the sample, are shown in alphabetically order. This database of European grain prices includes price series from 45 markets across Europe. The prices series represent annual average prices for wheat, if not mentioned otherwise. The conversions used to standardise the original prices are shown for the individual series. If not noted otherwise, conversions used to turn capacity into weight measures are 76kg/hl for wheat and 72kg/hl for spelt. See Göttmann, *Getreidemarkt am Bodensee*, p. 486. For the often used conversion of Pound Sterling into grams of silver, the following sources were used: For 1600-1816: Feavearyear, *The Pound Sterling: A History of English Money*, pp. 346, 348-9. For 1817-1829: International Monetary Conference, *United States Senate Executive Document No. 58*, pp. 611-613. The values for 1830-1832 are interpolated. For 1833-1900: United States, *Statistical Abstract of the United States*, p. 65. The conversions are available at http://www.nuff.ox.ac.uk/users/allen/studer/london.xls.

Lowland Europe

Amsterdam, 1700-1910

Source: Posthumus, *Inquiry into the History*, vol. 1. Prices in grams of silver per litre are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm

This series has some whole, which were filled with regression analysis using rye prices from Groningen from W. Tijms, 'Graanprizen', available at http://odur.let.rug.nl/~nahi

Antwerp, 1772-1913

Sources: Van der Wee, H., *The Growth of the Antwerp Market*; Verlinden, C. and J. Craeybeckx, *Documents pour l'histoire des prix*. Original prices in groats/viertel and in francs/hl or per 100kg. Calendar years. Prices in grams of silver per kg are available from http://www.nuff.ox.ac.uk/users/allen/studer/antwerp.xls

Berlin, 1624-1914

Source: *Vierteljahreshefte zur Statistik des Deutschen Reichs*, 44 (1935), pp. 319-321. Reichsmark/1000kg. Average market prices for calendar years, based on monthly average prices. The mark was on a gold standard, 2790 Mark equalled 1 kilogram of gold. Silver prices were obtained using the gold-silver price ratio given at http://www.measuringworth.com/gold/

Bilboa, 1700-1826

Source: House of Commons Parliamentary Papers 1826-27, Vol. XVI, pp. 207. Prices in grams of silver per litre are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm

Bordeaux, 1700-1825

Source for 1700-1824: House of Commons Parliamentary Papers 1826-27, Vol. XVI, pp. 72-73. Source for 1825-1913: Drame et al; *Un Siecle se Commerce du Ble en France*, available at http://www.sfu.ca/~djacks/data/prices/France/prices.html.

Boulogne-sur-Mer, 1700-1825

Source: House of Commons Parliamentary Papers 1826-27, Vol. XVI, pp. 72-73.

Bremen, 1770-1825

Source: House of Commons Parliamentary Papers 1826-27, Vol. XVI, pp. 149-150.

Cologne, 1816-1913

Source: *Vierteljahreshefte zur Statistik des Deutschen Reichs*, 44 (1935), pp. 296-299. Original prices in Reichsmark/1000kg. The mark was on a gold standard, 2790 Mark equalled 1 kilogram of gold. Silver prices were obtained using the gold-silver price ratio given at http://www.measuringworth.com/gold/.

Copenhagen, 1750-1800

Source: Friis and Glamann, 'A History of Prices and Wages in Denmark 1660-1800'. Prices in grams of silver per litre are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm.

Coruña, 1700-1826

Source: House of Commons Parliamentary Papers 1826-27, Vol. XVI, pp. 67-9. Prices in grams of silver per litre are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm

Dresden, 1750-1824

Source: House of Commons Parliamentary Papers 1826-27, Vol. XVI, pp. 444. Prices in grams of silver per litre are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm

Eton, 1600-1816

Source: Mitchell, 'Abstract of British Historical Statistics', pp. 484-487. Prices in grams of silver per litre are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm.

Exeter, 1620-1900

Source for 1620-1799: Mitchell, 'Abstract of British Historical Statistics', pp. 484-487. Prices in grams of silver per litre are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm.

Source for 1800-1900: Jacks, 'What drove the nineteenth century commodity market integration'; monthly data available from

http://www.sfu.ca/~djacks/data/publications/publications.html. Annual prices calculated as simple average of monthly prices.

Gdansk, 1703-1815

Source: Furtak, F., Ceny w Gdansk w Latach, 1701-1815 (Lwow, 1935). Prices in grams of silver per litre are available at http://www.nuff.ox.ac.uk/users/allen/studer/gdansk.xls.

