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Taxes, subsidies and gender gaps in hours and wages

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Abstract

Using microdata from 17 OECD countries, this paper documents a negative cross-country correlation between gender gaps in market hours and wages. We find that the cross-country differences in market hours are mostly accounted for by female market hours and the size of the sector that produces close substitutes to home production. We quantify the role played by taxes and family care subsidies on the two gender gaps in a multi-sector model with home production. Higher taxes and lower subsidies reduce the marketization of home production, leading to lower market hours. The effect is largely on women because both home production and the production of its market substitutes are female-intensive. The larger fall in female market hours reduces relative female labour supply, contributing to a higher female to male wage ratio.

1 | INTRODUCTION

Gender gaps in average market hours per adult and in wages vary widely across OECD countries. Using household surveys from 17 OECD countries, we show in Figure 1 that the ratio of market hours per female relative to hours per male in the USA is higher than in most European countries, especially among non-college graduates (hereafter referred to as low-skilled). In contrast, the gender ratio in wages (female to male) is larger in European countries, and the larger hour ratios are often associated with smaller wage ratios. More importantly, we find that the cross-country differences in market hours are mostly accounted for by the differences in the market hours of women and the sizes of the service sectors that produce close substitutes to home production.

A recent publication by the International Labour Organization (Addati *et al.* 2018) reveals that home production is the main self-reported barrier for women to participate in the labour market because the hours devoted to home production by women are triple those of men. Home production can be outsourced by purchasing close substitutes from the corresponding market service sectors. This process of marketization converts home production hours into

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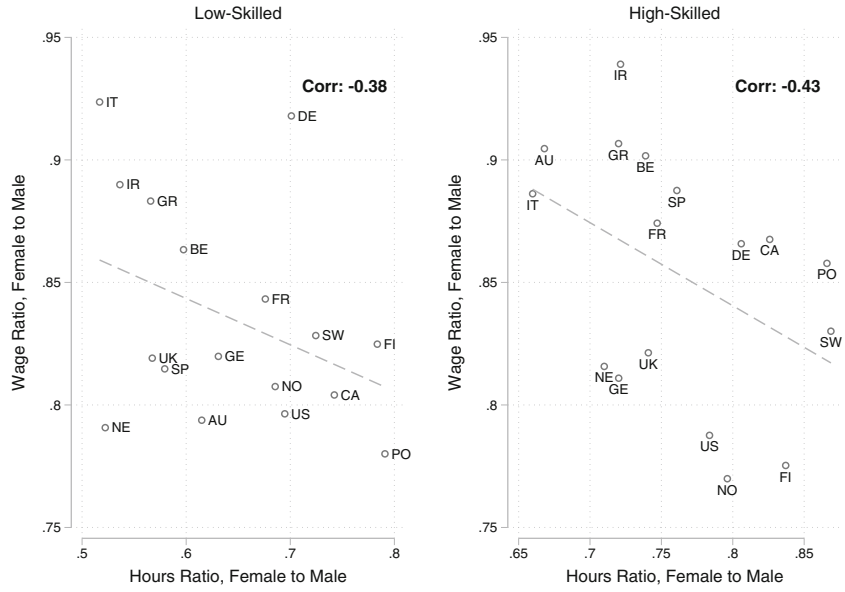

Figure 1 Gender gaps in market hours and wages. *Notes*: Hours are adjusted for demographic differences across countries and include zero hours for non-employed individuals. Hourly wage ratios are obtained from a Mincerian regression that controls for age and marital status. Low-skilled individuals are those without a college degree. Our sample is restricted to individuals between the ages 20 and 64. Data cover selected years between 2007 and 2015.

market hours. In this paper, we focus on the effects of social subsidies on family care and taxes on marketization of home production. The main contribution is to quantify the effects of taxes and subsidies on the cross-country differences in the gender gaps of hours and wages through marketization. Intuitively, higher taxes reduce the returns to market work and therefore reduce the incentive to marketize home production. In contrast, high subsidies lower the cost of marketizing home production and therefore increase market work. The marketization channel is especially relevant for women because home production and the market sectors that produce close substitutes to home-produced goods are both female-intensive.[1] Thus policies that reduce the cost of marketizing home production can be important in increasing female market hours.

Using the income and consumption taxes constructed by McDaniel (2020), and subsidies on family care from the OECD Social Expenditure Database, we document that taxes are negatively correlated with gender hour ratios (women relative to men) and positively correlated with the corresponding wage ratios for both high-skilled (college graduates) and low-skilled (non-college graduates) labour. In contrast, subsidies on family care display the opposite correlation with such gender ratios. These correlations operate mainly by affecting the marketization of home production, which primarily affects women.

Motivated by these stylized facts, we develop a multi-sector model to study the quantitative effects of taxes and social subsidies on gender gaps by skill group. The model consists of three market sectors, producing goods, non-substitutable services and substitutable services. Substitutable services and home services are good substitutes, while outputs from the three market sectors are gross complements in consumption. We model subsidies as a negative tax on the market consumption of substitutable services. There are four types of labour inputs: men and women with low or high skill. Labour can move freely across sectors, and production in each sector uses all four types of labour inputs. A representative household allocates time to market work, home production and leisure for each gender–skill group.

The model is calibrated to match wages and time allocations by gender–skill group in the US economy. The observed sector-specific gender intensity in labour inputs implies that the production functions of home services and substitutable market services place a higher weight on female labour input than other sectors.This implies that the extent of marketization has a larger impact on women than men. To examine the role of taxes and subsidies, we simulate the calibrated model with country-specific taxes and subsidies, and predict hours and wages by gender–skill group in Europe.

The quantitative results show that cross-country differences in taxes and social subsidies can indeed generate a negative correlation between gender ratios in hours and wages, as in the data. They also account well for the cross-country variations in the two gender ratios, as judged by the correlation coefficient and the coefficient of determination between model predictions and data. Overall, the predictions obtained from country-specific taxes and subsidies are 69% and 93% of the observed average differences in the gender hour ratios between western and southern Europe and the USA for the low-skilled and high-skilled, respectively. Further analysis of the separate effects of each policy shows that our results are driven mainly by the cross-country differences in taxes, and income taxes have a larger effect than consumption taxes. Subsidies play an important role in raising gender hour ratios in Nordic countries despite their higher taxes, but the quantitative effects are relatively small relative to taxes.

The marketization channel and the higher intensity of female labour in producing home services and their market substitutes are important in generating the results of the model. In particular, as taxes increase, households reduce the marketization of home production, and market hours decline as a result. The reduction in market hours is especially large in the substitutable services sector because it produces close substitutes to home services. Because female labour is used more intensively in producing home and substitutable services, the reduction in marketization of home hours is larger for women than for men. Given the limited substitutability between male and female labour, the fall in the relative labour supply of women drives up the relative female wage, resulting in higher gender wage ratios in countries with higher taxes. In contrast, social subsidies increase the incentive to marketize home services, leading to the opposite effect.

The model matches well the negative correlation between gender ratios in hours and wages presented in Figure 1, but it does not generate enough variation in the gender wage ratio. The predictions obtained from country-specific taxes and subsidies are 11% and 5% of the observed average differences between European countries and the USA for the low-skilled and high-skilled individuals, respectively. To explore further the factors that may affect gender wage ratios, we calibrate the parameters of the model to match the gender wage ratios and time allocations of each country by allowing for country-specific preferences and productivity. This exercise shows that the parameters that govern the gender intensity of the labour inputs have the largest quantitative effect on the gender wage ratio. The cross-country variation in these gender-specific parameters might not only be related to the cross-country differences in the productivity of women relative to men, but can also be related to factors affecting the preferences for female labour in market production, such as social norms or discrimination against women working in the market. Indeed, we find this parameter to be highly correlated with the fraction of respondents in the World Value Survey who agree that 'When jobs are scarce, men have more right to a job than women'. This is consistent with the view that country-specific gender norms are important for cross-country differences in gender wage gaps.

The negative correlation between gender gaps in hours and wages documented in this paper is related to the work of Olivetti and Petrongolo (2008), who find a negative cross-country correlation between the gender gaps in employment and wages. Using a reduced-form analysis, they show that selection into employment explains half of the negative correlation between the gender gaps in wages and employment. In contrast, we use a structural model to study the general equilibrium effects of taxes and subsidies on the cross-country differences of gender gaps in working

hours and wages. We find that the effects of taxes and subsidies through marketization of home production are important in accounting for the cross-country differences in the gaps.[2]

Olivetti and Petrongolo (2016) and Blau and Kahn (2017) provide comprehensive surveys of the literature on the two gender gaps over time and across countries. In addition to taxes and subsidies, other factors, such as discrimination, social norms and wage structure, may also contribute to cross-country differences in gender gaps. Among the proposed factors, our model mechanism is related to Olivetti and Petrongolo (2014), which studies the effects of international differences in the size of service industries on gender outcomes. In contrast, we study the effect of taxes and subsidies, and in our paper, one channel through which they affect gender outcomes is by affecting the size of the substitutable services sector.

Our focus on the role of social subsidies is related to the studies on child-related transfers. Cattan (2016) shows that an increase in the provision of government-subsidized preschool encourages women to work, and the impacts are concentrated among low-income women. Guner *et al.* (2020) show that increasing childcare subsidies in the USA has substantial positive effects on female labour supply, especially for low-skilled women. Hannusch (2022), on the other hand, finds that child-related transfers are important for explaining the labour market participation differences due to the presence of children among married women.

There is a large literature analysing the relation between taxes, subsidies and cross-country differences in market hours, beginning with Prescott (2004) and Ohanian *et al.* (2008). Recent cross-country studies on taxes and market hours focus on the structure of the tax system, taking into account the role of gender and marital status; see, for instance, Chakraborty *et al.* (2015) and Bick and Fuchs-Schündeln (2018). These studies abstract from home production and focus on the substitution margin between work and leisure. Using harmonized cross-country time-use data, Freeman and Schettkat (2005) and Burda *et al.* (2013) document the importance of marketization of home production in understanding market hours across countries. With a quantitative model, we further show that taxes and subsidies are important factors in determining the extent of marketization. In this sense, our work is related to Rogerson (2008), Olovsson (2009), McDaniel (2011) and Duernecker and Herrendorf (2018) in showing that home production is important in propagating the effect of cross-country differences in taxes.[3] Using a similar framework, Ngai and Pissarides (2011) and Ragan (2013) show that in addition to differences in taxes, social subsidies on family care also play an important role in accounting for cross-country differences in aggregate market hours. However, none of these papers focuses on the effect of taxes and subsidies on the gender gaps in both market hours and wages. Our contribution to this literature is to show that the effects of taxes and subsidies through the marketization channel are also quantitatively important for these two gender gaps.

Finally, the marketization channel is also emphasized by Ngai and Petrongolo (2017), who argue that the expansion of service sectors in the process of structural transformation generates higher demand for female labour and thus reduces gender differences in market hours and wages over time in the USA. In contrast, we show that higher taxes lead to a lower supply of female labour and thus raise female wages relative to male wages, leading to a negative cross-country correlation between gender gaps in market hours and wages.

The rest of the paper is organized as follows. Section II presents the data and the cross-country facts that motivate the paper. Section III presents the model. Section IV calibrates the model and presents the quantitative results of the model. Section V concludes.

2 | DATA AND CROSS-COUNTRY FACTS

Our data cover almost all of the EU-15 region, plus Norway, Canada and the USA over the period 2007–15.[4] This section describes briefly the data used in the analysis and presents a set of

key stylized facts about time allocation and wages by gender and skill. High-skilled workers are those with college degrees, and low-skilled workers are those without such degrees.[5]

2.1 | Data

2.1.1 | Market hours

Market hours are constructed using various Labour Force Surveys for European countries, the Current Population Survey for the USA, and the 2011 Population Census for Canada. The sample includes individuals between the ages of 20 and 64. The annual average hours worked per person are derived as the total annual hours divided by the number of individuals within the specified age range. Following procedures outlined by Bick *et al.* (2019), we construct consistent measures of annual market hours per person across countries.

