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Hours Inequality*

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Abstract

The vast literature on earnings inequality has so far largely ignored the role played by hours of work. This paper argues that in order to understand earnings dispersion we need to consider not only the dispersion of hourly wages but also inequality in hours worked as well as the correlation between the two. We use data for the US, the UK, France, and Germany over the period 1991-2016 to examine the evolution of inequality in hours worked and of the correlation between individual hours and wages, assessing their contribution to recent trends in earnings inequality. We find that, other than in the US, hours inequality is an important force, and that it has increased over the period under analysis. The elasticity of hours with respect to wages has also played a key role, notably in the two continental economies. This elasticity used to be negative, thus tending to reduce inequality as those with lower hourly wages worked longer hours, but has increased over the past decades, becoming nil or positive, and hence eroding an important equalizing force. The paper examines which are the potential factors behind the change in the elasticity, notably the role of trade and labour market institutions

JEL Classification*: D31, J22*

Key words*:* Earnings inequality, working hours, hours elasticity.

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1 Introduction

Over the past decades, a vast literature has documented changing patterns in the distribution of earnings in high-income countries.[1] The timing and the extent varies across countries, with some having experienced an increase in the 1980s and then stability (e.g. the UK), others witnessing increased inequality only in recent years (e.g. Germany). Changes in the dispersion of hourly wages have been seen as the major explanation for these differences. Earnings are, however, the product of hourly wages and hours of work, yet the behaviour of the latter has received little attention in the literature. This is particularly surprising in the light of the evolution of average hours of work, as a number of papers have shown a divergence in working patterns between the US and Europe since the 1970s and a decline in average hours in many countries.[2] Just as the average of working hours differs across countries and over time, its distribution may also have changed, thus contributing to overall earnings inequality. The aim of this paper is to document the extent of inequality in working hours and its impact on the distribution of earnings in four countries.

Figure 1 plots the distribution of weekly hours worked by employed individuals in our sample countries, France, Germany, the UK and the US.[3] The data cover a 5-year period, 2012-2016, so as to avoid choosing a single, potentially unrepresentative, year. The distribution of hours is fairly concentrated in France and the US, with about a third of individuals working between 36 and 42 hours, and France exhibiting a bimodal distribution following the introduction of the 35-hour week.[4] The distributions are much more dispersed in Germany and the UK, both of which present thick tails at both ends of the distribution. These differences raise the question of to what extent hours inequality has contributed to changes in earnings inequality.

In this paper we use the methodology we developed in Checchi et al. (2016) and proceed in three steps. First, following our earlier work, we decompose earnings inequality using as our inequality index the mean log deviation (MLD), an inequality index belonging to the general entropy family. The role of hours dispersion is not straightforward as it depends on the correlation between hours and hourly wages. If the two are positively correlated, a more unequal distribution of hours will reinforce wage inequality. However, when the correlation is negative, that is, when those with the lowest wages work the most, hours inequality will tend to dampen wage dispersion making the distribution of earning less unequal than that of wages. Our decomposition of earnings dispersion then involves three terms: inequality in

[1] See, for instance, Juhn et al. (1993) and Atkinson (2007).

[2] See, for instance, Prescott (2004), Bell and Freeman (2001), Alesina et al. (2006), and Blundell et al. (2013).

[3] See below for details on the data.

[4] The distribution for the US is consistent with that obtained by Lachowska et al. (2022). The aim of their paper is, however, different as they mainly seek to assess the quality of administrative records on working hours.

hourly wages, inequality in hours and a term capturing the covariance between hours and hourly wages, with the latter term being positive or negative depending on whether the two variables are positively or negatively correlated. As in our earlier paper, we consider Germany, France, the UK and the US, but extend the period of analysis to 1991-2016.

We then seek to understand the factors that may have driven the changes observed in hours worked. The second step in our analysis hence consists in estimating individual hour equations in which the key variable of interest is the individual's hourly wage. This relationship is seen as a statistical correlation, and we make no assumptions on causality since the hour-wage correlation can be the result of labour supply or labour demand forces. Hours worked are hence regressed on wages, as well as on individual and job characteristics, controlling for selection into employment on the basis of family characteristics. These regressions allow us to compute a (non-causal) elasticity of hours with respect to wages in order to understand how the dynamics – over time and across-countries – of this elasticity have contributed to changes in earnings inequality.

The final step consists in accounting for the factors that may shape the wage-hour elasticity. To guide our empirical approach we develop a simple model with supply and demand for labour. On the one hand, individuals have an elastic labour supply that depends on both wages and personal characteristics such as gender. On the other, firms simultaneously chose the number of workers and the hours they each work, and are subject to fixed costs, institutional constraints and demand shocks. The implication of our model is that the observed wage-hour elasticity is determined by these factors, hence we estimate the hours regression by including the interaction of the wage with both labour market features and macroeconomic shocks. This allows us to understand which shocks have shaped the elasticity displayed by a particular county in a particular year.

Our results indicate that in the US and France the overall contribution of hours and the covariance with earnings inequality is moderate, with wages accounting for at least two-thirds of inequality in earnings. In contrast, these two terms play a crucial role in the UK and Germany, being responsible for up to 52 percent of the dispersion in earnings. The dispersion of hours worked remained stable in the US, fell in the UK, and rose in France and, especially, in Germany. When we look at hours worked by quintile of the wage distribution, we find that these patterns are the result of different dynamics across countries. In the UK the reduction in hours inequality was driven by a decline in the hours worked by all except those in the bottom quintile; in the continental economies we document a decline in the hours worked by those in the bottom half of the distribution.

We also find that the dynamics of the hours-wage correlation are an important element. Wages and hours move together in the UK and the US economies, while in France and Germany they are negatively correlated at the start of the sample period, implying that part of the dispersion in wages was offset by low-wage individuals working more. These countries

exhibit, however, an increase in the covariance over time and by the end of the period, those with higher wages also work longer hours. In the case of Germany, this change accounts for a third of the increase in earnings inequality; in France, it has implied that earnings inequality has remained roughly constant despite a decrease in the dispersion of hourly wage rates. That is, the equalizing force due to those with lower wages working longer hours seems to have been eroded over time.

To understand what drives the covariance term, we focus on the elasticity of hours with respect to wages. The data display a positive and stable elasticity in the UK and the US, while in the other two economies it is initially negative and increases over time. Changes in population shares were a driver of inequality, as the increase in the employment share of women, who tend to work fewer hours than men, implied a rise in overall hours dispersion. Yet, the elasticity has also increased for men in the two continental European economies. We hence proceed to account for possible correlates of the wage-hour elasticity by interacting the wage with labour market institutions and macroeconomic variables. We find that greater trade openness or output volatility raise the elasticity, in line with the hypothesis that trade and uncertainty force firms to be more competitive and hence increase the correlation between hours and wages. Overall, our results indicate that increased uncertainty and trade and weakening labour market institutions can be behind the observed increase in the elasticity and thus in hours and earnings dispersion.

Our paper is related to several strands of literature. There is a substantial literature on cross-country differences in average working hours which has largely focused on documenting the divergence between the US and Western European economies; see, amongst others, Prescott (2004), Alesina et al. (2006), and Blundell et al. (2013). Recent work indicates that hours worked per person are on average 14 percent lower in Europe than in the US, although there are vast differences as the gap ranges from 7 percent fewer hours in Eastern Europe to 25 percent in Southern Europe (Bick et al., 2021). We complement this literature by arguing that it is important to consider not only how hours vary across countries but also how they vary across individuals within a country, and document the extent of within-country hours inequality.

Our main contribution is to advance our understanding of what drives earnings dispersion by focusing on the neglected role of hours. There is little work on inequality and working time. Bell and Freeman (2001) and Bowles and Park (2005) argue that greater wage inequality is associated with higher average hours of work, hence the increase in wage inequality that occurred over the last decades is likely to have spurred an increase in hours worked. Our analysis implies that the impact of this mechanism on earnings inequality depends on two channels: how unequal the hours response is across individuals and on the correlation of hours worked and hourly wages. In Checchi et al. (2016) we proposed the decomposition method and carefully addressed the issue of data comparability for the four countries that we

examine in this paper. Here, we have extended the period of study and examined the factors behind the dispersion of hours worked and the correlation between hours and wages. Closest to our work is Beckmannshagen and Schröder (2022), who use our methodology to examine German data. They find, as we do, that the major driver of rising earnings inequality in Germany over the past decades has been the change in working hours. Moreover, using data on desired working time, they document that much of the change has been driven by the underemployment of low-wage workers who are in involuntary part-time work and unable to realize their preferred volume of working hours.

The paper is also related to a small body of work that has documented the increase in leisure inequality in the US during the second half of the 20th century (Aguiar and Hurst, 2007; Sevilla et al., 2012). This finding can be reconciled with our result that inequality in hours worked barely changed in the US both because the papers above look at a much longer period of time than we do and because the increase in leisure time enjoyed by the low-skilled employed men relative to their high-skilled counterparts is largely driven by an increased involvement of the latter in child-care (Aguiar and Hurst, 2007). We share with these works an emphasis on the importance of broadening the set of variables for which we examine distributional outcomes, notably the allocation of time to differnt activities.

Lastly, a vast literature has examined the determinants of individual hours of work focusing on the supply side of the labour market in shaping working time (Blundell and McCurdy, 1999; Chetty et al., 2011; Keane, 2011). More recently, an alternative approach has emerged which considers how changes in demand affect the distribution of hours across different occupations (Goos et al., 2009; Autor and Salomons, 2017; Ngai and Petrongolo, 2017). This latter strand suggests that the trends in demand are the central element behind broad patterns of working hours, and in particular of the observed polarization in employment. Our work follows this literature and adds an analysis of how the various factors that affect labour supply impact– through their effect on hours – the distribution of earnings.

The paper is organized as follows. Section 2 describes our empirical approach, presenting first our decomposition of the inequality index and next a simple model that allows us to consider the supply and demand elements that may affect the wage-hours elasticity. Section 3 describes the data. Section 4 presents our main results, starting with a decomposition of earnings inequality. We then estimate individual hour regressions which yield an elasticity of hours with respect to wages that changes across countries and over time. The changes in the estimated elasticity are then correlated with changes in the institutional frameworks by interacting hourly wages with demand and supply shocks. We conclude in section 5.

2 Empirical strategy

2.1 Decomposing earnings inequality

The first step in our empirical strategy consists of decomposing the inequality index in order to assess the contribution of inequality in hours of work to earnings inequality. We will then examine the determinants of differences in the distribution of hours of work, in order to try to understand the elements that can explain changes in earnings that do not stem directly from the behaviour of hourly wages.

Defining total earnings of individual i as y_i, we can write them as the product of the hourly wage, w_i, and the number of hours worked, h_i. That is,

$$y_i = w_i h_i. \tag{1}$$

Our two terms of interest appear multiplicatively and, as a result, there are few inequality indices that can be satisfactorily decomposed. As we argue in Checchi et al. (2016), a suitable index is the mean log deviation (MLD), an index belonging to the general entropy (GE) family. The MLD, also called Theil's L index, is the general entropy index for α =0, and shares a number of desirable properties of this class of indices.[5]

The MLD is defined as the standard deviation of the logarithm of the variable of interest, that is

$$I_y = \frac{1}{N}\sum_{i=1}^{N} \ln \frac{\bar{y}}{y_i}, \tag{2}$$

where N is the number of observations and $\bar{y}$ is average earnings.[6] Inequality in earnings can be expressed as the sum of three components: inequality in hourly wages, inequality in hours worked, and a component capturing the correlation between hours worked and hourly wages. Denote by I_w and I_h the MLD of hourly wages and hours worked, namely,

$$I_w = \frac{1}{N}\sum_{i=1}^{N} \ln \frac{\bar{w}}{w_i}, \tag{3}$$

$$I_h = \frac{1}{N}\sum_{i=1}^{N} \ln \frac{\bar{h}}{h_i}, \tag{4}$$

where $\bar{w}$ and $\bar{h}$ are the average levels of the two variables. Define $cov(w,h)$ as the covariance between hourly wages and hours worked, and note that $cov(w,h) = \overline{y} - \overline{w}\overline{h}$. Then, equation (2)

[5] The parameter α in the GE class of indices captures the weight given to income differences at various parts of the income distribution. For lower values of α, such as $\alpha = 0$, GE is particularly sensitive to changes in the lower tail of the distribution. See Atkinson (1983).

[6] This index was first shown to be decomposable by Duro and Esteban (1998).

can be expressed as the sum of (3) and (4) plus a third term capturing the covariance between hours worked and hourly wages. That is,

$$I_y = I_w + I_h + \underbrace{ln\left(1+\frac{cov(w,h)}{\bar{w}\bar{h}}\right)}_{\rho} \tag{5}$$

These three terms represent the absolute contributions to inequality of the various elements. The first two terms are simply inequality in hourly wages and in hours worked, and both are positive. The third term, denoted ρ, captures the covariance between hours and wages. If the covariance is negative, this term will be negative, reducing earnings dispersion. The contribution of hours to overall inequality hence crucially depends on the covariance. Whenever the correlation between hours and wages is negative, a greater dispersion of hours tends to reduce overall inequality. If, instead, the correlation is positive, hours inequality magnifies the impact of wage inequality on earnings dispersion.

2.2 The determinants of hours worked

The second step in our analysis consists in identifying what are the factors determining both the dispersion of hours and the way they covariate with wages. The term ρ is determined by the covariance between hours and wages, with $cov(w, h)$ being a purely statistical concept that makes no assumptions about causality. A correlation between the two variables can hence be the result of supply-side factor or of the fact that, on the demand side, certain jobs imply certain hour-wage combinations. To understand which factors may affect the demand-side or supply-side correlation we present a simple model that considers both in turns.

2.2.1 A simple model

Labour supply Hours may vary across individuals because they choose to supply more or less labour. To examine some possible determinants, suppose that the individual's utility function takes the form $U = (c - \overline{c})^a / a - bh$, where c is consumption, $\overline{c}$ a minimum consumption requirement, h are hours worked and a and b are positive parameters. She maximizes utility subject to the budget constraint $c = wh + x$, where x is non-labour income. The source of this income can vary, and the term captures both capital income stemming from accumulated wealth or an income transfer from a spouse.

The resulting optimal hours chosen by the individual are then given by

$$h = \frac{1}{w}\left(\overline{c} - x + \left(\frac{w}{b}\right)^{\frac{1}{1-a}}\right).$$

This expression implies that there are both income and substitution effects, as a higher wage

may increase or decrease the hours worked. Note also that the higher the consumption requirement relative to wages, the more the individual works, while the higher her non-labour income is, the less she works. This second effect implies that both women with spousal income and those with capital income will work fewer hours. Women will also work less than men if they have a higher disutility of hours worked (higher b, potentially due to greater household responsibilities).

The elasticity of hours worked with respect to wages is given by

$$\varepsilon = \frac{dh}{dw}\frac{w}{h} = \frac{1}{1-a}\frac{(w/b)^{\frac{1}{1-a}}}{(w/b)^{\frac{1}{1-a}} + \overline{c} - x} - 1,$$

which is increasing in non-labour income. Women who enjoy some of their husband's income will hence tend to have higher elasticities, as will individuals who have accumulated savings in the past. Moreover, ε will be positive if and only if $a/(1-a)\,(w/b)^{\frac{1}{1-a}} > (\overline{c} - x)$. That is, the elasticity can be positive or negative depending on whether the income or the substitution effect dominates. Note that a high minimum consumption requirement, $\overline{c}$, implies a negative elasticity; as its value falls relative to both wages and non-labour income, the elasticity becomes positive. Over a long time span, such as the one we consider, it is conceivable that changes over time in wages relative to $\overline{c}$ change the sign of this elasticity.

