The Great Compression of the Wage Structure in France, 1969-2008

The Role of Supply and Demand Factors*

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Preliminary Version – Comments Welcome

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Abstract

This paper studies the evolution of the wage distribution in France from 1964 to 2008. Unlike the US or UK, this period is one of a large increase in the educational attainment of the labor force and a decrease in wage inequality. We investigate whether these differences in the timing of educational expansion in the last fifty years can explain the divergent evolution of wage inequality in France with respect to the US or the UK. Our estimates suggest that supply and demand mechanisms are related with changes in the wage premium *within* cohorts while the overall skill premium is better explained by minimum wage increases after 1990. This suggests that both market forces and institutional factors explain the recent compression of the French wage structure.

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Introduction

Several recent studies have described the recent dramatic growth in earning inequality which occurred in many developed countries.[1] Recently, Autor et al. (2008), Goldin and Katz (2008) and Dustmann et al. (2009) argued that the increase of the skill premium during the last decade in the US or Germany reflects a more rapid evolution of demand than supply of skills, particularly at the top of the wage distribution. On the other hand, Card and DiNardo (2002) argued that institutional explanations, particularly the decrease in the minimum wage during the 1980s, provided a more consistent explanation of these widening inequalities. Similarly, Lemieux (2006) underlined that composition effects might have mechanically increased residual wage inequality, particularly because of the increased level of education and aging of the US labor force in recent years. Moreover, Atkinson (2007) also point to the evidence that the increase in inequality has been uneven across countries.[2] Changes in the earnings distributuions have been quite different across countries. As a result, the respective role of institutions and market mechanisms remains unclear in explaining within- and cross-country differences in the evolution in wage inequality.

France might offer interesting evidence to contribute to the debates on the evolution of the wage structure. It can be argued, following Card et al. (1999), that similar negative shocks have affected the relative demand for less-skilled workers in France and in the US. However, institutional factors differ widely between the two countries and these differences might throw some interesting light on the relationship between wages, technology-driven changes in labor demand and institutions. In particular, we highlight that the major differences are not only the different evolution of the minimum wage real value[3] but also the differences in the timing of general and higher education expansion during the second part of the twentieth century. During this period, France experienced a large increase in general high-school graduation rates as late

[1] For the United Kingdom, Goos and Manning (2007), Machin and Van Reenen (2007) and Gosling et al. (2000) highlighted the increased polarization of the labor market, particularly at the top of the wage distribution since 1990. Similarly, Dustmann et al. (2009) showed that this increased polarization was also observed in Germany, a supposedly less flexible labor market.

[2] See Blau and Kahn (1996) for an earlier reference on this comparative literature. See also Peñalosa and Daniele (Forthcoming).

[3] Unlike the US, the French minimum wage was relatively low during the 1960s and much of the 70s and increased rapidly since the 1980s, a period during which the real federal minimum wage in the US declined widely.

as the 1970s and of university graduation rates only after the 1980s. This educational expansion occurred much later than in the US where the educational attainment of the population stagnated during this period (see Card and Lemieux, 2001; Goldin and Katz, 2008). While the first factor is relatively well known, the impact of the differences in the timing of education expansion on recent changes in wage structure across countries have not been explored in details in the recent literature.[4]

In this paper, we study the relationship between changes in education levels and changes in the wage structure in France during the second part of the 20th century. Our main analysis focuses on men but a companion paper in French reports additional figures for women (Verdugo et al., 2010). The basic relationship between education supply and wage inequality we seek to explain is illustrated in figure 1 (details of the data sources and methods are given below). The figure represents in the same graph upper tail inequality (the P90-P50 log wage gap) with the gap between years of education of workers between 26-35 and 46-55. As we detail below, the intercohort differences in education are an indicator of periods in which the increase in educational attainment of the population accelerated. The relationship between the two series is striking: the figures suggest that periods of decrease in upper tail wage inequality are characterized by a larger difference between the educational attainment of young and old workers. This relationship also holds when we control for minimum wage, changes in overall educated labor supply or unemployment rate changes. In this paper, we argue that part of the recent evolutions of the wage structure in France, particularly upper tail inequality, can be explained by differences in the timing of periods of educational expansions with respect to the US or the UK since the second half of the 20th Century.

