n° 2016-07
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Taxes and Technological Determinants of Wage Inequalities: France 1976-2010

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Thursday 25th February, 2016

Abstract

This paper makes two simple points. First, labour demand depends on product wage or labour cost. Hence, demand-side explanations for the rise in inequalities such as skill-biased technical change and job polarization should be tested using data on labour cost and not net wage or posted wage. Contrary to previous studies, we find evidence of skill-biased technical change in France when we measure wage inequality in terms of labour cost. In that respect, France is no exception. Second, the French case provides a clear evidence that changes in taxation can have very significant effect in converting market inequalities into consumption or net wages inequalities. In France, net wage inequalities have decreased by about 10%, while labour cost inequalities have increased by 15% over the 1976-2010 period. This fact provides support both for the supporters of the skill-biased technical change explanations of the secular increase in wage inequalities, as well to those who believe that institutions could have significant impact on inequalities in disposable incomes.

1   Introduction

A large literature has documented a significant increase in wage inequality in many developed countries since the 1980s. Studies on U.S. data have shown very steep increase in overall wage inequality in the 1980s (Bound & Johnson 1992; Katz & Murphy 1992 and Katz & Autor 1999 for a survey), a continued increase in the upper half of the distribution in the 1990s while the widening of the wage inequality halted in the bottom half of the distribution during that period (Autor et al. 2008). A similar pattern has been found for the U.K. (Gosling et al. 2000), and recent work has highlighted that Germany has not been an exception to this trend (Dustmann et al. 2009), albeit in a smaller scale and with a different timing.

The explanations of these secular trends in widening wage inequality in developed countries have been debated. First, the hypothesis that technological change was the driving force behind these trends, named skilled-biased technological change (henceforth SBTC) rests on the idea that modern IT technology has shifted the demand for labour in favour of skilled workers: those using computer technology see their productivity increase while unskilled workers see their tasks replaced by computerisation (Katz & Murphy 1992, Card & Lemieux 2001, Autor et al. 2008). A variant of the SBTC highlights polarisation of skills in the more recent period with declines in labour demand more pronounced for those clerical tasks, used to be realised by middle skilled workers, while the demand for unskilled labour is less affected, notably due to the demand for services that are hard to be replaced by IT technology (Autor et al. 2006, Goos & Manning 2007, Goos et al. 2009, Autor 2015). Second, the hypothesis that institutional changes are the main cause for widening inequality has been put forward with particular attention to the impact of the minimum wage in the U.S. (Lee 1999, Card & DiNardo 2002, Card & Lemieux 2001, Lemieux 2006), but also unionisation and economic deregulation (Fortin & Lemieux 1997).

In this debate, evidence from the UK and Germany (e.g. Lindley & Machin 2011 for the UK; Dustmann et al. 2009 for Germany) have provided support for the SBTC hypothesis. The case of France was, on the contrary, cited as a counter-example. A series of recent academic papers (Koubi et al. 2005, Charnoz et al. 2011, 2013, Verdugo 2014) have shown that France is almost the only developed country where overall wage inequalities have been decreasing over the past 40 years. For instance, the ratio d9/d1 of wages at the 9th and 1st deciles of distribution of net wages decreased from about 3.6 in 1976 to slightly less than 3 in 2010. This decrease is mostly driven by a reduction in lower-tail net wage inequalities (d5/d1), while upper-tail inequalities (d9/d5) remained roughly constant over the period

1976-2010.

This "French exception" casts doubts on the main demand-side explanations for the rise in inequalities, such as SBTC or job polarization. As those explanations derive from global technological changes, they should have hit all developed countries, and it is hard to claim that IT technologies or computerisation have not been adopted in France. However, studies of the French wage structure have concluded that SBTC does not apply in France, and suggested that institutional factors – in particular expansion of education – have been the main drivers for the compression of the wage distribution (Goux & Maurin 2000, Charnoz et al. 2011, Card et al. 1999, Verdugo 2014).

In this paper we revisit the French evidence with a simple (but often forgotten) argument, i.e. that the relative demand for skilled and unskilled labour depends on their relative product wages (or labour costs) rather than their relative gross wages. The main difference between the two measures of wage inequality comes from changes in employer social security contributions (SSCs) at different points of the wage distribution. For some countries the difference is small and only marginally change the overall picture on widening inequality. For instance, in the U.S., the combination of small increase in employer payroll tax (+1.6 ppt) and a relatively high payroll tax threshold (around the 9th decile) over the period 1970-2010, means that labour cost inequalities are only marginally different from gross wages inequalities[1] [2].

The picture is very different in France, where employer SSCs have changed dramatically over time and across the wage distribution. France has had historically high employer SSCs, with total employer marginal rates close to 40% under the social security threshold (SST). However, during the 1980s and 1990s, two sets of policies have radically transformed the distribution of employer SSCs: first, in the 1980s, a number of contributions have been "uncapped", i.e. applied to all earnings above the threshold. Second, during the 1990s, reductions in employer SSCs around the level of the minimum wage have been implemented. These policies were motivated by the concern that the French minimum wage was too high, contributing to high unemployment of unskilled workers. Over 40 years, these successives policies mean that employer SSCs have been reduced on low earners and increased on high

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[1]According to our computations, inequalities computed with the two concepts are virtually equal except for workers in the top decile of the distribution which got partly caught up by the payroll tax threshold and thefore experienced a slightly larger increase in their average payroll tax rate than other workers over the period 1970-2010.

[2]Another issue in some countries like the U.S. or the U.K. would be other form of remuneration (e.g. health insurance, employer contributions to pension funds) that are not mandatory and not included in posted gross earnings.

earners, leading to a very different picture when one looks at labour cost inequality or gross wage or net wage inequality. Using administrative data spanning from 1976 to 2010, we show that labour cost inequalities have actually increased in France by more than 15%, while net and gross wage inequalities have decreased by 5 to 10%.

Then, using labour cost measures of wage inequality, we revisit the SBTC hypothesis on French data. We follow the framework developed by Katz & Murphy (1992) and Autor et al. (2008) to estimate shifts in demand for skills using variations in their supply. Because the supply of skilled versus unskilled workers has been constantly increasing in France over this period, we cannot distinguish shifts in supply from time trend or SBTC, as has been shown using U.S. data. We offer an alternative evidence by calibrating the canonical SBTC model, with US estimates of the elasticity of substitution between skill groups. We show that French data, when labour cost is considered, is consistent with the SBTC hypothesis.

If the French case is not an exception that can be used against the SBTC hypothesis, it also exemplifies the fact that institutional factors, like taxation, can have powerful impacts on the evolution of net wage inequality. Most of the institutions studied carefully in the inequality literature concentrate on minimum wage, unionisation and education policies. Taxation seems to have attracted a lot less scrutiny from scholars looking at wage inequality, with the notable exception of top incomes inequality (Piketty & Saez 2003, Piketty et al. 2014). The impact of employer social security contributions on net wage inequality is however hard to assess, as it depends fundamentally on the ultimate incidence of these taxes and on their impact on employment, an issue where robust evidence is hard to find. Our analysis provides suggestive evidence that employer SSCs are shifted in the long run onto employees, and can thefore reduce gross wage inequality.

The rest of the paper is organised as follows: Section 2 presents the data and the institutional setting that make labour cost important to analyse in the French case. Section 3 reproduces the standard analyses of skill biased technical change using labour costs per worker instead of gross or net wages. In section 4, we discuss the relationship between the long term incidence of employer SSCs and the efficiency of these taxes to reduce gross wage inequalities. Section 5 concludes.

2 Labour cost inequalities in France

In this section we briefly describe the institutional setting, then the data we use before presenting basic results on labour cost inequalities in France over the 1976-2010 period.

2.1 Labour cost and social security contributions

SSCs are a very important part of taxation in France representing close to 40% of total tax revenues. They fund a number of aspects of the welfare system, notably health spending and pensions, but also family benefits, unemployment insurance and housing benefits. There is a large number of different SSCs, one for each scheme and type of risk, for instance one for the main pension system of private sector employee, one funding family benefits, another one funding unemployment insurance, etc. Each scheme differs according to the type of governance (State, Social security, management by employer and employee unions) and according to the nature of the contributory link between SSC and benefits (pensions are contributory, health is not).

