# Using Payroll Taxes as a Redistribution Tool

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**Abstract**

Payroll taxes are usually designed to fund social insurance and not to contribute directly to redistribution. Over the last fifty years, France has modified dramatically the schedule of payroll taxation, turning it into the most progressive part of its tax system. Using administrative data and detailed microsimulation model of labor income taxation, we show that pretax wage (or labor cost) inequality measured by the P90/P10 ratio has increased by 15.4%, while net wage inequality has actually decreased by 18.9% over the 1967-2019 period. This reduction in wage inequality can be largely attributed to the policy mix of reductions of employer payroll taxes for low wage earners joined with minimum wage increases. We discuss whether this unusual French experiment carries lessons for other countries.

**Keywords**: wage inequality, payroll tax, redistribution, Social Security contributions, labor cost, tax incidence
**JEL codes**: H24, H23, J31 J32.

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# Introduction

Payroll taxes, or Social Security contributions (SSC), are taxes on labor income used to fund social insurance programs such as old-age pensions, unemployment insurance (UI), or disability insurance (DI). They represent an important part of total tax revenues in OECD countries (on average 26 percent of total tax revenues, or 9 percent of GDP). By design, these taxes are not intended to contribute to redistribution, as they represent payments, like insurance premiums, for the benefits offered by social insurance. In most countries with social insurance systems, payroll taxes are based on labor earnings only and are capped at a threshold, making the tax schedule regressive when related benefits are not factored in.

Over the last fifty years, France has implemented a series of reforms to payroll taxation. First, starting in the 1970s, payroll taxes have been progressively uncapped in order to fund additional social spending, increasing contributions mostly for high-wage earners. Second, with the aim of reducing unemployment of unskilled workers, payroll tax on low-wage earners has been reduced from the mid-1990s onwards. From regressive, the French payroll tax schedule has become highly progressive. This change was not accompanied by corresponding changes in entitlements to benefits that remained largely unchanged across different groups of wage earners, implying that these reforms effectively changed the degree of redistribution carried out by payroll taxation.

In this paper, we exploit French administrative data on earnings spanning from 1967 to 2019 and a detailed microsimulation model of labor income taxation to study changes in labor income inequality. We obtain two main descriptive results: First, we find that pretax wage inequality, measured by the P90/P10 ratio, has increased in France by 15.4% over the 1967-2019 period, while net wage inequality has actually decreased by 18.9% over the same period. This puts France on a par with other developed countries which have experienced increasing pretax inequalities in the labor market in the 1970s and 1980s, while previous research had focused on showing the unusual French trend with the reduction in net wage or posted wage inequality (Charnoz et al. 2011, Verdugo 2014). This results reinforce the credibility of the skill-biased technological change, or other demand-side changes, which have been largely documented in the US and many other countries (Katz & Murphy 1992, Autor et al. 2008). More generally, we claim that the common use of posted wage for studying labor market inequality is likely to miss key drivers of labor demands across workers, and thus we advocate using pretax wage, or employer cost, a closer concept to product market inequality.

Second, we show that the reduction in net wage inequality in France cannot be explained

by larger increases in educational or skill attainment, but should be rather attributed to the policy mix of increasing minimum wage and decreasing employer payroll taxes for low-wage earners. The redistributive impact of increasing progressivity of payroll taxes is not straightforward as these contributions lead to deferred benefits that need to be taken into account, while the incidence of employer contributions on individual wages is far from obvious. Making different assumptions on incidence and taking into account the concomitant effect of minimum wage increases, we provide bounded estimates of the impact of payroll tax reforms on wage inequality showing that a large share of the reduction in net wage inequality can be ascribed to these reforms: our estimates point to a wage ratio P90/P10 between 16.6% and 29.7% lower than it would have been absent any reform.

We finally discuss whether this unusual French experiment carries lessons for other countries. On the one hand, this large redistribution has remained largely unnoticed and changes in payroll taxes escaped the standard political debate about redistribution, precisely because they were not seen as actual redistribution. On the other hand, using payroll taxes to carry out redistribution is not without its drawbacks. It is poorly targeted towards low income households, could generate efficiency costs, and the lack of transparency of redistribution can hardly be seen as very democratic.

Our work contribute to the literature on the secular increase in wage inequality and its determinants.[1] Within the Supply-Demand-Institutions framework (Katz & Autor 1999), a large literature has been devoted to the study of demand shifts toward skilled-workers induced by skill-biased technical change (e.g. Card & DiNardo 2002), job polarization (e.g. Autor et al. 2006, Goos et al. 2009) or globalization (Feenstra & Hanson 1999). Regarding institutions, most of the focus has been on the role of the minimum wage (e.g. Autor et al. 2016) or unions (e.g. Card 2001, Farber et al. 2021). We contribute to these papers by focusing on an alternative and largely unstudied institutional determinant which is payroll taxation. The fact that wage inequality is usually considered net of payroll taxes and that the incidence of payroll taxation is far from obvious makes it a legitimate determinant to be studied. Doing so, we contribute to the small literature highlighting the importance of taking into account employer-provided benefits when considering labor market inequalities (Pierce 2001, Finkelstein et al. 2023).

The rest of the paper is organized as follows. Section 1 presents the institutional context of payroll taxation in France, the data and methodology used in the paper. It shows how reforms have progressively turned payroll taxation from an initial regressive schedule into

[1]For key references, see Katz & Autor (1999) or Katz & Murphy (1992) for the U.S., Gosling et al. (2000) for the U.K. or Dustmann et al. (2009) for Germany.

a progressive one. Section 2 presents our key results on change in pretax vs net wage inequality in France, and how this analysis makes France much more comparable to other countries in terms of pre-tax wage inequality. Section 3 discusses the role of payroll tax reforms in explaining the reduction in net wage inequality in France, when one takes into account incidence and deferred benefits. Section 4 discusses the advantages and drawbacks of using payroll taxation for redistribution. Section 5 concludes.

# 1 Institutions, Data and Methodology

## 1.1 Institutional Context

**Historical Design of Payroll Taxation in France.** France's welfare system was designed in 1945 following closely a Bismarckian model of social insurance systems. Old-age insurance, UI, and DI offered earnings-related benefits funded by Social Security contributions (SSCs) on earnings up to the main Social Security threshold. The idea behind social insurance was that SSCs should be like insurance premiums with no objective of redistribution. As a result, the payroll tax schedule was from the start designed to be regressive along income, as high earners would not pay contributions nor receive deferred benefits for earnings above the threshold.[2]

The social insurance model has been extensively used in France, contrary to most other countries. For instance, in addition to earnings-related benefits, other parts of the welfare system—like child benefits and the health care system—were also funded through capped payroll taxes. As social spending rose in the 1960s and 1970s, payroll taxes became the dominant source of tax revenues in France, reaching 44% of total revenues in the early 1990s.

Within French payroll taxation, we can identify SSCs with strong tax-benefit linkage—where the benefit formula explicitly depends on past contributions or on past earnings subjected to SSCs—and those payroll taxes which are framed as social insurance contributions but which fund benefits without any direct relationship to effective contributions. Pensions and UI are part of the first contributive category, while health care, DI, and child benefit payroll taxes can be considered non-contributive.

**Reforms to Payroll Taxation.** During the period covered by our data (1967-2019), a number of payroll tax reforms have been carried out in France, which have fundamentally

[2]See Appendix B for a comprehensive summary on payroll taxes in France.

modified the schedule of these contributions. During the 1980s, increases in payroll taxes have mainly taken the form of uncapping of SSCs, i.e., rate increases for high wage earners, above the Social Security threshold. From the mid-1990s onwards, several reforms were introduced to reduce payroll taxation for low wage earners, at the minimum wage or slightly above. The main reason behind these reforms has been the widespread fear that the high French minimum wage coupled with high payroll taxes were reducing demand for unskilled labor, prompting high unemployment. These policies have been introduced in the public debate as tax cuts for firms, thus criticized by trade unions as "gifts to employers". As a result, the rationale for these policies was to reduce unemployment and not to carry out redistribution.

## 1.2 Data

Our main analyses rely on Social Security records called *Déclarations annuelles de données sociales* (DADS). DADS are individual-level annual earnings data that each employer needs to fill for each employee. We use a panel version of DADS which covers a 1/24 sample of all employees from 1967 to 2001, and a 1/12 of all workers from 2002 onwards.[3]

**Sample Restrictions.** One serious limitation of the data before 1993 is the absence of hours of work, implying that we cannot compute hourly wage nor payroll taxes for those working part-time or with multiple job spells within one year—as payroll tax thresholds are proportional to the number of hours worked. Consequently, we focus on individuals working full-time. We also restrict our sample to individuals between 20 and 64 years old, and drop individuals whose annual labor income is below 75% of the minimum wage. We further drop individuals who are not employed in the private sector through a standard labor contract. The latter restriction aims to ensure that we focus on a consistent definition of the sample over time.

**Wage Concepts.** The raw data about earnings come in the form of annual "net taxable earnings" (earnings reported for income tax). This definition of earnings is net of payroll taxes and gross of income tax. Earnings reported include basic earnings, as well as bonuses. We divide the different earnings concepts by the annual number of days worked to get wage concepts, since we focus on full-time workers. Our *net wage* concept corresponds to the net taxable earnings divided by the number of hours worked. We call *net-of-income tax*

[3]Details about the data are provided in Appendix C.

*wage* the net earnings to which personal income tax is deducted, divided by the number of days worked. *Posted wage* corresponds to net earnings plus all employee payroll taxes (divided by number of days worked). Posted wage is the contractual wage: it corresponds to the amount of pay stipulated in labor contracts, i.e., the "*salaire brut*" (gross earnings in French), and on which negotiations typically take place. We call *pretax wage* the actual labor cost paid for a full time equivalent worker by a firm. It corresponds to posted wage plus employer payroll taxes.

## 1.3 Simulation of Fifty Years of Labor Income Taxation in France

This paper applies a detailed microsimulation of both the income tax and payroll taxes to the administrative Social Security data described above. Our main objective is to provide a measure of pretax and net wage inequality for the past fifty years.

**Microsimulation of Payroll Taxation.** The rules for computing the numerous distinct payroll taxes are rather complex in France, as they depend on hourly wage, firm size, location of the firm, and affiliation to different pension schemes. The panel DADS provides information about the firm (identifier, sector, size), and each job spell (start and end date, earnings, occupation, part-time/full-time). We compute employer and employee payroll taxes using TAXIPP, a very precise tax simulator developed by some of the authors at the *Institut des politiques publiques (IPP)*. A strength of this tax simulator is to go back in time as early as the 1960s, hence making possible a study of tax or SSC reforms over more than fifty years. For the purpose of this study, the tax simulator has been adapted to DADS data and can reproduce very accurately the legislation in place each year between 1967 and 2019. We use TAXIPP to compute posted wage from net taxable wage before 1993,[4] and we compute pretax wage from net taxable wage by adding simulated employer and employee payroll taxes. Finally, we compute an *augmented net wage*, where we add back to the net earnings the Social Security contributions which provide direct deferred benefits in the form of additional pension benefits or unemployment benefits (see Section 3).

**Microsimulation of Income Tax.** Given that the French income tax is based on joint taxation, we estimate *net-of-income tax wage* using TAXIPP, assuming that workers live in one-individual household and have no other source of income. These assumptions lead

[4] After 1993, we observe both posted wage and taxable wage. For the period 1993-2019, we have checked that our simulation provides an accurate computation of employee payroll taxes.

to approximations but will allow us to provide a basic comparison of the evolution of the payroll tax and income tax schedules.

## 1.4 From a Regressive to a Progressive Payroll Tax Schedule

Figure 1a offers an overview of the impact of payroll tax reforms by showing the average payroll tax rate—adding the employer and the employee rate—as a share of pretax wage for P10, P50, and P90 of the earnings distribution[5]. In 1967 payroll taxation is clearly regressive in France. The average rate was of 28.6% for all workers below P70—the level of the Social Security threshold—while it decreased to 22.1% at P90 (and 13% at P99). From 1967 to the mid-1990s, the average payroll tax rates increased faster at the top of the earnings distribution, increasing from 22.1 to 43.6% for P90, compared to an increase from 28.6 to 44.7% for P50. This is explained by reforms uncapping payroll taxes above the Social Security threshold, while main rates under the threshold continued to increase. In the mid-1990s, the SSC tax schedule has become almost flat, at 45% of labor cost, for all earnings levels.

From the mid-1990s to 2019, reforms to SSCs are targeted at the lower part of the earnings distribution. Average payroll tax rates stabilized at around 46% of labor cost for the upper half of the earnings distribution while they dropped for lower percentiles, i.e., to 29% in 2019 for P10. This is the result of policies aiming to reduce labor cost at the minimum wage by cutting employer payroll taxes. Those payroll tax cuts started for workers whose wage was below 1.1 times the national minimum wage. They have progressively been extended to higher levels of the wage distribution, up to 2.5 times the minimum wage at the end of the period. These reforms were motivated by the idea that a high minimum wage combined with high employer payroll taxes were detrimental to employment. Their effect on employment has been widely studied (e.g., Kramarz & Philippon 2001, Crépon & Desplatz 2001). Incidentally, they also turned payroll taxation into a progressive tax schedule. In 2019, the average rate was 28.6% for workers at P10, increasing to 41.4% for workers at P50 and 45.3% for workers at P90.

**Changes in Benefits from Payroll Tax Reforms.** Given that payroll taxes have by nature a link to deferred benefits, it is important to gauge how changes in the payroll tax schedule have also affected future benefits. We study this point by distinguishing among

[5]Figure A2 shows the average payroll tax rate at each decile, and for employer and employee rates separately.

the different payroll taxes, those that are really *contributive*, in the sense that they lead to future benefits increases (e.g., pensions), from those that are not contributive, in the sense that they fund benefits not directly related to the amount of contribution paid (e.g., health care). Figure 1b shows the changes over time for non-contributive payroll taxes only. In 1967, low-wage earners were taxed at a 24% rate, while the rate of contribution reached 9% at P99. In contrast, in 2019, the rate is equal to 0 at the bottom (i.e., for minimum wage earners) and gets higher than 25% at the top. These numbers imply that between 1967 and 2019, the difference between the rates of non-contributive payroll taxes of the highest and the lowest wage earners has moved from a negative -13 percentage points to a positive 25 percentage points.

**Comparison with the Income Tax.** To gauge the distributive effects of the payroll tax reforms in France, we provide a comparison with the income tax. Figure 1c presents the changes in the income tax schedule on labor income from 1967 to 2019. Contrary to the payroll tax schedule, the French income tax schedule has become less progressive over time. The income tax rate (again expressed as a fraction of pretax wage) is close to 0% for low-wage earners in all periods and decreases from 30.1% to 11.1% for the highest-wage earners. Two reasons can explain this decreasing progressivity: first, top rates of the income tax schedule have been reduced from 60% to 45% ; second, as payroll taxes have been uncapped, net taxable income—labor income net of payroll taxes— has been decreasing for high earners. Mechanically, the increased progressivity of payroll taxation has decreased the progressivity of the income tax expressed as a fraction of pretax wage.

To summarize these changes in payroll taxation, we have computed the relative payroll and income tax wedge between low-, middle- and high-wage earners for the period 1967-2019.[6] We find that the total tax wedge of higher-wage earners (P90) has increased by 0.29 log points relative to the variation in tax wedge for low-wage earners (P10). More than 100% of this relative increase can be ascribed to payroll tax reforms, while income tax changes induced a modest reduction in the relative tax wedge of high-wage earners. More specifically, changes in income taxation "undid" less than 20% of the very large increase in progressivity between P10 and P90 induced by payroll taxation over the whole period. Hence, it only very partially compensated for it.

[6]See detailed results in Appendix Table A1 and Table A2, with this quantification split by period and provided for other percentiles.

# 2 Evolution of Wage Inequality

In this section, we present our main descriptive result, showing that pretax wage inequality has increased in France, while net was inequality has decreased.

## 2.1 Net and Pretax Wage Inequality

Figure 2a shows the evolution of the ratio P90/P10 for the net wage, posted wage, and pretax wage distributions for males and females working full-time full-year over the period 1967-2019.[7]

**Reductions in Net Wage Inequality.** Regarding net and posted wage inequality, the ratio P90/P10 declined by 18.9% for both wage measures, from 3.5 in 1967 to 2.8 in 2019. Most of the decline occurred before 1980; net wage inequality only declined slightly after that date. We thus confirm the decline in net wage inequality documented for France in previous studies (Charnoz et al. 2011, 2013, Verdugo 2014).

**Increases in Pretax Wage Inequality.** In contrast with these trends, pretax wage inequality, measured using the P90/P10 ratio, has increased by 15.4% during the period 1967-2019. This overall increase hides a clear U-shaped profile: pretax wage inequality first decreased from 1967 to 1980 and then increased sharply, by 31.6% over the period 1980-2019. This is a similar increase to the one observed for posted wage inequality in the U.S. over that period (31%), and higher than the one observed in the U.K. (11%).

In Figure 2b, we present the evolution of posted wage inequality (P90/P10 ratios) for a number of OECD countries. France appears as an outlier for posted wage inequality, with a decreasing trend when most countries experienced an increase in wage inequality. But when one uses pretax wage as a measure of wage inequality, France does not appear anymore as an outlier in the international experience of increasing wage inequality. In fact, compared to the seven countries for which we could recover statistics from 1980, France has the largest increase of the ratio P90/P10 if we consider pretax wage inequality ratio, but the lowest one if we consider net wage inequality (see Appendix Table A3).

**Decomposing Inequality Trends.** To understand the role played by tax reforms in explaining the diverging trends between net wage and pretax wage inequality, it is use-

[7] We also present different measures of wage inequality in France on various subsamples in a web application that accompanies the paper. See `https://payroll-tax-app.herokuapp.com`.

ful to decompose inequality trends between different part of the income distribution. In Figure 3a, we plot the inequality trend at the lower tail of the income distribution, with the ratio of P50/P10 wage inequality. From 1993 onwards the ratio P50/P10 increases for pretax wage and departs from the ratios observed for net and posted wages. This can be directly associated with the fact that the average payroll tax rate at P10 starts to decrease in 1993 due to payroll tax reductions for low wage earners. In Figure 3b, we present the same evidence for the upper-part of the wage distribution looking at the ratio P90/P50. During the period 1980-1993, the gap between posted and pretax wage inequality at the top starts to narrow. During that period, payroll taxes are progressively uncapped and the average rate at P90 increases faster than it does at P50.

## 2.2 Revisiting Skill-Biased Technological Change in Light of the French Experience

The dominant explanation of changes in wage inequality in the literature has been the skilled-biased technological change, also presented as the race between education and technology (Katz & Murphy 1992, Autor et al. 2008). The French experience of declining (posted) wage inequality was somehow a puzzle for this literature, unless the expansion of education had been strong enough in France to have counteracted the demand-side shift in favor of more skilled workers.