We evaluate this hypothesis using French data on education and wages over the period from 1968 to 2008. We find that if the contemporary wage dispersion is nowadays low in France with respect to other countries, this has not always been the case. We actually find that wage dispersion was higher in France than in the US during the 1960s, while the reverse is true after the 1990s, a period in which the supply of skilled labor in France increased rapidly while it stagnated in the US. Interestingly, the high level of wage inequality of the 1960s in France followed

[4] A notable exception is Walker and Zhu (2008) which documents the impact of the expansion of higher education in the UK during the 1990s. They find very little reduction for the college premium during this period.

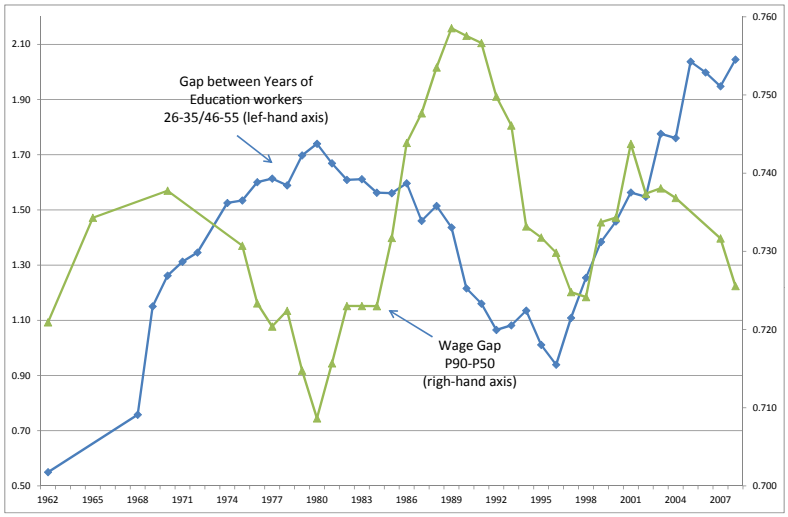


Figure 1: Upper Tail Wage Inequality and Educational Difference across Cohorts

Sources: Data of Upper Tail Wage Inequality from DADS. See notes of figure 5. The series *Gap between Years of Education workers 26-35/46-55* represent the difference in average number of years of education of between workers aged 26-35 and 46-55. Average years of education have been calculated using LFS 1969-2008 and the 1962 and 1968 Census.

a rapid increase in wage inequality after 1950, during the period of large post-war economic growth, in which the educational level of the workforce stagnated until the beginning of the 1970s. In practice, the evolution of the French wage structure in the second part of the 20th century is the opposite of the one in the US or in the UK: a large increase in wage inequality occurred after the second world war until the end of the 1960s, followed by a large decrease in inequality during the 1970s and after 1995. We find that changes in between groups wage inequality to be the major changes in the wage structure in the recent period in which residual inequality remained relatively unchanged. At the end of the 2000s, the overall and between group distribution of wages is one of the most egalitarian ever observed in France since the middle of the 1960s.

In the second part of the paper, we test several explanations for these dramatic changes in inequalities, looking particularly at the impact of the minimum wage and the increase in the supply of education. We use more structural models to identify how the price between different groups of labor had changed in response to change in supply. While changes in the minimum

wage over time explain rather well the evolution of the overall skill premium and of lower tail inequality, we do not find evidence of a relationship between the relative aggregate supply of education and the average skill premium after 1990. However, given the large intercohort differences in education levels over the period, we find that a model à la Card and Lemieux (2001) which allows for imperfect substitution between groups of experience explains quite well the evolution of between groups wage differences within cohorts, even if we find a lower wage elasticity than in the US.

Overall, we conclude that the recent "Great compression" of wages in France is the result of two distinct mechanisms: for the lower part of the wage distribution, most evidence indicates that the minimum wage reduced dramatically lower tail inequality and decreased widely the wage differentials of workers with low education and experience with respect to other workers. On the other hand, we significant evidence of a correlation between the increase in education supply within experience groups and the decrease in education returns. If changes in the demand for educated labor induced by technological change in France were slower than the large increase in supply of educated labor during these periods, this means that technology did not "win the race" with respect to education in France after most of the 1960s, unlike in the US. These differences in patterns of educational expansions between France and other countries such as US, UK and Canada, where education supply stagnated during this period, might thus explain why the wage structure changed so differently across these countries in recent years.