The tax schedule of SSCs is similar in France to most other OECD countries. The tax base is gross wage (or posted wage) capped at different thresholds. The reference threshold, called *social security threshold* (SST) is roughly mean gross earnings for full-time employees, and SSCs can be defined as a function of 1, 3, 4 or 8 SST. The SSC schedule is defined for each period of employment and adjusted for the number of hours worked: for instance, an employee working one hour for a high wage will be pay SSC based on the different multiple of hourly SST. One distinctive feature of French SSCs is that the main threshold (1 SST) is lower than in most other countries (around P70), while there are SSCs for very high level of earnings (the highest threshold is at P99.95).

During the period of our data (1976-2010) a number of reforms to SSCs have been carried out in France. Figure 1 offers a rapid summary of these, by showing average SSC rate over labour cost by decile of earnings. Two periods stand out: the most recent period spans from mid-1990s to the present day, when SSC average rates stabilise around 46% for the top half of the earnings distribution and average rates drop for lower deciles (to 34% for the first decile, to 40% for the second decile). This is the result of a set of measures, i.e. reductions of employer SSCs, implemented to reduce labour cost at the minimum wage by various governments[3]. These exemptions are total for workers paid the national minimum wage and decrease linearly up to the point where they have entirely disappeared (1.6 times the minimum wage in 2010). As a consequence, they have impacted only the three first deciles of the gross wage distributions. These reforms were motivated by the fear that high minimum wage combined with high employer SSC were detrimental to employment. They

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[3]See Appendix A. Those exemptions started for workers whose wage was below 1.3 times the national minimum wage. They have been progressively extended to higher levels of the wage distribution, up to 1.6 times the national minimum wage during the period covered by our data.

have been widely studied to assess their efficiency in terms of employment (Kramarz & Philippon 2001a).

The first period has attracted much fewer work. From 1976 to mid-1990s, SSCs increased substantially for all workers but even more so for top earners. For instance, for the median earnings the average SSC rate climbed from 35% to 45%, while the top decile of earnings started from 24% to reach 44%. This can be explained by two set of reforms of SSCs: a) uncapping of SSCs (previously capped at 1SST) for the main schemes (health, family, pensions); and b) increase in rates for complementary pension schemes for earnings above the SST. The uncapping of SSCs concerned mostly non-contributory benefits (health care and family benefits), implying that there was no individual-level link between the increase in the contributions and the benefits provided. The second set of increase in SSCs was different in nature as it led to both increase in contributions and in expected pension benefits.

2.2 Data

The data we use in this study come from administrative data called *Déclarations annuelles de données sociales* (DADS). DADS are individual level earnings data that each employer needs to fill for each employee. The main objectives of the data is to provide social security schemes with earnings information necessary to compute eligibility or level of benefits, notably for pension schemes. The French national statistics office, Insee, transforms the raw DADS data into user files available to researchers under restricted access[4]. The panel version of DADS presents a 1/25 sample of all employees, those born in October in pair years, from 1976 onwards. In 2002, the sample double to represent 1/12 of all workers. This represents roughly 1.1 million workers sampled each year from 1976 to 2001, and 2.2 million from 2002 onwards[5].

The data provide information about the firm (identifier, sector, size) and each job spell (start and end date, earnings, occupation, part-time/full-time). Hours of work are available since 1993. Although we cannot compute hourly wages for the entire period, we measure wages using daily earnings for full-time workers. Importantly, raw data about earnings come under the form of "net taxable earnings" (earnings reported for income tax). This definition of earnings is net of social security contributions and gross of income tax, but

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[4]We got access to the DADS data through decisions from *comité du secret* ME27 of 02/10/2013, ME56 of 25/06/2014 and ME91 of 25/06/2015.

[5]A number of years are unfortunately missing (1981, 1983, 1990). See Appendix B for more details.

does not recover exactly net earnings as some flat rate contributions are not deductible for the income tax, and therefore added in the net taxable earnings[6]. Earnings reported include basic earnings, as well as performance and non-performance related premiums and bonuses. We divide them by the numbers of working days in a given employment spell to obtain our *net wage* concept.

Gross wage corresponds to net wage plus employee social security contributions. Gross wage corresponds to the amount of pay stipulated in labour contracts, i.e. the posted wage, and on which negotiations typically take place. Gross wages are available in the DADS from 1993 onwards. Before that date, they have been computed from the net wages using the model TAXIPP, the microsimulation model of the *Institut des politiques publiques* (IPP)[7].

We call *labour cost* the actual cost paid by a firm for a given worker a given year. It includes both employer and employee social security contributions and has been entirely computed from net wages using TAXIPP. The rules for computing the numerous distinct employer SSCs are rather complex in France, as they depend on hourly wage, firm size, location of the firm, and affiliation to different pension schemes. Importantly, one serious limitation of the panel DADS before 1993 is the absence of hours of work, meaning that we cannot compute labour cost for those working part-time before 1993.

The net wage concept we can derive form 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, we are not able to derive *net of tax wage*. To estimate this concept – important for cross-country comparison – we make use of another restricted-use data, the *Enquête Revenus Fiscaux et Sociaux* (ERFS), i.e. the Labour Force survey matched with tax records. Using this data we estimate the income tax paid each year by each household and assuming income tax is split between household members proportionally to their earnings, we infer *net of tax wage* (see Appendix B for all computation details).

2.3 Labour cost inequalities in France (1976-2010)

Figure 2 presents the change in log real wage by percentile for male working full-time over the 1976-2010 period. We show the two often used measures, gross (i.e. posted) and net wage, which are slowly decreasing over the wage distribution and contrast them with

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[6] *Contribution sociale généralisée* (CSG) is partly deductible from the income tax base and *Contribution au remboursement de la dette sociale* (CRDS) is not-deductible.

[7] The TAXIPP model has been adapted for the purpose of this study to the DADS data. See Appendix B for more details.

the labour cost measure which is monotonically increasing over the wage distribution. This pattern can be compared to results from other countries, where this upward sloping curve has been well documented. Notwithstanding comparison issues of exact period, the French wage inequalities in terms of labour cost have been increasing, albeit on a smaller scale than in the U.S., but close to the German case (Dustmann et al. 2009).

Figure 3a shows the evolution of the log of the ratio d9/d1 for the net wage, gross wage and labour cost distributions. It confirms the striking difference it makes when one look at gross or net wage inequalities or labour cost inequalities in France. While the net wage d9/d1 ratio has decreased by 7 log-points over the period 1976-2010, the labour cost equivalent has increased by 16 log-points. Gross wage inequalities have also decreased, but slightly less than net wage inequalities[8]. To put these results in perspective, Table 1 compares our measures of inequality for France with the ratio d9/d1 in terms of gross wages provided by OECD for a series of other countries. We see that the increase in inequalities in France measured in terms of labour costs is comparable to that of the U.K or Australia when gross wages are used.

Figure 3b is similar but also includes the ratio d9/d1 for the net of tax wage. Changes in the income tax schedule have not counteracted the reduction in net wage inequalities, implying that inequalities in terms of wages net of all social security contributions and taxes have also decreased. Figure 3b finally shows wage inequalities in terms of a net wage measure that includes the value of contributory contributions, which fund for instance pension benefits. We find some evidence that part of the increase in SSC has been used to fund higher pension benefits for higher earners and has not reduced net total remuneration as much as the net wage measure might imply.

If we now look separately at the change in wage inequalities in the upper and lower tail of the income distribution, with the D9/D5 and D5/D1 ratios (Figure 4), we can clearly see the two periods we mentioned earlier in terms of SSC policy. The uncapping carried out in the 1980s and 1990s have only affected the upper tail of the distribution. As the SST lied around the 7th decile of the gross wage distribution, only individuals in the top 3 deciles have been concerned by these increase in SSCs. Lower-tail inequalities in terms of labour cost or net wage have remained almost unchanged. In the second half of the period, this is the opposite. Reductions in employer SSCs have only affected in the 1990s-2000s the lower-tail of the wage and labour cost distributions.

These timing of the increase in wage inequalities differ markedly in France from what

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[8]See also Appendix C for log ratios d8/d2 and d7/d3.

has been observed in other countries, namely the U.S. and the U.K. (and in some respect Germany too). The increase in the D5/D1 ratio happened in France later, but it is important to keep in mind that these policies aiming to reduce employer SSCs have been designed as a response to the rise of unemployment among unskilled paid at the minimum wage.