Hamburg, 1736-1913

Source for 1736-1825: *House of Commons Parliamentary Papers 1826-27*, Vol. XVI, pp. 148-149. Source for 1826-1913: *Vierteljahreshefte zur Statistik des Deutschen Reichs*, 44 (1935), pp. 296-299. Original prices in Reichsmark/1000kg. The mark was on a gold standard, 2790 Mark equalled 1 kilogram of gold. Silver prices were obtained using the gold-silver price ratio given at http://www.measuringworth.com/gold/

Königsberg, 1700-1913

Source for 1700-1825: *House of Commons Parliamentary Papers 1826-27*, Vol. XVI, pp. 146-147. Source for 1826-1913: *Vierteljahreshefte zur Statistik des Deutschen Reichs*, 44 (1935), pp. 296-299. Original prices in Reichsmark/1000kg. The mark was on a gold standard, 2790 Mark equalled 1 kilogram of gold. Silver prices were obtained using the gold-silver price ratio given at http://www.measuringworth.com/gold/

Lisbon, 1750-1855

Source: Coruche, *A questao Monetaria*. Reis/hl, calendar years. Available from David Jacks at http://www.sfu.ca/~djacks/data/prices/Iberia/Lisbon,%20Wheat,%201728-1893,%20annual.xls

Litre/kg conversion as noted above. For the currency conversion: Grams Ag/Reis available at http://gpih.ucdavis.edu/files/Portugal_1750-1855.xls

London, 1800-1900

Source: Jacks, 'What drove the nineteenth century commodity market integration'; monthly data available from

http://www.sfu.ca/~djacks/data/publications/publications.html. Annual prices calculated as simple average of monthly prices.

Paris, 1600-1914

Source: Hauser, *Recherches et Documents*, pp. 173-77. Prices in grams of silver per kg are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm

Rennes, 1740-1786

Source: Henri, 'Recherches et documents sur l'histoire des prix en France', pp. 291-4. Prices in grams of silver per litre are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm

Rotterdam, 1769-1925

Source: House of Commons Parliamentary Papers 1826-27, Vol. XVI, pp. 170. Prices in grams of silver per litre are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm

Toulouse, 1600-1913

Source for 1600-1792: Frêche, *Les prix des grains*, pp. 85-91. Centimes/hl., monthly prices. Annual average prices in grams Ag/litre are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm. Litre/kg conversion for wheat as noted above.

Source for 1806-1913: Drame, Silvie, et al., *Un siècle de commerce*. Centimes/hl., biweekly market prices. I calculated average annual prices for calendar years from the monthly prices of this dataset provided by David Jacks in Dollars/100kg at http://www.sfu.ca/~djacks/data/prices/France/prices.html. The silver contents of the dollar are also his.

Utrecht, 1668-1772

Source: Sillem, 'Tabellen van Marktprijzen van Utrecht'. Prices in grams of silver per litre are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm

Windsor, 1700-1801

Source: Ashton 'Economic Fluctuation in England 1700-1800', pp. 181-82. Prices in grams of silver per litre are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm

Winchester, 1620-1816

Source: Mitchell, 'Abstract of British Historical Statistics', pp. 484-487. Prices in grams of silver per litre are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm

Landlocked Europe

Appenzell, 1756-1810

Spelt prices. Source: Göttmann, *Getreidemarkt am Bodensee*. pp. 480-84. Gulden/hl, average market prices for calendar years. Litre/kg conversion as noted above (using wheat). Silver content of the gulden from W. Tijms at http://odur.let.rug.nl/~nahi

Augsburg, 1745-1820

Source: Elsas, *Umriss einer Geschichte der Preise und Lohne in Deutschland*, Vol. I. Prices in grams of silver per litre are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm

Basle, 1751-1797

Rye prices. Source: Hanauer, *Etudes économiques*, vol. II, pp 82-6. Grams Ag per litre, calendar years. Conversion into grams Ag/kg using a conversion of 72kg/100litre proposed by Göttmann, *Getreidemarkt am Bodensee*. p. 486.

Bern, 1739-1914

Spelt prices. Source: Pfister, *BERNHIST*. Average market prices for calendar years based on monthly prices. New Swiss francs/100kg. Conversion to Grams Ag/kg: Körner, *Währungsbewertung*.

Frankfurt, 1733-1799

Source: Elsas, *Umriss einer Geschichte der Preise und Lohne in Deutschland*, Vol. I. Prices in grams of silver per litre are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm

Geneva, 1820-1900

Source: Brugger, *Statistisches Handbuch*, pp. 320-1, 326-332. Swiss franc/100kg, average prices for calendar years, based on weekly market prices. Conversion to Grams Ag/kg: Körner, *Währungsbewertung*.

Grenoble, 1600-1780

Source: Hauser, *Recherches et Documents*, pp. 365-369. Prices in grams of silver per kg are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm

Krakow, 1749-1914

Sources: Tomaszewski, *Ceny w Krakowie;* Gorkiewicz, *Ceny w Krakowie*. Grams Ag/litre, calendar years. Available at http://www.nuff.ox.ac.uk/users/allen/studer/krakow.xls. Conversion into grams Ag/kg using a conversion (for wheat) of 76kg/100litre proposed by Brugger, *Statistisches Handbuch*, pp. 306.