It is well-known that market hours differ across demographic groups. Thus cross-country differences in demographic composition may lead to differences in aggregate market hours and in hours by gender–skill group. To isolate the effect of taxes and subsidies, we construct market hours controlling for cross-country differences in demographic composition. Specifically, we partition each country's population according to skill, gender, age and marital status, and calculate the average working hours for each group in this partition. The cell-specific averages are then aggregated into hours per person for each gender–skill group in each country using the US population shares. Furthermore, the US population shares are adjusted so that age and marital composition are constant across gender–skill cells. Therefore the estimates also control for differences in marriage rates across education groups and across countries.[6]

To highlight the importance of the marketization of home production in accounting for gender gaps, we divide the market production into three sectors and estimate market hours for each of the sectors: goods, non-substitutable services and substitutable services.[7] Broadly speaking, a service industry is classified as 'substitutable' if its product can be replaced by activities performed at home.[8]

2.1.2 | Time allocation across market, home and leisure

The data for time allocation come from the American Time Use Survey (ATUS), the Harmonised European Time Use Survey (HETUS), and the Multinational Time Use Study (MTUS). For the years that we study, publicly available micro-level data from time-use surveys are available for only twelve of the sample countries.[9] The construction of market and home hours follows closely Bick *et al.* (2019), with the key exception that we consistently include childcare in home hours. Leisure is any time not allocated to work either in the market or at home. These estimates are also adjusted for demographic composition differences following the procedure outlined earlier.

2.1.3 | Wages

We construct the pre-tax hourly wage rates using various sources, including the European Union Statistics on Income and Living Conditions (EU-SILC) for most countries, Labour Force Surveys for France and the UK, the Socio-Economic Panel (SOEP) for Germany, the 2011 population Census for Canada, and the March Current Population Survey (CPS) for the USA. Gender wage ratios for low-skilled and high-skilled labour are estimated after controlling for age and marital status through a standard Mincerian regression for employed workers.

2.1.4 | Taxes and social subsidies

We abstract from the complexity of the tax structure and use average labour income and consumption taxes as constructed by McDaniel (2020). Labour income taxes include Federal and State income taxes, as well as Social Security taxes.

Social subsidies on family care are applicable only to the substitutable services sector. We include public non-cash benefits (a.k.a. 'in-kind' expenditures) on old-age, incapacity and family care services. The main care items covered under these categories include residential care, home help services, rehabilitation, day care and early childhood education. The expenditure data from the OECD Social Expenditure Database (SOCX) include direct expenses on the provision of these services, as well as subsidies for the purchase of such services in the market. Following Ngai and Pissarides (2011), the subsidy rate is computed by expressing total expenditures on these services as a fraction of the sectoral output of the substitutable services sector.

The country-specific tax and subsidy rates are reported in Table A4 of the Appendix.[10] The tax rates and subsidy rates are much larger in Europe than in the USA. Among all countries, Nordic countries have the highest subsidy rates.

2.2 | Key stylized facts

In this subsection, we first discuss the cross-country differences of gender ratios in hours and wages. To better understand the gender ratio in hours, we also study market hours by gender and skill. We next explore the correlations between the two gender ratios by skill and our policy variables: taxes and subsidies to family care. Because of the differences in the substitutability between different types of market goods and home-produced goods, the marketization of home production has asymmetric effects across the market sectors. To explore these effects, we also investigate the cross-country differences in sectoral hours.

2.2.1 | Gender ratios

Figure 2(a) plots the gender ratio in market hours (female relative to male) by country relative to the values observed in the USA. In most countries, the ratio is smaller than in the USA, especially among the low-skilled. The exceptions are Nordic countries, together with Canada and Portugal.[11]

Figure 2(b) plots the corresponding difference in the gender wage ratio from the USA. Almost all countries have higher gender wage ratios than the USA, for both skill levels. In general, countries with smaller gender hour ratios also have larger gender wage ratios. This leads to a negative cross-country correlation between the two ratios (−0.38 for low-skilled, −0.43 for high-skilled), as documented in Figure 1.

2.2.2 | Market hours

We now turn to market hours by gender, skill and sector. Figure 3 presents the percentage difference in annual hours worked per person relative to the USA for each of the four population groups. Market hours of virtually every gender–skill group are lower in Europe than in the USA. In most western and southern European countries, the largest proportional differences occur for low-skilled women, and the differences are larger for women than for men with the same skill level. Columns (3)–(6) of Table 1 report the contribution of each demographic group to the difference in aggregate market hours with respect to the USA. In most western and southern European

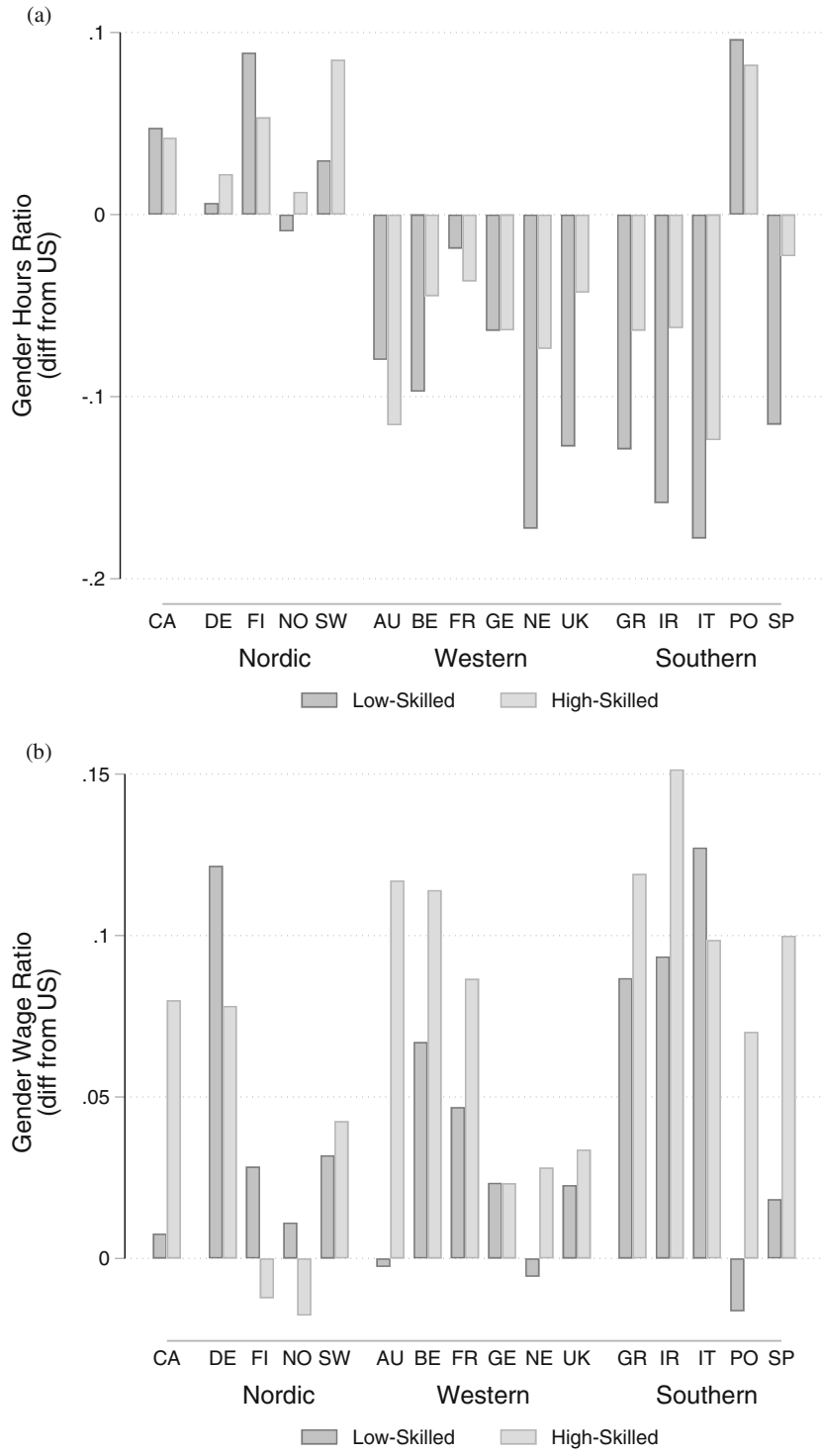

Figure 2 Gender ratios in market hours and wages relative to the USA. *Notes*: Gender hour and wage ratios are adjusted for age and marital status. Low-skilled individuals are those without a college degree. Data cover selected years between 2007 and 2015.

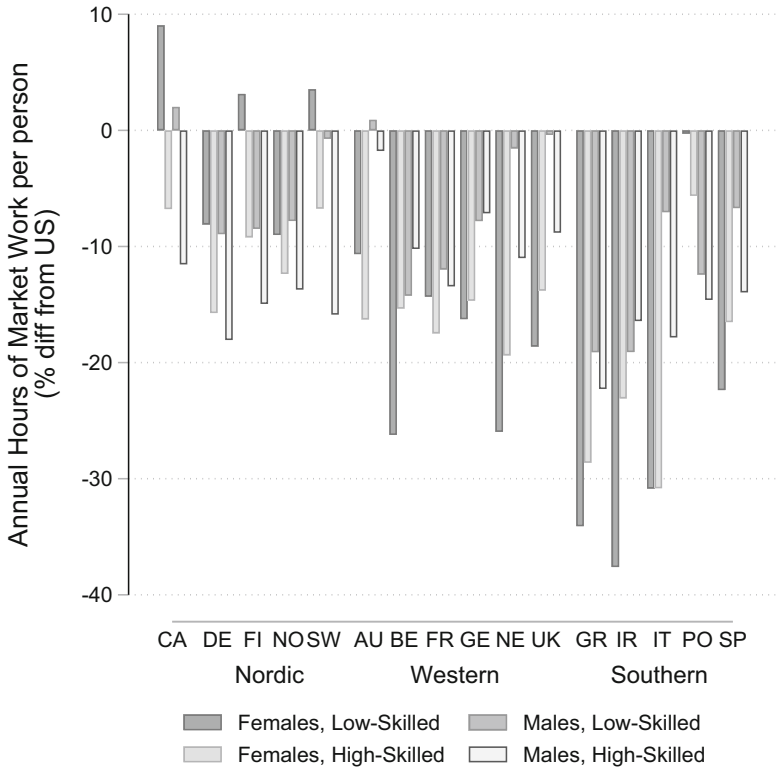

Figure 3 Hours worked in the market by population group relative to the USA. *Notes*: Hours are adjusted for demographic differences across countries. Low-skilled individuals are those without a college degree. Data cover selected years between 2007 and 2015.

countries, more than 60% of the difference in market hours is accounted for by the hours of women. In contrast, in Nordic countries, Canada and Portugal, women account for less than half of the difference with respect to the USA, and in some countries (such as Canada, Finland and Sweden), low-skilled women work more hours than their US counterparts. These results imply that in western and southern European countries, most of the differences in gender hour ratios come from differences in female hours, while in Nordic countries, most of the differences arise from differences in male hours.

Turning now to the sectoral dimension, Figure 4 displays the proportional differences in sectoral hours relative to the USA. In general, hours are lower in Europe (relative to the USA) at the sectoral level. This is particularly true in the substitutable services sector, where the largest differences in hours are observed. Columns (7)–(9) of Table 1 report the contribution of each sector to the difference in aggregate market hours from the USA. The large positive numbers observed in column (7) indicate that the substitutable services sector accounts for most of the differences in aggregate market hours from the USA.