3   Revisiting skill-biased technical change in France

In this section, we revisit the SBTC hypothesis using labour cost to measure wage inequalities.

3.1   Supply and wage premium for skilled workers

The SBTC hypothesis relies on estimating changes in the supply and wage premium of skilled versus unskilled workers. Following the previous literature, we define skilled workers with a college degree or more and unskilled workers as high-school equivalents or high-school dropouts. It is useful to mention from the onset that the standard definition of skilled versus unskilled, which makes sense in an U.S. institutional context, might not be as pertinent in all institutional settings. For instance Lindley & Machin (2011) suggest that the difference between postgraduates workers and workers with a college degree or less might be more appropriate in the U.K. In the French context, one could defend defining unskilled as high school dropouts, as they represent such a large share of low skills given the later development of secondary education (compared to the U.S., see Verdugo (2014)). Using this definition does not change significantly our conclusions. We therefore leave aside these considerations, and using the standard definition (college/no college), we compute year-by-year the wage premium and relative supply of skilled versus unskilled workers, either measured in terms of net wage or in terms of labour cost (Figure 5).

First, these figures alter significantly the position of the French case relative to the SBTC hypothesis. When we compare the estimates for the labour cost (panel A) or net wage (panel B), we obtain increasing skill premium in terms of labour cost, compared to a stable pattern in terms of net wage[9]. This dismisses the idea that no secular trend in the wage premium for skilled workers was evident in France.

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[9]Following previous literature for the U.S., we have split workers with some college equally between the skilled and the unskilled. Charnoz et al. (2011) and Verdugo (2014) actually find a moderate decrease in the education net wage premium over the period. This is explained by differences in the construction of the groups of skilled and unskilled, as well as in other methodological choices (see appendix B).

Second, the increase in the relative (labour cost) wage premium for skilled workers has been smaller in France than what has been shown for the U.S. The skill premium increased by about 6 log-points over the period 1976-2010 in France, compared to an increase of about 20 log-points in the U.S. over the same period – using gross wage measures (Autor et al. 2008). In that sense we do not dismiss earlier studies on French wage structure which tried to explain the almost flat net wage premium for skilled workers by the continuous expansion of higher education. The relative supply curves in Figure 5 demonstrate the linear increase in the supply of skilled workers in France over the period. As explained by Gurgand & Maurin (2006) and Verdugo (2014), the democratisation of education occurred later in France than in the U.S., and induced a much faster and larger change in the relative supply of skilled workers (see Verdugo 2014, Figure 2). This rapid and steady rise in the relative supply of skilled workers may have limited the growth of their relative wage and labour cost, even with a parallel shift in demand.

3.2 Estimating the standard supply/demand model on French data

To test the SBTC hypothesis more formally, the standard route is to estimate a version of the macro-level supply/demand model initiated by Katz & Murphy (1992). In this approach, SBTC is identified from the long-term changes in the relative wages of skilled and unskilled workers that cannot be explained by changes in the relative supply. Typically, an increase in the relative wages of skilled workers (as compared to unskilled) concomitant with an increase in their relative supply suggests a large increase in the demand for those workers, which is itself attributed to SBTC.

We follow Autor, Katz & Kearney (2008, AKK hereafter) and assume that aggregate output Q depends on two labour 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 and unskilled workers in period t. a_t and b_t are technical change parameters augmenting skilled and unskilled labour inputs. α_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 or α_t increase over time.

Assuming that the labour cost (and not their wage) associated to both skilled and

unskilled are equal to their marginal products, we can derive from equation (1) the following equation:

$$\ln\left(\frac{w_{st}}{w_{ut}}\right) = \ln\left(\frac{\alpha_t}{1-\alpha_t}\right) + \rho\ln\left(\frac{a_t}{b_t}\right) - \frac{1}{\sigma}\ln\left(\frac{N_{st}}{N_{ut}}\right) \tag{2}$$

where w_{st} and w_{ut} are the labour costs associated with skilled and unskilled workers. Equation (2) can be rewritten:

$$\ln\left(\frac{w_{st}}{w_{ut}}\right) = \frac{1}{\sigma}\left[D_t - \ln\left(\frac{N_{st}}{N_{ut}}\right)\right] \tag{3}$$

where D_t represents relative demand shifts favouring skilled workers. The impact of changes in relative skill supplies on relative wages depends inversely on the magnitude of σ, 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 augment this equation to take into account the unemployment rate or institutional factors such as the minimum wage, as in equation (4) of AKK:

$$\ln\left(\frac{w_{st}}{w_{ut}}\right) = \beta_0 + \beta_1 t + \beta_2\frac{N_{st}}{N_{ut}} + \beta_3 RealMinWage_t + \beta_4 Unemp_t + \varepsilon_t \tag{4}$$

In the U.S., the supply/demand model has done an excellent job in relating variations in the skill wage premium over time to concomitant accelerations and slowdowns in the accumulation of skills on the labour market. However, doing such an exercise appears almost impossible in France. This is because over the period 1976-2010, there have been no breaks in the relative supply of skilled labour. As evident in Figure 5, the supply of college-educated workers relative to high-school equivalents has risen linearly. The time trend in Figure 5 predicts almost entirely this rise ($R2 = 0.99$), making practically irrelevant to include in a same regression a linear time trend and the relative supply in skilled workers[10].

To get around this identification issue, we suggest another test for the presence of SBTC in France. We estimate equation (4) but we constrain β_2 to be the same value as the one estimated in other countries (in this case the U.S.). In doing so we effectively calibrate ex ante the elasticity of substitution σ between skilled and unskilled workers. This second-best strategy relies on the assumption that technologies used by firms in developed countries are

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[10]Verdugo (2014) provides estimates obtained from the slightly more sophisticated approach of Card & Lemieux (2001). In this approach, experience groups are imperfect substitutes nested within each skill group. Verdugo reaches the same conclusion regarding the reliability of the estimated elasticity of substitution between skill groups, and therefore on the ability to estimate SBTC on French data.

close enough for the technological parameters to be of the same order of magnitude. The question we ask then becomes the following: "Assuming that the effect of supply shifts on skills prices are the same in France and in the U.S., can we conclude that demand shifts have the same effects in both countries?" We can thus compare the coefficients β_1 to assess the size of the SBTC in France with respect to the US, and similarly for the coefficients β_3 and β_4.

3.3   Results

Results of the estimation of equation (4) are presented in Table 2. The three first columns directly report the estimates on US data from AKK (see AKK, Table 2). In the next columns, we estimate the same three models on French data using either log relative labour costs as dependent variable (models 4 to 6) or log relative wages (models 7 to 9). To construct the time series of wages, labour costs and supplies of skilled and unskilled workers, we apply the quality and composition adjustments made in previous literature (see Appendix B.2)[11]. In all cases, the effect of the relative supply of skilled versus unskilled is constrained to be equal to the value estimated in the corresponding model in the U.S.

The estimated effect of the linear time trend (β_2) is identical in all the three models based on labour costs. When we include a more flexible time trend, we find that trend demand growth for college relative to non-college workers slowed down over time. If anything, it seems to have slowed down slightly more in France which is perfectly consistent with the fact that we focus on a slightly more recent period than AKK, with the last years of this period being possibly less concerned with SBTC. Given that we expect little difference in labour cost measures of inequality in the US, we believe that the comparison of models (1) to (3) for the U.S., and (4) to (6) for France suggests very similar extent of SBTC in both countries. Or more precisely, we contend that it is impossible to reject that SBTC has been of similar magnitude in the two countries.