For our purposes, the analysis indicates that a number of factors can be behind the changes in both individual hours and their correlation with wages. On the one hand, the distribution of hours worked can change if the composition of the population changes, as individuals with different disutility of work (b) and/or non-labour income (x) become more or less numerous in the labour force. Notably, women have historically worked fewer hours and displayed a greater wage elasticity than men.[7]

On the other, the elasticity of hours with respect to wages may change over time for a particular category of individuals, thus affecting the covariance term. For example, as wages grow, the elasticity can shift from being negative to being positive; while changes in the minimum consumption requirement, $\overline{c}$, will also have an impact. The elasticity can also change if, for instance, women become less reliant on their spouses' income or if the amount of capital income received changes (e.g. if returns to assets change).

Labour demand To examine possible demand-side factors affecting this covariance consider the following simple partial-equilibrium model. Suppose that firms have tasks to be performed. A task requires a labour input of $\overline{l}$. Consider a worker i, whose hours of work h_i are assumed to exhibit diminishing returns, so that the actual labour input she provides is given by h_i^z

[7] See the reviews in Killingsworth and Heckman (1986) and Blundell and McCurdy (1999), as well Arntz et al. (2022) as on the heterogeneous labour-leisure preferences of men and women post-covid using the same data source we use for Germany.

with $0 < z < 1$.[8] The actual total labour input for the firm, l, is then given by $\sum_{i=1}^{n} h_i^z$. This expression implies that the more workers a firm uses, the more labour input they will get from a given number of hours.

The tendency to employ many workers is offset by the fixed costs associated with employing a worker. We suppose that there is a fixed administrative cost c_a and a firm-specific cost c_f. The first term includes things like administrative costs of payment, monitoring, organizing shifts, worker insurance, or compensation of workers for their commuting time and cost. The second cost can be thought of as the transmission of firm-specific knowledge or skills to the worker, and we assume that it is zero for the unskilled as there is no investment by the firm, but positive for the skilled.

The firm wants to hire the number of workers n that minimizes the cost of producing the task, which is given by $C(n) = n\left(\bar{l}/n\right)^{1/z} w + n\left(c_a + c_f\right)$, with the wage being exogenous and taken as given by the firm. The optimal number of workers and hours of work are then given by

$$n^* = \bar{l}\left(\frac{1-z}{z}\frac{w}{c_a+c_f}\right)^z, \tag{6}$$

$$h^* = \left(\frac{\bar{l}}{n}\right)^{1/z} = \frac{z}{1-z}\frac{c_a+c_f}{w}. \tag{7}$$

Our simple model has several implications. First, note that hours and employment are both positively correlated with demand as captured by $\bar{l}$, as a greater demand is spread along both the intensive and the extensive margins. Second, within a skill category, i.e. for given costs, these expressions imply a negative correlation between hours and wages –as those with a lower wage will be offered contracts with more hours– and thus a negative elasticity, equal to -1 under our assumptions. The intuition is simple. The firm faces a trade-off between the fixed cost and the reduction in productivity as workers work more; a low wage implies that it is not very costly to have individuals working long, not-very-productive hours, and the firm prefers to pay more in wages than in fixed costs. Second, the model implies that if we compare the skilled and the unskilled, the gap in hours can be either positive or negative. The higher wage of the skilled implies contracts with fewer hours but their higher cost (since $c_f > 0$) leads to contracts with more hours.[9] Either effect could dominate.

Moreover, the wage-hour contract offered may change over time. For example, if technology reduces the administrative cost c_a, hours will tend to fall. If c_f is large relative to c_a, this effect could be large for the unskilled but negligible for the skilled, for whom the main cost

[8] Empirical evidence of decreasing marginal productivity of worked hours in a day can be found in Collewet and Sauermann (2017).

[9] Note that $\bar{l}$ or z could also differ across skill groups. For example, tasks performed by the skilled could take longer or diminishing returns be weaker.

is the investment made by the firm. Those with low wages would hence be offered contracts with fewer hours in response to the change in administrative costs, while those with higher wages would not be affected.

We can also consider the role of labour market institutions. Suppose that there is a minimum number of hours required by law, η.[10] Suppose also that the optimal number of hours is such that $h^* < \eta$, i.e. they are below the legal contractual hours. The firm then needs to decide if to hire n^* workers and make them work the contractual hours η or if to hire $n^* - 1$ and have them work over-time. It is possible to show that there exists a $\overline{\eta}$ threshold value so that when $\eta > \overline{\eta}$ the firm prefers to hire $n^* - 1$ workers and have them work overtime.[11] A reduction in η, i.e. a weakening of labour market institutions, would make this inequality less likely to hold and can hence result in firms hiring more workers but offering them contracts with fewer hours.

Our partial equilibrium framework implies that there are both supply and demand considerations that affect the correlation between hours and wages. The demand function derived above implies a negative correlation, while supply-side effects indicate that the elasticity of hours with respect to wages can be either negative or positive, depending on the substitution and income effects. The interplay between the two will depend on whether the short or the long-side of the market prevails. These aspects indicate that both demand and institutional variables as well as the composition of the labour force, whether in terms of skills or gender, play an important role in the observed aggregate elasticity.

2.2.2 Hour regressions

Our analysis above indicates that both individual hours – and hence their dispersion – and the covariance between hours and wages can change in response to changes in the population composition – as preferences, marriage patterns, and non-labour incomes change – as well as in demand and supply forces that are affected by the institutional framework. In order to identify the forces behind the changes in hours inequality and the covariance term we estimate a regression for hours worked that will help us understand how individual characteristics affect h and give us values for the elasticity of hours with respect to hourly wages.

Suppose, to start with, that individual hours are given by

$$\ln h_{i(c)t} = \alpha + \beta \ln \frac{w_{i(c)t}}{\overline{w}_{ct}} + \gamma X_{i(c)t} + \delta Z_{ct} + u_{i(c)t}, \tag{8}$$

[10] Some countries have such laws. Notably, France imposes a minimum week of 24 hours on certain sectors and types of firms; see Carry (2022).

[11] To see this, note that if the firm hires $n^* - 1$ workers, they will each work $\overline{h} = \left(\overline{l}/(n^* - 1)\right)^{1/z}$ hours. We suppose that $\eta < \overline{h}$. The firm then compares the costs of hiring n^* workers and making them work 'too much', $C(n^*) = n^* \left(\eta w + c_a + c_f\right)$, or hiring one less worker at cost $C(n^* - 1) = (n^* - 1)\left(w\overline{h} + c_a + c_f\right)$. The firm prefers to hire n^* workers and have them all work η hours if and only if $\eta < \overline{\eta} = (1 - 1/n^*)\overline{h} - (c_a + c_f)/wn^*$.

where $h_{i(c)t}$ are hours worked by individual i in country c at time t, and $w_{i(c)t}$ is her hourly wage. $X_{i(c)t}$ is a vector containing the characteristics of individual i at t. Z_{ct} is a vector containing variables at the country level that capture the effect of, for example, labour market institutions, trade openness, or output volatility, and which vary over time, and $u_{i(c)t}$ is the error term. Country/year heterogeneity is controlled by country and year fixed effects. Our main parameter of interest is β. We assume that hours are correlated to the individual's wage relative to the average one. Given that we are using a log-log specification this has no effect on the estimate of β, but allows more a more intuitive decomposition of inequality when we look at a long period of time during which average wages grow.

Several remarks are in order. First, it is important to highlight that the elasticity β should not be interpreted as a causal impact of wages on hours but simply as a correlation because both wage and hours change in equilibrium, depending on the nature of the shock. Second, hours worked depend on personal characteristics and ideally we would have liked to use information on spousal income and capital income, but these are not available in all datasets. We hence use age, gender, educational attainment, whether the individual is foreign-born, household income (excluding that of the respondent), whether there is a self-employed individual in the household, marital status and the number of children as regressors. Lastly, recall that worked hours are observed if and only if a worker is hired, which raises the issue of selection into employment. In the empirical analysis we will hence account for potential biases by modelling the selection equation and including the Mills's ratio, $\widehat{\lambda}$, obtained from an associated selection amongst the individual characteristics in equation (8).[12]

Equation (8) implies a common elasticity of hours with respect to wages across countries and over time. Yet, our model indicates that gender, labour market institutions and the macroeconomic environment can affect the correlation between hours and wages. In order to allow for variation in the elasticity, we estimate an hours regression that allows, on the one hand, for interactions between gender and wages and, on the other, between the wage and the country-level variables. That is,

$$\ln h_{i(c)t} = \alpha + \alpha_f \cdot \phi_i + \beta \ln w_{i(c)t} + \beta_f \cdot \phi_i \ln w_{i(c)t} + \gamma X_{i(c)t} + \delta Z_{ct} + \beta_z Z_{ct} \cdot \ln w_{i(c)t} + u_{i(c)t} \quad (9)$$

where ϕ_i is a dummy variable identifying females. Since we have allowed for the interaction of the vector of country characteristics Z_{ct} with the wage, and these characteristics vary over time, then the overall elasticity will vary across countries and years, as well as across the genders. Thus the elasticity prevailing in country c on year t for men and women, respectively, will be given by

$$\widehat{\beta}_{mct} = \widehat{\beta} + \widehat{\beta}_z Z_{ct}, \quad (10)$$

[12] See below for further details on the selection equation.

$$\widehat{\beta}_{fct} = \widehat{\beta} + \widehat{\beta}_f + \widehat{\beta}_z Z_{ct}. \tag{11}$$

Allowing the elasticity to vary over time and across countries implies that hours inequality can be written as

$$I_{hct} = \ln \overline{h}_{ct} - \alpha_c + \beta_{ct} I_{wct} - \gamma \overline{X}_{ct} - \delta Z_{ct}, \tag{12}$$

where $\overline{X}_{ct}$ is the expected value of $X_{i(c)t}$. Using equation (12), we can rewrite earnings inequality, (2), as

$$I_{yct} = \ln \frac{\bar{y}_{ct}}{\overline{w}_{ct}} + (1 + \beta_{ct}) I_{wct} - \gamma \overline{X}_{ct} - \delta Z_{ct} - \alpha_c. \tag{13}$$

This expression allows us to compute the contribution to changes in inequality of various elements. The first term captures the ratio of average earnings to average hourly wages, and takes into account scale effects as both wages and earnings grow over time. It corresponds to (the log of) a weighted average of hours, where the weights are given by $w_{it}/\bar{w}_t$. The second term reflects both changes in wage inequality and in the elasticity of hours, and captures the fact that depending on this elasticity a given increase in wage inequality will have a stronger or weaker impact on earnings inequality. In particular, a negative β has the effect of dampening earnings inequality, while a positive β implies a magnifying effect of hours. The third term captures the impact of individual characteristics and measures how changes in demographics affect the distribution of hours worked and hence earnings inequality. For example, if women work, on average, fewer hours than men, then an increase in the share of women in employment will tend to increase hours dispersion and thus earnings inequality. Lastly, Z_{ct} captures the effect of country-level characteristics that affect hours worked

Other things constant, we can use equation (13) to describe the evolution of earnings inequality by means of changes in the estimated elasticity. Moreover, the decomposition in equation (13) allows us to perform a series of counterfactuals. If hours depended only on individual characteristics and not on the wage, i.e. $\beta = 0$, we would have $I_{yct} = \ln \bar{y}_{ct}/\overline{w}_{ct} + I_{wt} - \gamma \overline{X}_{ct} - \delta Z_{ct} - \alpha_c$, and a change in wage inequality would only have a direct effect.

3 Data

We use an updated version of the harmonized dataset we constructed for Checchi et al. (2016) that relies on different national surveys collected from national statistical institutes. These are household or labour force surveys for the US, the UK, Germany, and France, covering three decades, starting in 1991, and going up to between 2016 and 2019, depending on the country. In particular, we use the *Current Population Survey* for the US, the *British Household Panel Survey* and, from 2009, *Understanding Society* for the UK, the *German Socio-Economic*

Panel for Germany, and the *Enquete Emploi* for France (which becomes the *Enquete Emploi en temps continue* in 2003). Although changes in the survey design, notably the US in 1994 and France in 2003, require a careful interpretation of the results, all the surveys have been widely used in the empirical literature on inequality.[13] Measurement, comparability and alternative data sources are discussed in detail in Checchi et al. (2016).

Our sample is composed of prime-age workers, i.e. individuals aged between 25 and 54, who are dependent employees in either the private or the public sector. As is well established, employment patterns for young and for mature workers differ substantially across countries, much more than for prime-age workers. Focusing on this age group allows us to abstract for differences in the education system and in retirement possibilities. We also exclude the self-employed since the treatment of this type of workers varies across national surveys, as we discuss in our earlier work.[14] Details on sample sizes by country and year are provided in the Appendix.

Our two key variables of interest are weekly earnings and hours worked, out of which we then compute the hourly wage. For both variables we use questions referring to the current job of the individual. This contrasts with papers that use annual hours and earnings and compute wages from those. There are good reasons for not pursuing this path, since both unemployment rates and vacation patterns vary substantially across countries, gender and age, and would have a major impact on measured hours. Focusing on a snapshot of weekly hours/earnings implies greater comparability of the data.[15]

The measure of earnings that we employ is the usual gross income from labour that the individual receives over a week from the main current job, including both contractual wages and overtime pay.[16] Hourly wages are then computed by dividing earnings by hours worked. Hours are defined as follows. For most of the databases we use "usual hours worked in the main current job", which include both contractual hours and "usual hours of overtime" (although exceptional overtime is not included).[17] The harmonization of this variable was not straightforward due to coding problems. First, we had to make sure that it included both

[13] See, for instance, Murphy and Welch (1992) for an application using CPS data, Bell and Freeman (2001) for the GSOEP, and Blundell et al. (2013) for an international comparison of hours of work.

[14] Including income for the self-employed would be interesting as they tend to be over-represented at the top and bottom of the distribution. However, we decided against it for two reasons. The first is that this group is not always treated in the same way across countries and surveys. The second is that they are characterized by high non-response and under-reporting rates. For example, the self-employed are not asked about current usual earnings in the CPS, and in the BHPS, over one fifth of self-employed respondents either refuse to give information or do not know how much they earn. We therefore decided to remove the self-employed from our sample.

[15] When possible, we focused on the same period of the year, notably the first quarter or the month of March, to avoid capturing cross-country differences that may be due to seasonality as the first quarter is not affected by major holidays (as the third is) nor by performance pay (as is the fourth).

[16] Except for France where only labour income net of social security contributions is available.

[17] Actual hours, in contrast, may include exceptional over time. Actual hours were used to complement usual hours in the US if respondents answered that usual hours vary. This is not a possible reply in the other surveys.

contractual hours and overtime. Second, it is a variable that is often truncated. In particular, Germany truncates at 90 hours per week and the USA at 99 hours. Given the issue we are interested in, this may be a concern as truncation affects the upper tail of the distribution of hours worked. Inspection of the data indicates that this is not the case since we did not find a concentration of observations at the truncation points. We hence consider only workers that spend at least 2h a week working on their main job, and truncate hours worked at 90 hours for all four countries. We will use job and sector interactions as further controls for heterogeneity in labour demand. Descriptive statistics are reported in Table A.1.