2.2.3 | Gender ratios, taxes and subsidies

In order to understand how the gender ratios relate to taxes and subsidies, we report in Table 2 the linear regressions of gender hour and wage ratios against the effective tax rate and the subsidy rate to family care. The effective tax rate, as in Prescott (2004), is given by

$$\frac{\text{consumption tax rate} + \text{labour income tax rate}}{1 + \text{consumption tax rate}}.$$

Table 1 Decomposition of Difference in Market Hours Relative to the USA

			Contribution of difference in annual hours relative to USA						
			Population group				Sector		
	Weekly Hours (1)	Fraction of USA (2)	Females low-skilled (3)	Females high-skilled (4)	Males low-skilled (5)	Males high-skilled (6)	Substitutable services (7)	Non-substitutable services (8)	Goods (9)
Canada	25.5	0.98	−1.26	1.25	−0.71	1.72	2.10	−2.70	1.61
Nordic									
Denmark	22.7	0.87	0.14	0.29	0.23	0.35	0.60	0.11	0.29
Finland	23.8	0.92	−0.19	0.42	0.23	0.55	0.96	0.46	−0.41
Norway	23.1	0.89	0.12	0.36	0.16	0.37	0.65	0.15	0.20
Sweden	24.7	0.95	−0.15	0.31	0.05	0.79	1.93	−1.75	0.82
Western									
Austria	24.3	0.94	0.19	0.81	−0.19	0.19	1.87	0.06	−0.93
Belgium	21.8	0.84	0.34	0.22	0.29	0.16	0.74	0.02	0.24
France	22.2	0.86	0.15	0.36	0.21	0.28	0.71	0.19	0.10
Germany	23.1	0.89	0.29	0.33	0.20	0.18	1.08	0.23	−0.31
Netherlands	22.6	0.87	0.42	0.34	0.04	0.21	0.70	−0.09	0.39
UK	23.6	0.91	0.45	0.30	0.04	0.21	0.82	−0.09	0.27
Southern									
Greece	19.4	0.75	0.28	0.26	0.24	0.22	0.46	0.30	0.24
Ireland	19.9	0.77	0.34	0.23	0.26	0.17	0.45	0.38	0.17
Italy	20.6	0.79	0.28	0.40	0.07	0.26	0.64	0.31	0.05
Portugal	23.6	0.91	0.01	0.14	0.44	0.41	1.00	0.00	0.00
Spain	22.2	0.86	0.26	0.36	0.09	0.29	0.68	0.55	−0.23

Notes
Weekly hours are the annual market hours per person divided by 52 (including zero hours for non-employed individuals). In the USA, the weekly hours are 26. All estimates hold constant the distribution of demographic characteristics to its US value and keep the age and marital distribution of the population fixed across gender and skill groups (see the Appendix for details). Columns (3)–(6) report the contribution (share) of each labour input to the difference in aggregate hours. Columns (7)–(9) report the contribution of each sector to this difference. Low-skilled individuals are those without a college degree. Data cover selected years between 2007 and 2015, and correspond to a population aged 20–64.

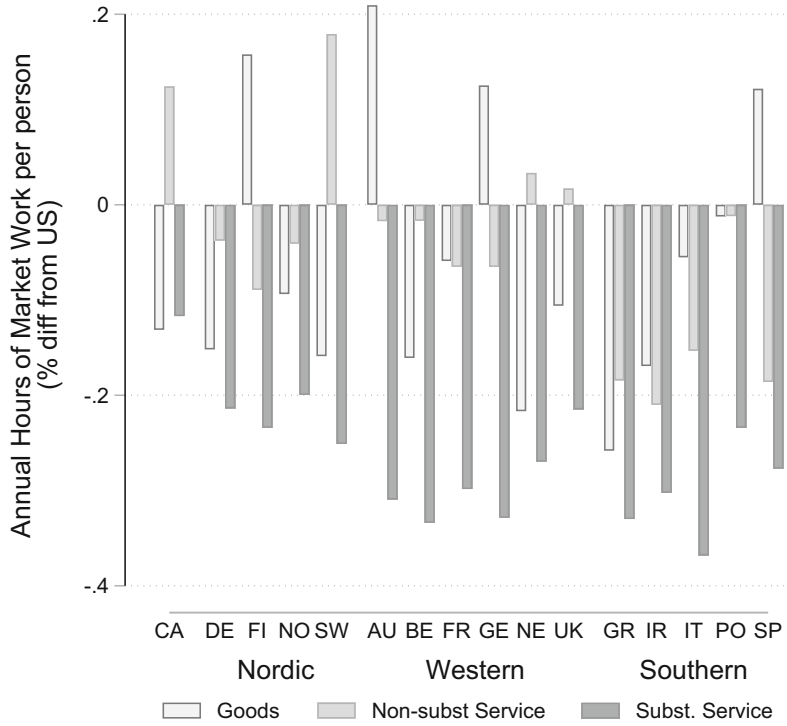

Figure 4 Hours worked by sector relative to the USA. *Notes*: Hours are adjusted for demographic differences across countries. Data cover selected years between 2007 and 2015.

The goal of the regressions is not to establish a causal relationship, but to illustrate the correlations of gender ratios with taxes and subsidies so as to motivate our quantitative analysis.

The regressions show a negative association between taxes and gender ratios in market hours, and a positive association between taxes and gender wage ratios for both skill groups. The opposite is found for subsidies. In our model, taxes and subsidies affect market hours of men and women differently through two substitution margins: across market work and home work, and across total work (market plus home) and leisure. We refer to the first margin as the marketization of home production. To examine the contribution of the two margins on the gender differences, we decompose the gender ratio in market hours into two components: a gender ratio in the fraction of market hours out of total work hours, and a gender ratio in total work hours:

$$\frac{\text{female market hours}}{\text{male market hours}} = \left(\frac{\text{female market hours}}{\text{female total work}} \Big/ \frac{\text{male market hours}}{\text{male total work}}\right) \frac{\text{female total work}}{\text{male total work}}. \quad (1)$$

The former (the term in the parentheses in equation (1)) measures the extent of marketization of female hours relative to male hours. The latter (the term outside the parentheses in equation (1)) measures the extent of the substitution between total work and leisure for women relative to men.

Regressing these two components on taxes and subsides can help us to understand the relative importance of the two substitution margins in affecting the gender hour ratios. Panels C and D in Table 2 report the regression results. In particular, panel C shows that the gender ratio in marketization is negatively associated with taxes and positively associated with subsidies. All the

Table 2 OLS Regressions of Gender Ratios against Taxes and Subsidies

	Low-skilled	High-skilled	Low-skilled	High-skilled
	Panel A: Market hours		*Panel B: Wages*	
Effective tax rate	−0.377	−0.463***	0.185	0.281*
	(0.149)	(0.007)	(0.236)	(0.078)
Subsidy rate	0.558**	0.565***	0.000423	−0.389**
	(0.014)	(0.004)	(0.998)	(0.025)
R^2	0.189	0.417	0.094	0.297
	Panel C: Marketization		*Panel D: Total work*	
Effective tax rate	−0.605**	−0.489**	0.173	0.00686
	(0.030)	(0.020)	(0.403)	(0.969)
Subsidy rate	1.040**	0.706**	−0.745**	−0.0527
	(0.011)	(0.013)	(0.036)	(0.827)
R^2	0.522	0.570	0.336	0.004
Panel E: Sector hours	Total market	Substitutable services	Non-substitutable services	Goods
Effective tax rate	−664.5*	−551.7***	−178.6	65.85
	(0.082)	(0.000)	(0.369)	(0.691)
Subsidy rate	522.5*	272.4***	342.0	−91.95
	(0.085)	(0.000)	(0.126)	(0.516)
R^2	0.246	0.724	0.158	0.022

Notes
Ratios in panels A–D are female to male values. Low-skilled individuals are those without a college degree. *p*-values are reported in parentheses. In panels C and D, only the countries with time-use surveys in the years under study are included. These countries are Austria, Belgium, Canada, Finland, France, Germany, Greece, Italy, Norway, Spain, the UK and the USA.
*, **, *** indicate $p \leq 0.10$, $p \leq 0.05$, $p \leq 0.01$, respectively.

estimated coefficients are statistically significant, and the coefficients are larger in absolute value for low-skilled workers than for high-skilled workers. The regressions in panel D indicate that the gender ratio in the total work hours is mostly unrelated to taxes and subsidies. These results suggest that taxes and subsidies affect gender ratios in market hours mainly through their effects on marketization.

Finally, panel E in Table 2 reports the corresponding regression results for sectoral hours. Market hours are negatively correlated with taxes and positively correlated with subsidies in the substitutable services sector, and the estimates for the other two sectors are statistically insignificant. These results are not surprising since substitutable services and home-produced services are close substitutes, therefore the effects of policies through the marketization channel have a larger impact on this sector.

Taking stock, this section shows that the ratio of female market hours to male market hours is larger in the USA than in most European countries, and the opposite is observed for the ratio of female to male wages. The cross-country differences in market hours, to a large extent, are accounted for by the differences in female market hours and by the hours worked in the substitutable services sector. More importantly, we find a negative association between taxes and gender ratios in market hours, and a positive association between taxes and gender ratios in wages. The

opposite associations are found for subsidies. These correlations are driven mostly by the effects of taxes and subsidies on the marketization of home hours.

3 | MODEL

This section presents a model with three market sectors and a home production sector, in an environment with government taxes and subsidies. The three market sectors produce goods, non-substitutable services and substitutable services, respectively. The production at home delivers a close substitute to the substitutable services produced in the market. Labour is supplied to each sector by a representative household and is indexed by gender and skill.

Government taxes labour income at rate τ, and the consumption of market good j at a net rate t_j. Here, t_j is the gross consumption tax rate less the subsidy rate, and j takes values 1,2,3, denoting the goods sector, the non-substitutable services sector and the substitutable services sector, respectively. The subsidy is therefore modelled as a negative consumption tax and is applicable only to the consumption of the substitutable services. The net revenue from taxes less subsidies is rebated back to the household as a form of lump-sum transfer T.

3.1 | Firms

Each of the three market sectors is competitive and consists of one representative firm. There are four types of labour inputs: high-skilled female, high-skilled male, low-skilled female and low-skilled male. The labour inputs can move freely across sectors. While production in each sector utilizes all four types of inputs, the intensity of factor inputs differs. The production function in each sector takes a nested constant elasticity of substitution (CES) form capturing the finite elasticity of substitution across skills and across genders. The CES aggregator first combines labour inputs of men and women of the same skill level, and then combines the aggregated low-skilled and high-skilled labour inputs.

Let subscript i index the skill level, where i takes one of the two values n and e, denoting low skill and high skill, respectively. Let g index gender, where g takes one of the two values m and f, denoting male and female, respectively. The production function of sector j is given by

$$Y_j = A_j L_j, \quad L_j = \left[\lambda_j L_{ej}^{(\rho-1)/\rho} + (1-\lambda_j) L_{nj}^{(\rho-1)/\rho}\right]^{\rho/(\rho-1)}, \quad j = 1,2,3, \tag{2}$$

where A_j is labour productivity, and ρ is the elasticity of substitution between low-skilled and high-skilled labour. Also, L_j is an aggregator of the low-skilled composite L_{nj} and the high-skilled composite L_{ej} of female and male labour inputs. We allow $\lambda_j \in (0,1)$ to differ across sectors. This is to capture the difference in the sectoral intensity of skilled labour. The skill composites L_{nj} and L_{ej} combine male and female labour inputs as follows:

$$L_{ij} = \left[\xi_{ij} L_{ifj}^{(\eta-1)/\eta} + (1-\xi_{ij}) L_{imj}^{(\eta-1)/\eta}\right]^{\eta/(\eta-1)}, \quad i = n,e, \quad j = 1,2,3, \tag{3}$$

where L_{ifj} denotes the amount of female labour input, and L_{imj} denotes the amount of male labour input, with skill level i in sector j. Here, η is the elasticity of substitution between female and male labour. The parameter $\xi_{ij} \in (0,1)$ affects the intensity of female labour input in producing the composite L_{ij}, and it varies by skill and sector; ξ_{ij} captures any factors that could affect the intensity of the female labour input in the production function, including social

norms, discrimination against women, and women's productivity relative to men by skill and by sector.

3.2 | The representative household

The representative household consists of four types of members, and L_{ig} ($i = n, e$ and $g = m, f$) is the share of household members with skill i and gender g. Each household member is endowed with one unit of time. The household utility is given by

$$U(c_1, c_2, c_3, c_h, L_l) = \ln c + \varphi \ln L_l, \tag{4}$$

where c is the consumption composite, and L_l is the leisure composite. The household derives utility from three types of goods and services: c_1 denotes market goods, c_2 denotes non-substitutable market services, and c_s denotes a composite of substitutable services that aggregates substitutable market services (c_3) and home services (c_h):

$$c \equiv \left[\sum_{j=1,2,s} \omega_j c_j^{(\varepsilon-1)/\varepsilon}\right]^{\varepsilon/(\varepsilon-1)}, \quad c_s = \left[\psi c_3^{(\sigma-1)/\sigma} + (1-\psi) c_h^{(\sigma-1)/\sigma}\right]^{\sigma/(\sigma-1)}, \tag{5}$$

where $\sum_{j=1,2,s} \omega_j = 1$. The elasticity of substitution across different kinds of goods and services is low, with $0 \leq \varepsilon < 1$, while the elasticity of substitution between substitutable market services and home services is high, with $\sigma > 1$.