If we now turn to the comparison between the French estimates based on labour cost or net wage (columns (4) vs (7), and (6) vs (9)), two results stand out. First, the time trend coefficient is significantly smaller when net wage measure is used, suggesting that estimates based on net wage can underestimate the extent of SBTC when there is redis-

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[11]Because of the colinearity issue, minor changes in the construction of the series usually have huge impacts on the estimates when the estimated effect of the relative supply is unconstrained. However, once this effect is constrained, the other estimates become very robust to small methodological changes in the construction of the changes. This is one more indication in favour of constraining the elasticity of substitution between skilled and unskilled workers.

tribution through SSCs. Those estimates, presented for the sake of completeness, should be interpreted very cautiously since, as we explained, the labor/supply framework should only be applied to labour costs. For example, the elasticity of substitution between skilled and unskilled workers that we took from AKK estimates captures the relationship between relative supply and relative labour cost. It is not clear that this elasticity should be used in a the relative net wages equation. Second and perhaps more interestingly, the impact of the real net minimum wage is much bigger than when we use the series of the minimum wage in terms of labour cost. The relatively high French minimum wage (in net terms) seems to have reduced the net wage skill premium more in France than in the U.S., while the impact in terms of labour cost is as muted as in the U.S. Figures 6 and 7 illustrate these simple facts: expressed in gross wage, French minimum wage as a share of median wage has been kept at high level (60% of median wage) during the entire period, while it was decreasing in most countries. Expressed in labour cost, i.e. once reductions for employer SSCs have been incorporated, the French minimum wage has also declined as a share of median (labour cost) wage – even if it still remains higher than in most other OECD countries.

4 Impact of taxation on wage inequalities

After the previous analysis, it is tempting to jump to the conclusion that employer SSCs changes have been one of the reason for the lower net wage inequalities observed in France (along with the higher supply of skilled labour). But such a conclusion would depend largely on the ultimate incidence of these SSC changes, and the behavioural responses they triggered in terms of employment or incentives to educate. We offer below a discussion of these potential effects, not pretending to any definite conclusions.

4.1 Can we infer SSC incidence from SBTC?

The issue of the long-term incidence of SSCs has been central within the public economics literature (see Fullerton & Metcalf 2002, for a survey). The question is whether SSCs are ultimately shifted to employees under the form of lower net wage, or do they impact labour cost, reducing profits (and employment), or alternatively are they shifted to consumers through higher prices. Depending on the ultimate incidence of SSC, the counterfactual wage distribution in the absence of any tax changes could have been radically different. We know that labour cost and net wage inequalities would have evolved according

to parallel trends (mechanically) but we do not know how they would have evolved.

Figure 8 illustrates two polar cases regarding these parallel trends, assuming that either i) SSCs have been shifted fully to employees, or ii) SSCs have been shifted to employers. In the former case, labour cost inequalities would have evolved similarly with or without SSCs reforms, while in the latter case, it is net wage inequalities that would have remained the same in the absence of changes in the relative wedge of social security contributions. These polar cases make a strong implicit assumption, i.e. that SSC changes have not led to any behavioural changes, neither in terms of quantity of labour supplied or demanded – we come back to that issue in the next subsection.

There are strong theoretical arguments for supporting the idea that SSCs are passed on workers in the long run, because labour costs should not depart from workers' productivity for long periods of time. Even in very rigid labour markets, with strong hiring and firing costs, firms that hire skilled and unskilled workers according to their marginal productivities are more efficient, and thus more likely to survive and to take over in the long run. This basic theoretical line implies that labour costs should not be impacted by taxes in the long run. Unfortunately the empirical evidence related to the incidence of SSCs has been limited at best, and a number of studies show that even after many years, some employer SSCs seem not to have been fully shifted to employees even many years after a reform occured (Saez et al. 2012, Lehmann et al. 2013, Bozio et al. 2016). An additional concern for France is the role played by the minimum wage and the reduction in employer SSCs. They cannot be analysed separately as the latter ones have made possible the policy of increasing or maintaining a high minimum wage. As a result, the evidence from the change in wage inequality in the bottom half of the distribution is plagued by the joint interaction of minimum wage and SSC policy.

The changes in the upper half of the wage distribution is more interesting in that sense, because it provides evidence without any possible contamination from the policies around the minimum wage. In that case, changes in workforce composition due to employment effects are also less of an issue as the unemployment rate is close to zero among (potential) top wage earners. Figure 4 show that labour cost inequalities in the upper half of the distribution increased steadily between 1980 and the early 2000s, which is exactly the period when the bulk of technical change took place. In contrast, net wage inequalities increased only marginally over the same period. This suggests that the increase in employer SSCs over the social security threshold that occurred in the 1980s and early 1990s have likely been passed on to workers whose wages would have otherwise become more unequal,

as in virtually all other developped countries.

4.2 Behavioral responses and the impact of taxes on wage inequality

The previous discussion relied largely on the assumption that changes in SSCs did not lead to behavioural responses in terms of the quantity of skilled/unskilled labour supplied or demanded. This is obviously a very strong assumption. There are two main channels for which one could expect SSC to change supply and demand for different skills.

First, what has been most debated, is the possibility for high employer SSCs to impact employment due to rigid wages, and an inability of employers to shift these contributions to employees in the form of lower net wages. We have seen that there are arguments for full shifting to employees in the upper end of the distribution, but at the minimum wage, any increase in employer contribution cannot be shifted into lower net wage. This had led to the concern that the high cost of the minimum wage in France combined with high employer SSCs could have caused the high unemployment experienced by low skilled workers, while preserving low level of wage inequality. In that respect, reduction in employer SSCs for low-wage earners may have been directly incident on employers, leading to a rise in the employment of low skilled workers (Kramarz & Philippon 2001b) without changing much wage inequality in the bottom half of the distribution.

Second, depending on its incidence, the large redistribution carried out by changes in SSC must have impacted negatively either the relative supply or the relative demand of skilled workers (or both)[12]. On the one hand, if changes in SSC were incident on workers, they would have changed the relative reward for acquiring skills in France (compared to other countries at least). This could have led to lower accumulation of skills from individuals. On the other hand, if changes in SSC were incident on firms, they would have changed the relative value of skilled workers and may have led firms to specialise in lower skills technology. Some have claimed that these mechanisms were at play in France, and were explaining the lack of innovations of French firms.

We do not have direct evidence on either of these possible impacts of taxes on the relative quantity of skilled labour. We may nevertheless try to get a couple of insights from our analysis. To start with, the stock of skilled workers has increased steadily over the past four decades. The changes in SSC have not been matched by a slowdown in the

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[12]In standard theory without market rigidities, wage bargaining or social norms, the incidence is a simple function of supply and demand elasticities and is mostly on the least elastic side of the market.

inflow of young skilled workers on the labor market, suggesting either that (i) they have not been incident on workers, (ii) they have been counteracted by concomitant policies favoring education, (iii) or they have not been large enough to discourage human capital investments. The absence of any reaction on the supply side is perhaps not surprising since the relative net wage premium for skilled workers has remained constant over the recent period.

Then, if it reflects the incidence of SSC changes on employers rather than pure market forces, the increase in the relative cost of skilled workers should have triggered a downward shift in their relative demand (counteracting SBTC). As shown in Figure 9, the unemployment rate of workers with at least some college education has remained limited over the entire studied period: about 10% for very unexperienced workers, and less than 5% for all workers with more than 5 years of experience. This contrasts sharply with the unemployment outcome of high school dropouts for whom unemployment rates have strongly increased over the recent period to reach levels around 50% for the least experienced and still higher than 10% for those with more than 10 years of experience. These simple unemployment series show that there is excess supply of unskilled workers while this is not the case for skilled ones: firms keep hiring almost all workers with a college degree despite their increasing average employer SSC over time, and despite the employer SSC deductions for less skilled workers. The dramatic SSC changes that occurred in the four previous decades have thus been sufficient to maintain and even decrease slightly inequalities in terms of gross wages, but in the presence of a binding minimum wage, they were still insufficient to shift back the relative demand for unskilled to the levels observed in the early 1970s. Finally, the unemployment series for low-educated workers also suggest that firms have invested in low-skill technology or jobs. We may actually even worry about what would have been the employment and wage positions of unskilled workers in the absence of the SSC changes.

5   Conclusive comments

Taken together, the former considerations suggest that taxes may be an efficient tool for redistribution against SBTC. However, our argument here is only tentative and the question remains largely open. Whatever the response, we contend that the issue of how to incorporate taxation into the framework explaining the secular changes in wage structure opens many interesting research perspectives and prospects. It will help understanding to

what extent taxation can be an well-suited institutional tool to limit growing inequalities among the "other 99 percent" (Autor 2014).

For the purpose of reducing inequalities, the combination of a relatively high minimum wage and employer SSC deductions for low-wage earners which is in place in France might however be dominated by more direct income tax credit policies such as the Earned Income Tax Credit in the U.S. or the Working Family Tax Credit in the U.K. Contrasting the effectiveness of these different approaches also appears as an interesting research avenue.