Although these data are the most suitable available and have been extensively used in previous work on both inequality and wages, two caveats are in order. First, data are for the main job and hence income and hours from additional jobs are not accounted for. If those at the bottom of the distribution are more likely to have multiple jobs, then we may be underestimating both their hours and their income, thus overestimating inequality; the opposite occurs if it is those at the top that have multiple jobs (e.g. managers doing external consultancy or doctors working in a secondary practice). This problem is common to the literature using labour market data to compute earnings or wage inequality. The under-reporting of earnings could be overcome by using fiscal data, however these data are not useful for our purposes since hours are not reported in tax records. Second, Borjas (1980) argues that computing wages as we do is problematic due to what he refers to as the 'division bias', i.e. the risk of downward-biased estimates of the elasticity of hours with respect to hourly wages if hours are miscomputed. Unfortunately, none of the surveys has data on all three variables, so there is no alternative option. Under the assumption that the measurement error in hours is consistent throughout the survey waves, the trends should be well identified.

These individual data are used to compute, on the one hand, the inequality index and its decompositions, and on the other the hour regressions that will give us information on the elasticity of hours with respect to the wage. In the second part of the analysis we include variables that can affect hours worked. As we argued above, the elasticity of hours may differ across job categories; we hence consider the role of both occupation and industry. We group occupations and industries into three categories each. We follow Goos et al. (2009) and divide occupations into top, middle and bottom-paying ones, while we loosely follow Autor and Salomons (2017) for the grouping of industries into (1) manufacturing, agriculture, mining and construction, (2) capital-intensive and health and education services, and (3) labour-intensive services. We also include a separate category for public sector workers.[18] The resulting ranking of occupations and the classification of industries are provided in tables A.2 and A.3 in the Appendix, respectively.

We also consider the impact of country-level variables in order to understand the role of

[18] In order to avoid having too few observations in certain industries, we group the categories in Autor and Salomons (2017) into three rather than five categories. See Table A.3 in the Appendix.

the supply and demand sides of the labour market in determining inequality.[19] To measure institutions that impact the supply of labour, we use the degree of employment protection on individual dismissal concerning permanent and temporary contracts, an indicator of union density, the presence of a minimum wage, the generosity of unemployment benefits and the legislation on parental leave, both its maximum length and the number of paid weeks. We argue that both unionisation and strict employment regulation promote wage rigidity and, therefore, decrease hour flexibility. We expect those variables to be negatively correlated with the elasticity of hours with respect to hourly wages. In contrast, a more generous parental leave or unemployment benefit increase flexibility and are thus expected to raise the elasticity.

Concerning the demand side, we focus on indicators that capture the demand for skills, output volatility and trade openness. By doing so, we account for changes in the profile of jobs, business cycles, and globalization. We use an aggregate measure of volatility and trade openness common to all sectors to measure the business cycle and exposure to trade. An additional proxy for demand is investment. As well as total investment, we use the composition of investment which we view as a proxy for the demand for skills, with more IT or R&D investment being associated with an increase (decrease) in the demand for high-skill (low-skill) labour with which this type of investment is complementary (substitute).

A complete list of the variables used as proxies for the supply side and the demand side of the labour market is presented in the data Appendix. Descriptive statistics of the aggregate datasets are provided in Table A.4 respectively, while time trends of the aggregate variables are reported in Figures A.2 and A.3.

4 Results

4.1 Decomposing earnings inequality

The decomposition of the Mean Log Deviation (MLD) of weekly earnings is presented in Figure 2, which plots the evolution over time of earnings inequality as well as of its three components, and in Table 1 which presents the corresponding figures for selected years.[20] In Table 1, we also report the relative contributions of wage dispersion, hour dispersion, and the covariance term that are obtained by dividing the three additive terms by earnings inequality so that they add up to 1. The top left panel of Figure 2 shows the evolution of the level of inequality in earnings, with high levels of overall dispersion in the UK and the US (the MLD index ranges between 0.27 and 0.31) and low ones in France (around 0.15). Over the period 1995-2016, earnings inequality grew by 4% in the US, remained constant in France, and fell by 10% in the UK. In Germany, earnings dispersion initially declined from 0.21 in 1991 to 0.19

[19] As detailed in the appendix, the data are from the OECD database and from the Penn World Tables; see Penn World Tables and OECD website for details.

[20] For additional years refer to Tables B.1, B.2, B.3, and B.4.

in 1995 (with the lowest value being 0.18 in 1994), and then rose sharply (by 48%), reaching a level comparable to that in the Anglo-Saxon economies (0.28 in 2016).[21]

The US and the UK show different patterns concerning the role of wage and hours inequality. The US records the highest wage inequality, with an increase in the MLD from 0.17 to 0.19, and has a low and roughly constant MLD of hours. As a consequence, hourly wages explain a large fraction of inequality in earnings, reaching 68%. In contrast, in the UK high (but lower than in the US) wage inequality is accompanied by a high dispersion of hours, and wage dispersion initially accounted for only 49% of the overall dispersion. With wage inequality stable over the period, inequality in hours falling and the covariance term becoming less positive, this share increased over time to reach 57% in 2015, higher than in the early 1990s but well below that observed in the US.

In Germany the increase in earnings dispersion is a result of three factors all moving in the same direction: higher wage dispersion, higher hours inequality, and a growing covariance term that went from being negative to being positive.The contribution of wages declined markedly, from 76% in 1992 and 72% in 1995 to 52% by the end of the period we study, while that of the correlation rose sharply. France stands out as the least unequal country in our sample. The slight increase in hours dispersion was accompanied by two offsetting factors: falling wage inequality (with the MLD of wages reaching values below 0.10) but a growing covariance term which, as is the case for Germany, went from being negative to being positive. As a result, the contribution of wages fell: it accounted for 81% in 1991, 75% in 1995 and only 60% in 2016.[22]

The bottom graphs of Figure 2 depict the absolute contribution of the dispersion of hours worked and of the covariance between hours and hourly wages, respectively. The patterns just described are apparent there. Hours inequality increased markedly in Germany, while it decreased in the UK. Concerning the contribution to earnings inequality of the covariance between hours and wages, we identify two different patterns: the UK and the US exhibit a mildly positive covariance, constant over time, explaining around 10% of overall inequality in those countries; Germany and France both exhibit negative or nil contributions in the 90's and positive values after the year 2000. Hence this term went from being an equalising force to becoming an unequalising one.

The figures in Table 1 allow us to compute the contribution of changes in the three terms to the overall change in earnings inequality over the period 1995-2016. In the US, the change was driven by wage inequality which accounts for 150% of the change in earnings inequality and is partially offset by the fall in the covariance term. In the UK the reduction in I_y is mainly due to the fall in I_h (which accounts for 61% of the change) and of ρ (36%). France

[21] Changes in sampling are clearly visible for the US in 1994, for Germany in 2003, for France in 2008, and for the UK in 2009.

[22] Our results on wage dispersion in France and Germany are in line with those in Kügler et al. (2018).

exhibits a decline in wage inequality which is exactly offset by a higher correlation term. In Germany, only 18% of the change is due to higher wage dispersion, the rest being caused by greater hour inequality (14%) and, above all, by a higher ρ (68%).

4.2 Hours worked by quintiles

In order to explore further the role of hours of work, we examine the evolution of average hours worked by quintiles of the hourly wage distribution. We partition the sample into quintiles according to their position in the distribution of hourly wages. The results are reported in Figure 3 which plots the evolution of average hours worked for each group in each country.

Our data identify a novel pattern: with the exception of Germany and France during the initial years, those with higher wages tend to work more. These gaps, however, vary across countries and over time. The US presents a stable pattern in which the lower the quintile the fewer hours individuals work, a pattern consistent with a standard labour supply in which the substitution effect dominates the income effect, and exhibits a large gap between the bottom quintile and the rest, with this group working (on average over the period) 5 fewer hours than the top one. Germany and the UK exhibit greater dispersion in the average hours by group, consistent with the greater overall dispersion that we identified earlier. The UK is striking in that those at the bottom of the wage distribution work less than anywhere else, although their hours increase over the sample period (from 30 hours in 1991 to 33 in 2016). In contrast, higher quintiles have slightly reduced their work hours, resulting in lower dispersion across groups at the end than at the start of the period. Germany presents the opposite pattern, with dispersion rising over time. The differences across quintiles are small in the early 1990s and widen over time. There is a marked decline in hours worked by the second and, especially, the first quintile, stability in the middle of the distribution, and an increase in the hours worked by those in the top quintile. The bottom and top quintiles worked, respectively, 38 and 39 hours in 1991 and 32 and 41 hours in 2016.

France stands out in various dimensions. In the early 1990s, it was the top and bottom quintiles that exhibited the lowest average hours, with the other three groups working more. The dynamics are characterised by a decline in working hours up to the early 2000s for all groups, except the top quintile for which there was no change. Thereafter there was an increase that was steeper for higher quintiles, so that by 2016 we observe the same pattern prevalent in other countries with higher quintiles working more. The gap is nevertheless smaller than in the other three economies, with the bottom quintile working 35 hours and the top 38 in 2016. The increase in working hours is surprising given that in 2000 France moved from a 39- to a 35-hour week, and is consistent with existing evidence on its limited impact.[23]

[23]The aim of the reform was to reduce hours per worker so as to increase employment rates, yet existing evidence indicates that there was no significant impact on the latter; see, for example, Chemin and Wasmer (2009).

The increase in working hours supplied by top earners that we observe in Germany and France is consistent with various arguments found in the literature. Corneo (2015), for instance, states that the increase in the progressivity of the tax-transfer system probably had differential effects across skill levels. The income effect is likely to have increased work effort among the high-skilled (and hence high-wage) workers, who seek to maintain living standards. Instead, both the substitution and the income effects may have led to a decrease in work hours for those in the lower part of the skill distribution.

Bell and Freeman (2001) claim that wage dispersion can be a source of hour dispersion. They argue that when earnings inequality is higher within an occupation, those in the occupation have greater incentives to get a promotion, and they react by working more so as to signal commitment and increase the chances of a promotion. An equivalent argument applies if earnings dispersion increases within the top quintile, inducing longer hours to try to get to the top of the quintile.

The UK and Germany display strikingly different behaviours of the poorest workers. In 2016, the less-well-paid worked on average around 32 hours a week in both countries, but while in the UK this is the result of an increase over the previous two decades, in Germany it was the result of a dramatic reduction in hours worked from a level that was close to that of other quintiles in the early 1990s. Differences in labour market regulation between the two countries could explain these patterns. As argued by Burda and Hunt (2011) increased flexibility in Germany favoured a positive labour demand change that increased the extensive margin of previously inactive workers, largely driven by female participation.[24] On the other hand, in the UK, a minimum wage was introduced in 1999, and kept increasing since. Such a policy might potentially have had the effect of reducing the demand for workers at the lower end of the wage distribution, in favour of more unemployment or better jobs, especially among low-skilled young workers.

4.3 Hours regression

We turn next to the determinants of individual hours and their elasticity with respect to hourly wages. We start by considering selection into employment. Table 2 presents the correlations between the probability of employment and various potential determinants of participation and employment, with the first column reporting the coefficients when all workers are pooled and the next two columns looking at men and women separately. Gender is important, with women exhibiting a probability of employment that is 13.5 percentage points lower than that for men, and the coefficients differing considerably across genders. The effect of age exhibits an inverted U-shape, which peaks at a younger age for women, and being of $foreign\ origin$ displays a negative coefficient, suggesting potential discrimination and/or segregation

[24] See Burda and Hunt (2011) for details on the Hartz reform and Caliendo et al. (2019) on the introduction of the minimum wage in Germany in 2015.

in the labour market.[25] Not surprisingly, educational attainment is positively correlated with employment, with an estimated employment differential of over 18 percentage points between a low-educated person and a college graduate, with the effect being lower for men and higher for women.

Four possible conditions are considered as potential candidates for exclusion restrictions in the selection equation. First of all, we take into account the possibility of an income effect, by summing the incomes of all family members (excluding the respondent's). This variable is an imperfect proxy for household income since we do not observe the earnings of the self-employed. We hence also include a dummy for the presence of at least one self-employed among the working members of the household. In line with the literature, we also include marital status and the number of children in the household. Household income exhibits a positive coefficient rather than the negative one that the theory would predict. This may be capturing assortative mating which implies that high earners marry individuals that are strongly committed to the labour market. The presence of self-employed in the household has a positive and significant coefficient, consistent with a positive income effect. Being single increases the likelihood of being employed, with the effect being much stronger for women than for men, while the coefficient on the number of children is positive for men and negative for women, as found in previous work.[26]

As is standard in the literature, from the selection equation we obtain the estimated *Mills ratio*,[27] which is then included in the regression for hours of work in order to correct for the bias induced by selection into the labour market. Note that both in the selection equation and in the following hours estimation, institutional differences across countries are controlled by country×year dummies. Table 3 reports the results for our regressions of hours worked, starting with the simplest version, where we only control for demographics (column 1). Females work fewer hours (between 40 and 50% fewer) than men, the wage elasticity is slightly positive for men and highly positive for women, and older people tend to work less than younger individuals.[28] Selection into employment is important, as shown by columns 2

[25] We exclude from the regression those who self-declare to be self-employed without indicating their level of earnings because in the Heckman procedure they would be considered non-employed as they do not report any income. Assigning them to non-employment barely changes the estimated coefficients.

[26] Most of the literature has focused exclusively on female selection, but recent work has started to address the question of male employment; see Arellano and Bonhomme (2017), Dolado et al. (2020), and Elass (2022). This literature points at the fact that while selection issues were usually seen as self-selection into the labour force, which was traditionally seen as absent for men, high rates of unemployment imply that selection into employment can also be driven by demand and hence is likely to affect men. Admittedly these are poor proxies for selection in our framework, since they do affect both the extensive margin (being employed or not) and the intensive margin (how many hours one wants to work). However we are constrained by the cross-country comparability of the information, and this is what is consistent across the four countries.

[27] It is computed from $Mills_i = \frac{f(\widehat{p}_i)}{F(\widehat{p}_i)}$ where $\widehat{p}_i$ is the individual predicted probability of employment, $f(\cdot)$ is the normal density function and $F(\cdot)$ is the cumulative normal function.

[28] The coefficient on *foreign origin* (not reported) is small and negative in column 1, zero when selection is considered (column 2), and becomes positive when separate *Mills ratio* are considered (columns 3). This

and 3, in which the *Mills ratio* is included in the regression. We consider two possibilities: in column 2 we do not distinguishing between selection for the two genders (corresponding to column 1 of Table 2), while in column 3 we allow for different selection equations for men and women (columns 2 and 3 of Table 2). In both cases the wage elasticity for men is not significantly different from zero once we control for selection, while the estimated elasticity for women is around 0.10.[29] In line with the recent literature, we consider a common *Mills ratio* in the next columns.[30] In column 4 we add educational attainment, which is positively associated to hours, though with a small elasticity. If we aim to isolate a "pure" wage effect, we should abstract from constraints associated to job requirements, as captured by the combination of skill by sector (column 5 of Table 3). In this case the elasticity for men is negative and significant (-0.031), while that for women remains positive (0.068) but smaller than that obtained in the absence of job characteristics.