Home services are produced with a technology similar to the one used in the substitutable market services sector (see equations (2) and (3)):

$$c_h = A_h L_h, \quad L_h = \left[\lambda_h L_{eh}^{(\rho-1)/\rho} + (1-\lambda_h) L_{nh}^{(\rho-1)/\rho}\right]^{\rho/(\rho-1)}, \tag{6}$$

where

$$L_{ih} = \left[\xi_{ih} L_{ifh}^{(\eta-1)/\eta} + (1-\xi_{ih}) L_{imh}^{(\eta-1)/\eta}\right]^{\eta/(\eta-1)}, \quad i = n, e, \tag{7}$$

and A_h is the labour productivity for the home sector.

Leisure L_l is a CES aggregator of male and female leisure time:

$$L_l = L_l(L_{nl}, L_{el}) = \left[\lambda_l L_{el}^{(\rho_l-1)/\rho_l} + (1-\lambda_l) L_{nl}^{(\rho_l-1)/\rho_l}\right]^{\rho_l/(\rho_l-1)}, \tag{8}$$

where

$$L_{il} = \left[\xi_{il} L_{ifl}^{(\eta_l-1)/\eta_l} + (1-\xi_{il}) L_{iml}^{(\eta_l-1)/\eta_l}\right]^{\eta_l/(\eta_l-1)}, \quad i = n, e, \tag{9}$$

and the elasticity of substitution is $\eta_l < 1$, indicating that male and female leisure time are complements.

Let w_{if} and w_{im} denote the wages for women and men with skill i, respectively. Because labour can move freely across sectors, wages differ by gender–skill group but not by sector. Taking as given government policy parameters (τ, t_1, t_2, t_3, T), wages $\{w_{if}, w_{im}\}_{i=n,e}$ and prices (p_1, p_2, p_3), a representative household chooses market consumption (c_1, c_2, c_3), home production time $\{L_{imh}, L_{ifh}\}_{i=n,e}$ and leisure time $\{L_{iml}, L_{ifl}\}_{i=n,e}$ to maximize the utility function (4) subject

to (5)–(9) and the household budget constraint

$$\sum_{j=1,2,3}(1+t_j)p_jc_j = T + (1-\tau)\sum_{i,g}w_{ig}(L_{ig} - L_{igh} - L_{igl}). \tag{10}$$

3.3 | Competitive equilibrium

A competitive equilibrium is defined by wages $\{w_{if}, w_{im}\}_{i=n,e}$, prices and consumption $\{p_j, c_j\}_{j=1,2,3}$ and time allocations $\{L_{ifj}, L_{imj}\}_{\forall i,j}$, such that the following hold.

(i) Given wages and prices, the firms maximize profits subject to production functions (2) and (3), and the representative household maximizes utility (4) subject to (5)–(10).
(ii) Given the optimal decisions of the firms and the household, wages and prices clear the goods market and the labour market:

$$c_j = Y_j, \quad j = 1,2,3, \tag{11}$$

$$\sum_{j=1,2,3} L_{igj} = L_{ig} - L_{igh} - L_{igl}, \quad i = n,e, \quad g = f,m. \tag{12}$$

(iii) The government budget constraint is satisfied:

$$T = \tau\sum_{i,g}w_{ig}(L_{ig} - L_{igh} - L_{igl}) + \sum_{j=1,2,3}t_jp_jc_j. \tag{13}$$

The derivation of the competitive equilibrium is provided in the Online Appendix.

4 | QUANTITATIVE RESULTS

In this section, we first calibrate the model to the US economy. We then quantify the effect of taxes and subsidies on gender ratios in hours and wages, and decompose the total effect into the contribution by income tax, consumption tax and subsidies on family care. Finally, we discuss the effect of social norms on the cross-country differences in gender wage ratios.

4.1 | Calibration

The model is calibrated to match time allocation and wage ratios of the US economy during 2011–15. The full calibration procedures are documented in the Online Appendix. The basic principle is as follows. Given the tax parameters $\{\tau, t_1, t_2, t_3\}$, the parameters needed to determine time allocation and wage ratios include the relative population shares $\{L_{ef}/L_{em}, L_{nf}/L_{nm}, L_{ef}/L_{nf}\}$, the elasticity parameters $\{\sigma, \varepsilon, \rho, \eta, \rho_l, \eta_l\}$, the gender-specific parameters $\{\xi_{ij}\}_{\forall i,j}$, the skill-specific parameters $\{\lambda_j\}_{\forall j}$, the preference parameter on leisure φ, and the relative productivity $\{\widehat{A}_{3h}, \widehat{A}_{23}, \widehat{A}_{12}\}$. [12]

The relative population shares $\{L_{ef}/L_{em}, L_{nf}/L_{nm}, L_{ef}/L_{nf}\}$ are calibrated to match the ratios between the numbers of workers for the relevant gender–skill groups. The six elasticity parameters $\{\sigma, \varepsilon, \rho, \eta, \rho_l, \eta_l\}$ for preferences and production functions are set directly to values derived elsewhere in the literature. The elasticity of substitution between substitutable services and home services, σ, is set to 1.9, which is the midpoint of the estimates in the literature ranging from 1.5

to 2.3.[13] The elasticity of substitution across goods and services, ϵ, is set to 0 given that Herrendorf *et al.* (2013) and Moro *et al.* (2017) both find a value not significantly different from zero. The elasticity between low-skilled and high-skilled labour, ρ, is set to 1.42 as in Katz and Murphy (1992).

For the elasticity between female and male labour, Weinberg (2000) finds an estimate 2.4, and Acemoglu *et al.* (2004) find estimates between 2.5 and 4. Using the equilibrium condition that sets the marginal rate of technical substitution across male and female labour equal to the gender wage ratio, Ngai and Petrongolo (2017) set the elasticity of substitution between female and male labour to match the observed response in the gender hour ratio given data on the gender wage ratio, and derive elasticity 2.3. We set the benchmark value of η to 3, a value in the middle of the literature estimates. There are no readily available estimates for ρ_l and η_l. We set the benchmark value $\rho_l = \rho = 1.42$ for the elasticity across high-skilled and low-skilled leisure time. As for the elasticity of substitution across male and female time in leisure, empirical papers have argued for complementarity of male and female leisure time (see Goux *et al.* (2014), and references therein), suggesting $\eta_l < 1$. We follow Ngai and Petrongolo (2017) to set $\eta_l = 0.2$ in the benchmark. The effects of alternative values for σ, η, η_l, ρ and ρ_l are explored in the next subsection.

The remaining 19 parameters are calibrated to match relative wages and time allocation for each of the four types of labour inputs in the five sectors (three market sectors, home sector, and leisure). There are a total of 19 independent data targets used in calibrating the 19 parameters. The Online Appendix explains how each of these parameters is uniquely pinned down by the data targets. In a nutshell, given the relative wages, the ratio between female and male hours of the same skill in the same sector pins down $\{\xi_{ij}\}$. Similarly, the ratio between low-skilled and high-skilled hours of the same gender in the same sector pins down $\{\lambda_j\}$. The final four parameters, $\{\varphi, \widehat{A}_{12}, \widehat{A}_{23}, \widehat{A}_{3h}\}$, are calibrated to match the three relative wages and leisure time for low-skilled women.

The construction of data targets on wage ratios and time allocation across market, home and leisure was discussed in the first subsection of Section I. The data targets are reported in Table 3. The calibration procedure is essentially solving 19 unknowns from 19 equations, and thus matches the targets exactly. Table 3 also reports the sectoral shares of low-skilled, high-skilled and total hours in the three market sectors, as well as the gender hour ratios for both skill groups. Although these statistics are not targeted, the model matches them quite well.

The calibrated parameter values are summarized in Table 4. The calibration delivers higher ξ_{ih} and ξ_{i3} than ξ_{i1} and ξ_{i2} for both skill groups ($\{\xi_{ih}, \xi_{i3}\}_{\forall i} > \{\xi_{i1}, \xi_{i2}\}_{\forall i}$). This calibration result is generated by the higher intensity of female hours in the production of home and substitutable services in the data.[14]

4.2 | Country-specific taxes and subsidies

The objective here is to examine how much of the cross-country differences in the gender gaps in market hours and wages can be generated by differences in taxes and subsidies. Using the calibrated parameters and the country-specific taxes and subsidies, we simulate the model to predict time allocation and wages by gender and skill for each country.

We use three statistics to evaluate the model predictions against the data. The first statistic is the average difference from the USA in the model across the studied countries. The second statistic is the correlation coefficient between the model prediction and the data. The third statistic is the coefficient of determination, as used in Chakraborty *et al.* (2015), which measures the variation in the data captured by the model. The coefficient of determination is defined as

$$R^2 = 1 - SSE/SST, \tag{14}$$

Table 3 Data Moments

Targets

Time allocation		Goods	Non-substitutable services	Substitutable services	Home	Leisure
Low-skilled females	L_{nfj}/L_{nf}	0.018	0.046	0.072	0.179	0.685
High-skilled females	L_{efj}/L_{ef}	0.016	0.094	0.077	0.163	0.651
Low-skilled males	L_{nmj}/L_{nm}	0.084	0.067	0.051	0.111	0.688
High-skilled males	L_{emj}/L_{em}	0.055	0.126	0.059	0.110	0.650

Relative wages	Gender ratio Low-skilled	High-skilled	Skill premium Women	Men
	0.80	0.79	1.63	1.65

Non-targets

Gender hour ratios	Low-skilled Model	Data	High-skilled Model	Data
	0.68	0.69	0.77	0.78

Time allocation		Goods	Non-substitutable services	Substitutable services
Low-skilled by sector	Model	0.28	0.33	0.39
	Data	0.30	0.33	0.36
High-skilled by sector	Model	0.15	0.51	0.34
	Data	0.16	0.51	0.33
Total	Model	0.23	0.41	0.37
	Data	0.24	0.42	0.35

where $SSE = \sum_c (x_{c,model} - x_{c,data})^2$, and $SST = \sum_c (x_{c,data} - x_{US})^2$. Here, $x_{c,model}$ is the value predicted by the model for country c, $x_{c,data}$ is the data value of variable x in that country, and x_{US} is the value of variable x in the data for the USA.[15] Table 5 reports the three statistics for the gender wage and hour ratios. Panel A contains the summary statistics for western and southern Europe, and panel B contains the same statistics for all countries. Results for individual countries are reported in Table A5 of the Appendix.

Columns (2) and (4) of Table 5 report the model-predicted average European differences from the USA in the female to male hour ratios, for low-skilled and high-skilled labour, respectively. Consistent with the data, the model predicts lower gender hour ratios for both skill groups in western and southern European countries relative to the USA. For these countries, the average predictions obtained by varying taxes and subsidies are 69% (−6.59/ − 9.49) and 93% (−4.81/ − 5.17) of the observed average differences in gender hour ratios from the USA, for the low-skilled and high-skilled, respectively. The correlation coefficients between the model predictions and the data are 0.15 and 0.48 for the low-skilled and high-skilled, respectively. Furthermore, the model generates 50% and 58% of the variation in the gender hour ratio from the USA for the low-skilled and high-skilled, as measured by the coefficient of determination.