We formally revisit the roles of demand shifts towards skilled labor, skill-biased technical change and educational expansion using pre-tax wage inequality (see Appendix D). We first use the standard macro-level supply/demand model initiated by Katz & Murphy (1992), and second the more direct approach proposed by Michaels et al. (2014) to link at the industry level variations in the wage bill of high-skilled, middle-skilled and low-skilled workers to the extent of ICT investments.[8] While these analyses are not new, including for France, our contribution here is to reapply them using pretax wage (instead of the posted or net wage) as this is how analyses of demand-side explanations should be made. We show that France was concerned by skill-biased technical change (based on the Michaels et al. (2014)'s approach) and that the magnitude of demand shifts toward high-skilled workers estimated in France over the past fifty years is comparable to estimates for the U.S. and the U.K., consistent with the idea that these shifts induced by changes in technology or

[8]For the first exercise, we use additional information on education coming from the DADS-EDP data, while for the second we combine industry-level data from EUKlems with the DADS for the period 1978-2015.

globalization should have hit developed countries to a similar extent.

In addition, we show that the increase in the relative supply of skilled workers in France is comparable to that observed in the U.S. and the U.K.[9] Hence, education expansion cannot explain the decrease in net wage inequality observed in France, which must have happened for other reasons.

# 3 Did Payroll Tax Reforms reduce Wage Inequality?

In this section, we test whether payroll tax reforms are a good candidate to explain the decrease in net wage inequality in France in the context of increasing pre-tax wage inequality. The answer to this question is far from obvious as payroll taxes have some form of linkage to deferred benefits, and their ultimate incidence on net wages should be properly assessed. One thing that should be stressed from the start, is that if payroll tax changes affect employment or the labor share, overall measures of income inequality are likely to be affected too. In what follows, we focus on the wage pass-through element that directly impacts measures of wage inequality.

## 3.1 Incidence of Payroll Taxes at the bottom

Payroll tax cuts that started to be implemented in the mid-1990s cannot be analyzed separately from the evolution of the minimum wage that can mechanically constrain the incidence on wages.[10] Figure 4a presents, in real terms, the evolution of the net, posted and pretax minimum wage in France. The largest increase in the net minimum wage occurred just after the May 1968 events: between 1968 and 1970, the gross (or net) minimum wage increased by almost 50%. It kept growing fast in the 1970s and early 1980s, reaching around 60% of the median wage and concerning about 15% of the workforce in 1985. These large increases in real terms are good candidates to explain the concomitant reduction in wage inequality observed during the same period, especially at the bottom of the distribution (see details in Appendix E).

Increases in the minimum wage concomitant with payroll tax cuts at the minimum wage have actually mechanically shifted part of these reductions to workers. For example,

[9] See Appendix, Figure A1.

[10] A minimum wage, defined as posted wage, was introduced in France for the first time in 1950. Initially indexed on inflation, it followed from 1970 onwards an index based on the average earnings of blue-collar workers. On top of these rules of automatic uprating, the government could decide additional discretionary increases.

if the payroll tax rate (as a fraction of the posted wage) at the minimum wage is reduced by 10 percentage points in a given year, but that the real minimum wage is increased by 10% the same year, one should consider that payroll tax reductions have been fully shifted to workers. We formalize this idea in the following way. We denote $w_t^{min}$, $z_t^{min}$ and $\tau_t^{min}$ the real minimum net wage, the real minimum labor cost, and the average payroll tax rate at the minimum wage in year $t$, so that we have $w_t^{min} = z_t^{min}(1 - \tau_t^{min})$. Payroll tax cuts started to be implemented in 1994, implying that for any $t > 1993$, $\tau_{1993}^{min} - \tau_t^{min}$ measures the reduction in payroll taxation induced by the successive reforms. To get an idea of how the minimum wage may have mechanically shifted these reductions to workers, we make the hypothesis that the counterfactual net wages of workers paid the minimum wage would have remained constant in real terms in the absence of any change in the minimum wage (they would have evolved like inflation). This hypothesis implies for example that payroll tax cuts would be fully incident on employers in the absence of any increase in the minimum wage. We study how the minimum wage may have generated a shift from this benchmark case.

Figure 4b presents the results of this computation, showing the "cumulative" share of the payroll tax reductions that have been mechanically shifted to workers due to changes in the *real* minimum wage: $\frac{w_t^{min} - w_{1993}^{min}}{\tau_{1993}^{min} - \tau_t^{min}}$. Results show that, as compared to a counterfactual scenario in which net wages evolve like the inflation and payroll tax cuts are fully incident on firms, more than 50% of payroll tax cuts had been shifted to employees by the end of the 1990s, and close to 100% by the end of the period. This means that all payroll tax reductions implemented since 1993 have been offset by increases in the real minimum posted wage that are roughly equivalent, keeping the pretax minimum wage almost constant over the period.

To summarize our analysis for the bottom half of the wage distribution, after a period of falling inequality likely fostered by large increases of the minimum wage, payroll tax cuts have allowed further decreases in net wage inequality while product wage inequality was rising.

## 3.2 Incidence of Payroll Taxes at the top

Outside the specific case of wages around the minimum wage, the issue of the long-term incidence of payroll taxes has been central within the public economics literature (see Fullerton & Metcalf 2002, for a survey). The conventional wisdom is that, while nominally incident on firms, employer payroll taxes are eventually passed onto workers. However, this

view has been partly challenged by recent studies that consistently find zero pass-through of employer payroll taxes to wages at the individual level in the short- to medium-run (e.g., Saez et al. 2012, 2019, Bozio et al. 2019). Bozio et al. (2019) exploits French reforms and shows that the earlier reforms that uncapped payroll taxes were not passed on workers at the individual level in the case of payroll tax reforms with no linkage to deferred benefits (e.g., reforms of payroll taxes funding health care or child benefits). They find however full pass-through onto workers of payroll tax increases in the case of strong tax-benefit linkage (e.g., pension contributions in actuarially fair system). French et al. (2022) present additional evidence that the contributory link matter for labor supply responses to payroll taxation, which reinforces the case for a separate treatment in our analysis.

Let us discuss first the case of tax-benefit linkage. The fact that payroll taxes are fully shifted to wages implies that total compensation inequality (including deferred benefits) remains unchanged. Therefore, changes in purely contributive payroll taxes should not be considered as a way to reduce wage inequality.[11]

In the case of payroll tax increases without linkage to future benefits, the evidence from Bozio et al. (2019) points to zero pass-through at the individual level. This does not mean that some pass-through at the firm or market level cannot appear over time—for instance with lower wage for a large part of the wage distribution. We are not able to provide good micro evidence for what may have happened in the long run as the incidence of payroll tax may have been ultimately borne by all wage earners, or by consumers or firm owners, with unknown distributional consequences. Saez et al. (2019) show for example that payroll tax reductions for young workers in Sweden have been eventually passed on workers at the firm level, meaning that wages for all employees grew faster in more affected firms.

## 3.3 Counterfactual Net Wage Inequality

To provide an assessment of the effect of payroll tax reforms on wage inequality, we present in Figure 5a two polar cases of counterfactual net wage inequality in the absence of any payroll tax reforms and assuming behavioral responses triggered by these reforms did not affect observed inequality. In the first case (counterfactual 1), we assume that employer payroll taxes are ultimately shifted to workers, according to conventional wisdom. In that case, the counterfactual net wage inequality exactly follows the labor cost inequality series.

[11] In Figure A4, we show that inequality in terms of net wages plus contributive payroll taxes is close to, and has evolved similarly to inequality in terms of net wages. This implies that most of the diverging trends between net wage and pretax wage inequality have been generated by reforms of non-contributive payroll taxes.

In the second case (counterfactual 2), we assume that only the payroll tax reductions after 1993 (observed at P10 only) have been shifted to workers through the minimum wage, and that they have been so only in the same proportion as in Figure 4b.[12] In particular, this scenario assumes that payroll tax increases triggered by the uncapping of payroll taxes at the top were never shifted to workers, even partially. We obtain in that case a milder counterfactual increase in net wage inequality, especially until payroll tax cuts are introduced in the 1990s. The two counterfactual series may be seen as upper and lower bound of the true counterfactual net wage inequality in the absence of the policy mix of increased minimum wage jointly with payroll tax reforms. Comparing these counterfactual estimates with observed net wage series leads us to the conclusion that wage inequality measured by the ratio P90/P10 has been between 16.6% (counterfactual 2) and 29.7% lower (counterfactual 1) than it would have been absent any reform.

Figures 5b and 5c show similar scenarios separately for the bottom and the top of the wage distribution. At the bottom of the wage distribution, the two counterfactual analyses are close to each other as most of the payroll tax reductions have been mechanically shifted to workers due to the minimum wage. At the end of the period, whatever the assumption regarding the incidence of payroll tax changes which are not at the minimum wage, we find that the ratio of P50/P10 would have increased significantly in the absence of payroll tax reforms combined with minimum wage increases, by 15% from the mid-1990s. When we look at the upper tail of the wage distribution, the two counterfactual scenarios differ markedly: in counterfactual 2 (i.e., assuming that payroll tax changes are not shifted to workers except at the minimum wage) there is no change over the period in the counterfactual net wage inequality, consistent with the idea that without shifting to workers, uncapping of payroll taxes do not reduce wage inequality. Instead, if one assumes that payroll tax reforms have been shifted to workers at the individual level (counterfactual 1), the counterfactual increase in the ratio P90/P50 is much stronger (15% increase), and hence the impact of payroll tax reforms would have been also very significant in the upper half of the distribution.

Although the interval of these bounded estimates remains large, it allows us to conclude that payroll tax reforms, in conjunction with the minimum wage, have played a major role in the observed reduction of net wage inequality in France.[13]

[12] Importantly, workers at P10 in the wage distribution are paid the minimum wage for the entire period 1993-2019, implying that we can assume that they are fully affected by minimum wage increases (see Figure A3).

[13] Our conclusion is robust to various robustness checks (available in the Appendix), like including

# 4 Which Lessons to Draw from this Policy Experiment ?

We have shown that a substantial redistribution has taken place in France since 1980, shifting more than 30 percentage points of taxation from low- to high-wage earners. This redistribution was done through reforms of payroll taxation, a policy instrument that was not primarily intended to do so. In this section, we discuss what lessons could be drawn from this policy experiment that could apply to other countries, reviewing the advantages and drawbacks of using payroll taxation to mitigate wage inequality.

**Is France an outlier?** There is no cross-country evidence available over a sufficiently long time span to answer directly the question. Using EUSILC survey over the 2007-2019 period, we compare Gini indexes in terms of pretax and net wage in various countries (see Appendix F and Figure A5a). France appears as a clear outlier: it is the country that does the largest redistribution between pretax and posted wage. Moreover, there is no clear trend towards more progressive payroll taxation over the recent period which would indicate that other countries might follow the French trajectory. This questions the relevance for other countries of the French policy mix.

**Political Economy Aspects.** The redistribution carried out in France by payroll taxation was achieved with other objectives in mind. The main political objective was to reduce unemployment of low skilled wage earners. The reduction in inequality is, in a way, an unintended consequence that has been largely unnoticed. The French policy experiment can therefore be characterized as not very transparent to the public. It is even sometimes poorly understood. For instance, labor unions often describe employer payroll tax cuts for low wage earners as a gift to firms. On the one hand, this has helped engineer substantial redistribution without standard political economy issues, in times of structurally increasing labor market inequality. On the other hand, it has fostered large confusion in the public eyes on the real impact of those policies and it can also be considered as not very democratic.

**Poor Targeting.** A limit of using payroll taxes and minimum wage for redistribution is that payroll taxes apply to individuals, preventing them to target directly poor families.

unemployed workers in the counterfactual wage distribution, or using different samples for measuring wage inequality.

Unemployed, inactive, and retired individuals are also excluded by design. In the debate about the tools of redistribution, most countries have focused on the use of comprehensive income tax, means-tested transfers, and EITC-like inwork tax credits to target low income wage earners. Inwork tax credits could be seen as better targeted towards low earners in low income households. However, workfare could be captured by employers in the form of lower posted wages (Rothstein 2010, Azmat 2019). Hence, the optimal policy mix might combine EITC with minimum wage floors, which would be close to the French policy mix, but with better targeting (Lee & Saez 2012). On the other hand, carrying out redistribution through reduction in payroll taxes—rather than topping up a low minimum wage with in-work credits—could potentially prevent workers from feeling that they need public assistance and are not able to make a living with what they earn.

# 5 Conclusion

Using French administrative data on earnings over the 1967-2019 period and detailed microsimulation model of labor income taxation, we compute wage inequality series that distinguish pretax, posted wage and net wage inequality. We show that pretax wage inequality measured by the P90/P10 ratio has increased in France by 15%, while net wage inequality has decreased by 25% over the same period. This places France as an international outlier for net wage inequality but not for pretax wage inequality which is more in line with the labor market inequality increases experienced by other developed countries. We show that this reduction in wage inequality can be largely attributed to the policy mix of minimum wage increases joined with reductions of payroll taxes for low wage earners. As a result, reforms of payroll taxation have been in France a major redistribution tool. Given potential drawbacks, and the lack of transparency of its effect, we remain cautious as whether this policy experiment should be copied in other countries.

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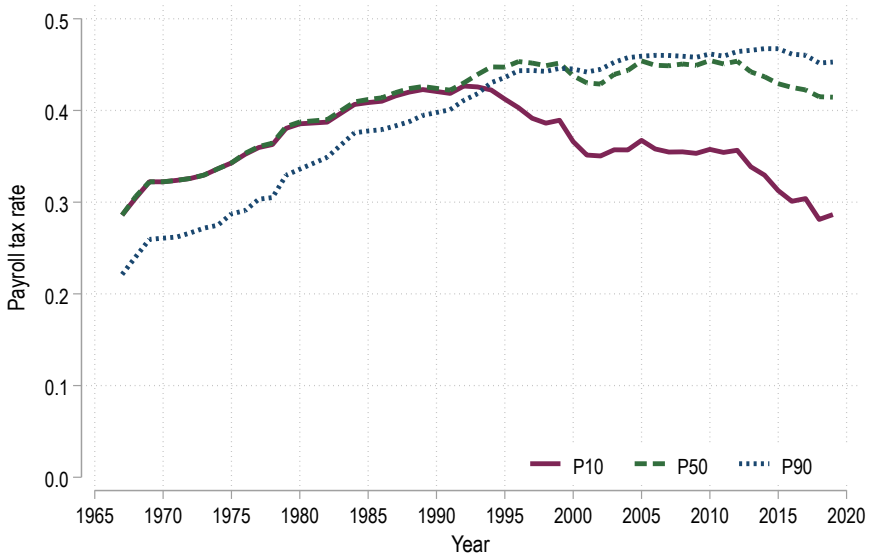
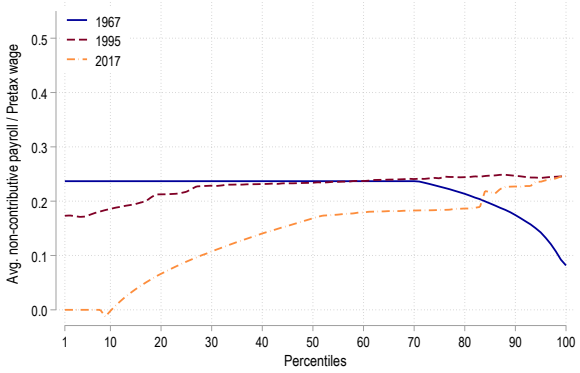
# Figures and Tables

Figure 1: From Regressive to Progressive Payroll Taxation (France, 1967–2019)

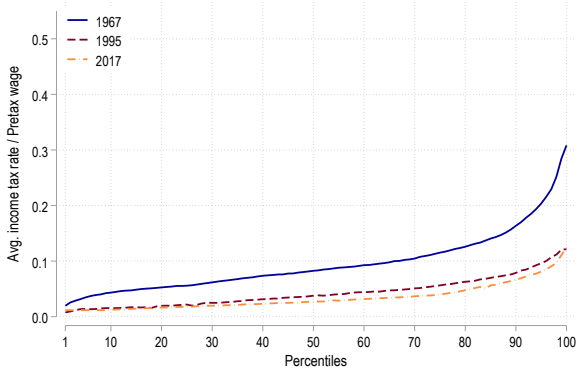
(a) Payroll Tax Rate for Percentile P10, P50 and P90 of the Pretax Wage Distribution




(b) Non-Contributive Payroll Taxes Only



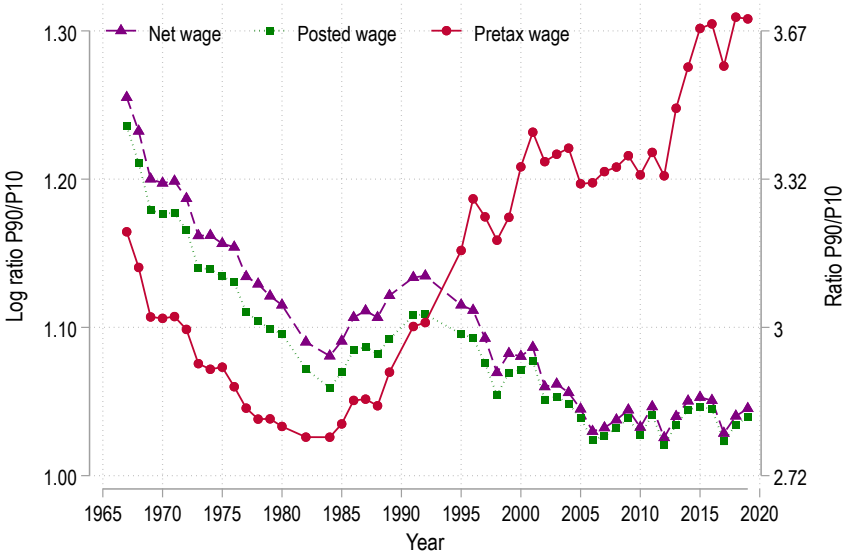

(c) Average Income Tax Rate



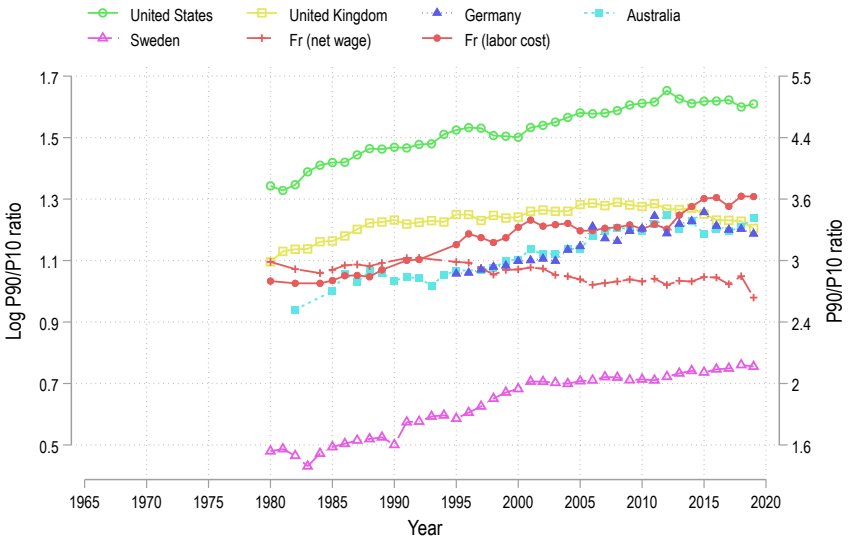

NOTES: The figure plots the ratio of payroll taxes (including both employer and employee payroll taxes) to the pretax wage at percentiles P10, P50 and P90 of the pretax wage distribution (panel a). Panel (b) excludes contributive SSCs from the simulations. Panel (c) focuses on the income tax resulting from the simple application of the income tax schedule to the taxable wage (see details in Appendix C.2). In all panels, the sample includes individuals between 20 and 64 years old working full-time in the private sector. SOURCE: DADS data 1967-2019.