The outline of the paper is as follows. The next section provides a rapid review of the literature on wage inequality in France. The second section describes the data while the third section presents the empirical models used in this paper to study the changes in wages distribution. The fourth section explores the impact of changes in the minimum wages and education supply on changes in returns to education and experience. The last section concludes.

1 Literature Review

Several papers explored changes in the wage structure in France in the 1980s and the 1990s but we are not aware of a paper looking at the relationship between wage dispersion and education

returns the long period of time of this paper.[5] This might be explained by the fact that many previous studies have used administrative data (DADS, see below) which provide long run series on wages of relatively good quality but do not contain information on education. A useful review of the data, the literature and the basic figures is given in Atkinson (2008, chapter G.). Following the development of the literature on skill-biased technological change during the 1990s, several studies looked at the relationship between technological change and changes in the wage structure in France. Among others, Card et al. (1999) compared the evolution of the wage structure between France, Canada and the US during the 1980s. In their paper, they find no relationship between computer utilization use across demographic groups at the end of the 1980s and subsequent wage change in France, contrary to the US. Similarly, Goux and Maurin (2000) concluded that France did not experience skilled biased technological change during the 1990s and argued that the source of wage inequality in France was mainly institutional and not technological. More recently, Kramarz and Perez-Duarte (2009) investigated changes in wages in France between 1977 and 1997 using administrative data but do not investigate the related changes in education returns. As in this paper, they find that between 1977 and 1997 most of the growth in wages has been concentrated on the lowest deciles (see figure 3 of their paper).

Finally, the conclusions of our study may superficially appear to contradict evidence from Piketty (2001, 2003) or Landais (2007) on the evolution of top income in France. Using French tax income data, Landais (2007) document a very rapid increase of the share of total *income* of individuals after P90, more particularly *after P99* in recent years. Similarly, Amar (2010), using an exhaustive administrative wage data, found that wages at P99 grew much faster than the median or P90 between 2002 and 2009. In this paper, we do not explicitly examine the evolution of very high wages for which specific explanations and specific studies seems more appropriate. Moreover, there are also some practical reasons for not studying very high wages: labor force surveys that we use to obtain information on both wages and education are unlikely to provide accurate measures of earnings at the highest and lowest percentiles. High percentiles are unreliable because high earnings value are truncated in public use samples.

[5] A recent exception is Charnoz et al. (2011) which use quantile regressions to estimate changes in the returns to education over time.

2 Data and Descriptive Statistics

The first subsection describes the various datasets that we use while the second subsection documents the changes in population characteristics and minimum wage from 1962 to 2008.

2.1 The Data

Our first basic microdata on wages and education come from the French Labor Force Survey (LFS) *Enquête Emploi* 1990-2002 and the redesigned LFS from 2003 to 2008.[6] The great advantage of this data is that the LFS is reasonably consistent over time and enable us to track annual changes in the wage structure. To document changes in earlier period, we use the survey *Training and Professional Qualification* (FQP thereafter, in French *Formation et Qualification Professionnelle*) which contains information on annual earnings and educational attaintment in 1969, 1976 and 1984. Salaries relate to the previous monthly earnings in the LFS (usually March) while FQP respondents are asked to report their exact payroll earnings the year prior the survey and the number of months of work corresponding to those earnings, with a breakdown into month of full time and part time work. We also use microlevel census data and data from LFS prior to 1990 construct annual series of the changes in the educational attainment of the population. In practice, we use all annual LFS from 1969 to 1989, except the 1973 LFS where the education variables are missing. We use six successive French censuses from 1962 to 1999 (1962, 1968, 1975, 1982, 1990, and 1999) using a 5% extract in 1962, 20% extract in 1975 and a 25% extract for other years. Our microdata sample from FQP and LFS includes all individuals aged between 16 and 65. We focus on employees working full time and exclude the self-employed.[7] Additional details on the construction of this sample are given in the appendix.

Recent papers have emphasized that there are important differences in the measured changes

[6] Microdata of the LFS are available since 1968 but wages are available only in categorical variables before 1990 and were not collected before 1981 which explains that we only use the LFS from the recent period. A minor issue is the transition to the redesigned LFS in 2003. We have tried whenever possible to harmonize our definitions of variables. We do not find evidence of major discontinuities between 2002 and 2003.