Table 4 Calibration

	Values	Targets
Model free parameters		
σ	1.9	Aguiar *et al.* (2012)
ε	0	Herrendorf *et al.* (2013) and Moro *et al.* (2017)
ρ	1.42	Katz and Murphy (1992)
η	3	Weinberg (2000) and Acemoglu *et al.* (2004)
η_l	0.2	Baseline based on Ngai and Petrongolo (2017)
Calibrated parameters		
$\frac{L_{ef}}{L_{em}}, \frac{L_{nf}}{L_{nm}}, \frac{L_{ef}}{L_{nf}}$	1.18, 0.95, 0.78	Ratios of population by skill and by gender
ξ_{nj}	0.32, 0.41, 0.47, 0.48, 0.38	Low-skilled gender hour ratios across sectors
ξ_{ej}	0.35, 0.43, 0.48, 0.49, 0.65	High-skilled gender hour ratios across sectors
λ_j	0.49, 0.67, 0.58, 0.55, 0.55	Ratio of high-skilled to low-skilled female hours across sectors
$\widehat{A}_{3h}$	0.78	Relative hours between substitutable services and home
$\widehat{A}_{23}$	5.78	Relative hours between non-substitutable and substitutable services
$\widehat{A}_{12}$	1.70	Relative hours between goods and non-substitutable services
φ	1.67	Relative hours between leisure and goods

Table 5 Model Prediction on Gender Ratios

	Gender hour ratio				Gender wage ratio			
	Low-skilled		High-skilled		Low-skilled		High-skilled	
	Data	Model	Data	Model	Data	Model	Data	Model
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Western and southern Europe								
Average difference	−9.49	−6.59	−5.17	−4.81	4.19	0.52	8.56	0.38
Correlation		0.15		0.48		0.28		0.39
Coefficient of determination		0.50		0.58		0.11		0.07
Panel B: All countries								
Average difference	−5.50	−5.88	−2.22	−4.29	4.14	0.45	6.96	0.34
Correlation		0.27		0.47		0.24		0.37
Coefficient of determination		0.31		0.19		0.10		0.07

Notes
'Average difference' is the average European difference from the USA (i.e. (Europe − USA) ∗ 100) in the female to male hour and wage ratios, both in the model and in the data. 'Coefficient of determination' as defined in equation (14). Low-skilled individuals are those without a college degree. Data cover selected years between 2007 and 2015.

When all countries are included, the correlation coefficients between model and data are roughly the same as for the western and southern European countries, while the coefficient of determination declines to 0.31 for the low-skilled and to 0.19 for the high-skilled. This implies that the model performs slightly worse for Nordic countries.

Columns (5)–(8) of Table 5 present the data and model predictions on the gender wage ratios. Consistent with the data, the model generates higher gender wage ratios in European countries and Canada than in the USA. Together with the results on gender hour ratios, the model generates a negative cross-country correlation between the gender ratios in hours and wages, as documented

in Figure 1. From panel B of Table 5, the correlation coefficient between the model predicted gender wage ratio and the data is 0.24 for the low-skilled and 0.37 for the high-skilled. As measured by the coefficient of determination, the model generates 10% of the cross-country variation in the gender wage ratio for the low-skilled, and 7% for the high-skilled. The correlation coefficient and the coefficient of determination do not change much by excluding Nordic countries for either skill group. Quantitatively, the model generates an average difference of 0.45 in the gender wage ratio from the USA for the low-skilled, and 0.34 for the high-skilled. Hence taxes and subsidies can generate 11% (0.45/4.14) and 5% (0.34/6.96) of the observed average differences in gender wage ratios from the USA for the low-skilled and high-skilled, respectively. Excluding Nordic countries does not change the estimates by much.

4.2.1 | The role of marketization

As mentioned previously, an important channel for taxes and subsidies to shape the gender gaps in wages and hours is through the process of marketization of home production. Marketization shifts hours of work from the home sector to market sectors, especially to the substitutable services sector because of the good substitutability between home services and substitutable services. Higher taxes or lower subsidies weaken the marketization process as they increase the relative costs of outsourcing home-produced services. This leads to lower market hours, especially among women because both the home sector and the substitutable services sector use female labour more intensively (as the calibrated $\{\xi_{ih}, \xi_{i3}\}_{\forall i} > \{\xi_{i1}, \xi_{i2}\}_{\forall i}$). Given the limited substitutability between male and female labour, less marketization of female market hours decreases the labour supply of women relative to men, and drives up the gender wage ratio. This explains why higher taxes or lower subsidies induce a lower gender hour ratio and a higher gender wage ratio.

There are two key implications of the marketization mechanism for countries with higher taxes. First, they would have a smaller substitutable services sector. Second, women would spend a higher fraction of their working hours in home production relative to men. To validate such a mechanism, Table 6 compares the model implied shares of hours across the three market sectors and the gender ratio in the fraction of market hours out of total work hours (market hours plus home hours) with the data.

Panel A of Table 6 compares the predicted sectoral shares of market hours with the data. Consistent with the data, the model predicts a smaller substitutable services sector in Europe and Canada compared to the USA. The predicted average differences from the USA for sectoral

Table 6 Marketization: Model Versus Data

	Correlation	Coefficient of determination	Average data difference	Average model difference
Panel A: Shares of market hours by sector				
Goods	0.32	0.26	0.02	0.02
Non-substitutable	0.24	0.57	0.04	0.04
Substitutable	0.81	0.91	−0.06	−0.06
Panel B: Gender ratio in the fraction of market hours out of total work hours				
Low-skilled	0.56	0.54	−0.07	−0.06
High-skilled	0.63	0.59	−0.06	−0.05

Notes
'Average data difference' and 'Average model difference' are the average differences in gender ratios from the USA (i.e. (Europe − USA) ∗ 100) in the data and model, respectively. Low-skilled individuals are those without a college degree. Data cover years 2007–15 for twelve countries with time-use data.

shares are the same as those in the data. The correlation coefficient and the coefficient of determination for the sectoral shares are all positive and especially large for the substitutable services sector. For this sector, the correlation coefficient is 0.81, and the coefficient of determination is 0.91, implying that the model also generates most of the cross-country variation in the sectoral share of hours in the substitutable service sector.

Panel B of Table 6 compares the predicted gender ratio in the share of market hours out of total work hours with the data. The model predicts lower values for this gender ratio in Europe and Canada relative to the USA, and the predicted average differences are close to the data for both skill groups. The correlation coefficient and the coefficient of determination of this gender ratio for both skill groups are larger than 0.5. These results, together with those reported in panel A, are consistent with less marketization of home services, especially for women, in Europe and Canada, because of their higher taxes.

4.2.2 | Decomposition: income taxes, consumption taxes and subsidies

In this subsubsection, we decompose the total effects of taxes and subsidies on the cross-country differences in gender ratios on hours and wages into the contribution of three policies: income taxes, consumption taxes, and subsidies on family care. In each decomposition, we simulate the model with only one country-specific policy, and keep the other two policy parameters at the US values for each studied country. Table 7 reports, in each decomposition, the model-generated average differences from the USA for the two gender ratios, the correlation coefficient between the model prediction and the data, and the coefficient of determination. The decomposition results for individual countries are included in Tables A6–A8 of the Appendix.

Panels A and B of Table 7 show that higher income and consumption taxes in Europe generate lower gender hour ratios and higher gender wage ratios for both skill groups, as the reported average differences from the USA are negative for hours and positive for wages. The decomposition shows that the income tax generates larger average differences from the USA for both gender ratios. This is because the income tax rate is generally higher than the consumption tax rate in all countries except for Sweden (see Table A4 of the Appendix). While the correlation coefficient and the coefficient of determination are comparable in the decomposition with income taxes and consumption taxes for western and southern Europe, they are much smaller when all countries are considered. These results imply that income taxes are more important than consumption taxes in generating the cross-country variations in the gender ratios of hours and wages.

Panel C of Table 7 shows that higher subsidies in Europe generate higher gender hour ratios and lower gender wage ratios relative to the USA, and the effects are larger for the low-skilled than for the high-skilled. However, the effects of subsidies alone are much smaller than those of either income or consumption taxes. Table A8 of the Appendix reveals that the main effects of subsidies are on gender hour ratios in Nordic countries since they have higher subsidy rates, as reported in Table A4. Qualitatively, high subsidies in Nordic countries operate in the opposite direction to their high taxes, and generate higher gender hour ratios of women relative to men. Although subsidies do help in raising gender hour ratios in Nordic countries, and therefore improve the model predictions, the quantitative effects are relatively small compared to taxes and thus are unable to produce the high gender hour ratios observed in these countries.

Our measure of social subsidies is likely to be a lower bound of the subsidies to family care, as it includes only non-cash benefits from the OECD SOCX. Nordic countries have other family-friendly policies that are not included here, such as larger tax credits and exemptions for domestic services.[16] If these policies were quantified, then they would lead to an even higher subsidy rate for Nordic countries, and would improve the model's performance in predicting female market hours in Nordic countries.

Table 7 Decomposition: Income Tax, Consumption Tax and Subsidy

	Gender hour ratio				Gender wage ratio			
	Low-skilled		High-skilled		Low-skilled		High-skilled	
	Data	Model	Data	Model	Data	Model	Data	Model
Panel A: Income tax								
Western and southern Europe								
Average difference	−9.49	−4.93	−5.17	−3.56	4.19	0.36	8.56	0.26
Correlation		0.15		0.48		0.18		0.25
Coefficient of determination		0.43		0.53		0.08		0.05
All countries								
Average difference	−5.50	−4.42	−2.22	−3.19	4.14	0.32	6.96	0.23
Correlation		0.24		0.48		0.23		0.16
Coefficient of determination		0.29		0.26		0.08		0.05
Panel B: Consumption tax								
Western and southern Europe								
Average difference	−9.49	−2.61	−5.17	−1.84	4.19	0.15	8.56	0.10
Correlation		0.19		0.38		0.26		0.41
Coefficient of determination		0.28		0.31		0.03		0.02
All countries								
Average difference	−5.50	−3.17	−2.22	−2.25	4.14	0.19	6.96	0.13
Correlation		−0.24		−0.34		0.20		−0.03
Coefficient of determination		0.12		−0.06		0.04		0.02
Panel C: Subsidy								
Western and southern Europe								
Average difference	−9.49	0.88	−5.17	0.60	4.19	−0.04	8.56	−0.02
Correlation		−0.24		−0.28		0.24		0.24
Coefficient of determination		−0.13		−0.14		−0.01		0.00
All countries								
Average difference	−5.50	1.96	−2.22	1.34	4.14	−0.07	6.96	−0.04
Correlation		0.34		0.45		−0.11		0.46
Coefficient of determination		−0.14		−0.02		−0.02		0.00

Notes
'Average difference' is the average European difference from the USA (i.e. (Europe − USA) ∗ 100) in the female to male hour and wage ratios, both in the model and in the data. 'Coefficient of determination' as defined in equation (14). Low-skilled individuals are those without a college degree. Data cover selected years between 2007 and 2015.

To summarize, the decomposition reveals that taxes, especially income tax, are more important than subsidies in generating the cross-country differences in the gender ratios, while subsidies help in explaining the high gender hour ratio in Nordic countries.

4.2.3 | Sensitivity analysis

This subsubsection discusses the robustness of the benchmark results to alternative values of $\{\sigma, \eta, \eta_l, \rho_l, \rho\}$. The results from the sensitivity analyses, including summary statistics similar to those in Table 5 for the benchmark results, are reported in Tables A9 and A10 of the Appendix.

As discussed in the first subsection of this section, the literature finds an estimate for σ between 1.5 and 2.3, and an estimate for η between 2.3 and 4. We use the lower and upper bounds as alternative values. The literature also argues for complementarity for male and female leisure time, thus we explore alternative values 0.1 and 0.9 for η_l. There are no good estimates for ρ_l, and we explore two alternative values, 0.5 and 2. In the benchmark simulation, we have assumed that the elasticity of substitution between high-skilled and low-skilled labour, ρ, is constant across sectors. One may expect that the two skill types are more substitutable in the home sector but less substitutable in the non-substitutable sector, since the non-substitutable sector is the most skill-intensive sector. As robustness checks, we perform two alternative experiments. The first sets $\rho = 2$ in the home sector, and the second sets $\rho = 0.9$ in the non-substitutable sector. Finally, in the benchmark case, we have also assumed that the elasticity of substitution between female and male labour, η, is constant across skill groups and across sectors. One may expect that male and female labour are more substitutable in service sectors than in the goods sector. As a robustness check, we set η to 4 in the two market service sectors, while holding it at the benchmark value elsewhere. We show in Tables A9 and A10 of the Appendix that the quantitative results with these alternative parameter values are similar to the benchmark results reported in Table 5.

4.3 | Discussion on the gender wage ratio

The quantitative analysis has shown that taxes and subsidies can generate 11% of the average cross-country difference in the gender wage ratio from the USA for the low-skilled, and 5% for the high-skilled. To explore other factors that may also contribute to the cross-country difference in the gender wage ratio, we calibrate the model to each country and target the same set of moments. This alternative calibration matches time allocations, and more importantly, wage ratios to the data values of each country. Moreover, this alternative calibration takes into account cross-country differences not only in taxes and subsidies (τ, t_j), but also in gender–skill intensities (ξ_{ij}, λ_j), productivity (A_j) and preference for leisure (φ).[17] Since this calibration requires time-use data, we perform this analysis only for the twelve countries with available time-use data.