The fact that the female dummy exhibits a positive coefficient even when controlling for job characteristics is consistent with the idea that compositional changes are important in understanding the evolution of overall elasticities and the correlation term in our decomposition above. As the share of women in the labour market increased, overall wage elasticities become more positive, thus making hours dispersion an increasingly important aspect in accounting for earnings inequality. This is highlighted by Figure 4 which plots the estimated wage elasticity using dummies defined by gender×country×year, while controlling for age, education, origin and jobs. The UK and the US look rather similar, with a rigid supply of hours by men (the elasticities fluctuate around zero) and a positive elasticity for women. Conversely, in the case of France, it is the female elasticity which is close to zero, while the male one is clearly negative. Germany represents an intermediate case, transiting from an initial situation similar to that of France to one closer to that observed in the other two countries, although it has higher (positive) values.

The case of Germany has been explored in detail by Beckmannshagen and Schröder (2022). Following our methodology, they show that the major drivers of rising earnings inequality in

indicates that – when they hold the same jobs as natives – foreign-born workers do not work less than natives. The US survey contains information about the ethnicity of the interviewees, which is missing for the other countries. In order to assess whether this may be relevant, we constructed the variable *minority* which is one for both foreign-born and non-white individuals and zero otherwise. When we substitute *foreign* with textitminority, the latter displays a positive and significant coefficient.

[29] These estimates are in line with those found in the literature. For example, Bargain et al. (2014) build a dataset for 18 countries with comparable variable definitions over the period 1998-2005, and estimate the same labor supply model for each country to establish consistent cross-country comparisons. Elasticities for married women are in the range 0.2-0.4 for Germany, 0.1-0.2 for France, the UK and the US. For married men they find very low elasticities although significantly different from zero, in the 0.05-0.15 range.

[30] When we obtain the Mills ratio by estimating selection equations separately for men and women, our estimates remain roughly unchanged except for the elasticities with respect to wages. When we include all controls, like in column (5), the coefficient on the hourly wage goes from -0.031 to -0.026 and that on the wage interacted with being female falls from 0.099 to 0.082. That is, the elasticity is slightly lower for both men and women.

Germany over the past decades have been changes in working hours and not changes in wages, and that low-wage workers are particularly likely to experience underemployment. They also find that that involuntary part-time work and the inability to realize the preferred volume of working hours significantly contributes to the rising earnings inequality.

4.4 Hours elasticity, labour market institutions and demand shocks

In order to investigate further the determinants of hours inequality, we examine the correlation between wage elasticity and proxies for the demand and supply sides of the labour market and estimate equation (9). The vector Z_{ct} is a vector of country-level variables that capture the supply side of the labour market (union density, employment protection legislation (EPL) for permanent and temporary contracts, unemployment benefits, minimum wage and weeks of parental leave) as well as demand shocks affecting the quest for more flexible use of working hours (output volatility, trade openness, investments and its share in ICT and $R\&D$ components).

Our intuition is that more regulated labour markets (i.e. where unions are powerful, possibly supported by minimum wage legislation, firing is limited and the unemployed are supported by public subsidies) are associated with lower elasticities because working time has to be negotiated. However, when family-friendly policies are in place and allow for better reconciliation between housework and market employment, we expect the elasticity to increase, because the labour supply becomes more adaptable.

From the employers' perspective, a number of shocks imply an increasing demand for flexible use of working hours, which we have proxied with four measures. If aggregate demand becomes more volatile, other things constant, the employer seeks more flexibility to adapt to these fluctuations thus reducing contractual working hours. Similarly, increased competition induced by globalization increases the demand for adaptability, thus suggesting a demand for more elasticity. But the possibility of flexibility is also associated to technological constraints: thus investment in information and communication, as well as in research and development, should favour greater flexibility in hours applied to production.

As can be seen in Figures A.2 and A.3, the data display well-established patterns. The most relevant institutional variations characterising our sample are the decline of union presence in Germany and the UK, partially compensated by the increase in the minimum wage. Despite its low union density, France remains a regulated country, as indicated by the high level of employment protection, minimum wage and unemployment benefit. Conversely, the market flexibility of the US is apparent from the lack of employment protection, the declining minimum wage and the absence of parental leave. Employment protection of temporary work in Germany becomes weaker over time, being close to the one in France in 1990 and as low as that in the UK by the end of the period. Germany also witnessed changes to maternity leave

legislation after the year 2000.

On the demand side, Germany is the country most open to trade, though its technology (proxied by type of investment components) is less ITC- and R&D-oriented than that of the US, which, in contrast, is less exposed to external trade and demand fluctuations. Output volatility behaves in comparable ways across countries and captures the shock stemming from the Great Recession. The index for trade openness indicates a general increase in the propensity to trade.

We introduce these additional regressors in the estimation of the number of hours worked, both in levels and interacted with the hourly wage, while retaining the controls for selection into employment (Mills ratio), gender (also interacted with the wage), age, educational attainment, and foreign origin. Results are reported in Table 4. In column 1 we include full interacted institutional and demand shocks, showing that only the $female$ component of the workforce is associated with a significant (and negative) wage elasticity, which is reduced by *unions*, *minimum wage* and *employment protection legislation* for temporary contract. Not surprisingly, it is also positively associated to conciliation policies (parental leave) and to the unemployment benefit replacement rate. The latter may seem counter-intuitive, but note that when the value of the outside option increases average hours worked fall (as captured by the negative coefficient on *unemployment benefit*) but this fall is smaller the higher the individual's wage is (as captured by the interaction term).

When the demand shocks *output volatility* and *trade openness* are larger, the elasticity of hours with respect to wages is higher, while it is lower for higher values of the investment share. This may be explained by their multiplicative impact on the aggregate demand: getting closer to full employment reduces flexibility in the utilization of the available workforce. When considering the investment components, information and communication technologies seems not to significantly affect the elasticity, while higher investment in research and development is associated with a greater wage elasticity.

These results are robust in alternative specifications, which are introduced in the following columns. The first one concerns the impact of the minimum wage, which was in place for fewer years in the UK and Germany than in the other two countries. In order to keep a balanced panel, the regression in column 1 replaced the missing values with zero (as if the minimum wage were set to be nil), while we have dropped this artificial variable in column 2. All the estimated coefficients retain their sign and significance except the interaction of the wage and union density, suggesting that unions and the minimum wage act as substitutes with respect to the elasticity of hours worked.[31] In column 3 we introduce additional controls given by job types and public sector (coefficients not reported), which reduces the statistical

[31] An alternative solution we have explored to cope with the absence of a minimum wage is replacing it with the country mean of the same variable, which does not alter the estimated coefficient. In such a case, the interaction between the wage and unionization has a negative but not significant coefficient.

significance for the interactions of *union density*, *parental leave* and $R\&D$, confirming that agreements and regulations on hours of work are to some extent job-specific.

In column 4 we report our preferred specification, where we have removed wage interactions that are not statistically significant (employment protection legislation for permanent contracts and ICT investment). Note that the wage level (i.e. the wage elasticity associated to men in a country with no institutional constraints) remains statistically insignificant.[32] Country heterogeneity is controlled by country and year fixed effects, but results are robust to the inclusion of country×year fixed effects, as done in column 5. Lastly, in column 6 we show the beta coefficients (namely the estimated coefficients when the regressors are standardised) associated to the model estimated in column 4. The strongest impact on wage elasticity is associated to EPL for temporary contracts, followed by trade openness and investment.

In order to appreciate the role of contextual factors in shaping the dynamics of wage elasticity, we have considered the variations of supply and demand shocks over the common sample period 1991-2016 and we have multiplied the change by the estimated interaction coefficient. Table 5 displays the $\widehat{\beta}_z \Delta Z_{jc}$ for each shock j and each country c. We define, for each country and year, the overall wage elasticity as the sum of all the coefficients that include the wage. According to the table, the German elasticity has grown by 16.6 percentage points, mostly due to the reduction in employment protection (+10.3 p.p.) and by increased trade exposure (+7.5 p.p.). Similarly, the French elasticity grew by 6.3 percentage points, mostly driven by increase trade openness (+3.7 p.p.) and increased investment in R&D (+1.3 p.p.). The elasticities in the UK and the US exhibit limited fluctuations: in the case of the UK the decline of 2 percentage points is driven by the increase in the minimum wage (+4.1 p.p.), while in the case of the US it is impossible to identify a dominant factor.

Institutions and demand shocks are effective in driving the elasticity dynamics. In Figures 7 and 8 we have computed the predicted wage elasticity by simply using the estimated interaction coefficients multiplied by the observed contextual variables. By comparing with the previous graph, Figure 6, it is easy to recognise that our estimated model replicates well the change observed in Germany, as well as the lack of trend for UK and US. Our model does not fully capture the upward trend of hours elasticity in France, which is predicted to remain almost nil for women and negative for men.

5 Conclusion

This paper argues that earnings dispersion is partly determined by the dispersion of hours, an aspect that has been largely neglected by the literature. We decompose an inequality index, the mean log deviation, into three components: earnings dispersion, hours dispersion and the

[32] Removing the Mills ratio intended to control for self-selection does not change the sign, magnitude and statistical significance of the coefficients in column 4.

covariance between hours and wages. Our results indicate that while the contribution of hours worked to earnings inequality is moderate in France and the US, it explains between 30 and 40 percent of earnings inequality in Germany and the UK. Moreover, substantial changes have occurred during the period we examine, with hours dispersion falling markedly in the latter and increasing in the former country. The data also show a marked change in the covariance of hours worked and wages. In both France and Germany this correlation was negative in the 1990's and became positive over time, therefore shifting from being an equalizing force to contributing positively to earnings dispersion. In France, the stability of earnings inequality has in fact been the result of a falling dispersion of hourly wages and an offsetting increase in the correlation term. In Germany, the sharp increase in this correlation has been the main culprit behind growing earnings inequality.

The observed changes in hours inequality and the covariance with wages can be due to both composition effects and changes for a particular category of individuals. For example, women tend to work fewer hours than men and have a greater elasticity of hours with respect to wages, hence some of the observed changes could be due to increased female participation in the labour market over the past decades. Our results from individual hours regressions suggest that changes in the hour-wage elasticity are an important driver of earnings inequality in the UK, France, and, most notably, in Germany.

Since changes in the hour-wage correlation have been a major factor affecting the dispersion of earning, we provide an exploratory analysis of what can be behind such changes. The correlation we examine is a purely statistical relationship, and hence it could be that individuals with higher wages now work more (supply-side) or that jobs that pay lower wages also provide fewer hours (demand-side). Changes in population shares have had a substantial impact, with the increase in female employment observed in all countries tending to increase inequality. Our findings also indicate that stronger labour market institutions reduce the elasticity, while trade openness and greater output volatility magnify it. These results imply that demand-side considerations and weaker institutions are likely to be behind the changes in the covariance and hence are important factors behind the emergence of low-pay/few-hours jobs that seem to have been a key element in rising earnings inequality in certain countries.

Our analysis raises important questions that our current framework cannot answer. Those at the bottom of the wage distribution are working today less than they did two decades ago. Our positive analysis implies that this increases earnings inequality, but is silent about the welfare implications. If reduced working hours are the result of individual choices, the increase in leisure may offset the loss in relative income and result in higher welfare. Alternatively, if low-pay workers are unable to work as much as they would like—as Beckmannshagen and Schröder (2022) find is the case in Germany—then a deteriorated income position will be associated with under-employment and hence a loss in utility. Answering these questions requires both further data on both actual and desired hours of work, but also a conceptual

framework to fully spell out the welfare implications. We leave these questions for future work.