[7] This restriction is traditional in longitudinal studies on the wage structure using a large time span since Katz and Murphy (1992). Excluding part time workers enables to obtain a measure of price changes not affected by measurements errors on the number of hours work related with changes in the method of data collection. Moreover, this restriction is technically imposed by the fact that the LFS does not report the exact number of hours of works throughout the period but only indicate whether the individual is working in full or part time. However, restricting the sample to full-time employees solves the problem of measuring the price of labor at the cost of an important selection bias if the population of interest includes part time workers.

in wage inequality depending on the dataset used.[8] Therefore, to asses the robustness of our results, we also use estimates of wage inequality using published administrative data (*DADS*, in French *Déclaration Annuelle de Données Sociales*) tabulated by the French Statistical Institute (INSEE) which were used among others by Piketty (2001, pages 671, 673, and 675) or OECD (1996, table 3.1).[9] Published DADS tables refer to full time full year workers. Notice that there is a difference in coverage between the two sources. While FQP and LFS are a nationally representative sample and thus include the whole population, DADS are an administrative data with much more individual observations but which are not representative of the labor force given some sectors of the economy are excluded. More particularly, civil servants and most large public sector firms such as *French National Rail* or *French National Electricity Company* are excluded. According to our estimates using LFS, they represent about 20% of the labor force during the 1990s and therefore their exclusion from the sample can significantly change the measured wage dispersion. Moreover, differences in data collection methods are important. DADS are collected from compulsory fiscal declaration which must be made annually by all employers and report annual earnings across workers per each employers. They are thus considered as very reliable given that individual income tax and employer taxes are based on that declaration. On the other hand, as for CPS in the US, wage data from LFS and FQP are self-reported from household surveys. In both sources, wage data relate to earnings net of employee social security contributions but before deduction of income tax.

2.2 Institutional Changes

In this section, we briefly highlight the major changes in individual workers characteristics and economic conditions which might have affected the wage distribution from 1962 to 2008. Notice first that the general economic conditions in France were very different before and after 1975 as indicated by the middle panel of table 1. While annual GDP growth averaged 5%

[8]For example, Lemieux (2006) discusses extensively the differences in measured wage inequality obtained using either CPS March or May. For Germany, Dustmann et al. (2009) emphasizes the differences between results using IAS with respect to the one from previous studies which used GSOEP. See also Atkinson (2008, chapter 3) for a general discussion on the issue of data quality and comparability in measuring changes in the wage distribution.

[9]We are not able to use this data at the micro level in the paper because its access is restricted to INSEE researchers for confidentiality reasons. See also Atkinson (2008, Chapter G.) for a presentation of DADS.

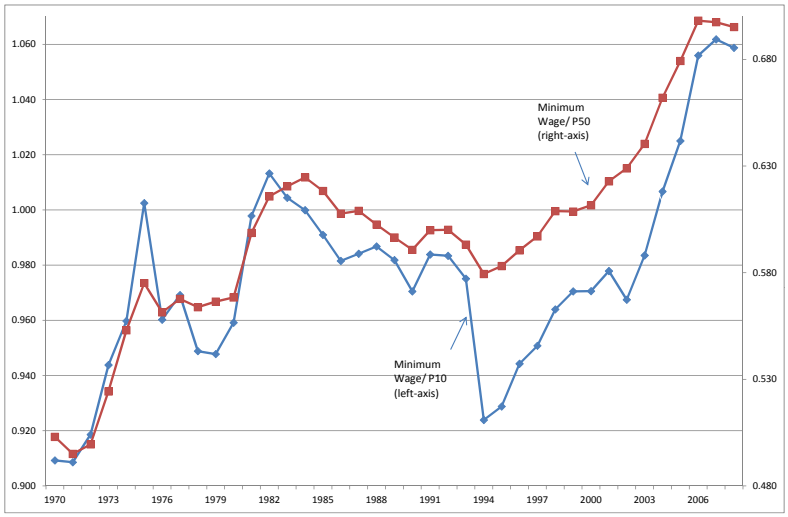


Figure 2: Ratio Minimum Wage over P50 and P10

Sources and Notes: The figure indicates the ratio (Minimum Wage/P50) and (Minimum Wage/P10) from 1970 to 2008. Wage and minimum wage data from DADS using published tabulations from the the French Statistical Institute.

before 1975, average growth rates declined widely thereafter, particularly during the 1990s. On the other hand, the 2000s were a period of falling unemployment and of moderate cyclical fluctuations until 2008. Panel A. of table 1 also documents the major changes in labor force participation by age groups over the period. The figures indicate that the participation rates of young and old workers declined widely from 1962 to 2000 while the participation rates of man aged 26-55 declined by less than a percentage point with respect to its value in 1962.