This calibration exercise implies a set of country-specific parameters (τ^c, t_j^c, ξ_{ij}^c, λ_j^c, A_j^c, φ^c) for matching the time allocation and the gender wage ratio in each country c. We perform the following counterfactual exercise to examine the role of each of these country-specific parameters on the gender wage ratio. Starting from the calibrated values for the USA, we change the parameters to the country-specific parameter values, one by one. We then measure the effect of a parameter by the fraction of the average differences in the gender ratios from the USA in the model to the data. In other words, the counterfactual exercise for τ^c, t_j^c is the same as that reported in the previous subsection. The results of the counterfactuals are reported in Table 8 for the twelve countries with time-use data.

Table 8 shows that while taxes and subsidies (τ, t_j) are the most important factor for the cross-country difference in the gender hour ratio, ξ_{ij}^c is the factor that has the largest quantitative effect on the gender wage ratio. ξ_{ij}^c determines the relative intensity of the two gender inputs in the production of sector j. It captures not only the productivity differences between men and women, but also factors that could affect preferences for female labour, such as social norms or discrimination against women working in the market. The literature (e.g. Heathcote *et al.* 2010; Ngai and Petrongolo 2017) sometimes refers to changes in ξ_{ij}^c as a gender-specific demand shift. One way to understand this is to think of the parameter for country c as

$$\xi_{ij}^c = \frac{\chi_{ij}^c}{\theta^c}, \quad j = 1, 2, 3, \quad i = n, e, \tag{15}$$

$$\xi_{ij}^c = \chi_{ij}^c, \quad j = h, \ell, \quad i = n, e. \tag{16}$$

Table 8 Contribution of Country-specific Parameters to Gender Ratios

	Gender hour ratio, av. % explained		Gender wage ratio, av. % explained	
	Low-skilled	High-skilled	Low-skilled	High-skilled
τ, t_j	99	120	12	5
ξ_{ij}	21	30	122	104
λ_j	−2	−16	−3	5
A_j	−30	−41	−26	−10
φ	0	0	0	0

Notes
Each row represents a counterfactual experiment of setting the parameter in that row to its country-specific value. The reported numbers are the ratio of the average model predictions on the difference in the gender ratio from the USA relative to the average difference in the data. Low-skilled individuals are those without a college degree. Data cover selected years between 2007 and 2015, for the twelve countries with time-use data.

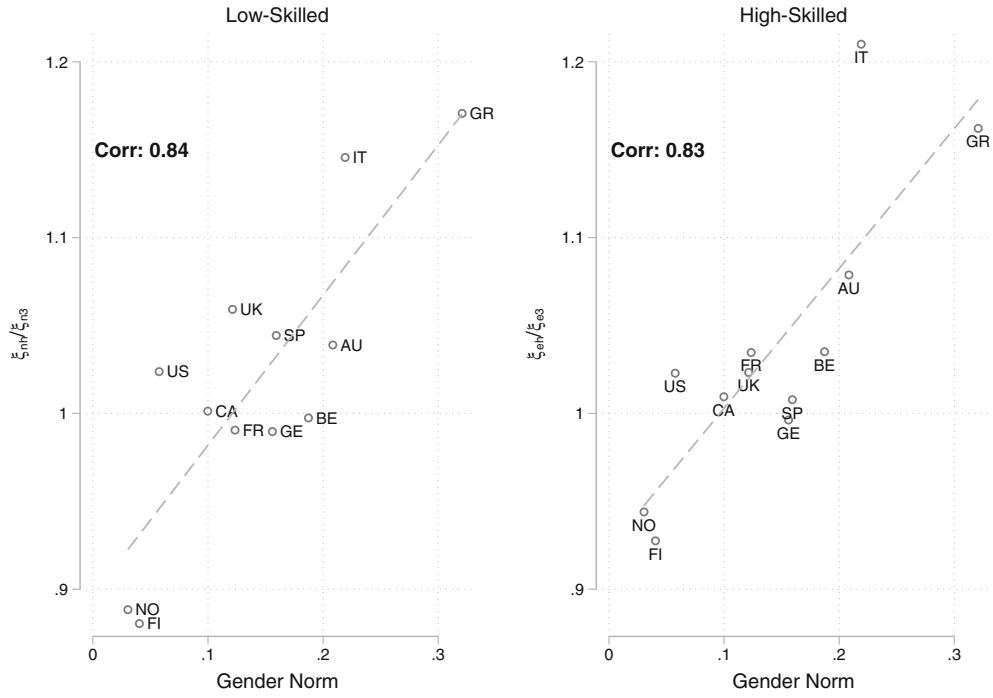

Figure 5 ξ_{ih}/ξ_{i3} and gender norms. *Notes*: Gender norm is measured by the fraction of respondents in the integrated European and World Values Survey who agree or strongly agree that 'When jobs are scarce, men have more right to a job than women'. Low-skilled individuals are those without a college degree. Data cover selected years between 2007 and 2015, for the twelve countries with time-use data.

Here, χ_{ij}^c is a technology parameter capturing the productivity differences between women and men in sector j for skill type i, and θ^c is a country-specific parameter that affects only market production. θ^c captures factors (such as social norms or discrimination) that lower women's perceived marginal product of labour relative to men in the market sectors, and thus generate a wedge that lowers the gender wage ratio relative to the marginal rate of technical substitution in country c.

Using this interpretation, suppose that the technology parameters are such that the relative productivity of women between home and market substitutable services is the same across all countries—that is, $\chi^c_{ih}/\chi^c_{i3} = \kappa_i$. Then the ratio ξ^c_{ih}/ξ^c_{i3} is equal to $\kappa_i\theta^c$. A natural question to ask is whether this country-specific wedge θ^c bears any relationship with cross-country variations in social norms towards women working in the market. One commonly used measure of gender norms in the literature is the fraction of respondents in the integrated European and World Values Survey (EVS 2021; Haerpfer *et al.* 2021) who agree or strongly agree that 'When jobs are scarce, men have more right to a job than women'. Figure 5 plots ξ^c_{ih}/ξ^c_{i3} against this measure of gender norm. As the figure shows, ξ^c_{ih}/ξ^c_{i3}, and hence the country-specific wedge, is highly correlated with this gender norm measure, with a correlation coefficient above 0.8 for both skill groups. Thus the findings of Table 8 are consistent with the view that gender norms play a quantitatively important role in understanding the cross-country differences in the gender wage ratio.

5 | CONCLUSION

Using microdata from 17 OECD countries, this paper documents a negative cross-country correlation between gender ratios (female relative to male) in market hours and wages. The gender hour ratios are usually higher in the USA than in Europe, while the opposite occurs for the wage ratios. We find that the cross-country differences in market hours are mostly accounted for by female market hours and the size of the sector that produces close substitutes to home production.

Using a multi-sector model with gender and skill differences, we show that cross-country differences in income taxes, consumption taxes and subsidies on family care can account for a substantial fraction of the cross-country differences in the gender ratios in market hours and wages, and can also account for the negative correlation between the two ratios. The marketization of female home hours is important for driving these results. Higher taxes in Europe reduce the marketization of home production and therefore reduce market hours. Higher subsidies lower the cost of marketization and improve the model prediction on market hours in Nordic countries. These effects are larger for women because both home production and its corresponding market substitutes are female-intensive.

Our study has implications that go beyond the European context and that concern more generally the types of policies that can be used to promote the participation of women in the market. For instance, the International Labour Organization (2016) documents that the gender gap in employment is much larger in many developing countries, and as in the case of Europe, women do most of the housework. That report also suggests that higher government spending on family policies, such as social care services, policies on family leave and family-friendly work schedules, are associated with higher female employment-to-population ratios. This is consistent with our finding that the key to increase female market hours is to establish policies that reduce the cost of marketizing home production.

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NOTES

[1] The closure of many of these market sectors during the recent COVID-19 pandemic has lead to a disproportionate impact on female market work around the world (see International Labour Organization 2021).

[2] In the Online Appendix, we present a detailed decomposition of the gender ratios in market hours into gender ratios in employment rates (extensive margin) and gender ratios in hours per employed worker (intensive margin). We find that the negative association between the gender ratios in market hours and wages reported in Figure 1 is driven mainly by the gender ratio in the employment rate. However, both extensive and intensive margins are important for the cross-country differences in the levels of gender ratios in market hours.

[3] Rendall (2018) analyses the impact of different taxation regimes, using a multi-sector model with home production, on structural transformation and the rise of female and service employment in the USA.

[4] The period analysed for a given country is centred around the year where time-use data are available. Table A1 in the Appendix lists the years analysed for each country. In the EU-15 region, only Luxembourg is excluded as there are no comparable tax data.

[5] For a more detailed description of the data sources and construction procedures, refer to the Appendix.

[6] Table OA.1 in the Online Appendix shows that cross-country differences in hours worked within a given demographic group explain most of the differences in aggregate market hours across countries.

[7] The substitutable services sector includes Retail trade, Hotels and restaurants, Health and social work, Personal and community services, and Domestic services hired by households. Given the available industry classification in most household surveys, it is not possible to do a more detailed disaggregation. Table A2 in the Appendix contains the detailed sector classification.

[8] Ideally, we would like to include preschool teachers in the substitutable services sector. However, in most countries, such a detailed breakdown of the data is not possible. In any case, preschool teachers represent only a very small share of the total employment in all countries studied. For example, the share is only 0.2% in the USA. Given that the substitutable services sector represents more than 36% of employment in the USA, the underestimation caused by excluding preschool teachers from the substitutable services sector is negligible.

[9] The countries are Austria, Belgium, Canada, Finland, France, Germany, Greece, Italy, Norway, Spain, the UK and the USA.

[10] Table A4 of the Appendix also includes the rates for the subcomponents of taxes (consumption tax and income tax) and for the subcomponents of subsidies (old-age, incapacity and family care).

[11] In all our analyses, we group Ireland together with southern European countries based on the similarity of the labour supply of women among these countries.

[12] $\widehat{A}_{3h} \equiv (A_3/A_h)\,(\psi/(1-\psi))^{\sigma/(\sigma-1)}$, $\widehat{A}_{23} \equiv (A_2/A_3)(\omega_s/\omega_2)^{\epsilon/(1-\epsilon)}\psi^{\sigma/(1-\sigma)}$ and $\widehat{A}_{12} \equiv (A_1/A_2)(\omega_2/\omega_1)^{\epsilon/(1-\epsilon)}$. Separate information on ψ and ω_j is not needed for the prediction of relative time allocations.

[13] See the survey by Aguiar *et al.* (2012), and Rogerson and Wallenius (2016). For individual papers, see, for example, Rupert *et al.* (1995), Chang and Schorfheide (2003), McGrattan *et al.* (1997), Aguiar and Hurst (2007a), Gelber and Mitchell (2012), and Fang and Zhu (2017).

[14] Table A3 in the Appendix shows that the share of female employment is the largest in the substitutable services sector, and is the smallest in the goods sector.

[15] See the Online Appendix for more details about the coefficient of determination.

[16] Carbonnier and Morel (2015) discuss the potential consequences on the labour market of alternative policies, including tax credits and exemptions on the purchase of care services in the private market.

[17] As discussed in the first subsection of Section I, we control for cross-country differences in demographics by applying the US population shares to all studied countries. Thus the shares of workers by gender and skill (L_{ig}) are the same across countries in our constructed data.

[18] Olivetti and Petrongolo (2014) find that high-school dropouts and high-school graduates are equivalent labour inputs based on their average wages.

[19] The EU Labour Force Survey does not separate wholesale trade from retail trade. We impute the hours going to 'retail trade' by using detailed information on the shares of population groups employed in retail in France and Germany.

[20] The EU Labour Force Survey does not contain detailed earnings information.

[21] In EU-SILC, these countries include Belgium, Denmark, Finland, the Netherlands, Norway and Sweden.

[22] Each regression is estimated separately by year and country. In all cases, the regressions are estimated using the surveys' sampling weights.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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APPENDIX A. DATA OVERVIEW

As mentioned previously, our data cover selected years in the period 2007–15. The years selected, shown in Table A1, are centred around the years where time-use information is available. For countries without time-use data, and for the USA, where we have yearly time-use data, we average data for the period 2011–15.