Lausanne, 1674-1902

Source for 1674-1719: Radeff, 'Le prix des céréales à Lausanne de 1550 à 1720', pp. 15-19. Florin Lausannois/quarteron, average institutional prices for harvest years. 1 quarteron = 13.7 l. Litre/kg conversion for wheat as noted above. Source for 1700-1802: Chevallaz, *Aspects de l'agriculture*, pp. 140-3. Batzen/quarteron. Average market prices for calendar years. Source for 1803-1902: Brugger, *Statistisches Handbuch*,

pp. 320-1, 326-332. Swiss franc/100kg, average market prices for calendar years, based on weekly market prices.
For the currency conversion to Grams Ag/kg: Körner, *Währungsbewertung*, and Körner et al., *Währungen und Sortenkurse*.

Lucerne, 1601-1900

Spelt prices. Source: Haas-Zumbühl, 'Die Kernenpreise', pp. 370-372. Swiss francs/100kg, calendar years. Based on different sources, most recording average market prices and some recording average institutional prices. For the currency conversion to Grams Ag/kg: Körner, *Währungsbewertung.*

Lwow, 1800-1914

Source: Hoszowski*, Ceny we Lwowie w Latach 1701-1914*. Prices in grams of silver per kg are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm

Madrid, 1600-1774

Source for 1600-1650: Hamilton, American Treasure and the Price Revolution in Spain, 1501-1650.
Source for 1650-1774: Hamilton, *War and Prices in Spain, 1650-1800*. Prices in grams of silver per kg are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm

Munich, 1650-1913

Source for 1700-1800: Seuffert, *Statistik*, p. 123. Kreuzer/Schäffel. Average market prices for calendar years, based on average monthly prices. 1 Schäffel = 362 l; Litre/kg conversion for wheat as noted above. 1 gulden = 60 kreuzer = 240 pfenning. The silver content of the pfennig is from David Jacks at http://www.sfu.ca/~djacks/data/prices/Metals/Silver%20content%20of%20currencies,%201258-1979,%20annual.xls Source for 1800-1914: Jacobs and Richter, 'Die Grosshandelspreise'. Reichsmark/1000kg. Average

wholesale prices for calendar years. For the currency conversions see Berlin.

Schaffhausen, 1700-1880

Spelt prices. Source for 1700-1800: Göttmann, *Getreidemarkt am Bodensee*. pp. 480-84. Gulden/hl, average market prices for calendar years. Litre/kg conversion as noted above (using wheat). Silver content of the gulden from W. Tijms at http://odur.let.rug.nl/~nahi Source for 1800-1880: Brugger, *Statistisches Handbuch*, pp. 349-50. Swiss francs/100kg. Calendar years, but no average price; prices based on 'Martinischlag'. For currency conversions see Lucerne.

St Gall, 1814-1904

Source: Brugger, *Statistisches Handbuch*, pp. 313-14. Swiss francs/100kg. Calendar years. For currency conversions see Lucerne.

Strasbourg, 1600-1875

Source: Hanauer, Etudes économiques sur l'Alsace, vol 2 pp. 91-101. Prices in grams of silver per litre are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm

Überlingen, 1719-1907

Source for 1719-1810: Göttmann, *Getreidemarkt am Bodensee*. pp. 480-84. Spelt prices. Gulden/hl, average market prices for harvest years. Litre/kg conversion for spelt as noted above. Silver content of the gulden from W. Tijms at http://odur.let.rug.nl/~nahi Source for 1820-1902: Vögele, *Getreidemärkte am Bodensee*, Anhang 2, pp. 233-4. Rye prices. Mark/Doppelzentner, average market prices for calendar years. For currency conversions, see Berlin.

Vienna, 1700-1913

Source: Pribram, vol. 1, pp. 371-373. Kreuzer/Metzen, annual average market prices for calendar years, based mostly on weekly prices ('Markttage'). Prices in grams Ag/litre available at

http://www.nuff.ox.ac.uk/users/allen/studer/krakow.xls. Litre/kg conversion for wheat as noted above.

Würzburg, 1752-1799

Source: Elsas, *Umriss einer Geschichte der Preise und Lohne in Deutschland*, Vol. I. Prices in grams of silver per litre are available from the Allen-Unger database at http://www.history.ubc.ca/unger/htm_files/new_grain.htm

Warsaw, 1800-1913

Source: Siegel, *Ceny w Warsawie w Latach 1816-1914*. Prices in grams Ag/litre available at http://www.nuff.ox.ac.uk/users/allen/studer/warsaw.xls. Litre/kg conversion for wheat as noted above.

Zurich, 1600-1877

Spelt prices. Source: Müller, Joh. Heinrich Waser, pp. 50, 52. Francs/100kg. For the currency conversions see Lucerne.

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