Figure 2: Wage Inequality Ratios: France vs OECD countries

(a) P90/P10 Wage Ratios, France 1967–2019



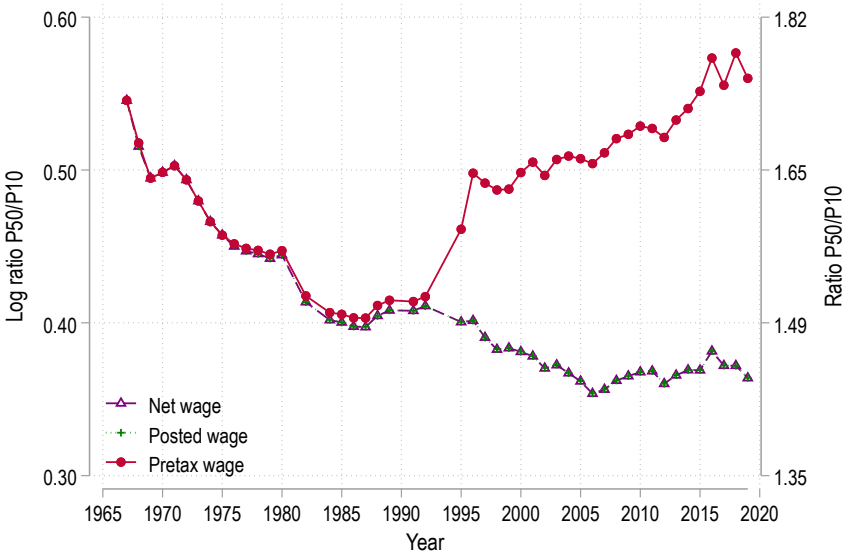

(b) P90/P10 Posted Wage Ratios, OECD Countries



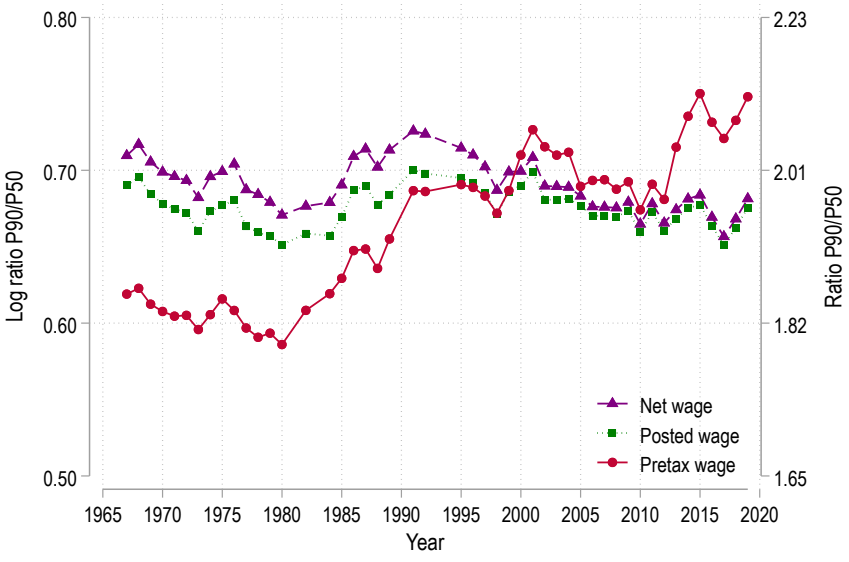

NOTES: The figure depicts the log wage ratios P90/P10 (panel a), P50/P10 (panel a) and P90/P50 (panel b) for net, posted and pretax wage. The right-hand side axis provides the equivalence with the wage ratios. On panel (a), the posted wage and the net wage curves are confused because the inequality ratio is equivalent for the two wage concepts. In all panels, the sample includes individuals between 20 and 64 years old working full-time in the private sector.
SOURCE: DADS data 1967-2019, OECD statistics.

Figure 3: Decomposition of Wage Inequality Ratios

(a) Lower-tail Inequality, P50/P10, 1967–2019



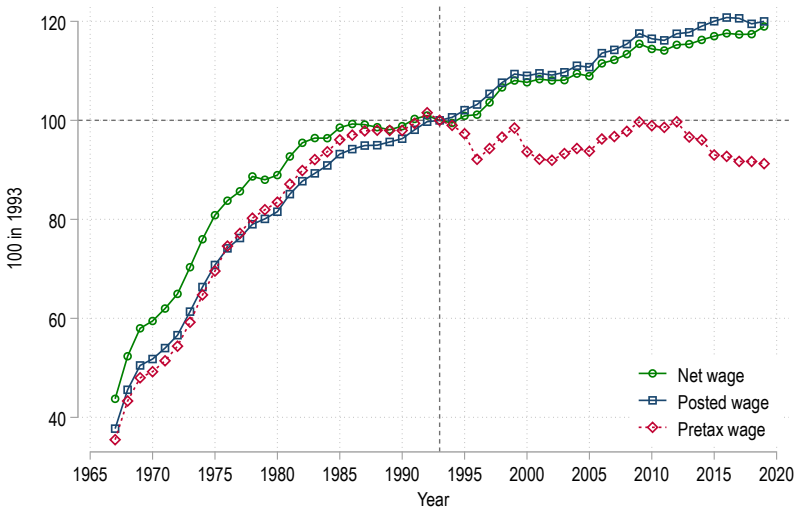

(b) Upper-tail Inequality, P90/P50, 1967–2019



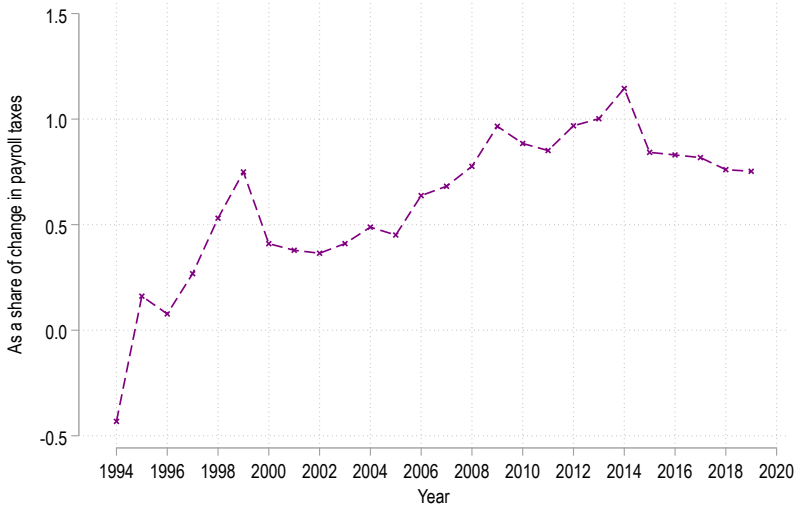

NOTES: The figure depicts the log wage ratios P50/P10 (panel a), P90/P50 (panel b) and P99/P90 (panel **??**) for net, posted and pretax wage. The right-hand side axis provides the equivalence with the wage ratios. On panel (a), the posted wage and the net wage curves are confused because the inequality ratio is equivalent for the two wage concepts. In all panels, the sample includes individuals between 20 and 64 years old working full-time in the private sector.
SOURCE: DADS data 1967-2019, OECD statistics.

Figure 4: The Minimum Wage and the Incidence of Payroll Tax Reductions

(a) Evolution of the Net, Posted and Pretax Minimum Wage (in real terms)



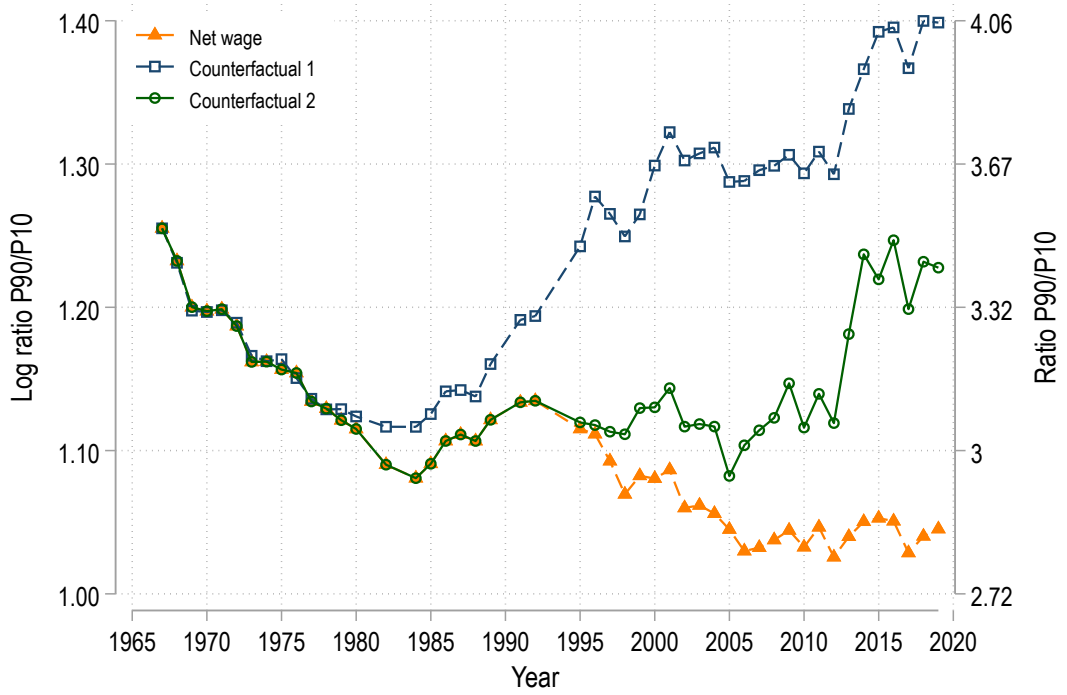

(b) Cumulative Share of the Payroll Tax Cuts at the Minimum Wage Mechanically Shifted to Employees



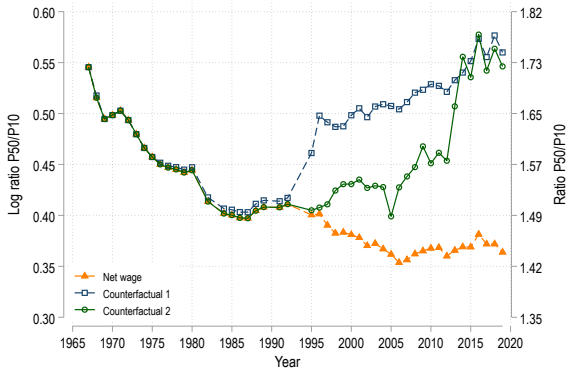

NOTE: Panel (a) presents the evolution of the minimum wage in real terms (normalized at 100 in 1993) for net, posted and pretax wage. Panel (b) shows $\frac{w_t^{min} - w_{1993}^{min}}{\tau_{1993}^{min} - \tau_t^{min}}$ , that is the cumulative share of the payroll tax changes implemented since 1993 that has been shifted mechanically to workers through minimum wage increases. The reference year is 1993. We do not take into account the CICE (created in 2013).
SOURCE: author's computation using TAXIPP

Figure 5: Impact of Payroll Tax Reforms on Wage Inequality

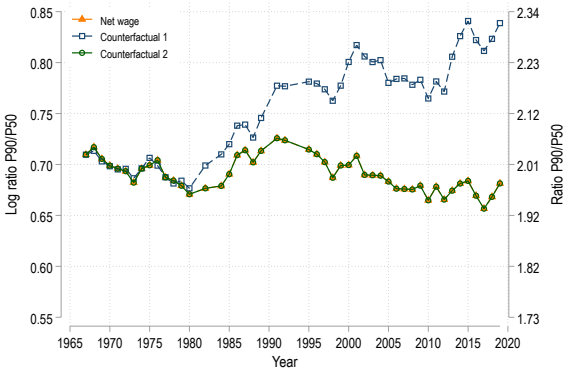
(a) P90/P10 Wage Ratios




(b) Impact on the Lower Tail, P50/P10




(c) Impact on the Upper Tail, P90/P50




NOTE: The Figure proposes two scenarios of incidence, on workers or on employers, absent any behavioral responses. Counterfactual 1 assumes that payroll tax changes have been entirely passed on workers whereas counterfactual 2 assumes that non-contributory payroll tax *increases* have been entirely passed on firms, while payroll tax *reductions* after 1993 (observed at P10 only) have been shifted to workers in the same proportion as in Figure 4b (due to the simultaneous increase in the minimum wage). Panel (a) shows the results for the P90/P10 ratio while panel (b) and panel (c) focus on the lower and upper tails. The P90/P50 ratio for the net wage and for counterfactual 2 are confounded.

SOURCE: DADS data 1967-2019. The sample includes full-time employees paid at the minimum wage in the private sector.

(For Online Publication)

Appendix to

# Using Payroll Taxation as a Redistribution Tool Inequality in France

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This Appendix provides additional results (Appendix A), complements to institutional details (Appendix B) and data (Appendix C), as well as an assessment of the demand-side explanation for changes in wage inequality (Appendix D) and the possible effect of the minimum wage on wage inequality at the bottom (Appendix E), and details on the international comparisons (Appendix F).

# A Additional Tables and Figures

Table A1: Contribution of Payroll Taxes and Income Taxes to Changes in the Relative Tax Wedge at Different Percentiles over the Period 1967-2019

| Inequality measure | Changes in relative tax wedge (in log points) | | | Contribution to changes in relative tax wedge of changes in | |
|---|---|---|---|---|---|
| | Payroll tax wedge (1) | Income tax wedge (2) | Total tax wedge (3) | Payroll taxation $\frac{(1)}{(3)}$ | Income taxation $\frac{(2)}{(3)}$ |
| A. Between 1967 and 2019 | | | | | |
| P90 vs P10 | 0.35 | -0.06 | 0.29 | 120.88% | -20.88% |
| P90 vs P50 | 0.16 | -0.03 | 0.13 | 119.63% | -19.63% |
| P50 vs P10 | 0.20 | -0.04 | 0.16 | 121.90% | -21.90% |
| P99 vs P50 | 0.27 | -0.11 | 0.15 | 174.76% | -74.76% |
| B. Between 1980 and 2019 | | | | | |
| P90 vs P10 | 0.34 | -0.03 | 0.32 | 107.98% | -7.98% |
| P90 vs P50 | 0.15 | -0.00 | 0.15 | 101.97% | -1.97% |
| P50 vs P10 | 0.19 | -0.02 | 0.17 | 113.21% | -13.21% |
| P99/P50 | 0.26 | -0.01 | 0.25 | 102.56% | -2.56% |
| C. Between 1967 and 1980 | | | | | |
| P90 vs P10 | 0.01 | -0.04 | -0.03 | -32.52% | 132.52% |
| P90 vs P50 | 0.01 | -0.02 | -0.02 | -34.44% | 134.44% |
| P50 vs P10 | 0.00 | -0.01 | -0.01 | -29.20% | 129.20% |
| P99 vs P50 | 0.01 | -0.11 | -0.10 | -7.88% | 107.88% |

NOTE: The Table reports in the three first columns the long-run changes (in log points) in the ratios of the tax wedge paid at different percentiles of the distribution. It does so for the payroll tax wedge only (column 1), the income tax only (column 2) or the sum of the two (column 3). It then shows the relative contribution of payroll taxation and income taxation to the overall change in the relative tax wedge paid at different percentiles of the distribution (columns 4 and 5). Formally, column (1) shows time variations $\Delta_{t_1}^{t_2} \ln(\frac{1+\tau_{p_1}^{payroll}}{1+\tau_{p_2}^{payroll}})$ where $p_1$ and $p_2$ are the two percentiles given in the first column and the dates $t_1$ and $t_2$ are given in the title of each panel of the table. Similarly, columns (2) and (3) show variations $\Delta_{t_1}^{t_2} \ln(\frac{1+\tau_{p_1}^{income}}{1+\tau_{p_2}^{income}})$ and $\Delta_{t_1}^{t_2} \ln(\frac{1+\tau_{p_1}^{payroll}+\tau_{p_1}^{income}}{1+\tau_{p_2}^{payroll}+\tau_{p_2}^{income}})$, respectively. More formally, note $z_{p_i}$, $w_{p_i}$ and $n_{p_i}$ the values of the labor cost, net wage and net-of-income tax wage at percentile $p_i$. The last two columns rely on the fact that $\Delta_{t_1}^{t_2} \ln(\frac{z_{p_1}}{z_{p_2}}) = \Delta_{t_1}^{t_2} \ln(\frac{w_{p_1}}{w_{p_2}}) + \Delta_{t_1}^{t_2} \ln(\frac{1+\tau_{p_1}^{payroll}}{1+\tau_{p_2}^{payroll}}) = \Delta_{t_1}^{t_2} \ln(\frac{n_{p_1}}{n_{p_2}}) + \Delta_{t_1}^{t_2} \ln(\frac{1+\tau_{p_1}^{income}}{1+\tau_{p_2}^{income}}) + \Delta_{t_1}^{t_2} \ln(\frac{1+\tau_{p_1}^{payroll}}{1+\tau_{p_2}^{payroll}})$, with $\tau_{p_i}^{income}$ and $\tau_{p_i}^{payroll}$ the average income and payroll tax rates at percentile $p_i$. They show $\frac{\Delta_{t_1}^{t_2} \ln(\frac{z_{p_1}}{z_{p_2}}) - \Delta_{t_1}^{t_2} \ln(\frac{w_{p_1}}{w_{p_2}})}{\Delta_{t_1}^{t_2} \ln(\frac{z_{p_1}}{z_{p_2}}) - \Delta_{t_1}^{t_2} \ln(\frac{n_{p_1}}{n_{p_2}})}$ and $\frac{\Delta_{t_1}^{t_2} \ln(\frac{w_{p_1}}{w_{p_2}}) - \Delta_{t_1}^{t_2} \ln(\frac{n_{p_1}}{n_{p_2}})}{\Delta_{t_1}^{t_2} \ln(\frac{z_{p_1}}{z_{p_2}}) - \Delta_{t_1}^{t_2} \ln(\frac{n_{p_1}}{n_{p_2}})}$, respectively, after multiplying these proportions by 100 to get percentages. This decomposition provides the respective contribution of payroll and income taxation to the long-run changes in the relative tax wedge observed at different percentiles and therefore to the fact that labor cost and net-of-income tax wage inequality did not evolve similarly.