Figure 1: Distribution of hours worked by country, years 2012-2016

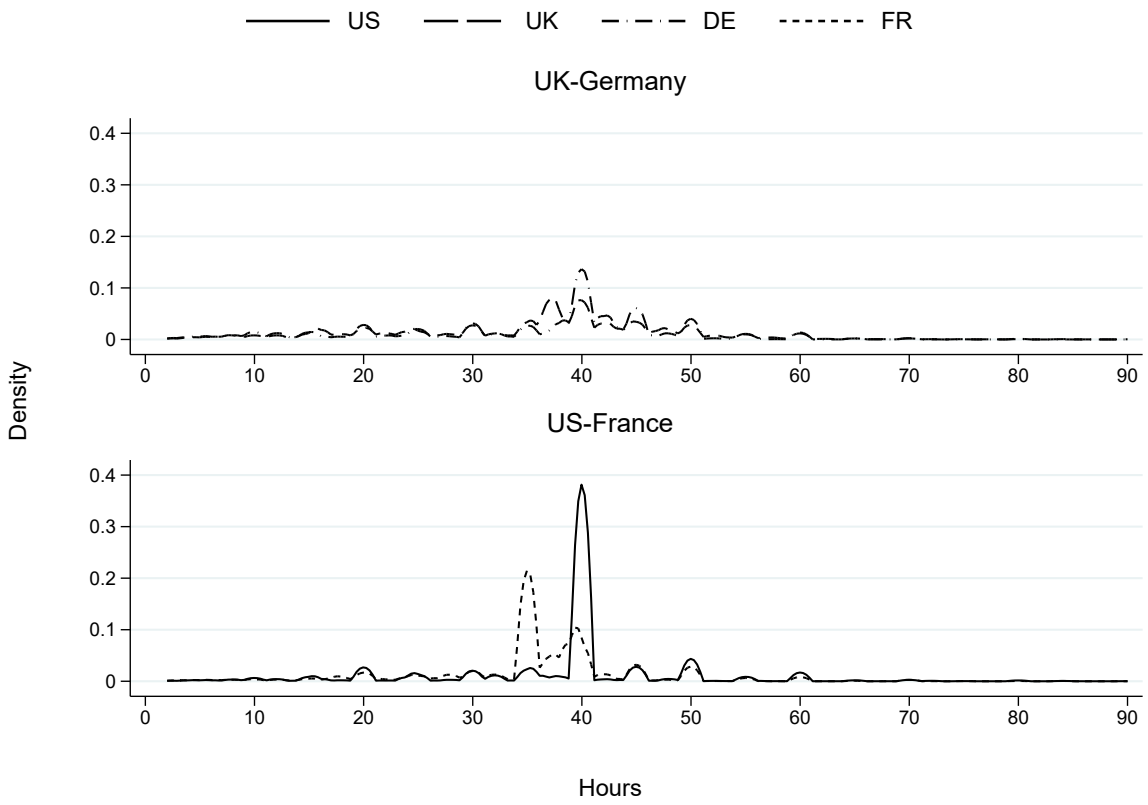


Figure 2: Decomposition of Earnings Inequality

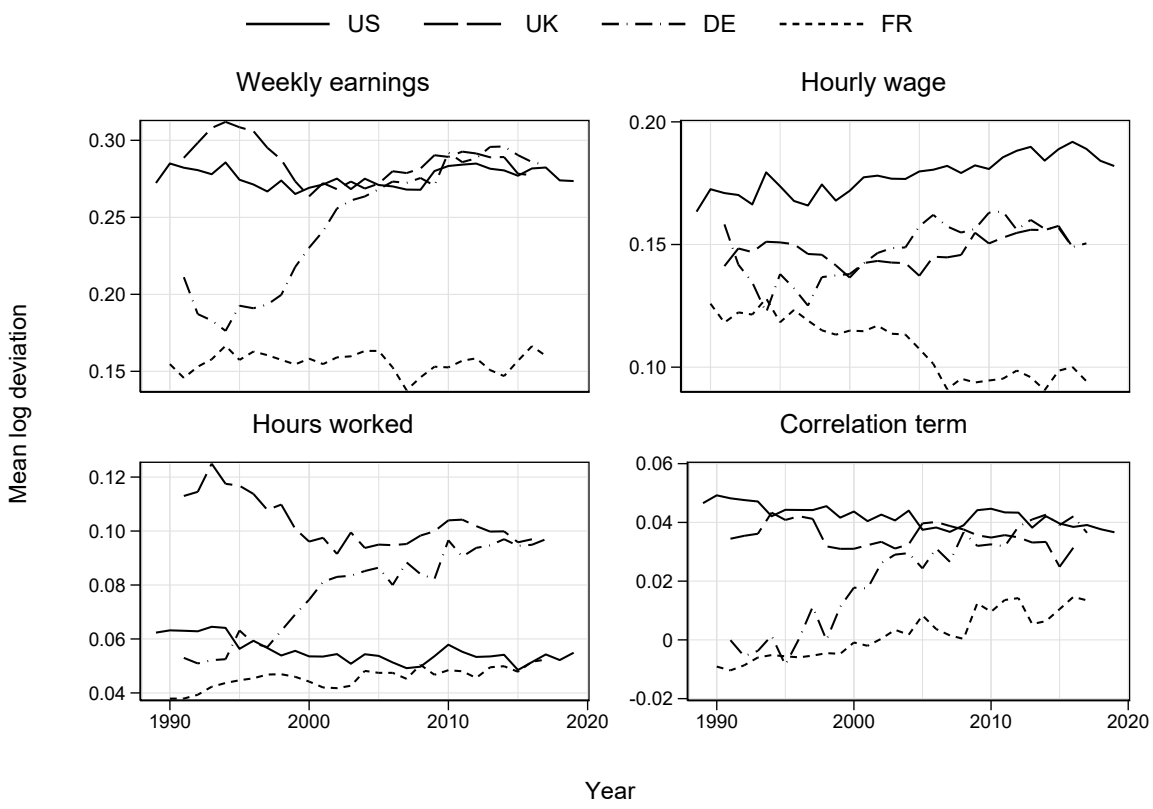


Figure 3: Average Hours Worked by Quintile of the Hourly Wage Distribution

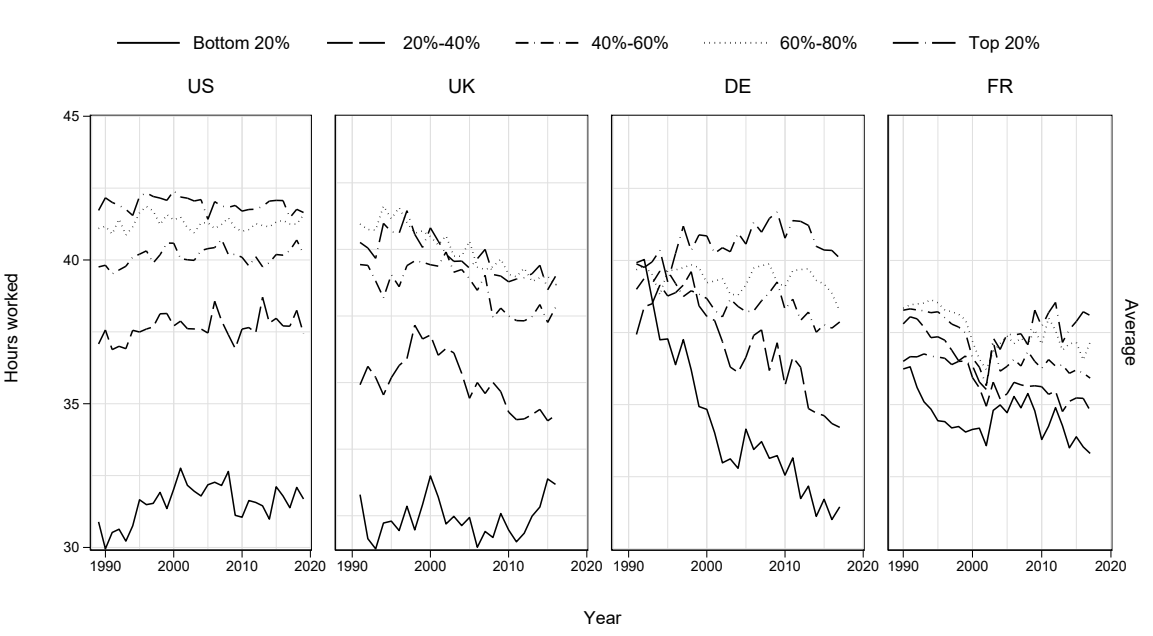
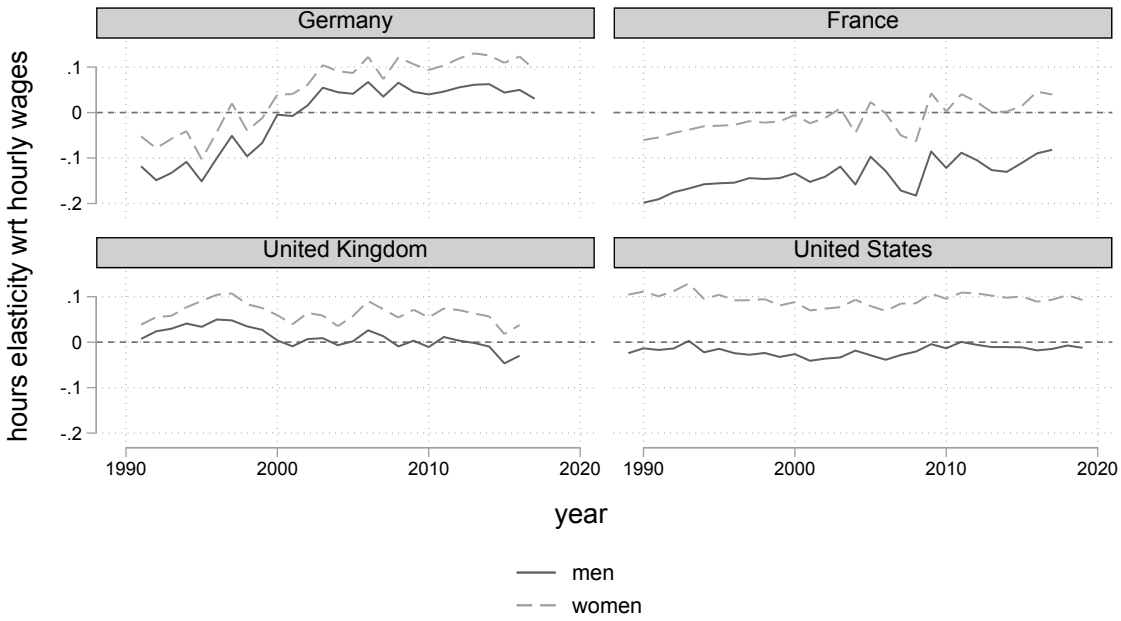


Figure 4: Elasticity of hours with respect to hourly wages



Estimates include controls for age and age², education, foreign born, job skill requirement, sector and country x year dummies - self-selection into employment controlled using household level information (single, number of children, others' incomes)

Figure 5: Simulated elasticity

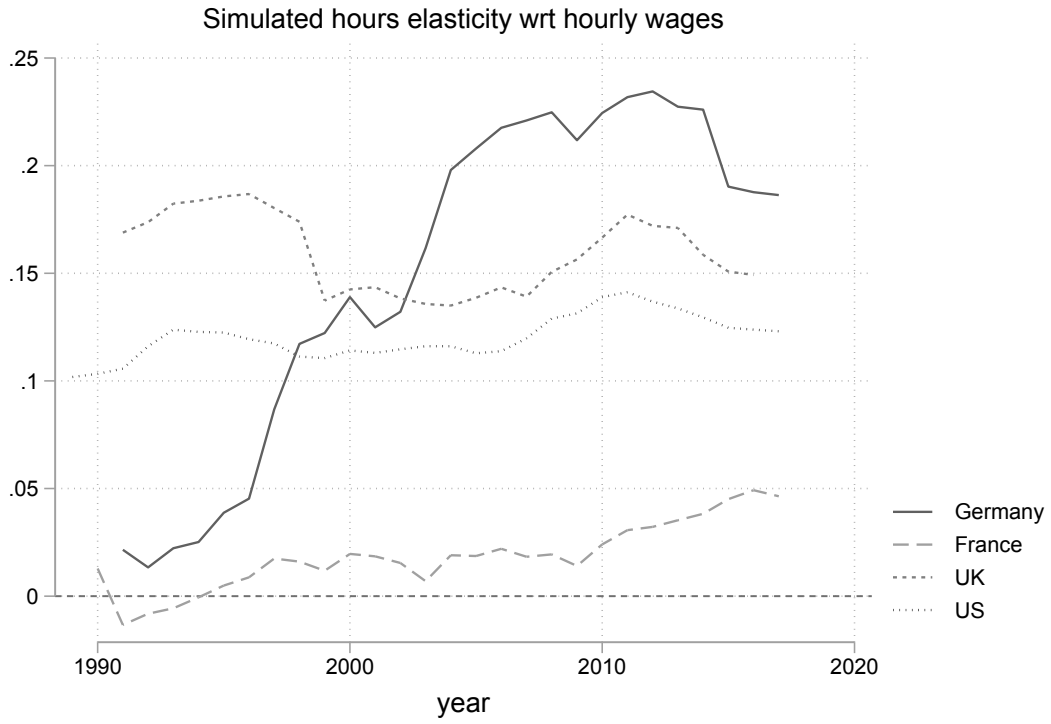
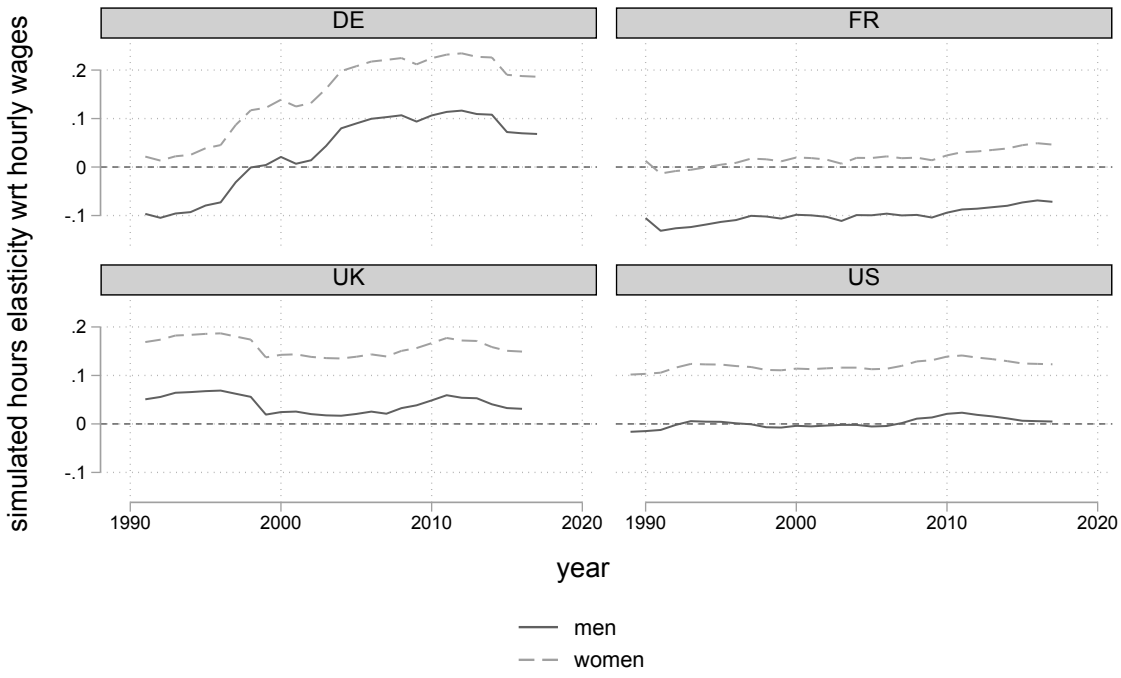
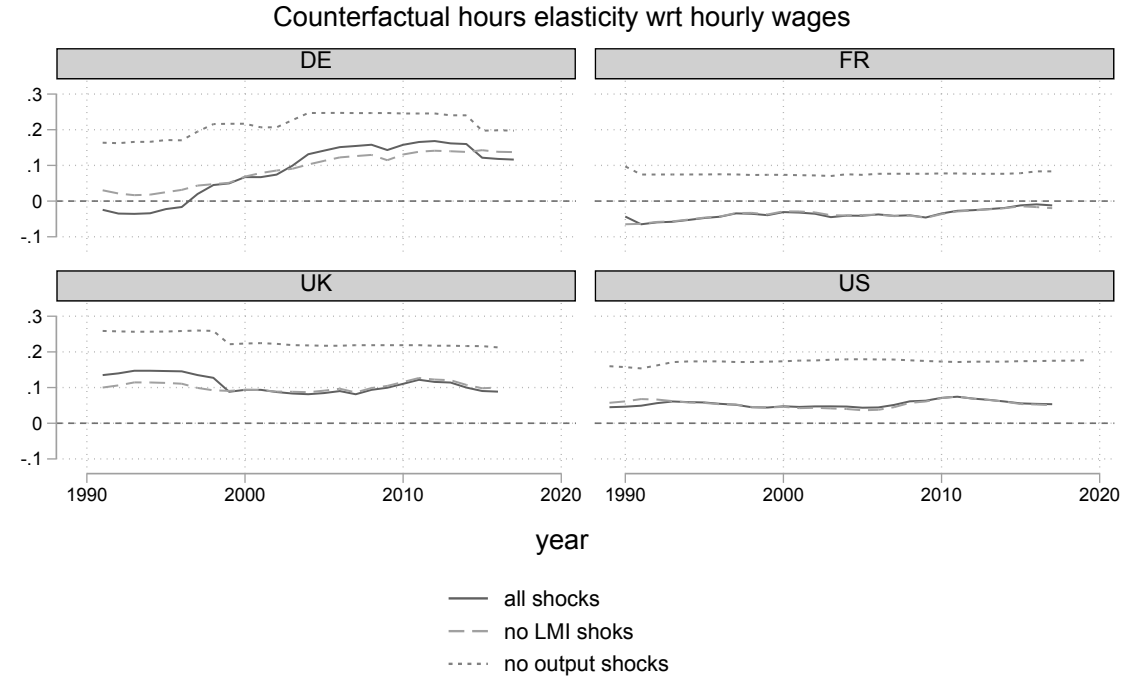