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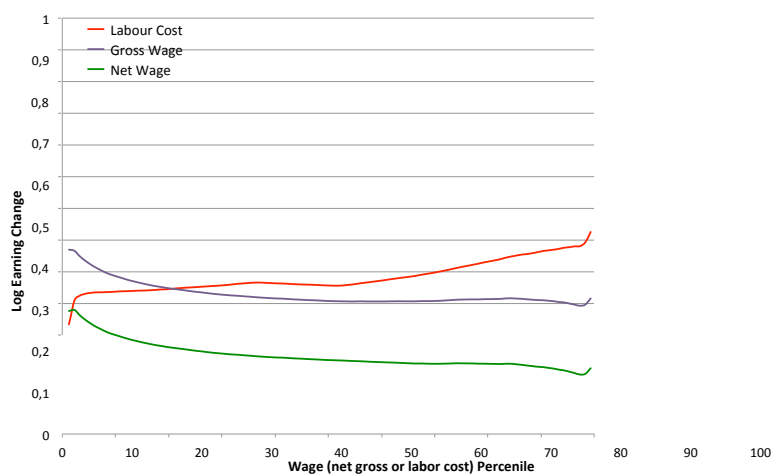
Figures and tables

Figure 1: Total Averag social security contributions as a fraction of average labour costs in the different deciles

Figure 2: Change in log real wage by percentile, full-time male workers, 1976-2010

SOURCE: DADS data 1976-2010. The figure shows the log of the ratio of real 2010 earnings to real 1976 earnings for net, gross and labour cost wages of male workers of the private sector working full-time full-year and by percentile of the relevant earning distribution.
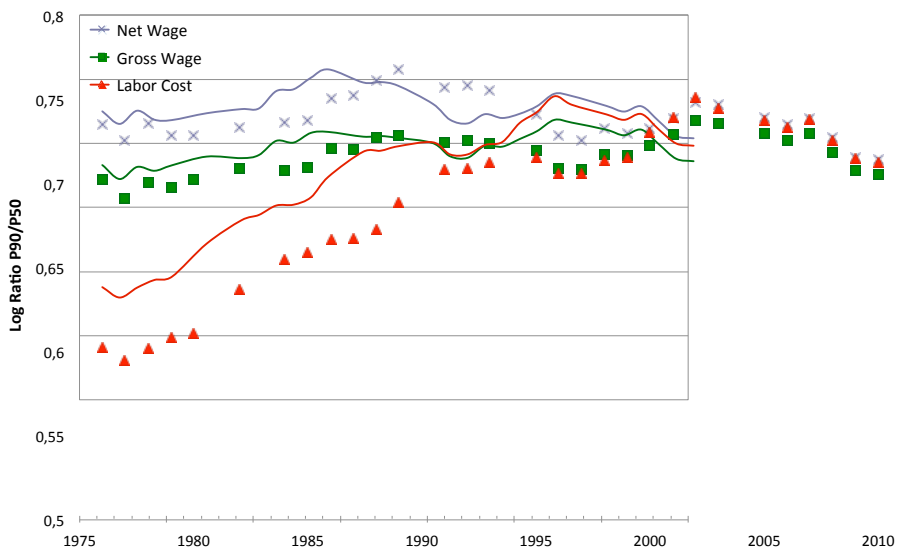
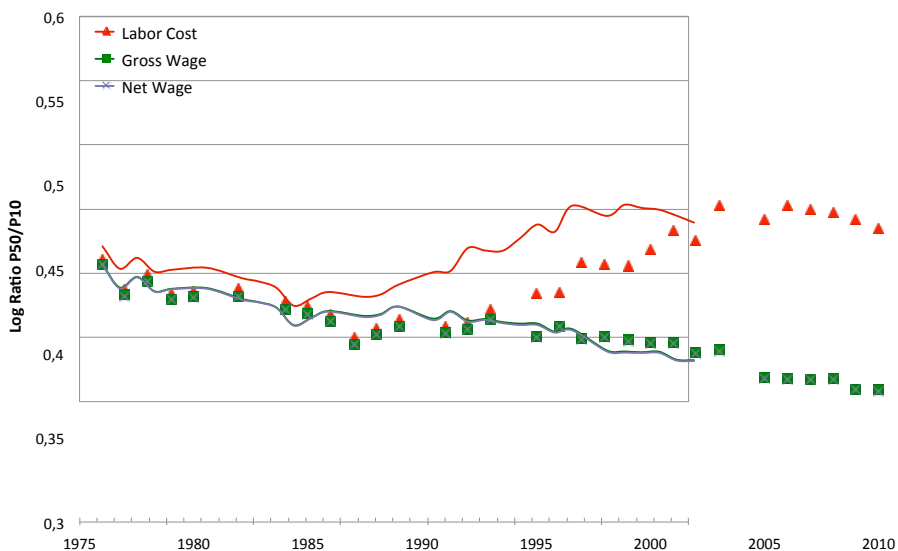Figure 3: P90-P10 ratio, full-time male workers, 1976-2010

(a)

(b)
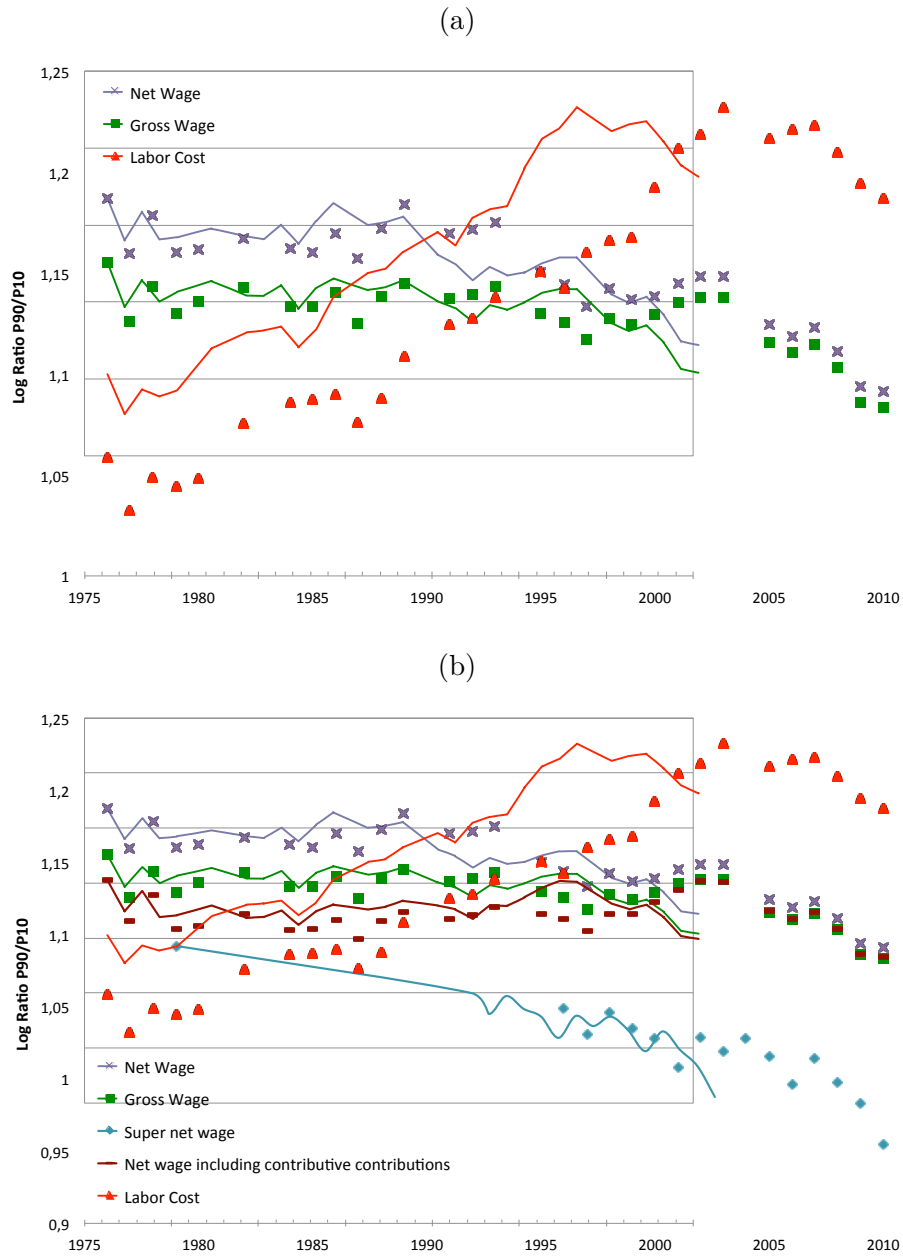
SOURCE: DADS data 1976-2010. The figure depicts the P90-P10 log wage gaps for net, gross and labour cost wages of male workers of the private sector working full-time full-year. Panel B include as well the P90-P10 log wage gaps for supernet wage and for a net wage including contributive employer and employe contributions.