SOURCE: DADS data 1967, 1980 and 2019.

Table A2: Contribution of Non-Contributive Payroll Taxes and Income Taxes to Changes in the Relative Tax Wedge at Different Percentiles over the Period 1967-2019

| Inequality measure | Changes in relative tax wedge (in log points) | | | Contribution to changes in relative tax wedge of changes in | |
|---|---|---|---|---|---|
| | Payroll tax wedge (1) | Income tax wedge (2) | Total tax wedge (3) | Payroll taxation $\frac{(1)}{(3)}$ | Income taxation $\frac{(2)}{(3)}$ |
| (a) Between 1967 and 2019 | | | | | |
| P90 vs P10 | 0.35 | -0.06 | 0.29 | 119.86% | -19.86% |
| P90 vs P50 | 0.15 | -0.02 | 0.13 | 117.50% | -17.50% |
| P50 vs P10 | 0.20 | -0.04 | 0.16 | 121.79% | -21.79% |
| P99 vs P50 | 0.28 | -0.13 | 0.15 | 186.33% | -86.33% |
| (b) Between 1980 and 2019 | | | | | |
| P90 vs P10 | 0.30 | 0.01 | 0.32 | 95.47% | 4.53% |
| P90 vs P50 | 0.11 | 0.04 | 0.15 | 75.25% | 24.75% |
| P50 vs P10 | 0.19 | -0.02 | 0.17 | 113.08% | -13.08% |
| P99 vs P50 | 0.19 | 0.06 | 0.25 | 77.17% | 22.83% |
| (c) Between 1967 and 1980 | | | | | |
| P90 vs P10 | 0.05 | -0.07 | -0.03 | -170.21% | 270.21% |
| P90 vs P50 | 0.04 | -0.06 | -0.02 | -251.12% | 351.12% |
| P50 vs P10 | 0.00 | -0.01 | -0.01 | -29.77% | 129.77% |
| P99 vs P50 | 0.09 | -0.19 | -0.10 | -89.82% | 189.82% |

NOTE: The Table reports in the three first columns the long-run changes (in log points) in the ratios of the tax wedge paid at different percentiles of the distribution. The difference with Table A1 is that we consider here the net wage augmented with the contributive contributions instead of the net wage. It does so for the non-contributive payroll tax wedge only (column 1), the income tax only (column 2) or the sum of the two (column 3). It then shows the relative contribution of payroll taxation and income taxation to the overall change in the relative tax wedge paid at different percentiles of the distribution (columns 4 and 5). Formally, column (1) shows time variations $\Delta_{t_1}^{t_2} \ln(\frac{1+\tau_{p_1}^{payroll}}{1+\tau_{p_2}^{payroll}})$ where $p_1$ and $p_2$ are the two percentiles given in the first column and the dates $t_1$ and $t_2$ are given in the title of each panel of the table. Similarly, columns (2) and (3) show variations $\Delta_{t_1}^{t_2} \ln(\frac{1+\tau_{p_1}^{income}}{1+\tau_{p_2}^{income}})$ and $\Delta_{t_1}^{t_2} \ln(\frac{1+\tau_{p_1}^{payroll}+\tau_{p_1}^{income}}{1+\tau_{p_2}^{payroll}+\tau_{p_2}^{income}})$, respectively. More formally, note $z_{p_i}$, $w_{p_i}$ and $n_{p_i}$ the values of the labor cost, net wage and net-of-income tax wage at percentile $p_i$. The last two columns rely on the fact that $\Delta_{t_1}^{t_2} \ln(\frac{z_{p_1}}{z_{p_2}}) = \Delta_{t_1}^{t_2} \ln(\frac{w_{p_1}}{w_{p_2}}) + \Delta_{t_1}^{t_2} \ln(\frac{1+\tau_{p_1}^{payroll}}{1+\tau_{p_2}^{payroll}}) = \Delta_{t_1}^{t_2} \ln(\frac{n_{p_1}}{n_{p_2}}) + \Delta_{t_1}^{t_2} \ln(\frac{1+\tau_{p_1}^{income}}{1+\tau_{p_2}^{income}}) + \Delta_{t_1}^{t_2} \ln(\frac{1+\tau_{p_1}^{payroll}}{1+\tau_{p_2}^{payroll}})$, with $\tau_{p_i}^{income}$ and $\tau_{p_i}^{payroll}$ the average income and payroll tax rates at percentile $p_i$. They show $\frac{\Delta_{t_1}^{t_2} \ln(\frac{z_{p_1}}{z_{p_2}}) - \Delta_{t_1}^{t_2} \ln(\frac{w_{p_1}}{w_{p_2}})}{\Delta_{t_1}^{t_2} \ln(\frac{z_{p_1}}{z_{p_2}}) - \Delta_{t_1}^{t_2} \ln(\frac{n_{p_1}}{n_{p_2}})}$ and $\frac{\Delta_{t_1}^{t_2} \ln(\frac{w_{p_1}}{w_{p_2}}) - \Delta_{t_1}^{t_2} \ln(\frac{n_{p_1}}{n_{p_2}})}{\Delta_{t_1}^{t_2} \ln(\frac{z_{p_1}}{z_{p_2}}) - \Delta_{t_1}^{t_2} \ln(\frac{n_{p_1}}{n_{p_2}})}$, respectively, after multiplying these proportions by 100 to get percentages. This decomposition provides the respective contribution of payroll and income taxation to the long-run changes in the relative tax wedge observed at different percentiles and therefore to the fact that labor cost and net-of-income tax wage inequality did not evolve similarly.

SOURCE: DADS data 1967, 1980 and 2019.

Table A3: Changes in P90/P10 by Country.

(a) 1980-2019.

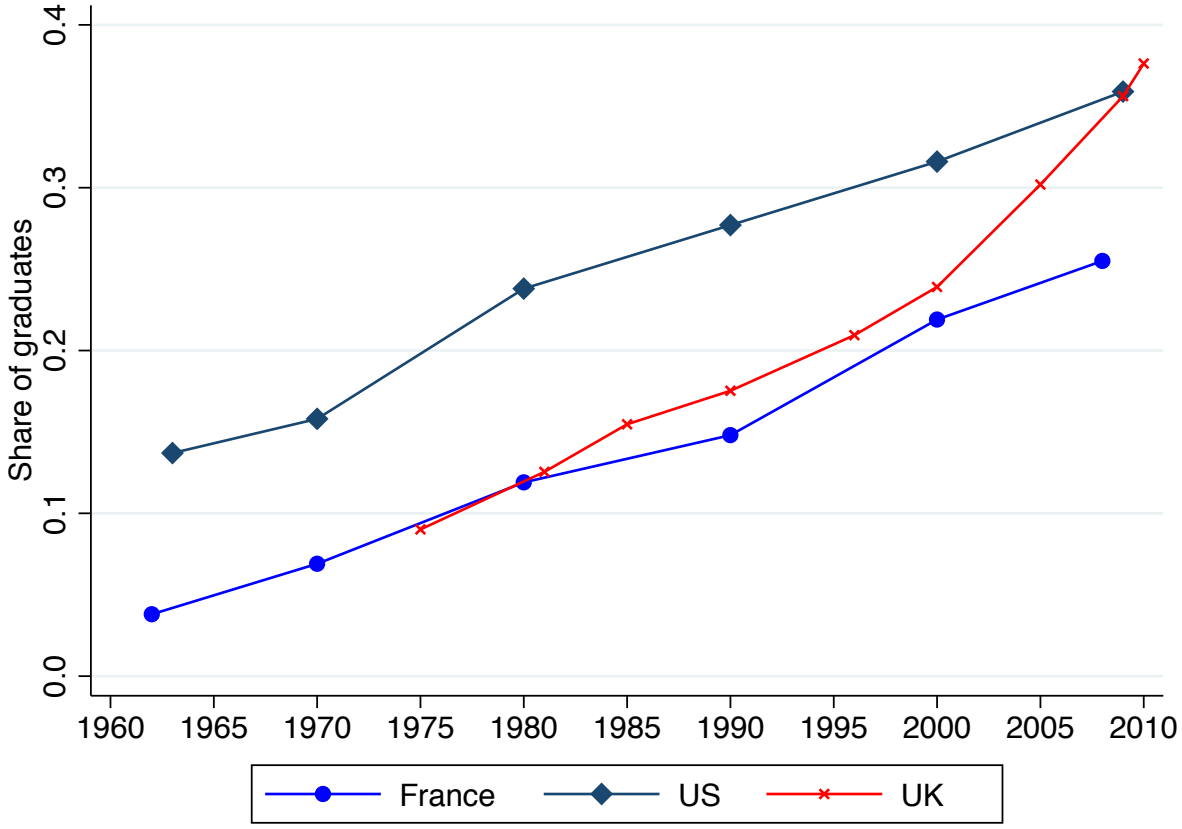
| | 1980 | 2019 | % change 1980-2019 |
|---|---|---|---|
| **France labor cost** | 2.81 | 3.70 | **0.32** |
| Sweden | 1.62 | 2.13 | 0.32 |
| United States | 3.83 | 5.00 | 0.31 |
| Poland | 2.81 | 3.58 | 0.27 |
| Australia | 2.75 | 3.45 | 0.25 |
| Italy | 2.22 | 2.75 | 0.24 |
| United Kingdom | 2.99 | 3.34 | 0.11 |
| Finland | 2.47 | 2.56 | 0.04 |
| **France net wage** | 3.05 | 2.84 | **-0.07** |

(b) 2000-2019.

| | 2000 | 2019 | % change 2000-2019 |
|---|---|---|---|
| Ireland | 3.30 | 3.91 | 0.19 |
| Norway | 2.01 | 2.36 | 0.17 |
| **France labor cost** | 3.35 | 3.70 | **0.10** |
| Denmark | 2.36 | 2.60 | 0.10 |
| Germany | 3.00 | 3.28 | 0.09 |
| Spain | 3.44 | 3.70 | 0.08 |
| Belgium | 2.37 | 2.56 | 0.08 |
| Netherlands | 2.75 | 2.77 | 0.01 |
| **France net wage** | 2.95 | 2.84 | **-0.03** |
| OECD countries | 3.49 | 3.33 | -0.04 |
| Greece | 3.58 | 3.35 | -0.06 |
| Bulgaria | 4.79 | 4.50 | -0.06 |
| Canada | 3.61 | 3.37 | -0.07 |
| Portugal | 4.10 | 3.28 | -0.20 |

SOURCES: Net, posted and pretax wages from the DADS data 1980-2019 for France, posted wage from the OECD for the other countries. We complete missing years by linear interpolation. Data not being available for New Zealand and Italy for 1980, we use 1984 and 1986 instead.

Figure A1: Evolution of the Share of Graduates in Employed Population in France, the U.K. and the U.S.

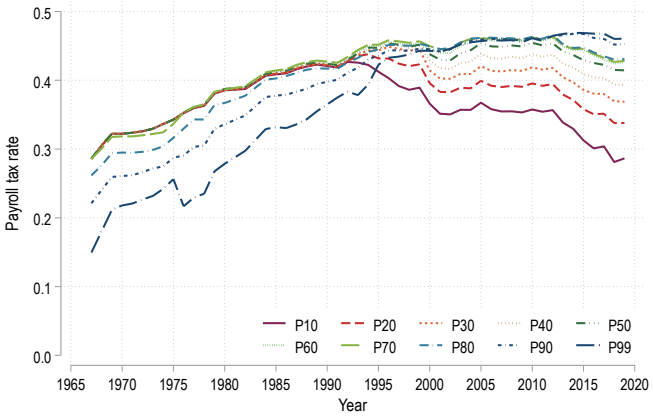



NOTE: The figure shows the share of graduates in the employed population for France, the US and the UK.

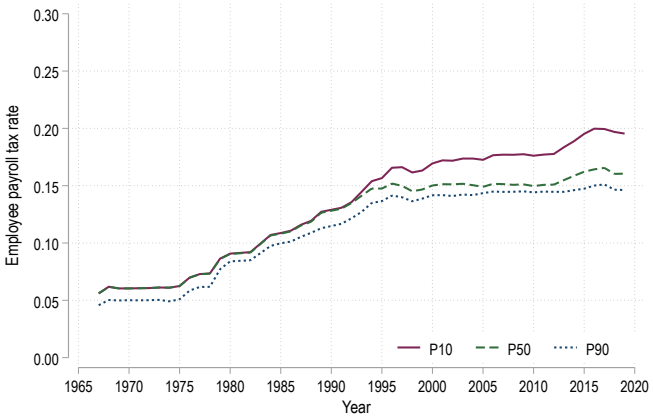
SOURCE: The data for the US come from Lindley & Machin (2011) who use March CPS data. The data for France come from Verdugo (2014) who uses the DADS-EDP. The data for the UK come from own computation using the Labour Force Survey.

Figure A2: Payroll Tax Rates in France

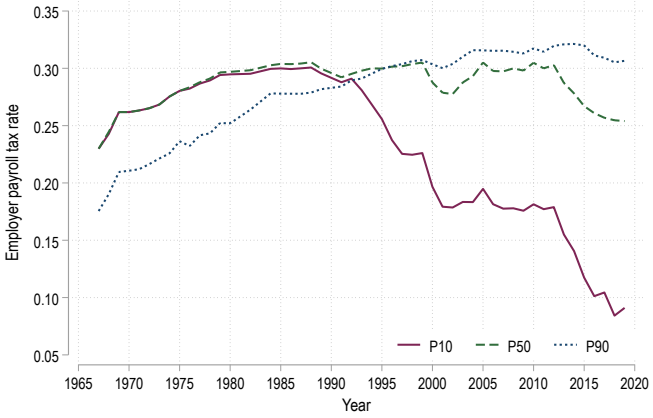
(a) Selected percentiles




(b) Employee Payroll Taxes



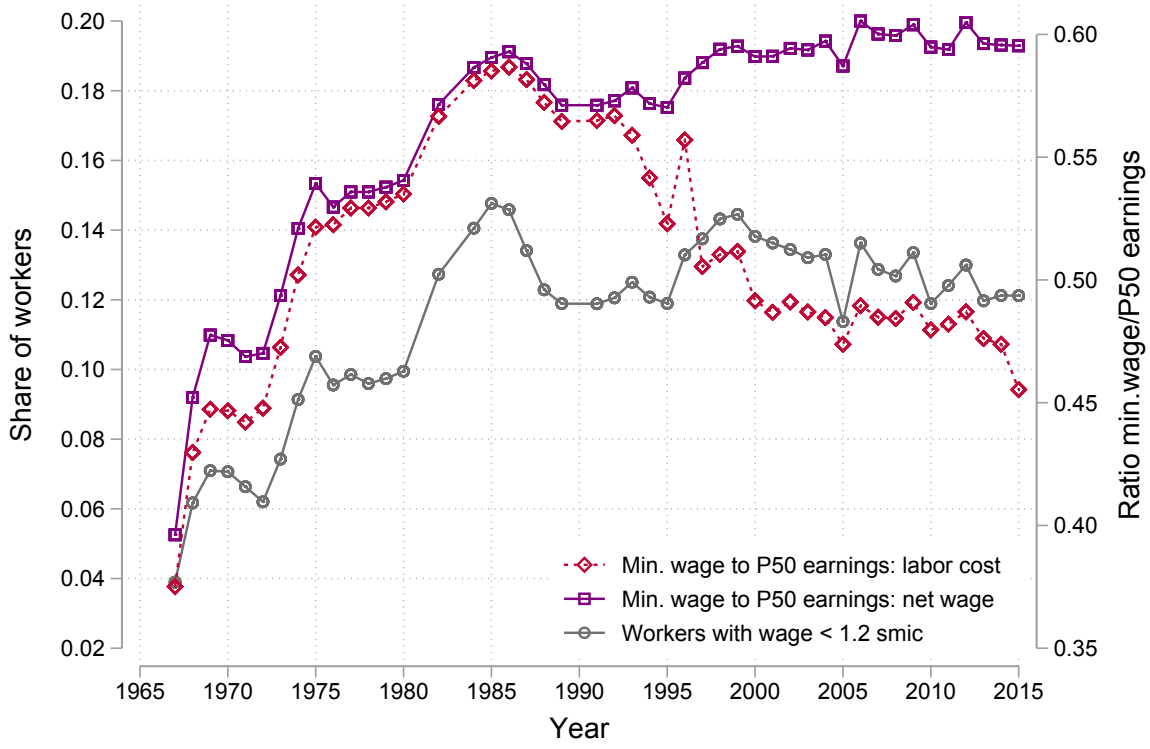

(c) Employer Payroll Taxes




NOTES: Panel (a) provides the ratio of the average total payroll taxes (employer and employee part) to the average pretax wage at selected percentiles of the pretax wage distribution. Panel (b) and (c) show the payroll tax rate for employer and employee contributions, respectively.

SOURCE: DADS data 1967-2019. The sample includes men and women between 20 and 64 years old working in the private sector.

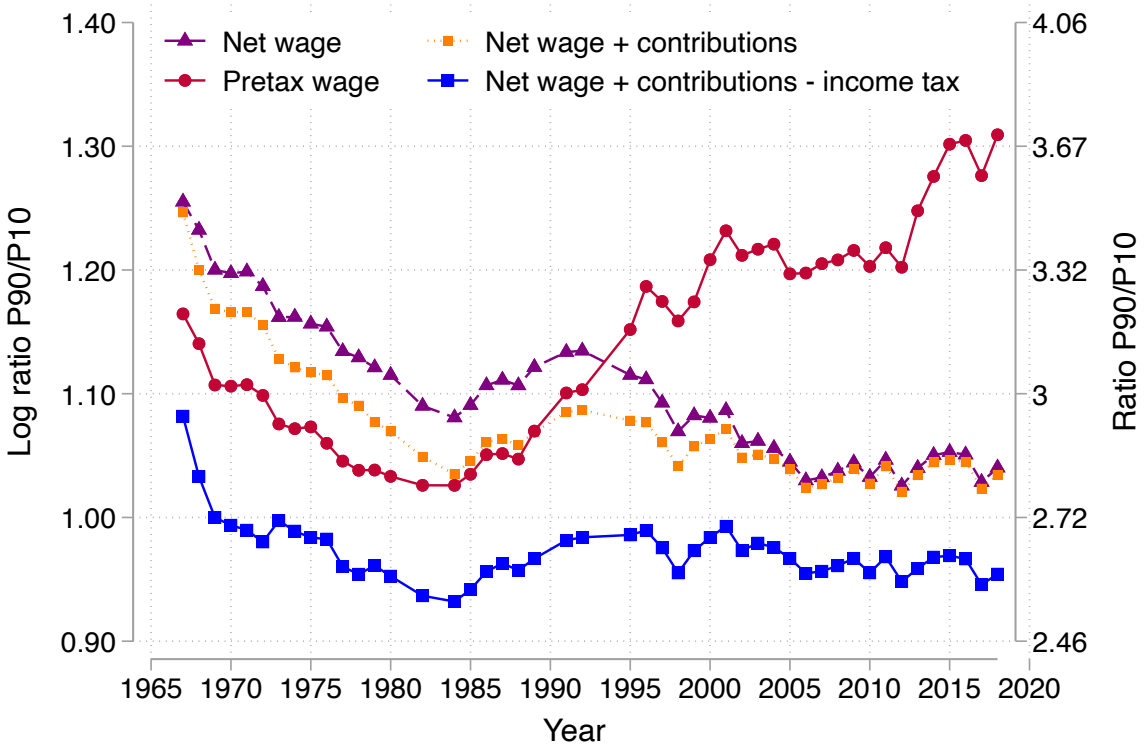
Figure A3: Evolution of the Share of Workers Potentially Affected by the Minimum Wage




NOTES: The figure presents the share of workers with a wage inferior to 1.2 the minimum wage (left-hand side). The purple and red lines (right hand side) are the ratio of the minimum wage to the median wage for the net wage and the labor cost.