Market hours

To analyse the hours of work in the market, we use the Labour Force Surveys in European countries (Eurostat 2021a; INSEE 2021; Office for National Statistics (ONS) 2021), the CPS for the USA (Flood *et al.* 2021), and the 2011 Population Census for Canada (Minnesota Population Center 2020). Our sample is restricted to individuals between the ages of 20 and 64. We classify individuals as high-skilled if they completed college.[18]

All these surveys contain information on weekly hours worked. In order to construct a consistent measure of annual hours of work per person, we follow the procedures outlined by Bick *et al.* (2019), including the use of their estimated weeks of effective work over a calendar year. In the case of Finland, we scale up the weekly hours using the average weeks worked in other Nordic countries, while for Canada, we scale up weekly hours by the number of weeks worked the previous year, since the aforementioned paper does not include these countries in its sample.

To control for demographic differences across countries, we partition each country's population according to skill, gender, age (nine 5-year groups) and marital status. As a result, there are 72 population groups for each year/country pair. For each one of the population groups, we calculate average hours and aggregate them at the gender–skill level using as weights the US population shares. Prior to the aggregation, we adjust the US population shares to ensure that the distribution of age and marital status is constant across gender–skill groups. This is done as follows.

Denote by g a member of the 72-group partition. For any given g, there is a corresponding gender–skill group GS_k such that $g \in GS_k$, and a corresponding age–marital status group AM_l such that $g \in AM_l$. Let $f(g)$, $f(GS_k)$ and $f(AM_l)$ be the fractions of the population in these groups, respectively. Then $f(g)$ can be rewritten as

$$f(g) = f(GS_k)\, f(AM_l|GS_k), \tag{A1}$$

where $f(AM_l|GS_k)$ is the fraction of group GS_k with age–marital status AM_l. This fraction $f(AM_l|GS_k)$ varies depending on the gender–skill group. To hold constant the distribution of age

Table A1 Selected Data Periods

Country		Selected years	Time-use data
Canada	CA	2009–11	2010
Nordic			
Denmark	DE	2011–15	
Finland	FI	2008–10	2009
Norway	NO	2009–11	2010
Sweden	SW	2011–15	
Western			
Austria	AU	2007–9	2008
Belgium	BE	2012–14	2013
France	FR	2008–10	2009
Germany	GE	2011–13	2012
Netherlands	NE	2011–15	
UK	UK	2013–15	2014
Southern			
Greece	GR	2012–14	2013
Ireland	IR	2011–15	
Italy	IT	2007–9	2008
Portugal	PO	2011–15	
Spain	SP	2007–9	2008
USA	US	2011–15	2011–15

and marital status across different gender–skill groups, we replace $f(AM_l|GS_k)$ by $f(AM_l)$. This gives the weights to aggregate the 72 groups:

$$\tilde{f}(g) = f(GS_k)\, f(AM_l). \tag{A2}$$

The weight $\tilde{f}(g)$ is constructed from the US population and is then applied to all countries to estimate average hours that control for differences in the demographic composition of the population.

Sectoral hours The detailed sectoral classification is presented in Table A2. Given the available industry classification in most household surveys, a more detailed disaggregation is not possible.[19] Sectoral hours are estimated by multiplying the average market hours per person with the share of hours in a given sector. To be consistent with the previous estimates, we also hold the demographics constant across countries in constructing the sectoral hours shares. Table A3 shows the percentage of female employment by sector.

Time-use data

The data for time allocation come from the US Time Use Survey (Flood *et al.* 2022), the Harmonised European Time Use Survey (Eurostat 2020) and the Multinational Time Use Study (Fisher and Gershuny 2016; Gershuny *et al.* 2020; Fisher *et al.* 2019).

The time-use classification used in this paper follows closely that of Aguiar and Hurst (2007b) with a few minor adjustments. First, our market hours correspond to the total market work in Aguiar and Hurst (2007b). Second, our hours of work at home is the sum of time in non-market work, including childcare, gardening and caring for pets.

Table A2 Sector Classification

Sector	ISIC (v. 3)	ISIC (v. 4)
Goods		
Agriculture, Hunting, Forestry and Fishing	A, B	A
Mining and Quarrying	C	B
Manufacturing	D	C
Electricity, Gas and Water	E	D, E
Construction	F	F
Non-substitutable services		
Wholesale Trade and Sale of Motor Vehicles	50, 51	45, 46
Transport and Communications	I	H, J
Financial Intermediation	J	K
Real Estate and Business Activities	K	L, M, N
Public Administration, Defence, Compulsory Social Security	L	O
Education	M	P
Substitutable services		
Retail Trade	52	47
Hotels and Restaurants	H	I
Health and Social Work	N	Q
Other Personal and Community Services	O	R, S
Private Households as Employers	P	T

Taxes and subsidies

The labour income and consumption taxes (τ, t_j) are from McDaniel (2020). Labour income taxes include Federal and State income taxes, as well as Social Security taxes. We use the average rates for the aforementioned selected years.

The expenditures on 'in-kind' social subsidies, S, are obtained from the OECD Social Expenditure Database (SOCX). The SOCX includes old-age, incapacity and family benefits. The in-kind expenditures S are the non-cash public benefits in these three categories, and include expenditures on residential care, home-help services, rehabilitation, and early childhood education and care (e.g. daycare and preschool services) (see Adema *et al.* (2011) for a description of the SOCX).

The subsidy rate s is given by

$$s = \frac{S}{SO_{SS}},$$

where SO_{SS} is the sectoral output in the substitutable services sector, constructed using the WIOD input–output matrices (see Timmer *et al.* 2015). As in Prescott (2004), the effective tax rate is

$$\tau_e = \frac{t_j + \tau}{1 + t_j}.$$

The net consumption tax in the substitutable services sector is $t_3 = t_1 - s$. The resulting tax and subsidy rates are reported in Table A4, where we also show the detailed components that make up the social subsidy.

Table A3 Percentage of Female Employment by Sector

	Goods	Non-substitutable services	Substitutable services
Canada	22.5	47.9	64.4
Nordic			
Denmark	19.2	41.7	70.9
Finland	20.1	44.6	77.8
Norway	16.5	41.2	75.0
Sweden	18.5	46.7	70.7
Western			
Austria	24.7	45.0	69.7
Belgium	17.7	46.1	67.1
France	23.1	47.4	69.1
Germany	23.7	46.0	70.6
Netherlands	18.1	39.9	71.8
UK	20.6	46.0	65.1
Southern			
Greece	28.7	40.9	53.9
Ireland	17.4	43.7	66.1
Italy	22.2	42.4	60.8
Portugal	28.8	45.3	69.9
Spain	18.8	42.9	67.3
USA	21.4	47.1	62.2

Notes
Data cover selected years between 2007 and 2015, and correspond to a population aged 20–64.

Wages

We construct hourly wage rates using the Labour Force Surveys for France and the UK (INSEE 2021; ONS 2021), the Socio-Economic Panel (SOEP) for Germany (SOEP 2021; Wagner *et al.* 2007), the 2011 population census for Canada, and the March CPS for the USA. For the rest of Europe, we use the European Union Statistics on Income and Living Conditions (EU-SILC; Eurostat 2021b).[20] In all cases, wages are estimated using the earnings of employees only.

Most surveys provide a measure of current monthly earnings, which is converted to hourly wages by dividing by the product of 4.33 and the weekly hours of work. However, monthly earnings are not available for the USA and some countries in EU-SILC, in which case hourly wages are constructed using earnings from the previous year.[21] For the USA, we divide the previous year earnings by the product of usual weekly hours and weeks worked in that year. For the EU-SILC countries, we divide the previous year earnings by the product of the number of months worked in that year and the current number of weekly hours times 4.33, because the number of weekly hours worked in the previous year are not available.

Gender wage ratios are estimated controlling for age and marital status through a standard Mincerian regression. More specifically, we regress log wages on a second-order age polynomial, a marital status dummy, and interacted dichotomous indicators for college and gender.[22] The predicted gender wage ratios are obtained by taking exponentials of the corresponding skill–gender interaction parameters.

Table A4 Taxes and Subsidies

	Taxes		Subsidies on care			
	Income	Consumption	Old-age	Incapacity	Family	Total
Canada	0.21	0.17			0.011	0.01
Nordic						
Denmark	0.34	0.30	0.069	0.091	0.092	0.25
Finland	0.36	0.20	0.044	0.041	0.060	0.14
Norway	0.32	0.22	0.094	0.026	0.082	0.20
Sweden	0.25	0.49	0.087	0.081	0.083	0.25
Average	*0.31*	*0.33*	*0.074*	*0.066*	*0.081*	*0.22*
Western						
Austria	0.40	0.22	0.018	0.015	0.019	0.05
Belgium	0.42	0.16	0.013	0.021	0.042	0.08
France	0.39	0.22	0.017	0.003	0.053	0.07
Germany	0.38	0.17	0.001	0.034	0.044	0.08
Netherlands	0.36	0.20	0.039	0.017	0.029	0.08
UK	0.25	0.17	0.013	0.013	0.044	0.07
Average	*0.37*	*0.19*	*0.019*	*0.017*	*0.037*	*0.07*
Southern						
Greece	0.34	0.18	0.000	0.001	0.013	0.01
Ireland	0.24	0.19	0.009	0.003	0.023	0.03
Italy	0.37	0.21	0.003	0.004	0.026	0.03
Portugal	0.29	0.19	0.003	0.001	0.017	0.02
Spain	0.30	0.12	0.018	0.007	0.025	0.05
Average	*0.30*	*0.18*	*0.007*	*0.003*	*0.021*	*0.03*
USA	0.20	0.07	0.001		0.020	0.02

Notes
Labour income and consumption taxes are obtained from McDaniel (2020). Subsidies are constructed following Ngai and Pissarides (2011), and are expressed as fractions of the sectoral output in the substitutable services sector.

Additional model results

Table A5, an extended version of Table 5, reports the model results for each country in the benchmark simulation. Tables A6–A8, extended versions of Table 7, report the model results for each country in the decomposition with income tax, consumption tax and subsidy, respectively. Tables A9 and A10 report the sensitivity analysis of alternative parameter values.

Table A5 Gender Ratios: Differences from the USA

	Gender hour ratio				Gender wage ratio			
	Low-skilled		High-skilled		Low-skilled		High-skilled	
Country	Data	Model	Data	Model	Data	Model	Data	Model
Canada	4.78	−2.46	4.22	−1.77	0.77	0.18	8.00	0.13
Denmark	0.64	−4.62	2.22	−3.41	12.16	0.32	7.82	0.26
Finland	8.83	−5.75	5.29	−4.21	2.84	0.43	−1.23	0.33
Norway	−0.91	−3.02	1.22	−2.23	1.11	0.20	−1.77	0.17
Sweden	2.99	−5.72	8.50	−4.20	3.19	0.42	4.25	0.33
Austria	−7.97	−9.27	−11.57	−6.78	−0.26	0.75	11.70	0.56
Belgium	−9.71	−8.62	−4.48	−6.30	6.70	0.68	11.41	0.51
France	−1.85	−8.78	−3.67	−6.42	4.69	0.70	8.66	0.53
Germany	−6.36	−7.20	−6.36	−5.26	2.34	0.56	2.33	0.42
Netherlands	−17.22	−7.10	−7.38	−5.18	−0.57	0.55	2.81	0.41
UK	−12.71	−2.75	−4.29	−2.00	2.27	0.20	3.37	0.15
Greece	−12.86	−7.23	−6.41	−5.25	8.68	0.57	11.91	0.42
Ireland	−15.89	−3.62	−6.25	−2.62	9.35	0.27	15.15	0.19
Italy	−17.78	−8.65	−12.40	−6.31	12.72	0.69	9.86	0.51
Portugal	9.63	−5.65	8.23	−4.10	−1.63	0.43	7.02	0.32
Spain	−11.67	−3.64	−2.34	−2.64	1.83	0.27	9.99	0.20
USA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western and southern Europe								
Average difference	−9.49	−6.59	−5.17	−4.81	4.19	0.52	8.56	0.38
Correlation		0.15		0.48		0.28		0.39
Coefficient of determination		0.50		0.58		0.11		0.07
All countries								
Average difference	−5.50	−5.88	−2.22	−4.29	4.14	0.45	6.96	0.34
Correlation		0.27		0.47		0.24		0.37
Coefficient of determination		0.31		0.19		0.10		0.07

Notes
This table reports differences from US values (i.e. (Europe − USA) ∗ 100). Low-skilled individuals are those without a college degree. Data cover years 2007–15.