Figure 4: Upper-tail and lower-tail wage inequalities, full-time male workers, 1976-2010
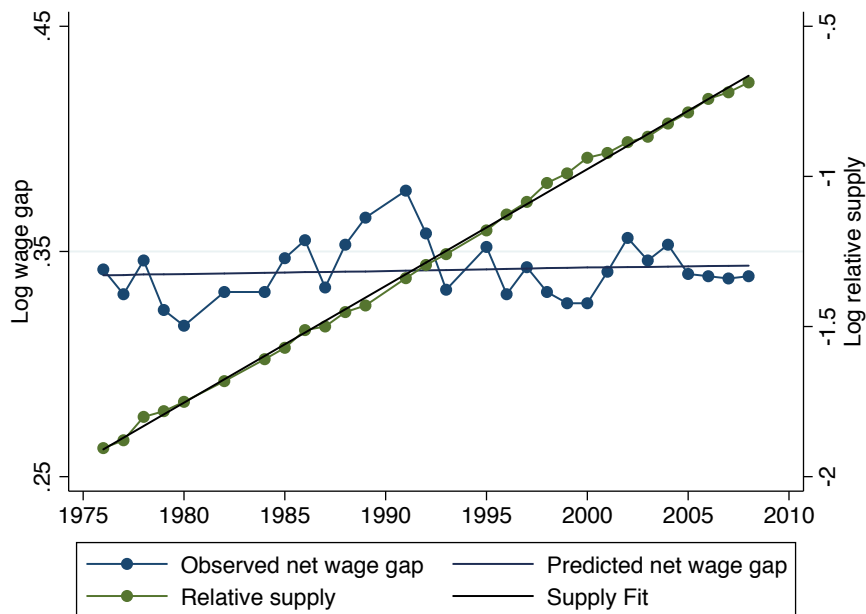
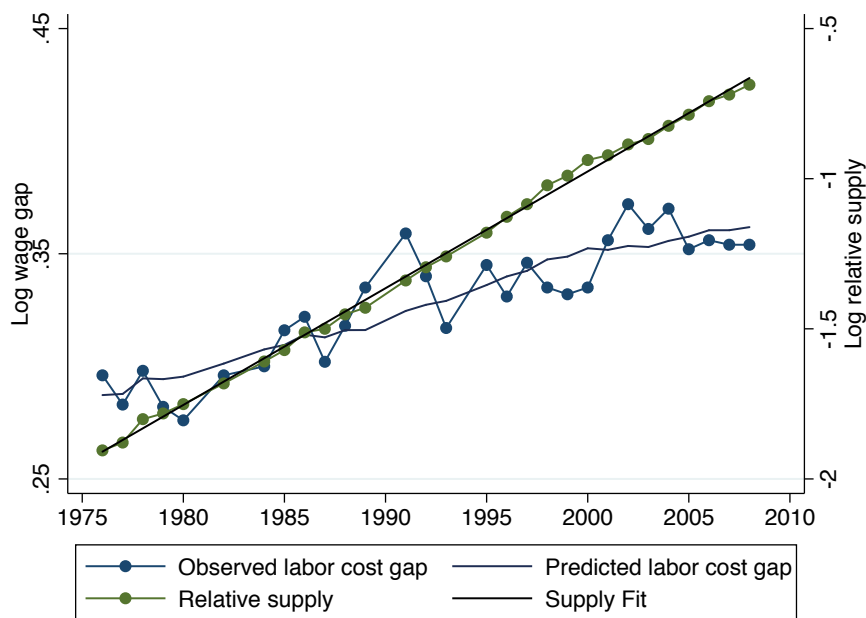(a) Upper-tail, ratio D9/D5

(b) Lower-tail, ratio D5/D1

SOURCE: DADS data 1976-2010. The figure depicts the P90-P50 (panel A) and P50-P10 (panel B) log wage gaps for net, gross and labour cost wages of male workers of the private sector working full-time full-year.

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Figure 5: College versus high school wage differential and relative supply, 1976-2008.
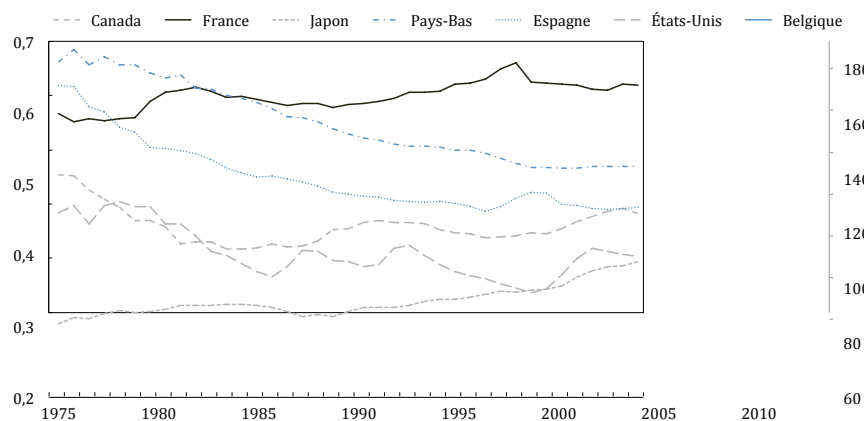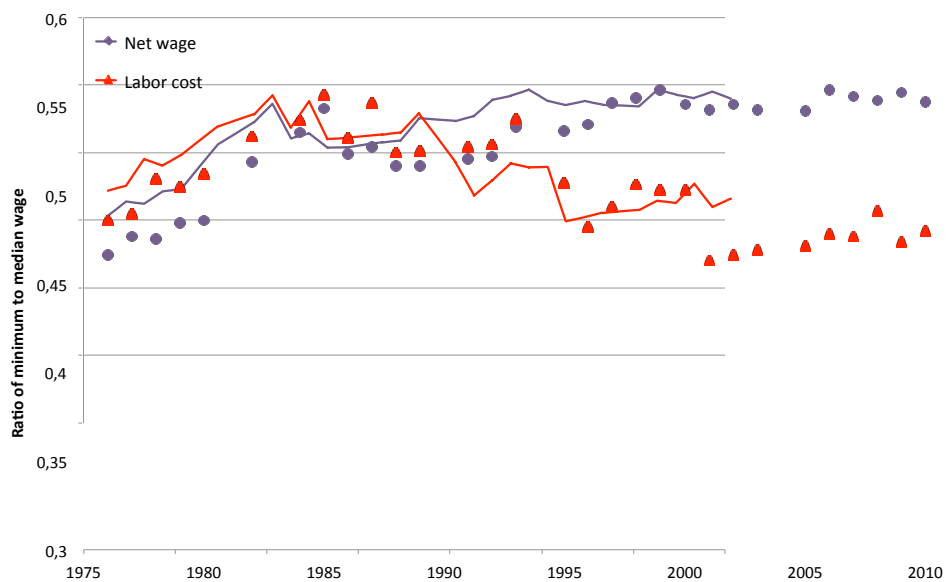
(a) Net wage