SOURCE: DADS data 1967-2015.

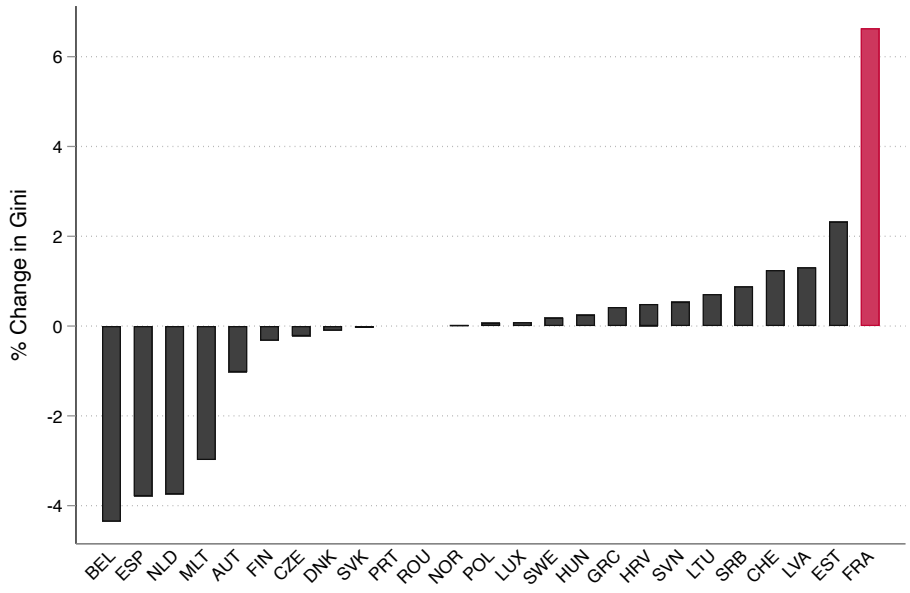
Figure A4: Wage Inequality Ratios in France, 1967–2015



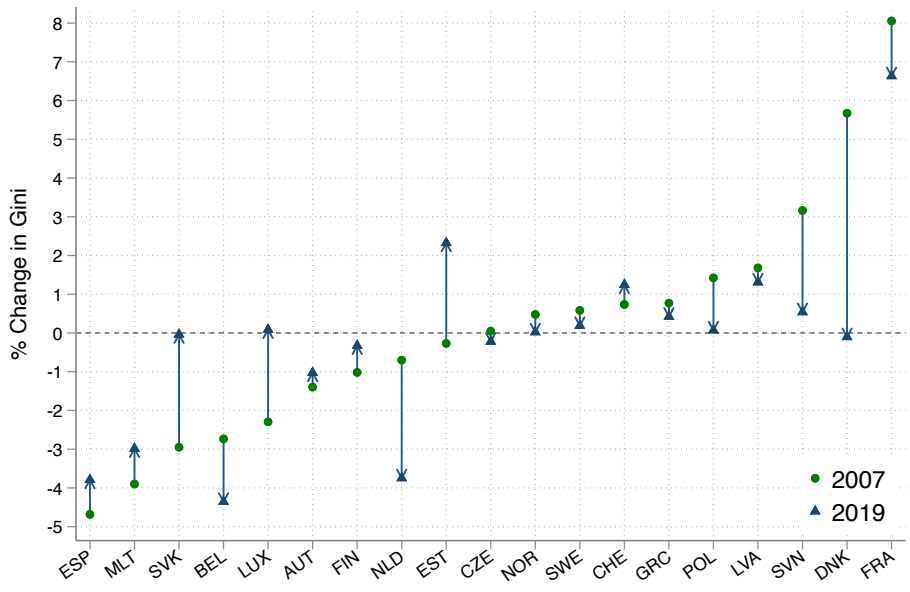

NOTES: The figure depicts the P90-P10 log wage ratio for the net wage, the pretax wage, the net-of-income tax wage and for the net wage to which contributive employer and employee payroll taxes have been added. The sample includes male and female workers of the private sector working full-time. The right-hand side axis provides the equivalence with the wage ratios.
SOURCE: DADS data 1967-2019.

Figure A5: International Comparisons for the Recent Period

(a) Reduction in Gini index when moving from pretax wage to posted wage distribution in 2019




(b) Evolution 2007-2019 of redistribution through SSCs/payroll taxes

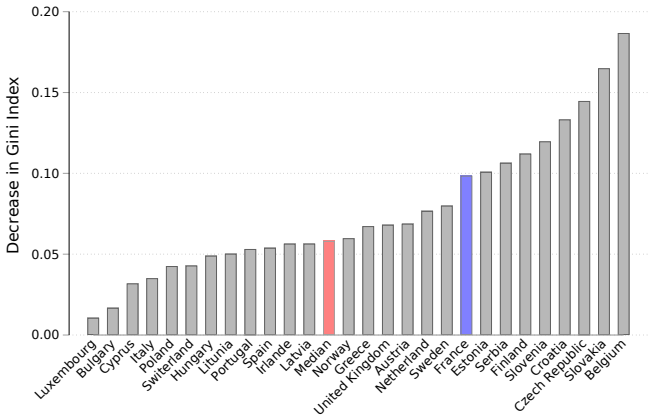



NOTES: The figure shows the relative change (in percentages) in the gini when moving from pretax wage to posted wage distribution. This measures captures the reduction in wage inequality coming from the employer social security contribution. Panel (a) shows that France implements a 6% in the gini index when moving from pretax wage to posted wage. Panel (b) shows how this measure evolves between 2007 and 2019 (dropping countries for which we do not have information for 2007).

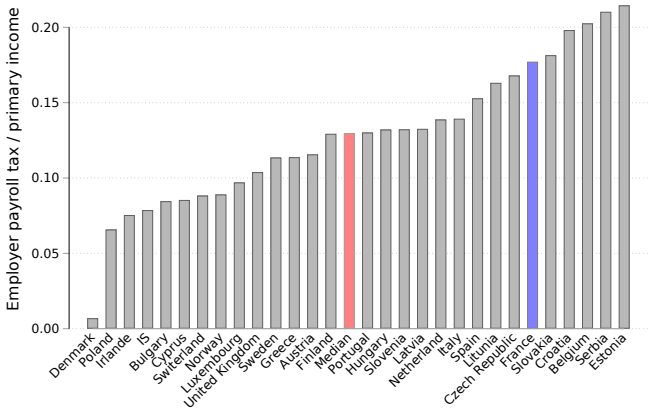
SOURCE: EU-SILC data 2007-2019.

Figure A6: Comparing Payroll Taxes Across Europe: Distributive Properties and Weight

(a) Change in Gini Index of Disposable Income when Including Employer Payroll Taxes, by Country




(b) Employer Payroll Taxes as a Share Household's Primary Income, by Country

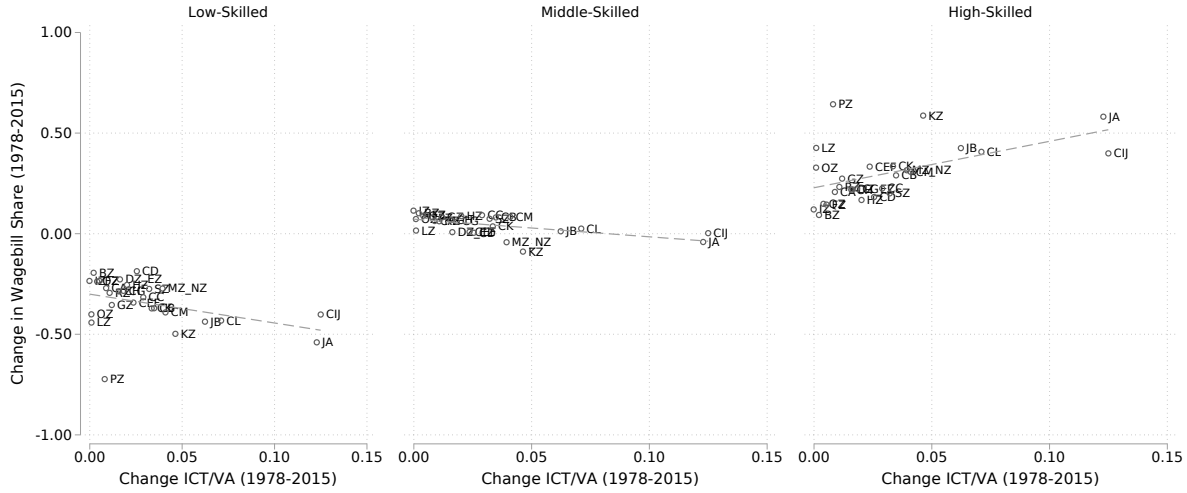



Source: data from EU-SILC 2017 and computations by France Stratégie (Rousselon & Viennot 2020). Data for panel (a) come from Figure 92 (page 143 of the document). Panel (b) reproduces Figure 93 (page 144 of the document).

Note (a): in France, the gini index of disposable income is 9.9% lower than the gini index of disposable income plus employer payroll taxes. This decrease in the Gini index illustrates the progressivity of employer payroll taxes.

Note (b): in France, employer payroll taxes amount to 17.7% of households' primary income.

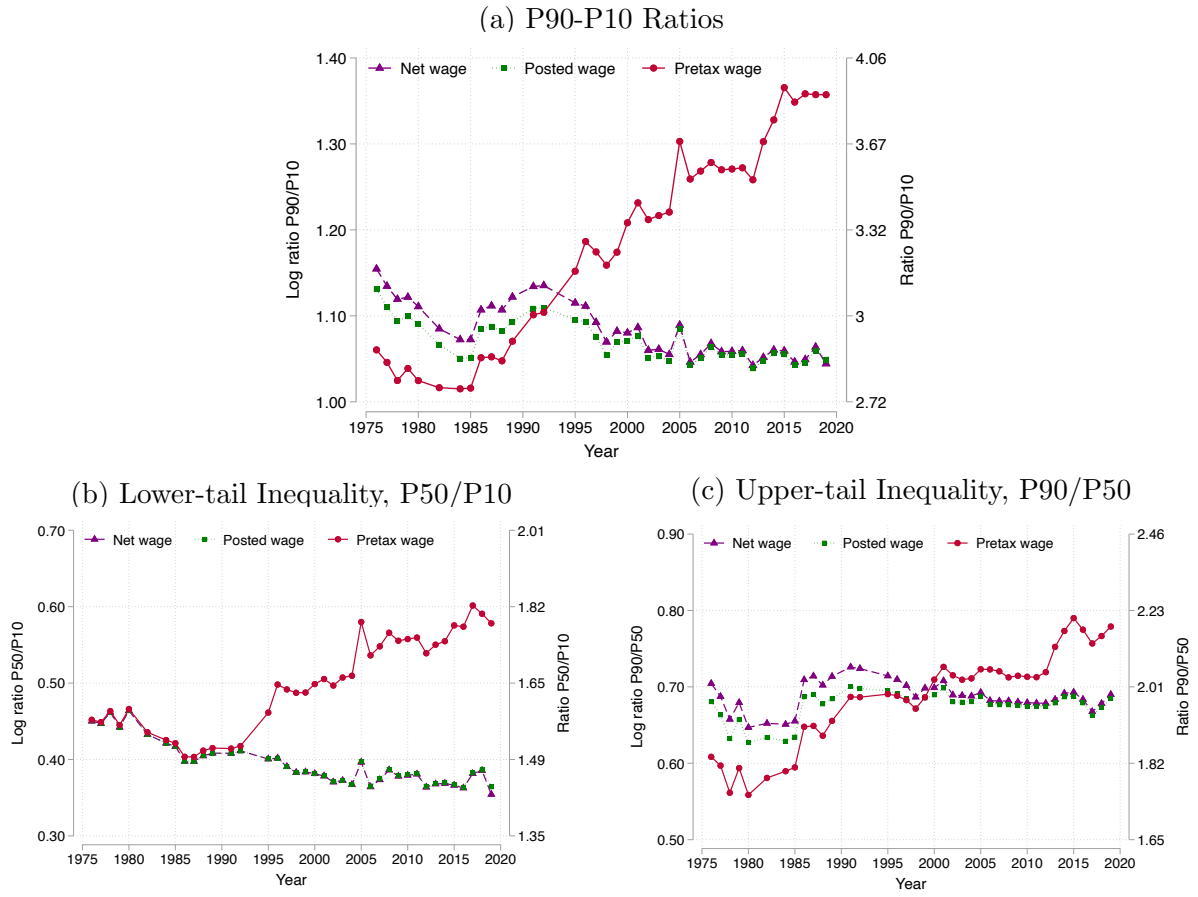
Figure A7: Cross-industry Comparisons of Change in the Wage Bill Share Relative to Changes in ICT Capital, by Workers' Skill




NOTE: The Figure shows the 37-years difference (1978 vs. 2015) in wage bill share of low-, middle- and high-skilled workers (y-axis) with respect to 37-years difference in ICT/VA by sector (x-axis). The dashed lines correspond to the linear fits.

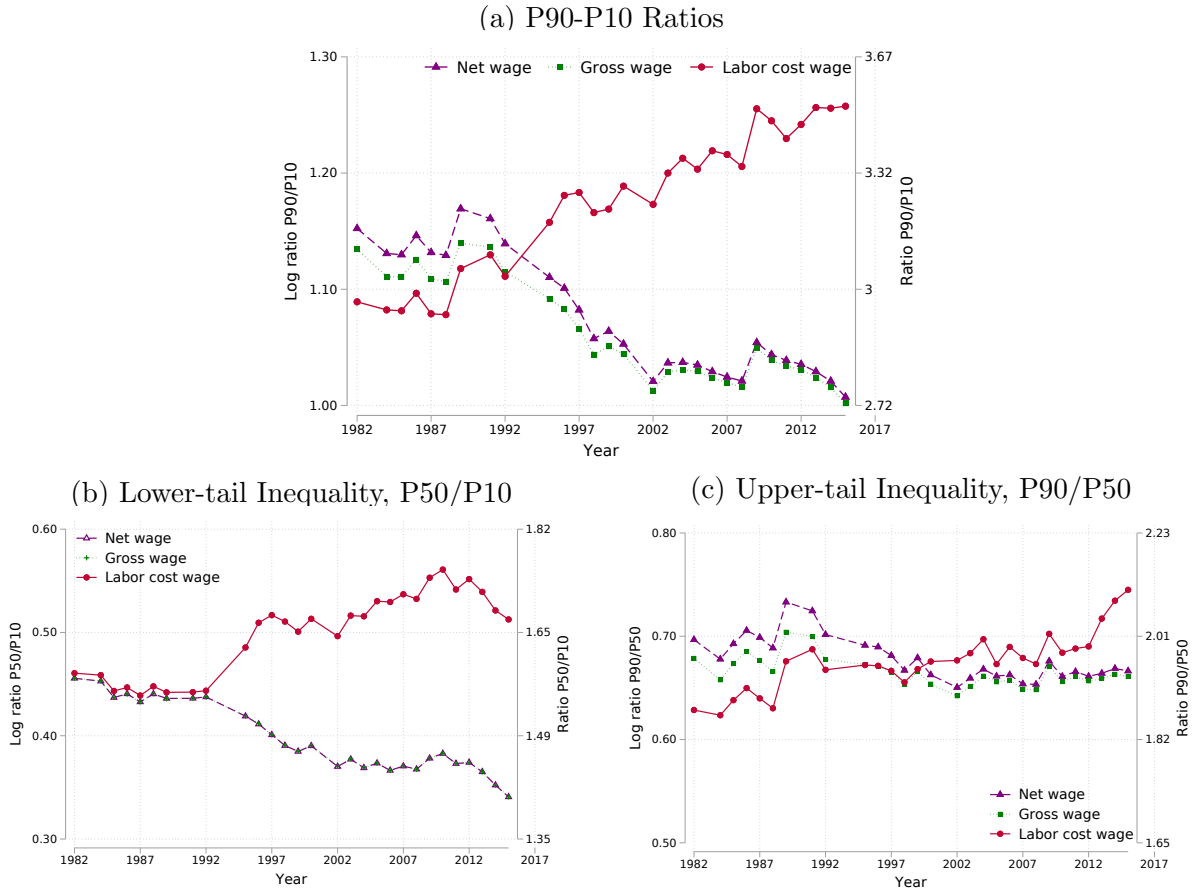
SOURCES: DADS-EDP data 1976-2015 and EUKlems data 1978-2015. Individuals working full-time full-year in the private sector.

Figure A8: Wage Inequality Ratios Including the Unemployed Population at the Bottom of the Wage Distribution




NOTES: The figure depicts the log wage ratios P90/P10 (panel a), P50/P10 (panel b) and P90/P50 (panel c) for net, posted and pretax wages. The sample includes male and female workers of the private sector working full-time. It is also augmented by the unemployed population, based on the yearly unemployment rate. More precisely, for each year $t$, we add at the bottom of the wage distribution (below P10) $U_t$ "unemployed" workers to the $N_t$ wage earners in the data so that $\frac{U_t}{N_t+U_t}$ is equal to the difference between the unemployment rate in year $t$ and the minimum unemployment rate of 2.25% observed for the period in 1969 (which is considered as a pure frictional unemployment rate that does not need to be imputed). The percentiles of the distribution are then adjusted for this increase of the population at the bottom of the wage distribution. The advantage of this approach is that it does not require to make a precise imputation of unemployed workers earnings or benefit. Results are indeed identical whether we impute them a labor income of zero or unemployment benefits that are below the minimum wage.
SOURCE: DADS data 1967-2015.