Table A6 Decomposition with Income Tax Only: Differences from the USA

	Gender hour ratio				Gender wage ratio			
	Low-skilled		High-skilled		Low-skilled		High-skilled	
Country	Data	Model	Data	Model	Data	Model	Data	Model
Canada	4.78	−0.03	4.22	−0.02	0.77	0.00	8.00	0.00
Denmark	0.64	−4.85	2.22	−3.50	12.16	0.35	7.82	0.25
Finland	8.83	−5.74	5.29	−4.14	2.84	0.42	−1.23	0.30
Norway	−0.91	−4.03	1.22	−2.90	1.11	0.29	−1.77	0.20
Sweden	2.99	−1.75	8.50	−1.26	3.19	0.12	4.25	0.08
Austria	−7.97	−7.10	−11.57	−5.13	−0.26	0.53	11.70	0.39
Belgium	−9.71	−8.03	−4.48	−5.82	6.70	0.61	11.41	0.45
France	−1.85	−6.82	−3.67	−4.93	4.69	0.51	8.66	0.37
Germany	−6.36	−6.49	−6.36	−4.69	2.34	0.48	2.33	0.35
Netherlands	−17.22	−5.80	−7.38	−4.18	−0.57	0.42	2.81	0.31
UK	−12.71	−1.58	−4.29	−1.13	2.27	0.11	3.37	0.08
Greece	−12.86	−4.76	−6.41	−3.43	8.68	0.34	11.91	0.25
Ireland	−15.89	−1.22	−6.25	−0.87	9.35	0.08	15.15	0.06
Italy	−17.78	−6.19	−12.40	−4.47	12.72	0.46	9.86	0.33
Portugal	9.63	−3.01	8.23	−2.16	−1.63	0.21	7.02	0.15
Spain	−11.67	−3.25	−2.34	−2.33	1.83	0.23	9.99	0.16
USA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western and southern Europe								
Average difference	−9.49	−4.93	−5.17	−3.56	4.19	0.36	8.56	0.26
Correlation		0.15		0.48		0.18		0.25
Coefficient of determination		0.43		0.53		0.08		0.05
All countries								
Average difference	−5.50	−4.42	−2.22	−3.19	4.14	0.32	6.96	0.23
Correlation		0.24		0.48		0.23		0.16
Coefficient of determination		0.29		0.26		0.08		0.05

Notes
This table reports differences from US values (i.e. (Europe − USA) ∗ 100). Low-skilled individuals are those without a college degree. Data cover years 2007–15.

Table A7 Decomposition with Consumption Tax Only: Differences from the USA

	Gender hour ratio				Gender wage ratio			
	Low-skilled		High-skilled		Low-skilled		High-skilled	
Country	Data	Model	Data	Model	Data	Model	Data	Model
Canada	4.78	−2.20	4.22	−1.55	0.77	0.12	8.00	0.08
Denmark	0.64	−5.03	2.22	−3.57	12.16	0.30	7.82	0.21
Finland	8.83	−3.01	5.29	−2.13	2.84	0.17	−1.23	0.12
Norway	−0.91	−3.30	1.22	−2.34	1.11	0.19	−1.77	0.13
Sweden	2.99	−8.52	8.50	−6.09	3.19	0.56	4.25	0.39
Austria	−7.97	−3.28	−11.57	−2.32	−0.26	0.19	11.70	0.13
Belgium	−9.71	−2.12	−4.48	−1.50	6.70	0.12	11.41	0.08
France	−1.85	−3.45	−3.67	−2.44	4.69	0.20	8.66	0.14
Germany	−6.36	−2.25	−6.36	−1.59	2.34	0.13	2.33	0.09
Netherlands	−17.22	−2.95	−7.38	−2.08	−0.57	0.17	2.81	0.12
UK	−12.71	−2.33	−4.29	−1.64	2.27	0.13	3.37	0.09
Greece	−12.86	−2.55	−6.41	−1.80	8.68	0.14	11.91	0.10
Ireland	−15.89	−2.75	−6.25	−1.95	9.35	0.16	15.15	0.11
Italy	−17.78	−3.07	−12.40	−2.18	12.72	0.18	9.86	0.12
Portugal	9.63	−2.78	8.23	−1.96	−1.63	0.16	7.02	0.11
Spain	−11.67	−1.15	−2.34	−0.81	1.83	0.06	9.99	0.04
USA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western and southern Europe								
Average difference	−9.49	−2.61	−5.17	−1.84	4.19	0.15	8.56	0.10
Correlation		0.19		0.38		0.26		0.41
Coefficient of determination		0.28		0.31		0.03		0.02
All countries								
Average difference	−5.50	−3.17	−2.22	−2.25	4.14	0.19	6.96	0.13
Correlation		−0.24		−0.34		0.20		−0.03
Coefficient of determination		0.12		−0.06		0.04		0.02

Notes
This table reports differences from US values (i.e. (Europe − USA) ∗ 100). Low-skilled individuals are those without a college degree. Data cover years 2007–15.

Table A8 Decomposition with Subsidy Only: Differences from the USA

	Gender hour ratio				Gender wage ratio			
	Low-skilled		High-skilled		Low-skilled		High-skilled	
Country	Data	Model	Data	Model	Data	Model	Data	Model
Canada	4.78	−0.28	4.22	−0.19	0.77	0.01	8.00	0.01
Denmark	0.64	6.67	2.22	4.55	12.16	−0.20	7.82	−0.10
Finland	8.83	3.46	5.29	2.37	2.84	−0.13	−1.23	−0.07
Norway	−0.91	5.14	1.22	3.51	1.11	−0.17	−1.77	−0.09
Sweden	2.99	6.65	8.50	4.54	3.19	−0.20	4.25	−0.10
Austria	−7.97	0.86	−11.57	0.59	−0.26	−0.04	11.70	−0.02
Belgium	−9.71	1.50	−4.48	1.03	6.70	−0.06	11.41	−0.04
France	−1.85	1.40	−3.67	0.96	4.69	−0.06	8.66	−0.03
Germany	−6.36	1.59	−6.36	1.09	2.34	−0.07	2.33	−0.04
Netherlands	−17.22	1.74	−7.38	1.19	−0.57	−0.07	2.81	−0.04
UK	−12.71	1.31	−4.29	0.90	2.27	−0.05	3.37	−0.03
Greece	−12.86	−0.19	−6.41	−0.13	8.68	0.01	11.91	0.01
Ireland	−15.89	0.37	−6.25	0.25	9.35	−0.02	15.15	−0.01
Italy	−17.78	0.31	−12.40	0.21	12.72	−0.01	9.86	−0.01
Portugal	9.63	−0.01	8.23	−0.01	−1.63	0.00	7.02	0.00
Spain	−11.67	0.80	−2.34	0.55	1.83	−0.03	9.99	−0.02
USA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Western and southern Europe								
Average difference	−9.49	0.88	−5.17	0.60	4.19	−0.04	8.56	−0.02
Correlation		−0.24		−0.28		0.24		0.24
Coefficient of determination		−0.13		−0.14		−0.01		0.00
All countries								
Average difference	−5.50	1.96	−2.22	1.34	4.14	−0.07	6.96	−0.04
Correlation		0.34		0.45		−0.11		0.46
Coefficient of determination		−0.14		−0.02		−0.02		0.00

Notes
This table reports differences from US values (i.e. (Europe − USA) ∗ 100). Low-skilled individuals are those without a college degree. Data cover years 2007–15.

Table A9 Robustness: Model Predictions on Gender Ratios for Western and Southern Europe

	Gender hour ratio						Gender wage ratio					
	Low-skilled			High-skilled			Low-skilled			High-skilled		
	Diff.	Corr.	Determ.	Diff.	Corr.	Determ.	Diff.	Corr.	Determ.	Diff.	Corr.	Determ.
Benchmark	−6.59	0.15	0.50	−4.81	0.48	0.58	0.52	0.28	0.11	0.38	0.39	0.07
$\sigma = 1.5$	−5.24	0.15	0.45	−3.84	0.48	0.54	0.41	0.28	0.09	0.31	0.39	0.06
$\sigma = 2.3$	−7.90	0.15	0.52	−5.74	0.47	0.58	0.61	0.28	0.13	0.45	0.40	0.08
$\eta = 2.3$	−6.54	0.15	0.50	−4.77	0.48	0.58	0.64	0.28	0.14	0.48	0.39	0.09
$\eta = 4$	−6.64	0.15	0.50	−4.84	0.48	0.58	0.40	0.27	0.09	0.30	0.39	0.06
$\eta_l = 0.1$	−6.68	0.15	0.50	−4.88	0.48	0.58	0.56	0.28	0.12	0.41	0.39	0.08
$\eta_l = 0.9$	−6.22	0.15	0.49	−4.49	0.48	0.57	0.33	0.29	0.08	0.26	0.39	0.05
$\rho_l = 0.5$	−6.60	0.15	0.50	−4.82	0.48	0.58	0.51	0.28	0.11	0.38	0.39	0.07
$\rho_l = 2$	−6.59	0.15	0.50	−4.80	0.48	0.58	0.52	0.29	0.12	0.38	0.39	0.07
$\rho_h = 2$	−6.54	0.15	0.50	−4.83	0.48	0.58	0.46	0.28	0.10	0.37	0.40	0.07
$\rho_2 = 0.9$	−6.97	0.15	0.50	−5.24	0.48	0.58	0.52	0.28	0.11	0.39	0.40	0.07
$\eta_2 = \eta_3 = 4$	−6.75	0.15	0.50	−4.91	0.48	0.58	0.48	0.27	0.11	0.34	0.39	0.06

Notes
Low-skilled individuals are those without a college degree. 'Diff.' refers to the average model prediction on the differences from the USA (i.e. (Europe − USA) ∗ 100). 'Corr.' refers to the correlation between model and data. 'Determ.' refers to the coefficient of determination.

Table A10 Robustness: Model Predictions on Gender Ratios for All Countries

	Gender hour ratio						Gender wage ratio					
	Low-skilled			High-skilled			Low-skilled			High-skilled		
	Diff.	Corr.	Determ.	Diff.	Corr.	Determ.	Diff.	Corr.	Determ.	Diff.	Corr.	Determ.
Benchmark	−5.88	0.27	0.31	−4.29	0.47	0.19	0.45	0.24	0.10	0.34	0.37	0.07
$\sigma = 1.5$	−4.67	0.27	0.31	−3.43	0.47	0.23	0.36	0.25	0.08	0.28	0.38	0.06
$\sigma = 2.3$	−7.06	0.27	0.29	−5.13	0.46	0.11	0.54	0.25	0.12	0.40	0.38	0.08
$\eta = 2.3$	−5.84	0.27	0.31	−4.26	0.47	0.19	0.56	0.25	0.13	0.43	0.38	0.09
$\eta = 4$	−5.92	0.27	0.31	−4.33	0.47	0.18	0.35	0.24	0.08	0.26	0.38	0.05
$\eta_l = 0.1$	−5.96	0.27	0.31	−4.36	0.47	0.18	0.49	0.25	0.11	0.36	0.38	0.07
$\eta_l = 0.9$	−5.55	0.27	0.32	−4.01	0.47	0.20	0.29	0.26	0.07	0.23	0.38	0.05
$\rho_l = 0.5$	−5.89	0.27	0.31	−4.30	0.47	0.19	0.45	0.25	0.10	0.34	0.37	0.07
$\rho_l = 2$	−5.88	0.27	0.31	−4.29	0.47	0.19	0.45	0.25	0.11	0.34	0.37	0.07
$\rho_h = 2$	−5.83	0.27	0.31	−4.31	0.47	0.18	0.40	0.24	0.09	0.32	0.39	0.07
$\rho_2 = 0.9$	−6.22	0.27	0.31	−4.67	0.47	0.16	0.45	0.25	0.10	0.34	0.38	0.07
$\eta_2 = \eta_3 = 4$	−6.01	0.27	0.31	−4.38	0.47	0.18	0.42	0.24	0.10	0.30	0.37	0.06

Notes
Low-skilled individuals are those without a college degree. 'Diff.' refers to the average model prediction on the differences from the USA (i.e. (Europe − USA) ∗ 100). 'Corr.' refers to the correlation between model and data. 'Determ.' refers to the coefficient of determination.