(b) Labour cost

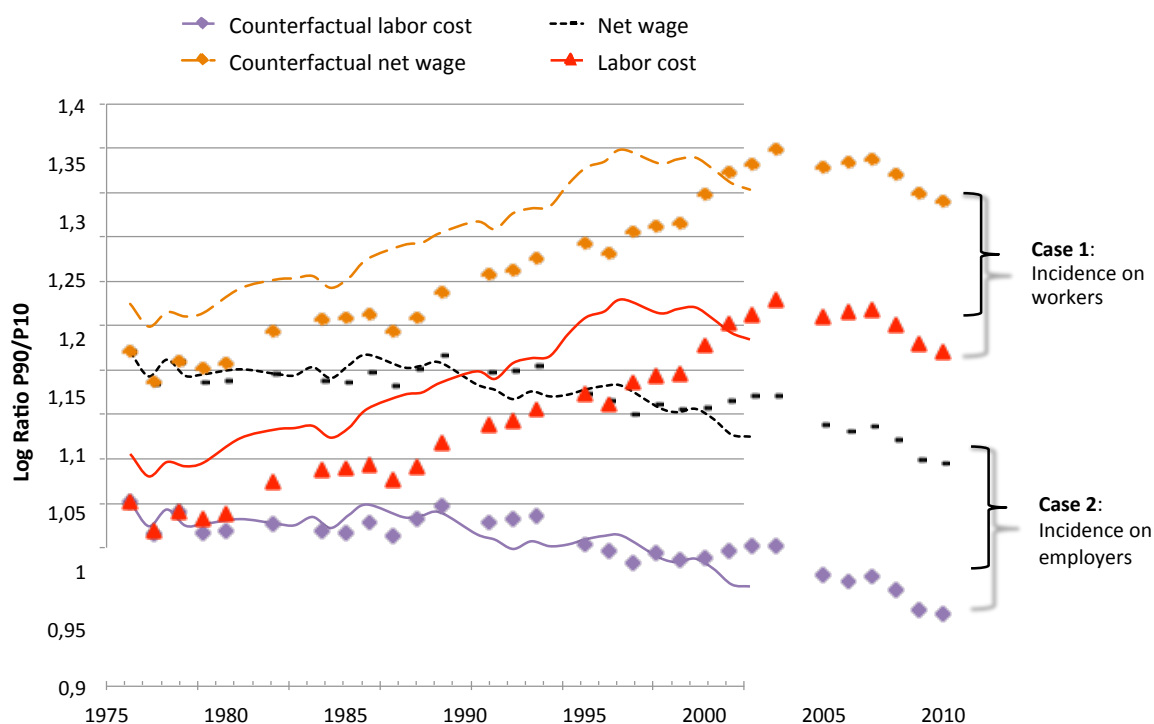Figure 6: Ratio of minimum to median gross wage, OECD countries, 1975-2013

Figure 7: Ratio of minimum to median wage, France: net versus labour cost

Figure 8: Wage inequalities in the absence of tax changes: two polar cases.

SOURCE: DADS data 1976-2010. The figure propose two scenarios of incidence, on workers or on employers, absent any behavioral responses, for male workers of the private sector working full-time full-year.

Figure 9: Unemployment rate by educational attainment, 1978-2010

(a) Workers with less than five years of experience
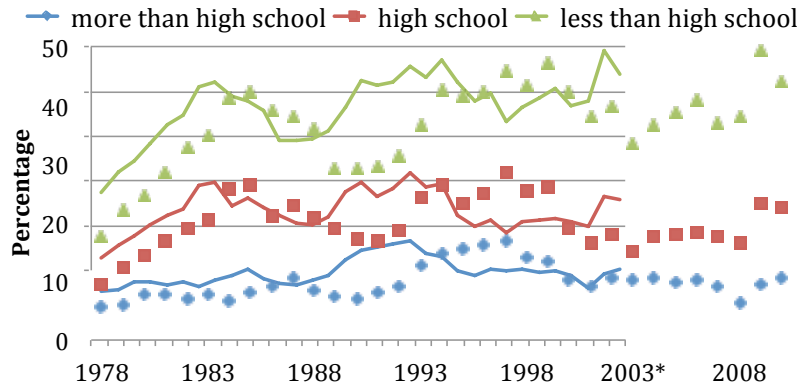
(b) Workers having between five and nine years of experience
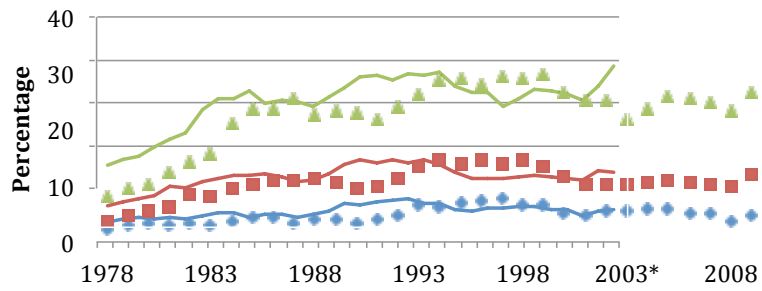
(c) Workers having more than ten years of experience

SOURCE: Labor force survey 1978-2010.

Table 1: Changes in P90/P10 by country, 1980-2010.

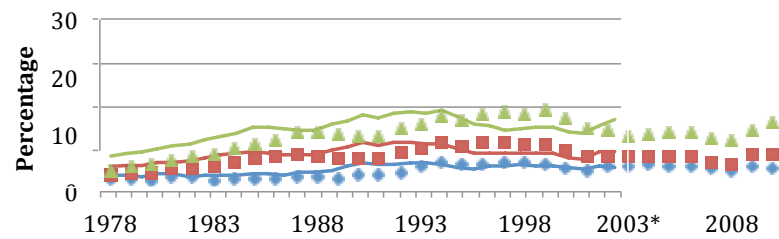|	1980	1990	2000	2010	% change, 1980-2010
Poland	2.81	2.88	3.56	3.96	0.33
U.S.	3.83	4.34	4.49	5.01	0.20
Sweden	1.96	1.99	2.35	2.23	0.20
U.K.	2.99	3.43	3.46	3.58	0.16
Australia	2.83	2.81	3.01	3.33	0.16
France labor cost	3.00	3.14	3.32	3.46	0.13
Finland	2.47	2.49	2.41	2.52	0.02
Japon	3.00	3.16	2.97	2.96	-0.01
France net wage	3.28	3.30	3.04	2.99	-0.08
New Zealand	–	2.43	2.63	2.83	–
Italie	–	2.20	2.22	2.22	–

SOURCE: net, gross and labor cost wages from the DADS data 1980-2010 for France, gross wage from the OECD for the other countries. When a value is missing for one year but given for the year before and the year after, we take the average between the two years.

Table 2: Regression models for the College/High School og wage and log labour cost gap, 1976-2010.

	AKK estimates for the U.S. 1965-2005			Log Labour cost gap in France			Log Net wage gap in France		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CLG/HS relative supply	-0.411	-0.599	-0.403	-0.411	-0.599	-0.403	-0.411	-0.599	-0.403
	(0.046)	(0.112)	(0.067)	calibrated	calibrated	calibrated	calibrated	calibrated	calibrated
Log real minimum wage			0.117			0.114			0.319
			(0.047)			(0.107)			(0.063)
Male prime age unemp. Rate			0.001			-0.002			-0.002
			(0.004)			(0.197)			(0.114)
Time	0.018	0.028	0.017	0.017	0.028	0.017	0.014	0.025	0.014
	(0.001)	(0.006)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Time2/100		-0.011			-0.014			-0.012	
		(0.006)			(0.004)			(0.003)	
Constant	0.043	0.143	0.266	-0.587	-1.015	-1.66	-0.534	-0.960	-1.747
	(0.037)	(0.108)	(0.112)	(0.000)	(0.000)	(0.018)	(0.000)	(0.000)	(0.000)
Observations	43	43	43	31	31	31	31	31	31
R2	0.934	0.940	0.944	0.987	0.993	0.987	0.987	0.993	0.988

SOURCE: DADS data 1976-2010.

NOTE: Standard errors in parentheses. All variables are in 2010 euros. Minimum wage is net terms in columns (4) to (6) and in labour cost in columns (7) to (9).

A Institutional details on social security contributions and income tax in France

A.1 Uncapping of the social security contributions

The social security contribution schedule involves thresholds evolving every year, namely, the social security ceiling (*plafond de la sécurité sociale*). In the 80s and 90s, some of the social security contributions 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 distribution of employment incomes. The social security 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.

A.2 Reduction of employer social security contributions

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*[13]). The maximum rate of reduction over the period is of 26%[14] of the gross 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 decrease 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 the 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 who 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.

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[13]We do not calculate the Robien scheme of 1996 because of lack of information and do not study the CICE (Crédit d'impôt pour la compétitivité et l'emploi), created in 2013.

[14]28.1% for firms with fewer than 20 employees.