Figure A9: Wage Inequality Ratios Including the Unemployed Population with Wages Imputed Depending on their Education. France, 1982–2015




NOTES: The figure depicts the log wage ratios P90/P10 (panel a), P50/P10 (panel b) and P90/P50 (panel c) for net, posted and pretax wages. The sample includes male and female workers of the private sector working full-time. As in Figure A8, it is also augmented by the unemployed population following a similar methodology, but here, the imputation depends on the unemployed workers' diploma, taking advantage of the availability of unemployment series by education level since 1982. Low-skilled "unemployed" workers (less than high school) are still added at the bottom of the wage distribution (below P10) while middle-skilled workers (high-school degree) are introduced between P10 and P50 (at the P25, but the exact point has no impact on the series presented in the Figure), and high-shilled ones (at least some college education) between P50 and P90. The total yearly unemployment rate still corresponds to the one represented on Figure **??** and to be consistent with Figure A8, we only impute the difference between the unemployment rate in year $t$ and the minimum unemployment rate of 2.25% observed for the period in 1969 (which is considered as a pure frictional unemployment rate that does not need to be imputed). The imputations by education groups may be more realistic regarding the potential wages unemployed workers could obtain, and also regarding their actual unemployment benefits (which correspond approximately to 80% of their past earnings). Conclusions in this case are very similar to our main results for the period 1982-2015.
SOURCE: DADS data 1982-2015.

# B Institutional Details on Payroll Taxation in France

We provide here more details about payroll taxation in France, following closely the detailed description provided by Bozio et al. (2019).

## B.1 Structure of the Payroll Tax Schedule

**Basic structure.** The French payroll tax schedule follows the same structure for most of the schemes. The tax base is gross (or posted) earnings, with different marginal payroll tax rates corresponding to different thresholds. The reference threshold, which is referred to as the Social Security threshold (SST) (*plafond de la securite sociale* or PSS, in French), corresponds roughly to mean posted earnings, i.e., around the 70th percentile of the earnings distribution (40,500 euros of posted annual earnings in 2019). The threshold is adapted to the actual hours of work and duration of the job spell, leading to different thresholds for wages expressed in hourly, weekly, quarterly, or annual amounts. For instance, a job spell of only one hour will be subject to a specific hourly threshold.

**Types of payroll taxes.** The French Social Security system is composed of a large number of different schemes, each financed through a specific Social Security contribution (SSC). Social Security schemes vary according to the insured risk, and the population covered. The main risks covered by French social insurance schemes are, as in most European countries, old-age pensions, health care, and unemployment insurance. In addition, there exists in France a separate scheme which funds child benefits and child care provisions through employer SSCs. Smaller specific schemes are dedicated to survival benefits, or elderly care.

In addition to SSCs, payroll taxation in France includes other taxes on earnings paid by firms but which do not offer any rights to specific benefits, and These taxes, e.g., the *taxe sur les salaires*, or literally payroll tax, are not earmarked to Social Security budget and fund general government expenditures. Another example includes a payroll tax dedicated to funding public transport (*versement transport*), and other smaller payroll taxes fund training or apprenticeship.

**Payroll Tax Thresholds.** The French payroll tax schedule is composed of four different thresholds (expressed as multiples of the SST) depending on the population considered—the main distinction being between executives and non-executives in the private sector. For

executives, payroll tax rates apply to four wage brackets: (i) below the SST; (ii) between the SST and 4 times the SST; (iii) between 4 times the SST and 8 times the SST; and (iv) above 8 times the SST. For non-executives, payroll tax rates apply to a different splitting of the payroll tax schedule: (i) below the SST; (ii) between the SST and 3 times the SST; (iii) between 3 times the SST and 4 times the SST; and (iv) above 4 times the SST.

Like most payroll tax schedules around the world, French payroll taxes are capped. The main SST is lower in the earnings distribution than in most countries (between P65 or P70 of the earnings distribution) but the upper threshold is much higher. For non-executives, the upper threshold of four times the SST (162,000 euros of posted annual earnings in 2019) corresponds to the 99th percentile of the earnings distribution of full-time wage earners in the private sector. For executives, the upper threshold of eight times the SST (324,000 euros of posted annual earnings in 2019) corresponds to the 99.9th percentile of the same earnings distribution.

Table B4 lists the main payroll taxes for a wage earner in the private sector between 1976 and 2010, distinguishing for each scheme the coverage, the legal liability, and the rates that apply to the different earnings brackets.

# Table B4: Payroll Tax Rates in France, Private Sector, 1976–2010

| SSC designation | French acronym | Workers concerned | Legal liability | Earnings bracket | Rates (in percent) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1976 | 1980 | 1985 | 1990 | 1995 | 2000 | 2005 | 2010 |
| ***Panel A. Pension schemes*** | | | | | | | | | | | | |
| Old-age pension scheme | CNAV | all private sector | employee | < SST | 3.25 | 4.70 | 5.70 | 7.60 | 6.55 | 6.55 | 6.55 | 6.65 |
| | | all private sector | employer | < SST | 7.50 | 8.20 | 8.20 | 8.20 | 8.20 | 8.20 | 8.20 | 8.30 |
| | | all private sector | employee | all earnings | – | – | – | – | – | – | 0.10 | 0.10 |
| | | all private sector | employer | all earnings | – | – | – | – | 1.60 | 1.60 | 1.60 | 1.60 |
| Widows' pension scheme | VEUVAGE | all private sector | employee | < SST | – | – | – | – | – | – | – | – |
| | | all private sector | employee | all earnings | – | – | 0.10 | 0.10 | 0.10 | 0.10 | – | – |
| Complementary pension scheme | ARRCO | non-executives | employee | < SST | 1.76 | 1.76 | 1.84 | 1.92 | 2.00 | 3.00 | 3.00 | 3.00 |
| | | non-executives | employer | < SST | 2.64 | 2.64 | 2.76 | 2.88 | 3.00 | 4.50 | 4.50 | 4.50 |
| | | non-executives | employee | 1–3 SST | 1.76 | 1.76 | 1.84 | 1.92 | 2.00 | 5.00 | 8.00 | 8.00 |
| | | non-executives | employer | 1–3 SST | 2.64 | 2.64 | 2.76 | 2.88 | 3.00 | 7.50 | 12.00 | 12.00 |
| | | non-executives | employee | 1–3 SST | – | – | – | – | – | 8.00 | 8.00 | 8.00 |
| | | non-executives | employer | 1–3 SST | – | – | – | – | – | 12.00 | 12.00 | 12.00 |
| Complementary pension scheme | AGIRC | executives | employee | 1–4 SST | 2.00 | 2.06 | 2.06 | 2.34 | 5.00 | 7.50 | 7.50 | 7.70 |
| | | executives | employer | 1–4 SST | 6.00 | 6.18 | 6.18 | 7.02 | 10.00 | 12.50 | 12.50 | 12.60 |
| | | executives | employee | 4–8 SST | – | – | – | – | 5.00 | 7.50 | 7.50 | 7.70 |
| | | executives | employer | 4–8 SST | – | – | – | – | 10.00 | 12.50 | 12.50 | 12.60 |
| Early retirement complementary pension scheme | AGFF | all private sector | employee | < SST | – | – | – | – | – | – | 0.80 | 0.80 |
| | | all private sector | employer | < SST | – | – | – | – | – | – | 1.20 | 1.20 |
| | | non-executives | employee | 1–3 SST | – | – | – | – | – | – | 0.90 | 0.90 |
| | | non-executives | employer | 1–3 SST | – | – | – | – | – | – | 1.30 | 1.30 |
| | | executives | employee | 1–4 SST | – | – | – | – | – | – | 0.90 | 0.90 |
| | | executives | employer | 1–4 SST | – | – | – | – | – | – | 1.30 | 1.30 |
| Additional complementary pension scheme | CET | non-executives | employee | 4–8 SST | – | – | – | – | – | 0.11 | 0.13 | 0.13 |
| | | non-executives | employer | 4–8 SST | – | – | – | – | – | 0.17 | 0.22 | 0.22 |
| ***Panel B. Unemployment insurance*** | | | | | | | | | | | | |
| Unemployment insurance scheme | UNEDIC | all private sector | employee | < SST | 0.48 | 0.84 | 1.12 | 1.67 | 2.42 | 2.21 | 2.40 | 2.4 |
| | | all private sector | employee | 1–4 SST | 0.48 | 0.84 | 1.62 | 2.17 | 2.97 | 2.71 | 2.40 | 2.4 |
| | | all private sector | employer | < SST | 1.92 | 2.76 | 2.88 | 3.23 | 4.18 | 3.97 | 4.00 | 4.00 |
| | | all private sector | employer | 1–4 SST | 1.92 | 2.76 | 2.88 | 3.23 | 4.18 | 3.97 | 4.00 | 4.00 |
| Early retirement scheme | ASF | all private sector | employee | < SST | – | – | 0.80 | 0.80 | 0.80 | 0.80 | – | – |
| | | all private sector | employer | < SST | – | – | 1.20 | 1.20 | 1.16 | 1.16 | – | – |
| | | all private sector | employee | 1–4 SST | – | – | 0.80 | 0.80 | 0.89 | 0.89 | – | – |
| | | all private sector | employer | 1–4 SST | – | – | 1.20 | 1.20 | 1.29 | 1.29 | – | – |
| Job placement for executives | APEC | executives | employee | 1–4 SST | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 | 0.024 |
| | | executives | employer | 1–4 SST | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 |
| | | executives | employee | < SST | – | – | – | – | – | – | – | – |
| | | executives | employer | < SST | – | – | – | – | – | – | – | – |
| ***Panel C. Health care*** | | | | | | | | | | | | |
| Health insurance scheme | MMID | all private sector | employee | < SST | 2.50 | – | – | – | – | – | – | – |
| | | all private sector | employer | < SST | 10.45 | 8.95 | – | – | – | – | – | – |
| | | all private sector | employee | all earnings | 1.50 | 5.50 | 5.50 | 5.90 | 6.8 | 0.75 | 0.75 | 0.75 |
| | | all private sector | employer | all earnings | 2.50 | 4.50 | 12.60 | 12.60 | 12.80 | 12.80 | 12.80 | 12.80 |
| ***Panel D. Family benefits*** | | | | | | | | | | | | |
| Family benefits | CNAF | all wage earners | employer | < SST | 9.00 | 9.00 | 9.00 | – | – | – | – | – |
| | | all wage earners | employer | all earnings | – | – | – | 7.00 | 5.40 | 5.40 | 5.40 | 5.40 |

SST refers to the Social Security threshold (*plafond de la sécurité sociale*, in French) and 4 SST to four times this threshold. The SSCs presented in this table are the main SSCs for private sector wage earners. They do not include specific schemes such as regional schemes or various payroll taxes. Description of French acronyms for each scheme: CNAV: *Caisse nationale d'assurance vieillesse*; ARRCO: *Association pour le régime de retraite complémentaire des salariés*; AGIRC: *Association générale des institutions de retraite des cadres* ; CET *Cotisation exceptionnelle et temporaire*; UNEDIC: *Union nationale interprofessionnelle pour l'emploi dans l'industrie et le commerce*; ASF: *Association pour la gestion de la structure financière*; APEC: *Association pour l'emploi des cadres*; MMID: *maladie, maternité, invalidité, décès*; CNAF: *Caisse nationale des allocations familiales*. Details for every year with legislative references are available on the website of the Institut des Politiques Publiques (IPP): `https://www.ipp.eu/en/tools/ipp-tax-and-benefit-tables/social-security-contributions/`.

## B.2 Uncapping of Payroll Taxes

In the 1980s and 1990s, some of the payroll taxes were uncapped. As a result, the overall rate of contribution increased. Yet, this concerns the earnings above the cap i.e., who belong to the top 3 deciles of the earnings distribution. The payroll tax rates of the high-income deciles progressively caught up with those of the lower-income deciles. The health and family contributions were progressively uncapped between 1981 and 1984, and 1989 and 1990 as well as the contribution covering work-related injuries and retirement contributions in 1991.

## B.3 Payroll Tax Cuts around the Minimum Wage

Starting in 1993, social security reductions were created for low incomes under 1.3 minimum wages. Since then, there has been a succession of reduction schemes (*exonérations famille*, *ristourne Juppé*, *allègements Aubry et Fillon*[14]). The maximum rate of reduction over the period is of 26%[15] of the posted wage and concerns employees paid at the minimum wage. The reduction schedules are such that the rate of reduction is the highest at the minimum wage level and decreases with the increase of the wage, until it fades away. The maximum level of wage giving the right to reductions ranged between 1.3 and 1.7 minimum wage.

In the context of high unemployment in 1998, a policy aimed at reducing working time, hoping that it would contribute to job creations. This led to many changes in the reduction scheme. Indeed, two different schedules prevailed between 2000 and 2003 for firms that implemented the reduction of the working time and for firms who did not. After 2003, the Fillon law framed the convergence of the two schedules and came about with a unified schedule for all firms.

Finally, a last reform has been enacted in 2013 in the form of a tax credit for the corporate income tax (CIT) called *Crédit d'impôt pour la compétitivité et l'emploi* (tax credit for competitiveness and jobs), or CICE for the French acronym. The CICE reduces nominally the CIT liability but is computed like a payroll tax cut as a percentage of individual earnings of firms liable to the CIT. In 2019 the CICE was converted into a payroll tax cut, underlying the similarity in the design of this policy. Nevertheless, it is unclear whether the impact of such CIT tax credit is really similar to previous cuts of payroll taxation. Another difference is that the CICE did not target specifically workers

[14]We do not calculate the Robien scheme of 1996 because of lack of information.
[15]28.1% for firms with fewer than 20 employees.

around the minimum wage, but encompassed earnings up to 2.5 times the minimum wage, with a flat rate schedule (i.e., a 6% cut for all earnings below that threshold).

## B.4 Computation of the Income Tax

The French income tax works as follows. The income tax base is composed of several income components (from labor and capital), that are combined to form the gross taxable income of the fiscal household. Then, some rebates can be deduced from the gross taxable income to constitute the next taxable income. The French income tax schedule is then applied to the net taxable income, divided by the number of fiscal shares (depending on the composition of the household). The schedule is progressive, with a top bracket starting at €152 108 in 2015 with a marginal tax rate of 45%. There is also a phasing-in scheme that reduces the income tax due of low-income households (called the *dÃ©cote*). To obtain the income tax due, one has last to deduce several tax credits (refundable or not) can then be deduced from the gross income tax.

## B.5 Computation of the Flat Income Tax

In 1991, a second component in the French income tax system was introduced with the creation of a flat income tax at source on labor income (*Contribution sociale gÃ©nÃ©ralisÃ©e* or CSG). The flat rate, low at the start (1.1%), increased to 9.2% in 2018. We nonetheless consider this flat income tax as a payroll tax for three reasons. First, it was created in parallel with a reduction of non-contributive employee payroll tax rate that exactly matched the flat tax rate ; second, the revenue of this tax aim at funding the social security system : third, our choice relies on accounting reasons that do not have any redistributive impact due to the flat nature of this tax schedule.

# C Main data source, Micro-simulation, Sample Restrictions and Variables

This section first provides further details on the main source of data used in the paper (Section C.1), the administrative payroll tax data (DADS). Second, we describe the micro-simulation software used to compute the payroll taxes (Section C.2). Third, we explain our sample selection (Section C.3) and, last the variables' definition (Section C.4).

## C.1 Payroll tax Data

Worker-level information comes the payroll tax data for job-related variables.

For 1976-2019, wages and job-related information comes from the DADS *panel tous salariés*. First, the DADS panel is a representative extraction of the DADS (*Déclarations Annuelles de Données Sociales*) data, which is the main administrative data source constructed by the French national statistical office (INSEE) from social security records on all private sector French workers (see Charnoz et al. (2011)). We used all the annual extractions, except for 1981, 1983 and 1990 years due to missing data and 1994 due to bad quality of the data. The panel contains individuals born in October of even years and who worked at least once in the private sector.

For 1967-1975, the DADS *panel tous salariés* does not exist. Instead, we rely on the DADS-Salariés, which is similar to the *panel tous salariés* in many regards. We call "DADS data" the payroll tax data composed of the DADS salariés for 1967-1975 and of the DADS *panel tous salariés* for 1976-2019. We compute payroll taxes on this database and use the results for all figures and tables showing payroll tax rates and inequality ratios.

## C.2 Microsimulation of Payroll Taxes

We compute the payroll taxes since 1967 by applying a microsimulation model on the information available in the DADS data. We use the TAXIPP model which is developed at the Institut des Politiques Publiques (IPP) and in particular the payroll tax module. The model applies the payroll tax schedule, as collected in the IPP Tax and Benefit Tables (Institut des Politiques Publiques, 2018), and computes employer and employee SSCs, reductions in employer SSCs, flat-rate income tax (CSG and CRDS) as well as other payroll taxes.

This exercise relies on ad hoc assumptions needed when applying the legislation to the

raw data. We face two main challenges in computing payroll taxes from the DADS data. First, we have to use the net taxable earnings variable as the main input to the model, because it is the only earnings measure consistently available throughout the period. We then compute posted wage, pretax and net wage using the microsimulation model. Second, payroll taxes should be computed as a function of hourly wage. Since we do not observe working hours in the DADS data before 1993, the payroll taxes for part-time workers cannot be computed precisely before 1993. This is the reason why we focus on full-time workers.

We also use the microsimulation model to apply the income tax schedule to the taxable earnings so as to compute the amount of income tax that a worker would have paid, assuming that she is alone in her household and has no other source of income. This assumption is not trivial, but this computation serves our purpose which is to compare the changes in the payroll tax schedule and the income tax schedule.

## C.3 Sample Restrictions

To compute consistent measures of inequality over time, we have to overcome challenges related to the evolution of the DADS data in terms of the variables and observations it contains.

We operate sample restrictions to ensure that the composition of the sample is consistent over time and that we can compute correctly payroll taxes on the analysis sample during the whole period 1967-2019. We restrict our sample to jobs in the private sector, dropping the following categories of job that were missing from the data in the early years: (semi-)public sector, apprenticeship, internships, homework. We also drop unemployed workers who have been included in the dataset only in 2008. We finally remove workers paid less than 75% of the minimum wage, consistent with what is done in the literature. These workers may be under very specific working contracts that have not been removed by our previous trim, and the computation of payroll taxes for them can be subject to errors due to imperfect observation of their exact labor market situation.

We also restrict the sample to individuals working full-time and being observed in the same job an entire calendar year. The main reason for keeping only full-time workers is that contractual hours worked per year are only available in the data from 1993 onward. This prevents us from studying hourly wages for the whole period. To make sure that we observe wages (earnings per unit of time) which are much more relevant than earnings to study market explanations, we therefore have to restrict the analysis to individuals working

full-time. Additionally, the computation of payroll taxes requires knowledge of the hourly wage because the thresholds at which the marginal payroll tax rate changes depend on hourly wages–contrary to the income tax. This means that we cannot compute payroll taxes and measure the pretax wage of part-time workers before 1993.

The second restriction–keeping only workers observed an entire year in the same firm–is not mandatory. We apply it because it simplifies tremendously the computation of social security contributions, both for us in the micro-simulation model and for the administration officially in charge of the computation. This is in part because keeping full-time full-year workers removes multiple jobs owners for whom total payroll taxes are split across the different employers according to sophisticated rules that are difficult to apply to the data and that are also likely to be imperfectly applied by firms. Therefore, keeping only full-year workers makes us confident that we capture the true pretax wage for all individuals observed in our final sample. We have nevertheless checked that including in the analysis workers not working an entire year in the same firm does not alter the paper's conclusions (results available upon request).