Figure 6: Simulated elasticity by gender



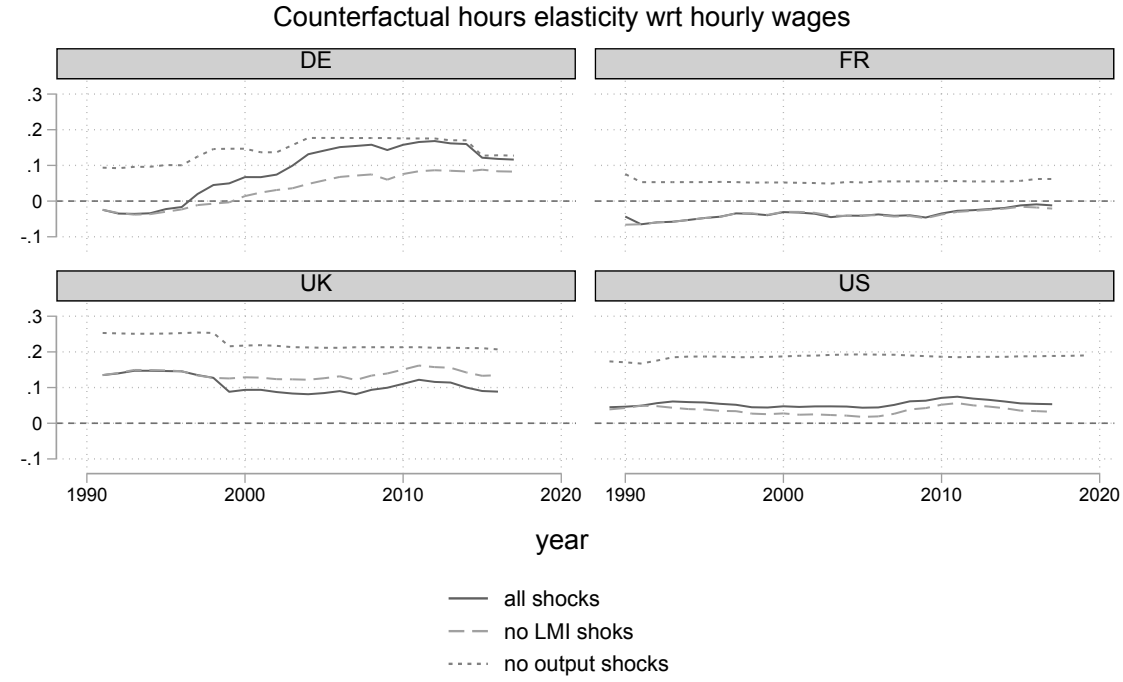
Simulated values using interactions with shocks

Figure 7: Simulated elasticity: Average values of aggregate shocks



Simulated values using interactions with shocks - averaged over the sample period

Figure 8: Simulated elasticity: Initial values of aggregate shocks



Simulated values using interactions with shocks - using initial values(1991)

Table 1: Decomposition of Earnings Inequality

Country	Year	MLD_Y	MLD_W	MLD_H	$CorrTerm$	Rel_W	Rel_H	Rel_Corr
US	1995	0.274	0.174	0.056	0.044	0.633	0.205	0.161
	2002	0.275	0.178	0.054	0.043	0.647	0.198	0.155
	2009	0.280	0.182	0.054	0.044	0.651	0.191	0.158
	2016	0.282	0.192	0.051	0.038	0.681	0.182	0.137
UK	1995	0.309	0.151	0.117	0.041	0.489	0.379	0.132
	2002	0.268	0.143	0.092	0.033	0.534	0.341	0.125
	2009	0.290	0.155	0.100	0.036	0.533	0.344	0.123
	2016	0.277	0.149	0.097	0.031	0.537	0.350	0.113
DE	1995	0.193	0.138	0.063	-0.009	0.716	0.328	-0.044
	2002	0.256	0.147	0.083	0.026	0.573	0.325	0.102
	2009	0.271	0.156	0.082	0.032	0.578	0.304	0.118
	2016	0.286	0.149	0.095	0.042	0.521	0.332	0.147
FR	1995	0.157	0.118	0.045	-0.006	0.751	0.284	-0.035
	2002	0.159	0.117	0.042	0.000	0.735	0.263	0.002
	2009	0.153	0.094	0.047	0.013	0.613	0.306	0.082
	2016	0.166	0.100	0.052	0.015	0.602	0.310	0.088

Note: This table reports the decomposition of earnings inequality for selected years for the US, the UK, Germany and France. The first column reports the MLD of earnings, followed by those for wages and hours, while the fourth column reports the value of the correlation term. Columns (2) to (4) sum up to the total inequality index reported in column (1). Columns (5) to (7) report the relative contribution of the three terms, inequality in wages, inequality in hours and the correlation coefficient to total inequality. They sum up to 1. See the appendix for the results for all years.

Table 2: Linear probability model for employment

	(1) All	(2) Men	(3) Women
Female	-0.135***		
	(0.00437)		
Age	0.0388***	0.0282***	0.0498***
	(0.00158)	(0.00151)	(0.00218)
Age Squared	-0.000486***	-0.000363***	-0.000631***
	(0.0000194)	(0.0000181)	(0.0000277)
Foreign born	-0.0709***	-0.0342***	-0.108***
	(0.00626)	(0.00834)	(0.00536)
Medium Educ.	0.113***	0.0860***	0.127***
	(0.00396)	(0.00361)	(0.00484)
High Educ.	0.183***	0.142***	0.204***
	(0.00476)	(0.00446)	(0.00597)
Household income (exc. respond.)	0.0138***	0.0164***	0.0141***
	(0.000563)	(0.000514)	(0.000562)
Self-employed in the household	0.0379***	0.0392***	0.0517***
	(0.00453)	(0.00507)	(0.00495)
Single	0.0403***	0.0297***	0.0976***
	(0.00368)	(0.00482)	(0.00467)
Number of children	-0.0330***	0.0180***	-0.0760***
	(0.00172)	(0.00194)	(0.00291)
Adjusted R^2	0.085	0.063	0.099
Observations	1831494	830806	1000688

Notes: The dependent variable is whether or not the individual is employed. All regressions include country×year fixed effects. Standard errors clustered by country×year in parentheses. Notation for statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Correlation with working hours - Individual determinants

	(1) No Mills	(2) Mills	(3) Mills by Sex	(4) Mills	(5) Mills
Hourly wage	0.0225***	0.00858	0.00548	0.00419	-0.0311***
	(0.00603)	(0.00665)	(0.00692)	(0.00654)	(0.00739)
Female	-0.524***	-0.481***	-0.423***	-0.492***	-0.437***
	(0.0366)	(0.0344)	(0.0357)	(0.0336)	(0.0324)
H. wage x Female	0.119***	0.116***	0.0987***	0.116***	0.0987***
	(0.0129)	(0.0126)	(0.0132)	(0.0126)	(0.0120)
Mills ratio		-0.678***		-0.508***	-0.478***
		(0.0557)		(0.0708)	(0.0660)
Mills ratio by sex			-1.072***		
			(0.0659)		
Medium Educ.				0.0159***	0.00730**
				(0.00353)	(0.00366)
High Educ.				0.0291***	0.00704
				(0.00617)	(0.00615)
Low skill - Capital int.					-0.0970***
					(0.00745)
Low skill - Labour int.					-0.122***
					(0.00934)
Medium skill - Agr. manufacturing					0.0393***
					(0.00654)
Medium skill - Capital int. services					0.00740
					(0.00517)
Medium skill - Labour					0.00595
					(0.00511)
High skill - Agr. manufacturing					0.103***
					(0.00644)
High skill - Capital int. services					0.0382***
					(0.00656)
High skill - Labour int. services					0.0816***
					(0.00651)
Public sector					-0.0149***
					(0.00313)
Adjusted R^2	0.146	0.150	0.162	0.151	0.175
Observations	1339479	1339479	1339479	1339479	1316238

Notes: The dependent variable are hours worked. All regressions include country×year fixed effects. Coefficient on age, age squared and foreing born not reported. Standard errors clustered by country×year in parentheses. Notation for statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Correlation with working hours - Individual and country determinants

	(1) Basic	(2) Alt. Min.W	(3) Incl. Jobs	(4) Only Signif.	(5) Country×year	(6) Beta coef.
Hourly wage	-0.0427	-0.183***	-0.0850**	-0.037	0.0126	-0.0556
	(0.0436)	(0.0421)	(0.0399)	(0.0432)	(0.0467)	
Female	-0.499***	-0.500***	-0.441***	-0.499***	-0.497***	-0.657***
	(0.0319)	(0.0320)	(0.0307)	(0.0320)	(0.0319)	
H. wage×Female	0.118***	0.118***	0.0997***	0.118***	0.118***	0.375***
	(0.0119)	(0.0119)	(0.0113)	(0.0119)	(0.0119)	
Output volatility	-0.537***	-0.602***	-0.385*	-0.478**		-0.0676***
	(0.195)	(0.224)	(0.195)	(0.193)		
Out.Vol.×Wage	0.238***	0.236***	0.210***	0.216***	0.219***	0.095***
	(0.0638)	(0.0760)	(0.0647)	(0.0590)	(0.0565)	
Trade Openness	-0.00565***	-0.00517***	-0.00558***	-0.00561***		-0.2664***
	(0.00129)	(0.00141)	(0.00120)	(0.000684)		
Tr.Open.×Wage	0.00206***	0.00162***	0.00197***	0.00204***	0.00202***	0.2840***
	(0.000500)	(0.000558)	(0.000487)	(0.000183)	(0.000194)	
Investment	0.0201***	0.0179***	0.0157***	0.0190***		0.1079***
	(0.00485)	(0.00544)	(0.00485)	(0.00435)		
Investment×Wage	-0.00633***	-0.00544***	-0.00521***	-0.00593***	-0.00680***	-0.2047***
	(0.00177)	(0.00201)	(0.00174)	(0.00157)	(0.00169)	
Invest. ICT	0.0194	0.0353**	0.0168	0.0336***		0.0567***
	(0.0151)	(0.0170)	(0.0148)	(0.00634)		
Inv.ICT×Wage	0.00578	0.0000695	0.00361			
	(0.00538)	(0.00648)	(0.00517)			
R&D Invest.	-0.0335***	-0.0502***	-0.0191**	-0.0378***		-0.0787***
	(0.00938)	(0.0107)	(0.00856)	(0.00823)		
R&D Invest.×Wage	0.00811*	0.0152***	0.00406	0.0102**	0.00812**	0.0899***
	(0.00448)	(0.00530)	(0.00400)	(0.00400)	(0.00399)	

Table 4 cont.: Correlation with working hours - Individual and country determinants.

	(1) Basic	(2) Alt. Min.W	(3) Incl. Jobs	(4) Only Signif.	(5) Countryxyear	(6) Beta coef.
Union density	0.00561***	0.00321**	0.00224	0.00494***		0.1144***
	(0.00149)	(0.00148)	(0.00138)	(0.00130)		
Union den.×Wage	-0.00135**	0.000172	-0.000464	-0.00112**	-0.00148***	-0.0608***
	(0.000554)	(0.000579)	(0.000504)	(0.000434)	(0.000418)	
EPL Permanent	-0.0625*	-0.0777**	-0.0503	-0.0594***		-0.1642***
	(0.0344)	(0.0366)	(0.0323)	(0.0192)		
EPL Per.×Wage	0.00163	0.0103	-0.00665			
	(0.0140)	(0.0160)	(0.0134)			
EPL Temporary	0.0980***	0.120***	0.0952***	0.0959***		0.3172***
	(0.0211)	(0.0227)	(0.0199)	(0.00822)		
EPL Tem.×Wage	-0.0496***	-0.0633***	-0.0453***	-0.0486***	-0.0469***	-0.3703***
	(0.00858)	(0.00915)	(0.00817)	(0.00264)	(0.00287)	
Minimum wage	0.194***		0.175***	0.189***		0.0960***
	(0.0456)		(0.0408)	(0.0433)		
Min.wage×Wage	-0.0958***		-0.0892***	-0.0936***	-0.108***	-0.1151***
	(0.0192)		(0.0173)	(0.0178)	(0.0203)	
Unemp. Benefit	-0.00342***	-0.00586***	-0.00335***	-0.00324***		-0.1088***
	(0.000867)	(0.00105)	(0.000850)	(0.000817)		
Un.Ben.×Wage	0.000903**	0.00189***	0.00107***	0.000852**	0.000670*	0.1263***
	(0.000358)	(0.000429)	(0.000358)	(0.000339)	(0.000351)	
Parental leave	-0.00121**	-0.00152***	-0.000349	-0.00105**		-0.0848***
	(0.000534)	(0.000577)	(0.000525)	(0.000491)		
Par.Leav.×Wage	0.000535***	0.000644***	0.000231	0.000477**	0.000469**	0.0977***
	(0.000204)	(0.000228)	(0.000198)	(0.000188)	(0.000189)	
Adjusted R^2	0.158	0.158	0.183	0.158	0.158	0.158
Observations	1323746	1323746	1300505	1323746	1323746	1323746

Notes: The dependent variable are hours worked. All regressions include individual determinants (age, age^2, foreign born, level of education), control for self-selection into employment (Mills ratio) and country and year fixed effects. Standard errors clustered by country/year in parentheses. Column (1) reports our basic equation, while (2) uses the alternative definitionfor the minimum wages. Column (3) includes dummies for the various jobs categories (with a fraction of missing information on sector and/or level of skill), column (4) uses only those variables with significant coefficients, while column (5) includes country×year fixed effects. Column (6) reports the beta coefficients from regression (4). Notation for statistical significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Contribution over the period 1991-2016

	Germany	**France**	**UK**	**US**
Union Density	0.021	0.002	0.018	0.006
EPL—temporary	0.103	0.006	-0.006	0.000
Minimum wage	-0.039	-0.001	-0.041	0.007
Unemployment benefit	-0.007	-0.001	-0.004	0.016
Parental leave	-0.012	0.012	0.010	0.000
Output volatility	-0.011	-0.014	-0.023	-0.034
Trade openness	0.075	0.037	0.027	0.014
Investment	0.027	0.008	0.018	-0.001
R&D Investment	0.009	0.013	-0.018	0.010
Total	0.166	0.063	-0.020	0.018

Note: The table displays the product of the estimated coefficients on interactions (from column (4) of Table 4) and the observed changes in the level of the demand and supply shocks. We report only the impact of those variables that had a statistically significant coefficient in the regression.

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Appendices

A Data Appendix

A.1 Individual-level Data

This appendix provides information on the individual level data as well as the classification of industries and occupations.