B   Data and methods

B.1   Data and variables

DADS panel - EDP   The database is a panel that comes from two sources. Wages and job-related information comes from the DADS panel and education information from the EDP database. 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 Appendix B and 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. Second, the EDP database (*Échantillon Démographique Permanent*) consists of demographic information, including the highest degree for individuals born one of the four first days of October of even years. Information is available for census years: 1968, 1975, 1982, 1990 and 1999 for the old census design and one fifth of the population every year starting in 2003. The two databases are matched by the French statistical administration based on date of birth and names.

Working time variables   Hours worked are available from 1993 onwards. This prevents us from studying hourly wages for the whole period. Nevertheless, number of days of each job spells are available as well as a full-time dummy variable. Restricting ourselves to full-time full-year jobs thus enables us to measure wages. Because of these data issue, our analysis is based on the full-time full-year population.

Earning variables and tax simulation with TAXIPP   We use three concepts of individual annual earning, calculated from the net fiscal earning variable using the Institute of Public Policy tax simulator (TAXIPP). TAXIPP applies the payroll tax legislation to compute employers' and workers' social security contributions since the beginning of the 70s. To our knowledge, it is the most comprehensive existing simulator, including both a long time-span, and a large set of small specific contributions on top of the general schedule. Hence, it allows the computation of the contributions at the individual level taking into account relevant individual characteristics (private sector, white collar worker, number of hours worked) and firm characteristics (number of employees). It is key for this study to be able to rely on a simulator that can account for most of the complex rules of the French

legislation, which includes several thresholds where marginal tax rates change, a different schedule for white and blue collars, and several exemptions and special rules.

The broader concept of earning is the labour cost, which includes all social security contribution. It is the actual cost paid by the firm. The gross wage does not include employers' social security contributions but include the workers' contribution. The net wage is net of all social contributions but is not net of the income tax.

Education variable   We use the variable (dip_tot) homogenized by the French National Institute of Statistics (INSEE) coming from the censuses. Following Abowd and ali. (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 four-categories education variable: high school dropouts, high school graduates, some college and university graduate.

School-leaving age and school leaving year   The school-leaving age is available for years 1968, 1975 and 1982. As information collected by these three censuses is not always consistent, we correct the information by keeping the higher school-leaving age stated as the correct one. For 75% of the global sample, we have missing information because the individual finished her studies after 1982. For missing data, we impute a school-leaving age based on the educational attainment information (legal minimum school-leaving age for high school dropouts, 18 for individuals who only high school graduate, 21 for graduates, 24 for post graduates).

Experience variable   Unlike the article using the CPS databases, we do not define experience as the number of years since the end of schooling. Instead, we take advantage of the long panel nature of our data and define experience as the cumulative sum of time worked over years. Charnoz et al, 2011 do likewise. Share of working days per year are cumulated over the years since the beginning of the panel, 1976. For people who were presumably working before 1976, we use their school leaving year and assume that they worked full-time between the end of their study and 1976. We argue this is not a strong assumption because the male working force between 25 and 60 years old was mainly full-time (cf. Bozio, Blundell, Laroque IFS WP 2011) and male employment rate was high. For missing years, we impute an annual share of working days based on the year before.

Table B3: 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 BEA BEC BEH BEI BES BATA,	Vocational advanced	2
6	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	4

Following Autor, Katz and Kearny (2008), we cluster experience into four categories (0-9, 10-19, 20-29, 30-39 years).

B.2 Methodology

To a large extend, our methodology is based on the one of Autor, Katz and Kearny (2008). We consider two different samples for the measure of wage premiums (*wage sample*) and for the relative labour supply measure (*supply sample*). Indeed, the wage premiums measure the price of the different education groups and must be as homogenous as possible along the period. The relative supply measure is based on a broader conception of the sample, where we try to recompose aggregate quantities of labour supplied across groups.

The *wage sample* contains full-time full-year workers from the private sector aged 26 to 60 with 0 to 39 years of potential work experience. 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 they were introduced in 2002, we have to drop unemployed individuals receiving benefits. Yet we do not restrict the sample to full-year or full-time workers.

Relative Wage Series We calculate the composition-adjusted college/high school relative wage series using the previous *wage sample*. The following method applies two the three concepts of wage considered. The data are sorted into two sexes – four categories of

education (high school dropouts, high school graduates, some college and university graduate) – four groups of experience (0-9, 10-19, 20-29, 30-39 years). For each year and sex, the log real wage is regressed on dummies of the four-categories education variable, a quartic in experience, geographic dummies for the population density, interaction of the experience quartic with three education dummies (university graduate, some college and high school graduate). For each education – sex – experience cell, the composition-adjusted log wage is the predicted value from the previous regressions evaluated for the mean geographic region as well as for the corresponding education, sex and experience of the cell. These 992 cells (we have 31 years) are collapsed at the education and year level by a weighting average over the group. For each year, we calculate the weight as the number of individual in a cell divided by the total number of individual.

Relative Supply Measures   We calculate the relative supply measures using the previous *supply sample*. The quantity each individual supplies each year cannot be a number of hours because of missing information. Instead, we count one for each individual. These quantities of labour supplied are aggregated at the number of experience year, sex and education level to form a *quantity series*. At the same time, we calculate a normalized price measure at the experience group – sex – education categories level by averaging over the years the wage of each cell normalized by the wage of high school graduate male with ten years of potential experience. This latter series of price is called *"efficiency unit"* price, as it is supposed to represent how efficient is a cell relative to the others in the production process. These *efficiency units* are computed based on the reduced *wage sample*. For each year, prices and quantities are brought back together by the aggregation of quantities over sex and experience groups: at the education level, the supply is the sum over sex and experience groups of each group efficiency unit wage multiplied by the quantity of labour supplied by the group.

C Additional Figures

Figure C10: Wage and labour cost inequalities in French private sector for male workers: 1976-2010, P80/P20.
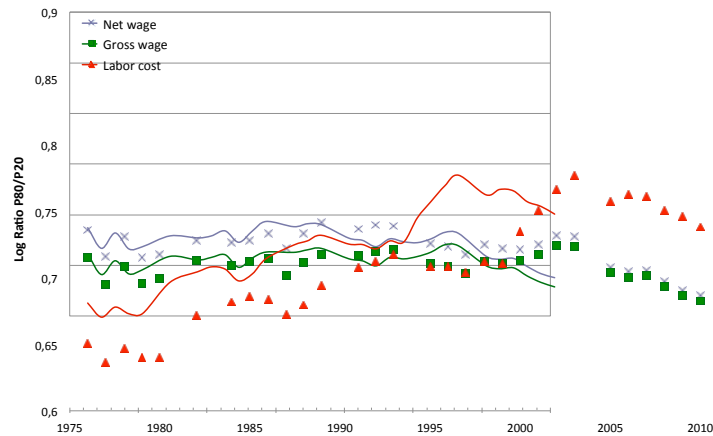
SOURCE: DADS data 1976-2010. The figure depicts the P80-P20 log wage gaps for net, gross and labour cost wages of male workers of the private sector working full-time full-year.

Figure C11: Wage and labour cost inequalities in French private sector for male workers: 1976-2010, P70/P30.
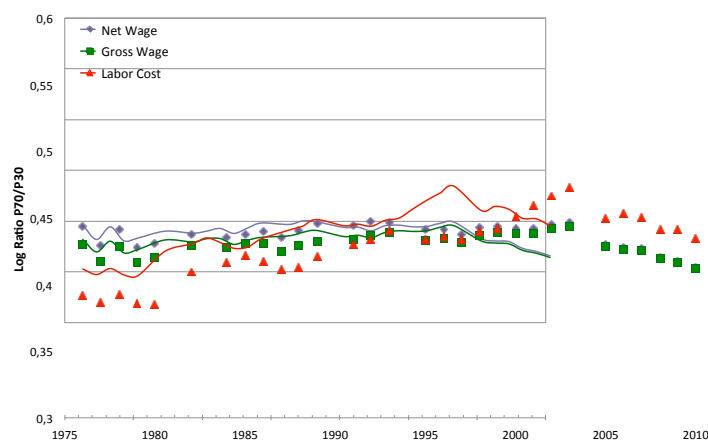
SOURCE: DADS data 1976-2010. The figure depicts the P70-P30 log wage gaps for net, gross and labour cost wages of male workers of the private sector working full-time full-year.