As a result of the sample restrictions, we drop roughly half of the individuals from the original datasets. Before selection, we have 497 050 workers in 1967, 720100 in 1980 and 2 318 393 in 2015. Table C5 presents some descriptive statistics for 1967, 1980 and 2015.

Table C5: Descriptive Statistics – Payroll Tax Sample

| | 1967 | | 1980 | | 2015 | |
|---|---|---|---|---|---|---|
| | Mean | Std Dev | Mean | Std Dev | Mean | Std Dev |
| Pretax wage | 20247 | 14797 | 34431 | 20398 | 48966 | 60120 |
| Posted wage | 16345 | 13816 | 25086 | 16803 | 35052 | 40311 |
| Net wage + contributions | 16349 | 14117 | 26812 | 17232 | 39096 | 40518 |
| Net wage | 15362 | 13520 | 22112 | 15482 | 27481 | 34936 |
| Net-of-income tax wage | 12381 | 7657 | 18950 | 10371 | 24110 | 19968 |
| Observations | 282740 | | 408536 | | 839517 | |

NOTE: Earnings are in constant euros 2010.
SOURCES: DADS data 1967-2015

## C.4 Earning and wage variables.

The raw data about earnings in the DADS come under the form of annual "net taxable earnings" (earnings reported for income tax). This definition of earnings is net of payroll taxes and gross of income tax, except for the taxable part of the *Contribution Sociale Généralisée* (CSG). Earnings reported include basic earnings, as well as bonuses.

The *net wage* corresponds to the "net taxable earnings" before 1990. From 1991 onward (when the CSG is introduced), the net wage corresponds to the net taxable earnings less the (deductible part of the) CSG.

*Posted wage* corresponds to net wage plus all employee payroll taxes (see Figure **??**). This is the contractual wage: it corresponds to the amount of pay stipulated in labor contracts, and on which negotiations typically take place. Posted wages are available in the DADS from 1993 onward, but we compute it for the entire period to keep consistent earnings definitions.

We call *pretax wage* the actual cost paid per day worked full time by a firm for a given worker. It includes both employer and employee payroll taxes and has been entirely computed from net wages using TAXIPP.

Our measure of net wage concept from the DADS data is gross of income tax. As income taxation is in France assessed at the household level and thus depends on the family structure, it is not possible to derive an exact measure of the *net-of-income tax wage*. To estimate it, we apply the income tax schedule to taxable earnings, assuming that workers live in one-individual household and have no other source of income. Even though these assumptions lead to approximations, they will serve our purpose of providing a broad comparison of the evolution of the payroll tax and income tax schedules.

As we focus on workers for which we observe earnings corresponding to a full-time job during a full calendar year, we do not need to divide these earnings by hours worked to get wage concepts. We have however also divided earnings by the number of working days in a given employment spell (which are always observed in the DADS data). Daily wages are then used when individuals working only part of a calendar year in a given firm are also included in the analysis (this is only done as a robustness check not presented in the paper).

We call the *net augmented wage* the net wage to which we add the contributive employee and employer payroll taxes, i.e. the contribution which fund pension and unemployment benefits related to past contributions. More precisely, we consider main earnings related pension scheme and point-based complementary pension schemes as contributive payroll

taxes as these contributions have been shown to exhibit strong tax-benefit linkage (Bozio et al. 2019). We also add the main earnings related unemployement scheme, even though the tax-benefit linkage is here less clear-cut given the difference in unemployment probabilities across earnings level (see table B4 for the different schemes).

# D Market-Driven Explanations of the Rise in Wage Inequality

In this Appendix, we assess the traditional explanations for the increase in wage inequality, namely the relative shift in the demand/supply for skilled labor. Using pretax inequality measures, we show that the French experience reinforces the case for a global demand shift in favor of skilled workers. We document also direct evidence of skill biased technical change underlying these increasing inequality trends.

## D.1 A Demand Shift Towards Skilled Workers.

**Empirical model and expectations.** We first test for the existence of a general demand shift towards skilled workers over time. To do so, we estimate a version of the macro-level supply/demand model initiated by Katz & Murphy (1992). In this approach, the evolution of the demand for skilled workers is identified from the long-term changes in the relative pretax wage of skilled and unskilled workers that cannot be explained by changes in their relative supply.

Formally, we follow Autor, Katz & Kearney (2008, AKK hereafter) and assume that aggregate output $Q$ depends on two labor inputs, skilled ($s$) and unskilled ($u$) according to the following CES production function:

$$Q_t = [\alpha_t(a_t N_{st})^\rho + (1-\alpha_t)(b_t N_{ut})^\rho]^{1/\rho} \tag{1}$$

where $N_{st}$ and $N_{ut}$ are the quantities of skilled workers (with at least some college education) and "unskilled" workers (with a high-school degree or less) in period $t$. $a_t$ and $b_t$ are technical change parameters augmenting skilled and unskilled labor inputs. $\alpha_t$ is a time-varying technology parameter; $\sigma = \frac{1}{1-\rho}$ is the elasticity of substitution between skilled and unskilled workers. SBTC hypothesis implies that $a_t/b_t$ increases over time.

Assuming that the pretax wage (and not their net or posted wage) associated to both skilled and unskilled are equal to their marginal products, we can derive from equation (1) the following relation:

$$\ln\left(\frac{z_{st}}{z_{ut}}\right) = \frac{1}{\sigma}\left[D_t - \ln\left(\frac{N_{st}}{N_{ut}}\right)\right] \tag{2}$$

where $z_{st}$ and $z_{ut}$ are the pretax wages associated with skilled and unskilled workers

and $D_t$ represents relative demand shifts favoring skilled workers. The impact of changes in relative skill supply on relative wages depends inversely on the magnitude of $\sigma$, the aggregate elasticity of substitution between the two skill groups. It is common in the literature to approximate $D_t$ by a time trend, and possibly to add control variables such as the minimum wage or the unemployment rate. This leads to the following empirical model:

$$\ln\left(\frac{w_{st}}{w_{ut}}\right) = \beta_0 + \beta_1 t + \beta_2 \ln\left(\frac{N_{st}}{N_{ut}}\right) + \beta_3 X_t + \varepsilon_t \tag{3}$$

### D.1.1 Main results

We have estimated variants of equation (3). Results are available in Table D8. In the simplest specification without any control variable, we find $\beta_2 = -0.26$, corresponding to an elasticity of substitution between skilled and unskilled workers of 3.8, which is larger than what is typically found for the U.S., but consistent with the estimates obtained by Verdugo (2014) for France. Estimates of $\beta_1$ are also positive and significant, consistent with the existence of a demand shift toward skilled workers. This result is robust to controlling for the minimum wage and the unemployment rate.

To illustrate the mistake that one makes using net wage instead of pretax wage to capture changes in demand, we have also estimated equation (3) using relative net wages as the dependent variable. In such a model, we still find evidence of a significant demand shift for skilled workers, but its magnitude is under-estimated by 30% while the elasticity of substitution between skill groups is over-estimated by around 20%. As the evolution of lowest-skilled workers wages in France is likely to be strongly influenced by the minimum wage and because research on job polarization has shown that middle-skilled workers are likely to have suffered more than low-skilled ones from automation, we reproduce the whole analysis with a production function with three inputs obtained after splitting further "unskilled" workers into lowest-skilled (less than high school) and middle-skilled (high-school degree). We then show in Panels (c) and (a) of Table D8 that there were very similar demand shifts toward high-skilled workers with respect to either middle-skilled or lowest-skilled ones.

**Wrapping-up.** The magnitude of demand shifts toward high-skilled workers estimated in France over the past fifty years is comparable to estimates for the U.S. and the U.K., consistent with the idea that technological change should have hit developed countries

to a similar extent. The increase in the relative supply of skilled workers in France is also comparable to that observed in the U.S. and the U.K.[16] Together, these comparisons imply that supply and demand forces are likely to have affected wage inequality across skill's groups similarly in France and in other developed countries. Therefore they are unlikely explain the decrease in net wage inequality observed in France, which has probably happened for other reasons.

### D.1.2 Additional details on data and methodology.

Most important to our analysis is the construction of the categories of education. This variable not being present in the payroll tax data, we rely on information coming from the census that is linked to the payroll tax data for a subsample of workers. Using the education variable, we can then categorize the workers into three categories of skill, and construct the relevant samples for computing the aggregated variable for estimating equation 3. This section details the corresponding methodology.

**Census data.** We rely on a census based dataset, the EDP database (*Échantillon Démographique Permanent*), administratively linked to the employer-employee data for a reduced sample. The EDP database consists of demographic information, including the highest degree obtained, for individuals born one of the four first days of October of even years. Information for these individuals have been retrieved from the census which took place for the whole population in 1968, 1975, 1982, 1990 and 1999 and for one fifth of the population according to a rotating sampling every year starting in 2003. The two databases are matched by the French statistical administration based on date of birth and names. The job-related variables being the same in the DADS panel and in the DADS-EDP panel, the following details on these concepts are relevant for both databases. We use this version of the data for analyses that use individuals' education.

**Education Variable.** We use the variable (*dip_tot*) homogenized by the French National Institute of Statistics (INSEE) coming from the censuses. Following Abowd et al. (1999) and Charnoz et al. (2011), we use a breakdown of the highest diploma in eight categories. We then construct four education groups (right column of table 3). Unfortunately, the precision of the original census variable does not allow us to differentiate between graduates and postgraduates. We use a three-categories education variable: less than high school,

[16] See Appendix, Figure A1.

Table D6: Education variable

| dip_tot | French Label | English Label | Education Variable |
|---|---|---|---|
| 1 | Aucun diplôme déclaré (aucun diplôme ou pas présent au recensement) | No diploma | 1 |
| 2 | CEP, DFEO | Elementary school | 1 |
| 3 | BEPC, BE, BEPS | Junior High School | 1 |
| 4 | CAP, BEP, EFAA, BAA, BPA, FPA | Vocational basic | 1 |
| 5 | Baccalauréats technique et professionnel, Brevet professionnel, autres brevets | Vocational advanced | 2 |
| 6 | BEA BEC BEH BEI BES BATA, Baccalauréat général, brevet supérieur, CFES | High School Graduate | 2 |
| 7 | BTS, DUT, DEST, DEUL, DEUS, DEUG, diplôme professions sociales ou de la santé | Undergraduate university | 3 |
| 8 | Diplôme universitaire de 2ème ou 3ème cycle, diplôme d'ingénieur, grande école | University Graduate | 3 |

high school graduates, more than high school.

**Samples** Using the DADS-EDP data, we construct two different samples, the wage sample aiming at measuring the relative wage gap, and the supply sample for the relative supply. Importantly, we only include in the sample the individuals who belong to the historical EDP panel (born on October 1-4 on even-numbered years), excluding individuals incorporated through the enlargement of the panel in 2002. This restriction ensures that we have comparable information before and after 2002.[17] The *wage sample* contains individuals between 20 and 60 years old working full-time full-year in the private sector. In this sample, we trim the bottom part of the distribution by excluding people whose total annual earning is less than 75% of the minimum wage. The only restrictions on the *supply sample* are imposed by the data. Because unemployed individuals (receiving benefits) were only introduced in 2002, we have to drop them from the data in order to get consistent series. Yet we do not restrict the sample to full-year or full-time workers. Table D7 provides descriptive statistics for both samples.

To a large extent, our methodology follows Autor et al. (2008), without the re-weighting component. Using the wage and supply samples described in the previous section, we construct time series of the average net and pretax wage, and quantities of labor supplied by the education groups described in C. We then take the log of the ratio of these variables for high-skilled (at least some college) versus middle-skilled (high school graduate) or low-skilled (high-school dropouts) in order to obtain our log net wage gap, log pretax wage gap

[17]The education variable, coming from the census, has more missing observations after 2002.

Table D7: Descriptive Statistics on the DADS-EDP Sample

(a) Wage sample

| | 1980 | | 2000 | | 2015 | |
|---|---|---|---|---|---|---|
| | Mean | Std.Dev | Mean | Std.Dev | Mean | Std.Dev |
| Net wage | 22087.05 | 14680.73 | 24782.35 | 21497.47 | 27686.87 | 25181.49 |
| Gross wage | 25062.01 | 16036.35 | 31246.17 | 25399.65 | 35335.13 | 30031.83 |
| Labour cost | 34408.86 | 19350.61 | 44528.79 | 36423.39 | 49575.48 | 45138.19 |
| Age | 37.32 | 10.98 | 40.04 | 9.68 | 43.60 | 9.46 |
| Share of Male | 0.65 | 0.48 | 0.63 | 0.48 | 0.60 | 0.49 |
| **Education** | | | | | | |
| Less than highschool | 0.81 | 0.39 | 0.63 | 0.48 | 0.48 | 0.50 |
| Highschool | 0.11 | 0.31 | 0.15 | 0.36 | 0.20 | 0.40 |
| More than highschool | 0.08 | 0.27 | 0.22 | 0.41 | 0.32 | 0.47 |
| Observations | 46291 | | 45731 | | 47131 | |

(b) Supply sample

| | 1980 | | 2000 | | 2015 | |
|---|---|---|---|---|---|---|
| | Mean | Std.Dev | Mean | Std.Dev | Mean | Std.Dev |
| Number of days worked | 264.73 | 133.00 | 241.25 | 138.89 | 265.44 | 134.01 |
| Age | 34.40 | 12.25 | 36.23 | 11.39 | 44.38 | 11.04 |
| Share of Male | 0.62 | 0.49 | 0.55 | 0.50 | 0.48 | 0.50 |
| **Education** | | | | | | |
| Less than highschool | 0.79 | 0.41 | 0.61 | 0.49 | 0.50 | 0.50 |
| Highschool | 0.11 | 0.31 | 0.16 | 0.36 | 0.20 | 0.40 |
| More than highschool | 0.10 | 0.31 | 0.24 | 0.42 | 0.30 | 0.46 |
| Observations | 91384 | | 149545 | | 152601 | |

Sources: DADS-EDP data 1976-2015

and relative labor supply. The regression models estimated using these series are described in the main text.

## D.2 Direct Evidence of Skill-Biased Technical Change.

A limit of the macro supply/demand model above is to capture changes in demand without relating them directly to their potential causes. To show direct evidence of skilled-biased technical change, an appealing approach followed by Michaels et al. (2014) consists in showing that the share of total pretax wages accruing to skilled workers increased relatively more in countries and/or industries that experienced the largest increases in their Information and Communication Technologies (ICT) capital. Such empirical findings are indeed consistent with a stronger complementary in production between skilled workers and ICT capital than between other types of workers and ICT capital. This is exactly the idea of skill-biased technical change.

Using the EUKlems data matched with the DADS data for the period 1978-2015, we have reproduced the analysis of Michaels et al. (2014) for France, using pretax wages instead of net wages. We find that sectors which increased the most the share of ICT capital in total value-added are indeed those where the share of total pretax wages accruing to skilled workers increased the most.

This rest of the section details the methodological approach, its implementation and the associated results.

### D.2.1 Methodology

We follow the methodology proposed by Michaels et al. (2014) in order to demonstrate the role played by the ICT capital in the polarization of the labor market. They test whether the sectors in which ICT capital use increased the most are also the sectors where the demand of high skilled labor increased and middle-skilled labor decrease. While they rely on international data and propose many robustness checks, we only propose a simple one-country application of their method in order to provide direct evidence that the demand shift toward high-skilled workers in France is driven by technological change. Our contribution for France with respect to Michaels et al. (2014) is to match the EU KLEMS data with the DADS data in order to have measures of pretax wage by skill groups since 1978, that is the very first year for which we have measures of capital inputs in EU KLEMS. Indeed, the information on labor compensation comes from the French labor force survey since 1982. However, the earnings variable from the labor force survey is the net wage, while we use the pretax wage, and is capped before 1990. Another difference with Michaels et al. (2014) comes from our skill categories, that we choose to be consistent with our time-series evidence of demand shifts (cf ). While our middle-skill group contains only highschool graduates, they include also workers with any other diploma, except for the university graduates that constitute the high skill-skilled group. For the low-skilled group, we are left with vocational and lower school diploma (including secondary education) while they only have workers with no diploma. Their skill categories are directly coming from EUKlems, which have country-specific skill definition. Our definition for France is consistent with the one for several countries in EUKlems.

**Empirical model and expectations.** We aim at testing the hypothesis that the increase in ICT technologies polarizes the labor market by increasing the demand for highly skilled workers while decreasing the demand for middle-skilled workers. For that pur-

pose, Michaels et al. (2014) propose the following simple long differences estimations for $S = \{H, M, L\}$ at the industry $i$, year $t$ level :

$$\Delta Z_{it}^S = \beta_0 + \beta_1^S \Delta(C/Q)_{it} + \beta_2^S \Delta(K/Q)_{it} + \beta_3^S \Delta ln(Q)_{it} + u_{it}^S$$

where

- $H, M, L$ denotes the three skill groups (high, middle and low skill)
- $Z_S$ is the payroll share accruing to the skill group $S$
- $C$, $K$ and $Q$ are respectively ICT capital, non-ICT capital and value added.

Then, a positive $\beta_1^H$ associated with a negative $\beta_1^M$ would validate the polarization hypothesis because the larger the increase in ICT/VA over the period, the higher the increase in payroll share accruing to the high skill group while the same increase in ICT/VA would be associated with a decrease in the payroll share of the middle-skilled. The expectations regarding the sign of $\beta_1^L$ are unclear.

### D.2.2 EU KLEMS data

The EU KLEMS data[18] provides industry-level variables on output, capital and labor inputs and productivity for several countries. The data are available for 34 industry-levels categories, corresponding to the NACE Rev. 2 classification. We use the data for France, available since 1975 (1978 for the capital inputs variables). We rely on the DADS EDP data to construct industry level measures of the wage bill for the low-, middle- and high-skilled workers. Our main data step consist in matching EU KLEMS with the aggregation of the micro data from the DADS EDP at the industry level. For details on the DADS EDP database, see Appendix Section D.1.2.

**Matching EU KLEMS and DADS EDP at the Industry Level** The industry-level analysis relies on a matching of EU KLEMS and DADS EDP data at the industry level. Some adjustments in the industry categories were necessary to construct a variable consistent over time and across database. We end up with a 31 levels classification, described in table D9. First, in the case of the EUKLEMS data, we only modify the 34 levels classification by aggregating some categories in two cases. We aggregate the three levels

[18]Funded by the European Commission and freely available at `http://euklems.net/`

(45; 46; 47) of the G category and the two levels (49-52; 53) of the H category and obtain our 31 categories. Second, the DADS industry-level aggregation needs more attention as the definition of the industry category variable changes over time. An aggregated variable (`ape40` up to 1993, `a38` after 1994 ) of the detailed classification variable (NAP 73 to 1993, NAF between 1994 and 2002, NAF rev. 1 between, 2003 and 2008, NAF rev. 2 starting in 2009) is provided. We use the aggregated variable `a38` after 1994. However, the aggregated variable of the beginning of the period (`ape40`) does not match well with the more recent aggregation (aligned on the NACE Rev. 2 classification). To deal with this issue, we rely on a mapping of the most detailed level of classification, provided by the National Institute of Statistics (INSEE). The mapping provides, for each new category, the share of establishments and the number of workers that belonged to each old category (and vice versa). We attribute to each old category the new category for which the number of workers is the highest. The precise category obtained is then converted into the corresponding aggregated variable (`a38`), that we aggregate at the 31 industry levels, as shown in D9. This task enables us to have consistent industry categories overtime, that we can then use for the matching with EU KLEMS. We drop the following industry levels : AZ (agriculture), TZ (household as employers) and UZ (extra-territorial activities) which are not covered during the whole period by the DADS. We also have to drop the JC category because there are not enough observations at the beginning of the period. We are left with 27 industry levels.