Table A.1: Summary statistics for the main variables in selected years

		Earnings		Wages		Hours		
Year	Country	Mean	SD	Mean	SD	Mean	SD	N
1995	US	494.86	371.38	12.33	8.03	38.38	10.81	13,476
	UK	253.13	190.54	6.53	3.99	37.24	14.46	4,556
	DE	405.54	225.70	10.50	5.90	39.22	10.74	6,813
	FR	304.90	187.20	8.31	4.86	36.91	9.17	55,891
2002	US	648.80	496.78	16.14	10.69	38.43	10.53	14,299
	UK	331.53	241.18	8.74	5.35	36.89	13.10	8,186
	DE	547.64	396.69	13.91	8.15	38.18	12.26	10,876
	FR	347.68	221.55	9.92	5.74	35.05	8.61	56,892
2009	US	792.34	589.84	19.82	12.93	38.20	10.59	12,804
	UK	420.99	316.80	11.39	7.01	35.65	13.42	22,618
	DE	568.77	417.85	14.54	8.56	37.72	12.68	9,016
	FR	403.93	249.14	10.93	5.53	36.47	9.56	8,229
2016	US	913.37	677.94	22.78	15.24	38.60	10.41	12,588
	UK	481.81	347.06	13.07	7.91	35.91	13.14	18,170
	DE	599.09	457.39	16.08	9.52	35.60	12.71	12,658
	FR	442.79	285.00	12.24	6.66	35.75	9.62	8,041

Table A.2: Classification of occupations

Classification	Goos et al. (2009) ref.year=1993
8 top-paying occupations	
	corp. managers
	eng. profess.
	life science profess.
	other profess.
	small ent. managers
	eng. associate profess.
	other associate profess.
	life sc. ass. profess.
9 middling-paying occupations	
	drivers plant oper.
	stat. plant oper.
	metal and trade workers
	precision trade workers
	office clerks
	customer service clerks
	extraction workers
	machine operators
	other craft workers
4 bottom-paying occupations	
	personal services
	constr. transports
	models, demonstrators
	sales and elementary occ.

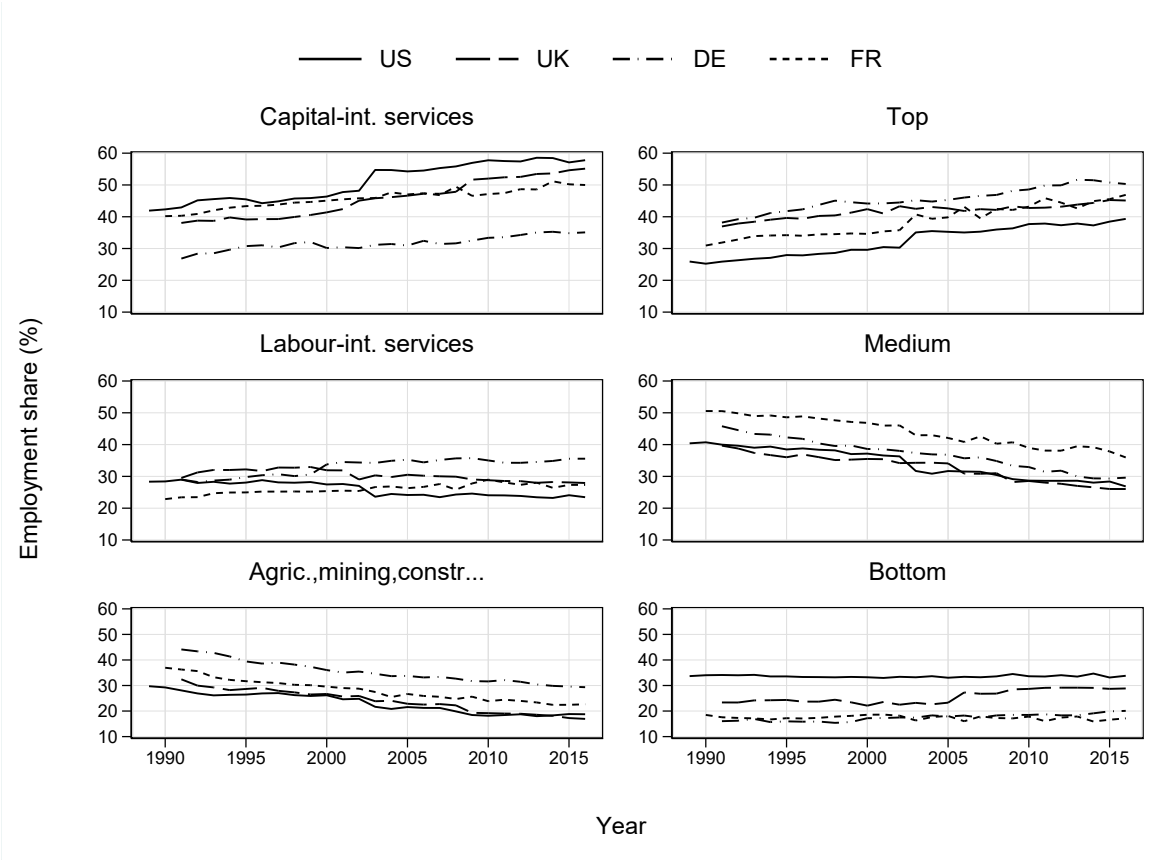
Note: occupations are classified referring to the two digit-level international standard classification of occupations (ISCO) variable.

Table A.3: Classification of industries

Our classification	Autor and Salomons (2017)
Agriculture, mining, construction and manufacturing	(1) agriculture, mining, construction: industries C, E, F (2) manufacturing: industries 15 to 37
Capital-intensive services	(3) education and health services: industries M to N (4) capital-intensive (high-tech) services: industries 64, J, and 71 to 74
Labour-intensive services	(5) labour-intensive (low-tech) services industries 50 to 52, H, 60 to 63, 70 and O

Note: industries are classified referring to the two digit-level standard industry classification (SIC) variable. The distinction between high- and low-tech services is obtained from the OECD.

Figure A.1: Employment Shares by Industry and Occupation



Note: employment is measured as number of workers. Employment share = employed + self-employed.

A.2 Country-level data

We use a number of indicators of both demand and supply shocks in the labour market, mainly obtained from the OECD website.[33] The indicators vary by country and year. The variables that we use as proxy of the supply side of the labour market are:

- Strictness of employment protection: We use two indicators, one regarding the protection of open-ended contracts (individual dismissal-regular contracts-version 1 1985-2019), which captures procedural firing costs, and another regarding temporary contracts (Version 1 1985-2019). Source:

  http://stats.oecd.org/INDEX.aspx?datasetcode=EPL_OV

- Union density: Ratio of unions members on total of employees, obtained from administrative data in the case of France, Germany and the UK Source:

  http://stats.oecd.org/Index.aspx?DataSetCode=TUD

- Weeks of paid leave: Total length of paid maternity and parental leave, measured in weeks. Source: https://stats.oecd.org/index.aspx?queryid=54760

- The Kaitz index: It is defined as the ratio of the nominal legal minimum wage to average wages of full-time workers. When there is no legal minimum wage, we either set it to zero or drop those years. Source: https://stats.oecd.org/Index.aspx?DataSetCode=MIN2AVE

- Unemployment benefit: We use the historical gross replacement rate series when in unemployment (for a couple without children) up to 1999, when it was discontinued (available at https://stats.oecd.org/Index.aspx?DataSetCode=HGRR). From 2001 we use the net replacement rates in unemployment (for a couple with children), available at https://stats.oecd.org/Index.aspx?DataSetCode=NRR.

The indicators for the demand side of the labour market that we focus on are:

- Output volatility: It corresponds to the coefficient of variation computed over a 5-year moving average centered on the relevant year. The original GDP series are available at https://stats.oecd.org/Index.aspx?DatasetCode=SNA_TABLE1.

- Openness: Trade openness is computed as the ratio $(exports + imports/GDP)$ and covers the period 1995-2011. The data were backward and forward extended using the rates of change of analogous measures obtained from another dataset: Bilateral Trade in Goods by Industry and End-use (BTDIxE), ISIC Rev.4, which contains import and export by sector (in US dollars). The constituent series are obtained from http://stats.oecd.org/Index.aspx?DataSetCode=TIVA_2016_C1.

[33] Refer to http://stats.oecd.org for details.

- Investment: We use three series, capturing overall investment (Gross fixed capital formation over GDP - variable name GFCF/GDP in current prices) and two components proxing ICT (information and communication equipment - variable name OTHMACHINEQT PC_GFCF) and R&D (intellectual property products - Variable name FIXASSET PC_GFCF). All are expressed as a ratio to GDP. All series are available at https://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE8A#.

Table A.4: Summary statistics for aggregate variables

Country	Variable	Obs	mean	SD	Min	Max
Germany						
	age	27	39.98	1.19	38.08	41.37
	high education share	27	0.27	0.03	0.22	0.31
	union density	27	23.21	5.49	16.70	36.00
	EPL permanent	27	2.59	0.03	2.50	2.60
	EPL temporary	27	1.77	0.89	1.00	3.25
	Kaitz index	27	0.05	0.14	0.00	0.43
	Unemployment benefit	27	92.10	1.95	90.00	98.30
	Length parental leave	27	75.07	23.59	58.00	109.30
	Trade openness	27	66.27	16.49	40.58	86.51
	Investment over GDP	27	21.35	1.94	19.08	25.20
	ICT equipment	27	1.69	0.27	1.31	2.31
	Investment intellectual property	27	3.11	0.30	2.66	3.68
	Output volatility	27	0.14	0.02	0.12	0.17
France						
	age	28	39.44	0.84	37.81	40.85
	high education share	28	0.29	0.08	0.18	0.43
	union density	28	9.27	0.56	8.50	10.70
	EPL permanent	28	2.56	0.08	2.50	2.71
	EPL temporary	28	3.10	0.11	2.56	3.13
	Kaitz index	28	0.50	0.01	0.49	0.54
	Unemployment benefit	28	85.15	1.09	84.00	87.50
	Length parental leave	28	29.00	13.24	16.00	42.00
	Trade openness	28	52.26	6.87	39.91	61.75
	Investment over GDP	28	21.65	1.09	19.52	23.60
	ICT equipment	28	2.74	0.37	2.17	3.58
	Investment intellectual property	28	4.52	0.42	3.97	5.45
	Output volatility	28	0.16	0.02	0.13	0.20
UK						
	age	26	39.21	0.95	38.13	40.89
	high education share	26	0.36	0.10	0.22	0.54
	union density	26	29.52	4.52	23.70	39.80
	EPL permanent	26	1.43	0.08	1.35	1.51
	EPL temporary	26	0.32	0.07	0.25	0.38
	Kaitz index	26	0.26	0.18	0.00	0.44
	Unemployment benefit	26	59.38	1.31	58.00	62.90
	Length parental leave	26	27.31	9.83	18.00	39.00
	Trade openness	26	53.40	4.57	45.07	62.38
	Investment over GDP	26	17.51	1.15	15.60	20.68
	ICT equipment	26	2.79	0.41	2.24	3.52
	Investment intellectual property	26	3.90	0.66	3.31	5.57
	Output volatility	26	0.20	0.03	0.16	0.26
US						
	age	29	39.16	0.83	37.29	39.99
	high education share	29	0.62	0.05	0.51	0.70
	union density	29	12.72	1.75	10.30	15.90
	EPL permanent	29	0.09	0.00	0.09	0.09
	EPL temporary	29	0.25	0.00	0.25	0.25
	Kaitz index	29	0.28	0.03	0.23	0.32
	Unemployment benefit	29	74.71	7.20	53.70	81.00
	Length parental leave	29	0.00	0.00	0.00	0.00
	Trade openness	29	24.71	3.60	19.42	30.79
	Investment over GDP	29	21.04	1.33	18.38	23.14
	ICT equipment	29	3.12	0.37	2.49	4.09
	Investment intellectual property	29	4.81	0.41	4.09	5.41
	Output volatility	29	0.24	0.05	0.18	0.35

Figure A.2: Trends in labour market institutions

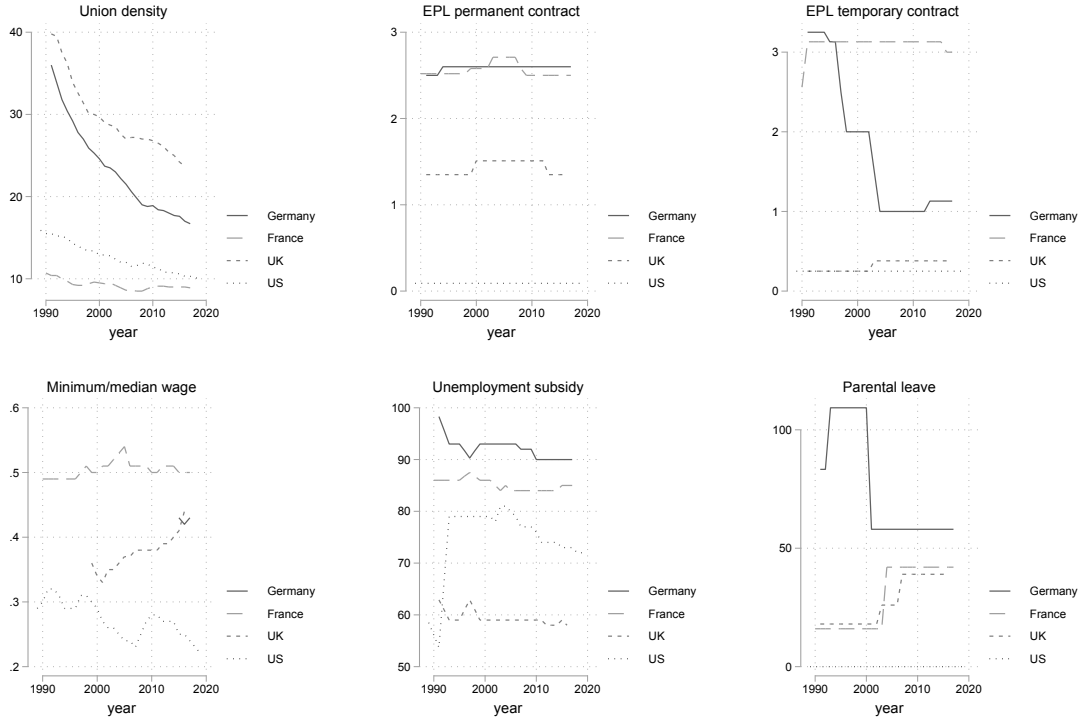
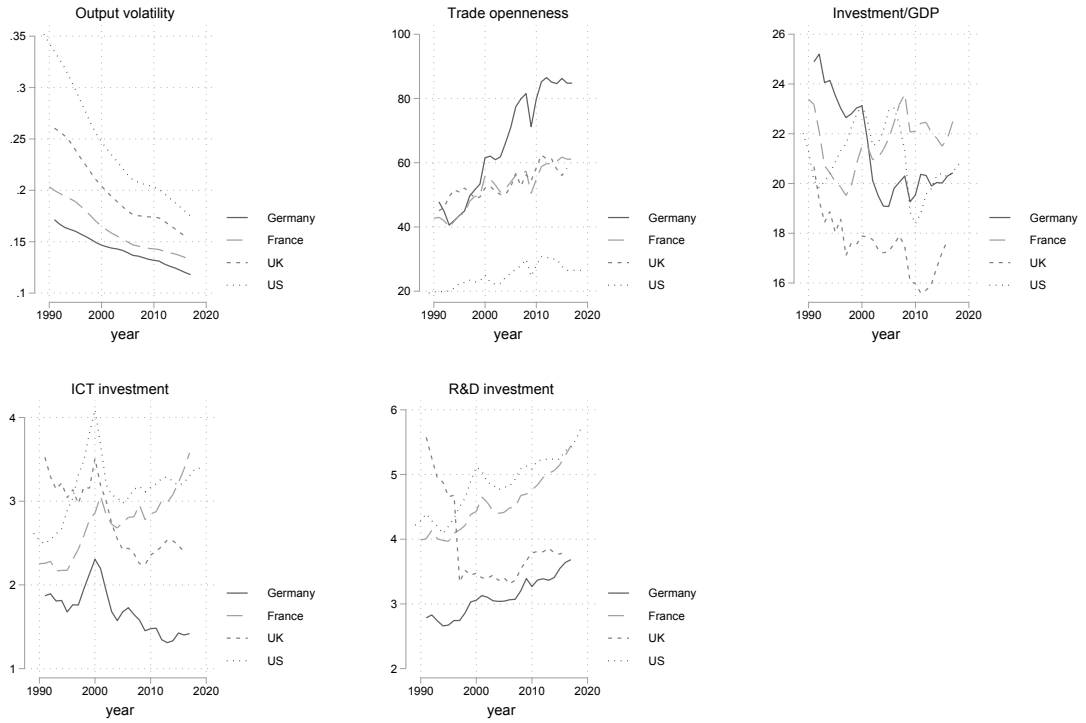


Figure A.3: Trends in macroeconomic variables



B Additional results

This appendix provides additional results mentioned in the text.