**Capital variables.** Our ICT capital variable comes from EU KLEMS data. It is the sum of three variables (computing equipment, communications equipment and Computer software and databases). Our non ICT capital variable contains the rest of the capital variables available. We divided both the ICT capital and the non-ICT capital variables by the value added.

### D.2.3 Application and results.

We aggregate the supply and wage sample at the industry level variable (defined in Section D.2.2). We construct the wage bill share by summing pretax wage at the year x industry x education levels that we divide by the sum of the corresponding wage concept at the year x industry levels.

Figure A7 shows the 37-years change in wage bill share for the three-skill category with respect to the 37-years change in ICT capital over value added ratio at the industry level.

Table D10 provides the corresponding empirical estimates from the skill share regressions. The dependent variables are changes from 1978 to 2015 in the wage bill share of the low skilled (3 columns on the left), middle skilled (3 columns in the middle) and high skilled (3 columns on the right). The regressions are estimated by OLS on the 37 years changes [19]. Columns (1) report the coefficients on the constant. It indicates that, on average, there was between 1978 and 2015 a 28.2% increase in the high skilled share, a 4.3% increase in the middle skilled share and a 32.5% decrease in the low skilled share. Columns (2) includes the growth in ICT capital intensity while columns (3) include also changes in non ICT capital and in the log of the value added.

The coefficient on changes in ICT/VA have the expected sign and significance: strongly positively significant for high skilled, strongly negatively significant for middle skilled. For the low-skilled, the coefficients are negative with a lower significance, while the model is undecided regarding the sign of this coefficient. The coefficients confirm that industries in which ICT capital grew more were those with larger shifts toward the higher skilled and away the middle skilled while the low skilled category is probably less affected.

[19]The corresponding panel regressions results with year and industry fixed effects give consistent results.

Table D8: Relative Wage Gap: Evidence of SBTC

(a) High skilled vs "unskilled" (=middle+low) skilled

| | Labor cost gap of H vs M+L | | Net wage gap of H vs M+L | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Relative supply of H vs M+L | -0.261*** | -0.173*** | -0.270*** | -0.174*** |
| | (0.035) | (0.029) | (0.040) | (0.033) |
| Linear time trend | 0.010*** | 0.011*** | 0.007*** | 0.009*** |
| | (0.002) | (0.001) | (0.002) | (0.001) |
| Log(real min. wage) | | -0.663*** | | -0.765*** |
| | | (0.120) | | (0.137) |
| Unemployment rate (15-24 y.o.) | | 0.000 | | 0.000 |
| | | (0.001) | | (0.001) |
| Constant | -0.099 | 6.198*** | -0.039 | 7.216*** |
| | (0.085) | (1.123) | (0.097) | (1.281) |
| Observations | 35 | 34 | 35 | 34 |
| $R^2$ | 0.688 | 0.860 | 0.888 | 0.953 |

(b) High skilled vs middle skilled

| | Labor cost gap of H vs M | | Net wage gap of H vs M | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Relative supply of H vs M | -0.286*** | -0.191*** | -0.234*** | -0.132** |
| | (0.036) | (0.034) | (0.040) | (0.037) |
| Linear time trend | 0.010*** | 0.012*** | 0.007*** | 0.009*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Log(real min. wage) | | -0.406*** | | -0.475*** |
| | | (0.106) | | (0.116) |
| Unemployment rate (15-24 y.o.) | | -0.001 | | -0.001 |
| | | (0.001) | | (0.001) |
| Constant | 0.173*** | 3.932*** | 0.223*** | 4.616*** |
| | (0.007) | (0.971) | (0.008) | (1.066) |
| Observations | 35 | 34 | 35 | 34 |
| $R^2$ | 0.955 | 0.972 | 0.888 | 0.932 |

(c) High skilled vs low skilled

| | Labor cost gap of H vs L | | Net wage gap of H vs L | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Relative supply of H vs L | -0.268*** | -0.180*** | -0.277*** | -0.181*** |
| | (0.039) | (0.032) | (0.045) | (0.037) |
| Linear time trend | 0.012*** | 0.013*** | 0.009*** | 0.010*** |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| Log(real min. wage) | | -0.707*** | | -0.811*** |
| | | (0.129) | | (0.151) |
| Unemployment rate (15-24 y.o.) | | 0.000 | | 0.000 |
| | | (0.001) | | (0.001) |
| Constant | -0.048 | 6.643*** | 0.022 | 7.685*** |
| | (0.091) | (1.207) | (0.105) | (1.405) |
| Observations | 35 | 34 | 35 | 34 |
| $R^2$ | 0.666 | 0.848 | 0.890 | 0.951 |

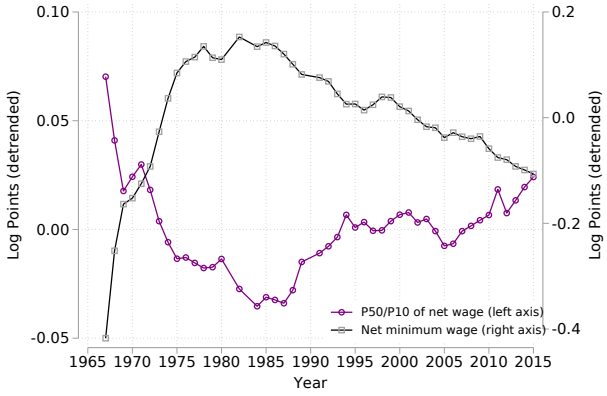
NOTE: The table shows time series regression results corresponding to the estimating equation 3. The dependent variables are relative wage (in net wage and pretax wage) of high-skilled workers (at least some college) relative to "unskilled" workers (high school or less) in panel (a) or decomposing this group into middle-skilled (high school degree, panel (b)) and low-skilled (less than high school, panel (c)). The main independent variable of interest is the relative supply of these types of workers. H, M and L are abbreviations standing for "high skilled", "middle skilled" and "low skilled". Standard errors in parentheses. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
SOURCES: DADS-EDP data 1976-2015.

Table D9: Industry-level Classification

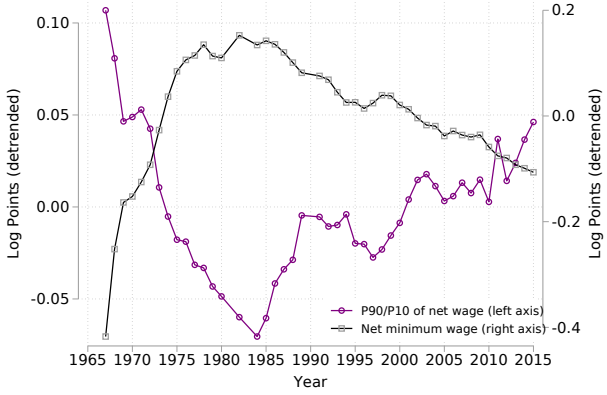
| Industry Levels | Code EUKLEMS | ape40-DADS Pre 1993 | a38-DADS Post 1994 | Label |
|---|---|---|---|---|
| AZ | A | 1 | AZ | Agriculture, forestry and fishing |
| BZ | B | 7-9 | BZ | Mining and quarrying |
| CA | 10-12 | 2-3 | CA | Food products, beverages and tobacco |
| CB | 13-15 | 18-19 | CB | Textiles, wearing apparel, leather and related prodcuts |
| CC | 16-18 | 20-22 | CC | Wood and paper products; printing and reproduction of recorded media |
| CD | 19 | 4 | CD | Coke and refined petroleum products |
| CEF | 20-21 | 11-12 | CE+CF | Chemicals and chemical products |
| CG | 22-23 | 10 23 | CG | Rubber and plastics products, and other non-metallic mineral products |
| CH | 24-25 | 13 | CH | Basic metals and fabricated metal products, except machinery and equipment |
| CIJ | 26-27 | 15-16 | CI+CJ | Electrical and optical equipment |
| CK | 28 | 14 | CK | Machinery and equipment n.e.c. |
| CL | 29-30 | 17 19 | CL | Transport equipment |
| CM | 31-33 | | CM | Other manufacturing; repair and installation of machinery and equipment |
| DE | D-E | 5 6 | DZ+EZ | Electricity, gas and water supply |
| FZ | F | 24 | FZ | Construction |
| GZ | G= 45+46+47 | 25-29 | GZ | Wholesale and retail trade; repair of motor vehicles and motorcycles |
| HZ | H=49-52+53 | 31-32 | HZ | Transportation and storage |
| IZ | I | 30 | IZ | Accommodation and food service activities |
| JA | 58-60 | | JA | Publishing, audiovisual and broadcasting activities |
| JB | 61 | | JB | Telecommunications |
| JC | 62-63 | | JC | IT and other information services |
| KZ | K | 36 | KZ | Financial and insurance activities |
| LZ | L | 37 | LZ | Real estate activities |
| MN | M-N | 33-34 | MA+MB+MC+NZ | Professional, scientific, technical, administrative and support service activities |
| OZ | O | 38 | OZ | Public administration and defence; compulsory social security |
| PZ | P | | PZ | Education |
| Q | Q | | QA+QB | Health and social work |
| RZ | R | | RZ | Arts, entertainment and recreation |
| SZ | S | | SZ | Other service activities |
| TZ | T | | TZ | Activities of households as employers |
| UZ | U | | UZ | Activities of extraterritorial organizations and bodies |

Figure D10: Detrended net P50/P10, P90/P10, net P90/P50 and net minimum wage: 1967-2015

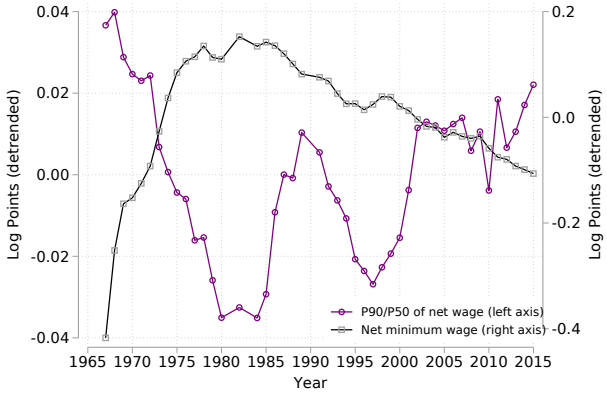
(a) Evolution of the P50/P10 log net Wage Ratio (detrended) and of the log net Minimum Wage in Real Terms (detrended)




(b) P90/P10




(c) P90/P50




SOURCE: DADS data 1967-2015.

NOTE: the figures shows the co-evolution of detrended log real net minimum wage (right axis) and detrended log net P50/P10 (panel a), P90/P10 (panel b) and detrended log net P90/P50 (panel c). All series are in logs and are de-trended. The minimum wage is expressed in real terms.

Table D10: Sector-level Wage Bill Share: the Role of ICT Capital, 1978-2015

| | Low-skilled wage bill share | | | Medium-skilled wage bill share | | | High-skilled wage bill share | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (1) | (2) | (3) | (1) | (2) | (3) |
| Change in ICT/VA | | -1.433* | -1.636** | | -0.875*** | -0.828*** | | 2.308** | 2.464*** |
| | | (0.564) | (0.526) | | (0.191) | (0.171) | | (0.691) | (0.614) |
| Change in non ICT/VA | | | 0.0196 | | | -0.0177 | | | -0.00185 |
| | | | (0.018) | | | (0.009) | | | (0.023) |
| Change in ln(VA) | | | -0.0266 | | | -0.0239* | | | 0.0506 |
| | | | (0.031) | | | (0.011) | | | (0.035) |
| Constant | -0.343*** | -0.300*** | -0.257*** | 0.0459*** | 0.0721*** | 0.109*** | 0.298*** | 0.228*** | 0.148** |
| | (0.023) | (0.033) | (0.045) | (0.010) | (0.009) | (0.015) | (0.028) | (0.036) | (0.047) |
| Observations | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 |
| $R^2$ | 0.000 | 0.154 | 0.245 | 0.000 | 0.323 | 0.414 | 0.000 | 0.276 | 0.353 |

SOURCES: DADS-EDP data 1976-2015 and EUKlems data 1978-2015
NOTE: The table shows OLS regressions corresponding to figure A7. The outcomes are the 37 years changes in sector-level wage bill share accruing to low-, middle- and high-skilled (column 3) workers in the 27 sectors. Standard errors in parentheses. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

# E Analysis of the Relationship Between the Minimum Wage and Inequality at the Bottom

To study the relationship between the minimum wage and wage inequality, we first rely on suggestive graphical evidence. We start by noting that wage inequality decreased sharply in the lower-tail of the wage distribution during the period 1967-1985 when the yearly increases in the real minimum wage were the largest (Figure 4a). Just like the minimum wage, lower-tail inequality then stagnated over the decade 1985-1994, before decreasing again after 1994, but at a slower pace than in the earlier period. These simple comparisons exploit the fact that the upward (downward) trend in the minimum wage (lower-tail inequality) was not linear and experienced clear breaks over the period we look at.

To better understand the possible effects of these breaks and avoid a basic comparison of common trends, Figure D10a shows the de-trended series of the log net minimum wage in real terms and of lower-tail net wage inequality (log of P50/P10). The Figure fully confirms that when the minimum wage increases more (less) than usual, lower-tail inequality decreases more (less) than usual.[20] The pairwise correlation $\rho$ between the two series is as small as $-0.944$ ($\rho = -0.986$ when trends are not removed).

We also find a large correlation between the year-to-year variations in the real net minimum wage and the year-to-year variations in lower-tail net wage inequality ($\rho = -0.795$, see Table E11), confirming a tight link between the minimum wage and lower-tail inequality. The corresponding elasticity is around $-0.2$ over the period 1967-2015: when the net minimum wage increases by 10% in real terms a given year, the P50/P10 ratio for the net wage decreases by about 2% that same year. In contrast, the correlation between year-to-year variations in the minimum wage and upper-tail inequality is much smaller ($\rho = -0.210$, not statistically different from 0), suggesting that we might capture a causal impact of the minimum wage in the bottom-half of the wage distribution rather than a spurious correlation between the minimum wage and overall wage inequality.[21]

The sharp decrease in net or posted wage inequality observed in the late 1960s and 1970s might therefore be partly attributable to the large increases in the minimum wage

[20] Figures D10b and D10c show the joint evolution between of de-trended series of the log net minimum wage in real terms and of upper-tail (log of P90/P50) or overall (log of P90/P10) net wage inequality. The relationship between upper-tail wage inequality and the minimum wage appears much more blurred.

[21] Note that removing the trend has no incidence on the correlation between the first differences of the considered series, so that we only provide results for the raw series.

that have taken place at that time. This conclusion is also consistent with the large increase during that period in the share of workers at or close to the minimum wage and in the ratio between the minimum and the median wage (Figure **??**).

Table E11: Correlations Between the inequality Ratios and the Minimum Wage (Net Wage Concept)

| | log(real minimum wage) | | |
|---|---|---|---|
| | Raw series | De-detrended | First difference |
| log(P90/P10) | -0.981 | -0.948 | -0.612 |
| log(P50/P10) | -0.986 | -0.944 | -0.795 |
| log(P90/P50) | -0.676 | -0.800 | -0.210 |

SOURCE: DADS
NOTE: Each column shows the correlation between the log of the net minimum wage and three different inequality ratios in logs for the net wage. The first column corresponds to the raw data. The second column contains de-trended series (for both the minimum wage and the inequality ratio) corresponding to the residuals from separate OLS regressions of the corresponding variable on a constant and a linear time trend. The last column shows the the correlation between first-differenced variables.

# F International comparisons with EU-SILC data

We rely on the EU-Statistics on Income and Living Conditions (EU-SILC) database for international comparisons. EU-SILC is a yearly survey performed in European Union countries aiming to collect consistent cross-country information on income and living conditions. The survey is performed at the household level, but collects information on all households members above 16 years old. We rely on the individual-level tables (`Personal files`), focusing on a sample similar to that of our main analysis (employees between 20 and 64 years old working full-time).

We then use the information available in the survey to reconstruct our pretax wage, posted wage and net wage concepts. The posted wage and the net wage are given by the `PY010G` and `PY010N` variables. Starting in 2007, the survey also provides information on the employers' social insurance contributions (`PY030G`) that we add to the posted wage concept in order to define the pretax wage. Further, we use the number of months worked to scale our income concepts by the working time, thus relying on monthly wages for our cross-country comparisons. Moreoever, we rely on individual sampling weights for our analysis.

We then computes the gini index by year and country for the different wage concepts. Our main measure of the redistributive role of employer social contributions is the relative change in the gini from the gross to the pretax wage defined as follow :

$$r_{c,t} = \frac{\text{gini}_{t,c}^{\text{pretax wage}} - \text{gini}_{t,c}^{\text{posted wage}}}{\text{gini}_{t,c}^{\text{posted wage}}}$$

where $c$ is a country and $t$ a year. Figure A5a shows the measure for a wide range of countries for 2019. Figure A5b shows how the measure evolved from 2007 to 2019.

Table F12: International Comparisons for the Recent Period

| Country | % change in gini 2007 | 2019 |
|---|---|---|
| Austria | -1.4 | -1.0 |
| Belgium | -2.7 | -4.4 |
| Czechia | 0.1 | -0.2 |
| Denmark | 5.7 | -0.1 |
| Estonia | -0.3 | 2.3 |
| Finland | -1.0 | -0.3 |
| France | 8.1 | 6.6 |
| Greece | 0.8 | 0.4 |
| Latvia | 1.7 | 1.3 |
| Luxembourg | -2.3 | 0.1 |
| Malta | -3.9 | -3.0 |
| Netherlands (the) | -0.7 | -3.7 |
| Norway | 0.5 | 0.0 |
| Poland | 1.4 | 0.1 |
| Slovakia | -3.0 | 0.0 |
| Slovenia | 3.2 | 0.5 |
| Spain | -4.7 | -3.8 |
| Sweden | 0.6 | 0.2 |
| Switzerland | 0.7 | 1.3 |

NOTES: The table shows for each country the relative change (in percentages) in the gini when moving from pretax wage to posted wage distribution. This measures captures the reduction in wage inequality coming from the employer social security contribution.
SOURCE: EU-SILC data 2007, 2019.