Figure B.1: Distribution of hours worked by country, years 1995-1999

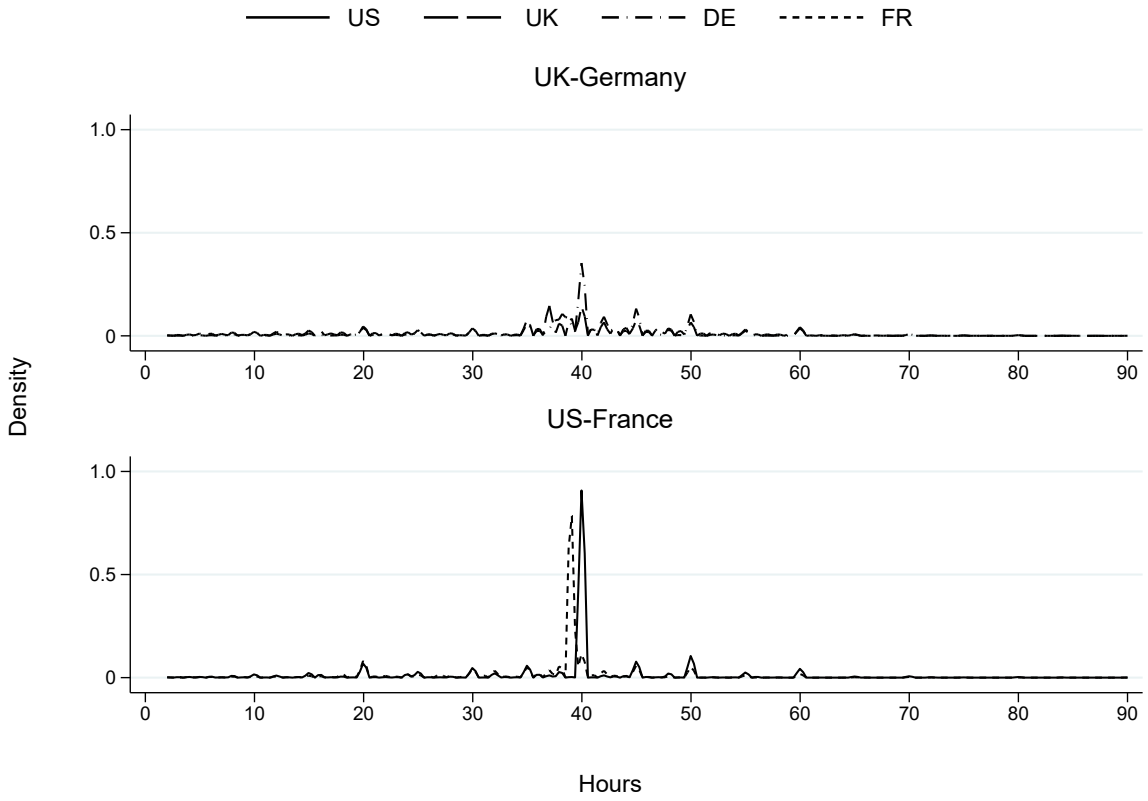


Table B.1: Decomposition of earnings inequality - US

Country	Year	MLD_Y	MLD_W	MLD_H	$CorrTerm$	Rel_W	Rel_H	Rel_Corr
US	1991	0.282	0.171	0.063	0.048	0.606	0.223	0.171
US	1992	0.281	0.170	0.063	0.048	0.606	0.224	0.170
US	1993	0.278	0.166	0.065	0.047	0.598	0.232	0.170
US	1994	0.286	0.179	0.064	0.042	0.628	0.224	0.147
US	1995	0.274	0.174	0.056	0.044	0.633	0.205	0.161
US	1996	0.271	0.168	0.059	0.044	0.618	0.219	0.163
US	1997	0.267	0.166	0.057	0.044	0.622	0.212	0.166
US	1998	0.274	0.174	0.054	0.046	0.637	0.197	0.166
US	1999	0.265	0.168	0.056	0.042	0.633	0.210	0.157
US	2000	0.269	0.172	0.054	0.044	0.639	0.199	0.162
US	2001	0.271	0.177	0.053	0.040	0.654	0.197	0.149
US	2002	0.275	0.178	0.054	0.043	0.647	0.198	0.155
US	2003	0.268	0.177	0.051	0.041	0.659	0.189	0.152
US	2004	0.275	0.177	0.054	0.044	0.642	0.198	0.160
US	2005	0.271	0.180	0.054	0.037	0.663	0.198	0.138
US	2006	0.270	0.180	0.051	0.038	0.668	0.190	0.142
US	2007	0.268	0.182	0.049	0.037	0.679	0.184	0.137
US	2008	0.268	0.179	0.050	0.039	0.669	0.186	0.146
US	2009	0.280	0.182	0.054	0.044	0.651	0.191	0.158
US	2010	0.283	0.181	0.058	0.045	0.638	0.204	0.158
US	2011	0.284	0.186	0.055	0.043	0.653	0.194	0.153
US	2012	0.285	0.188	0.053	0.043	0.661	0.187	0.152
US	2013	0.282	0.190	0.054	0.038	0.674	0.190	0.136
US	2014	0.280	0.184	0.054	0.042	0.657	0.193	0.150
US	2015	0.277	0.189	0.049	0.040	0.682	0.175	0.143
US	2016	0.282	0.192	0.051	0.038	0.681	0.182	0.137
US	2017	0.282	0.189	0.054	0.039	0.669	0.192	0.138
US	2018	0.274	0.184	0.052	0.038	0.672	0.190	0.138
US	2019	0.274	0.182	0.055	0.037	0.665	0.201	0.134

Note: This table reports the decomposition of earnings inequality for all years available for the US. The first column reports the MLD of earnings, followed by those for wages and hours, while the fourth column reports the value of the correlation term. Columns (2) to (4) sum up to the total inequality index reported in column (1). Columns (5) to (7) report the relative contribution of the three terms, inequality in wages, inequality in hours and the correlation coefficient to total inequality. They sum up to 1.

Table B.2: Decomposition of earnings inequality - UK

Country	Year	MLD_Y	MLD_W	MLD_H	$CorrTerm$	Rel_W	Rel_H	Rel_Corr
UK	1991	0.289	0.141	0.113	0.034	0.489	0.391	0.119
UK	1992	0.298	0.148	0.115	0.035	0.497	0.384	0.119
UK	1993	0.308	0.147	0.125	0.036	0.477	0.406	0.117
UK	1994	0.312	0.151	0.118	0.043	0.484	0.377	0.139
UK	1995	0.309	0.151	0.117	0.041	0.489	0.379	0.132
UK	1996	0.306	0.150	0.114	0.042	0.491	0.372	0.138
UK	1997	0.295	0.146	0.108	0.041	0.495	0.365	0.140
UK	1998	0.287	0.146	0.110	0.032	0.507	0.382	0.111
UK	1999	0.273	0.142	0.101	0.031	0.518	0.369	0.113
UK	2000	0.264	0.137	0.096	0.031	0.518	0.364	0.118
UK	2001	0.272	0.142	0.098	0.032	0.523	0.358	0.119
UK	2002	0.268	0.143	0.092	0.033	0.534	0.341	0.125
UK	2003	0.273	0.143	0.099	0.031	0.522	0.364	0.114
UK	2004	0.269	0.142	0.094	0.033	0.530	0.349	0.121
UK	2005	0.272	0.137	0.095	0.040	0.505	0.349	0.146
UK	2006	0.280	0.145	0.095	0.040	0.518	0.339	0.143
UK	2007	0.279	0.145	0.095	0.039	0.519	0.342	0.139
UK	2008	0.282	0.146	0.098	0.038	0.517	0.349	0.133
UK	2009	0.290	0.155	0.100	0.036	0.533	0.344	0.123
UK	2010	0.289	0.150	0.104	0.035	0.520	0.359	0.120
UK	2011	0.293	0.153	0.104	0.036	0.522	0.356	0.122
UK	2012	0.291	0.155	0.102	0.035	0.531	0.349	0.120
UK	2013	0.289	0.156	0.100	0.033	0.540	0.345	0.115
UK	2014	0.289	0.156	0.100	0.033	0.539	0.345	0.115
UK	2015	0.278	0.158	0.096	0.025	0.566	0.344	0.089
UK	2016	0.277	0.149	0.097	0.031	0.537	0.350	0.113

Note: This table reports the decomposition of earnings inequality for all years available for the UK. The first column reports the MLD of earnings, followed by those for wages and hours, while the fourth column reports the value of the correlation term. Columns (2) to (4) sum up to the total inequality index reported in column (1). Columns (5) to (7) report the relative contribution of the three terms, inequality in wages, inequality in hours and the correlation coefficient to total inequality. They sum up to 1.

Table B.3: Decomposition of earnings inequality - Germany

Country	Year	MLD_Y	MLD_W	MLD_H	$CorrTerm$	Rel_W	Rel_H	Rel_Corr
DE	1991	0.211	0.158	0.053	-0.000	0.749	0.251	-0.000
DE	1992	0.187	0.142	0.051	-0.006	0.758	0.272	-0.030
DE	1993	0.183	0.135	0.052	-0.004	0.735	0.285	-0.020
DE	1994	0.176	0.122	0.053	0.001	0.694	0.298	0.008
DE	1995	0.193	0.138	0.063	-0.009	0.716	0.328	-0.044
DE	1996	0.191	0.132	0.058	0.000	0.692	0.306	0.002
DE	1997	0.193	0.125	0.057	0.011	0.647	0.295	0.058
DE	1998	0.200	0.137	0.063	-0.000	0.685	0.316	-0.000
DE	1999	0.218	0.137	0.069	0.011	0.631	0.317	0.052
DE	2000	0.230	0.138	0.075	0.018	0.599	0.324	0.077
DE	2001	0.241	0.142	0.081	0.018	0.590	0.337	0.073
DE	2002	0.256	0.147	0.083	0.026	0.573	0.325	0.102
DE	2003	0.261	0.149	0.083	0.029	0.569	0.320	0.111
DE	2004	0.264	0.149	0.085	0.030	0.565	0.323	0.112
DE	2005	0.268	0.157	0.086	0.024	0.587	0.322	0.091
DE	2006	0.273	0.162	0.080	0.031	0.593	0.293	0.114
DE	2007	0.272	0.157	0.088	0.027	0.578	0.325	0.098
DE	2008	0.276	0.155	0.084	0.037	0.562	0.305	0.133
DE	2009	0.271	0.156	0.082	0.032	0.578	0.304	0.118
DE	2010	0.292	0.163	0.097	0.033	0.558	0.331	0.111
DE	2011	0.286	0.163	0.091	0.032	0.572	0.317	0.111
DE	2012	0.288	0.156	0.094	0.039	0.541	0.325	0.134
DE	2013	0.296	0.160	0.095	0.041	0.541	0.320	0.139
DE	2014	0.296	0.156	0.097	0.043	0.528	0.328	0.144
DE	2015	0.290	0.157	0.094	0.039	0.540	0.325	0.135
DE	2016	0.286	0.149	0.095	0.042	0.521	0.332	0.147
DE	2017	0.284	0.150	0.097	0.036	0.530	0.342	0.128

Note: This table reports the decomposition of earnings inequality for all years available for Germany. The first column reports the MLD of earnings, followed by those for wages and hours, while the fourth column reports the value of the correlation term. Columns (2) to (4) sum up to the total inequality index reported in column (1). Columns (5) to (7) report the relative contribution of the three terms, inequality in wages, inequality in hours and the correlation coefficient to total inequality. They sum up to 1.

Table B.4: Decomposition of earnings inequality - France

Country	Year	MLD_Y	MLD_W	MLD_H	$CorrTerm$	Rel_W	Rel_H	Rel_Corr
FR	1991	0.146	0.118	0.038	-0.010	0.811	0.260	-0.071
FR	1992	0.153	0.122	0.039	-0.009	0.800	0.257	-0.057
FR	1993	0.158	0.121	0.042	-0.006	0.770	0.268	-0.038
FR	1994	0.167	0.128	0.044	-0.005	0.769	0.262	-0.031
FR	1995	0.157	0.118	0.045	-0.006	0.751	0.284	-0.035
FR	1996	0.163	0.123	0.045	-0.006	0.758	0.279	-0.037
FR	1997	0.160	0.119	0.047	-0.005	0.741	0.292	-0.033
FR	1998	0.157	0.115	0.047	-0.005	0.731	0.298	-0.029
FR	1999	0.155	0.113	0.046	-0.005	0.733	0.298	-0.031
FR	2000	0.158	0.115	0.044	-0.001	0.726	0.279	-0.006
FR	2001	0.155	0.115	0.042	-0.002	0.741	0.272	-0.013
FR	2002	0.159	0.117	0.042	0.000	0.735	0.263	0.002
FR	2003	0.160	0.114	0.043	0.003	0.712	0.267	0.021
FR	2004	0.163	0.113	0.048	0.002	0.694	0.295	0.011
FR	2005	0.163	0.107	0.047	0.008	0.658	0.291	0.051
FR	2006	0.153	0.101	0.047	0.004	0.665	0.311	0.024
FR	2007	0.138	0.091	0.045	0.002	0.661	0.328	0.011
FR	2008	0.146	0.095	0.050	0.000	0.652	0.345	0.002
FR	2009	0.153	0.094	0.047	0.013	0.613	0.306	0.082
FR	2010	0.153	0.095	0.048	0.010	0.620	0.317	0.063
FR	2011	0.157	0.095	0.048	0.014	0.607	0.306	0.087
FR	2012	0.158	0.099	0.046	0.014	0.622	0.288	0.090
FR	2013	0.151	0.096	0.050	0.005	0.636	0.328	0.036
FR	2014	0.147	0.091	0.050	0.006	0.617	0.340	0.043
FR	2015	0.157	0.099	0.048	0.010	0.628	0.305	0.067
FR	2016	0.166	0.100	0.052	0.015	0.602	0.310	0.088
FR	2017	0.160	0.094	0.052	0.013	0.589	0.327	0.084

Note: This table reports the decomposition of earnings inequality for all years available for France. The first column reports the MLD of earnings, followed by those for wages and hours, while the fourth column reports the value of the correlation term. Columns (2) to (4) sum up to the total inequality index reported in column (1). Columns (5) to (7) report the relative contribution of the three terms, inequality in wages, inequality in hours and the correlation coefficient to total inequality. They sum up to 1.