We now provide more details on the evolution of the minimum wage and the educational attainment of the population which are likely to have had a strong influence on the evolution of the wage structure during the period. The relationship between the minimum wage and the wage distribution is given in Figure 2. While the real US minimum wage declined steadily since the beginning of the 1980s[10], the real minimum wage in France increased by 10 log points while, according to LFS data, the median wage increased by 7.5 log points for men over the period. To capture the changing prevalence of the minimum wage over time, figure 2 represents in the same graph the evolution of the ratio minimum wage over P10 and P50 since 1970 where

[10] Autor et al. (2010) reports that July 2007 marks the point where the US federal minimum wage reach its low point for 50 years.

Table 1: Population and Economy Characteristics, Men

	1962	1968	1975	1982	1990	1995*	1999	2008*
A. Labor Market								
Participation Rate by Age								
less 25	62.7%	68.9	68.8	64.8	53.0	43.7	48.0	55.3
25-55	95.1%	95.5	95.4	94.7	95.4	94.9	94.6	94.4
more than 55	74.5%	72.7	63.0	56.6	41.8	36.9	38.4	41.9
Unemployment	0.6%	1.8	2.7	6.6	8.3	10.0	11.1	7.4
Av. GDP Growth in Past 5 years	7%	5.6	5.4	2.7	3.1	1.3	2.5	2
B. Education								
Primary School	78.3%	68.3	56.5	50.2	39.5	31.2	24.5	20.6
Secondary	13.0%	20.1	26.1	28.9	35.9	38.9	40.7	37.1
High School	4.9%	7.5	9.5	11.2	11.2	12.4	14.7	18.3
University	3.7%	4.2	7.8	9.7	13.4	17.6	20.1	24.0
Annual Increase in Percentage Points of the Share of Educated Workers in the Population								
Δ High-School	na	0.4%	0.3	0.2	0.0	0.2	0.6	0.4
Δ Univ	na	0.1%	0.5	0.3	0.5	0.8	0.6	0.4
$\Delta \geq$High-School	na	0.5%	0.8	0.5	0.5	1.1	1.2	0.8
gap years of education between age groups 26-35/46-55	0.55	0.76	1.59	1.61	1.07	0.86	1.4	2.2

Sources and Notes: Census of Population 1962, 1968, 1975, 1982, 1990, 1999; LFS 1995, 2008. Tabulations from the author. Tabulations include men aged between 18 and 64 years old. * indicates computed with the Labor Force Survey.

the percentile data come from DADS.[11] The figures indicate that the ratio minimum wage over P50 or P10 increased particularly rapidly during the beginning of the 1970s and after 2000.

The evolution of the educational level of the French workforce in the last fifty years is described in panel B of the lower panel of table 1. The table indicates the share of workers in the population across four basic levels of education which are always reported across censuses since 1962.[12] Available evidence indicate that the level of education of the labor force during

[11] In 2000, the 35 hours workweek changed the statutory working hours and changed the minimum monthly wage for a full-time employee. The government left industry level's collective agreements to adapt the transition to the new working time. As a result, it existed until 2007, five different minimum wages depending on the sector. Since the transition was progressive across sectors until 2007, we have normalized the transition by using an hours-weighted minimum wage for years after 2006.

[12] We denote by primary schooling level those reporting only basic levels of education and secondary schooling those who made at least three years of studies after primary school. We call by high-school graduates students who passed a national examination, the baccalaureate. Entrance to higher education is restricted to those who passed this national examination. University graduates are those with at least two years of study at the post-high school level.

the 1960s was relatively low compared with the US or other European countries. The high-school graduation rate was 70% in the US at the beginning of the 1960s (Goldin and Katz, 2008, p. 196) while the first column of table 1 indicates that the share of individuals with level of education superior or equal to high-school is about 9% in 1962.

In practice, during the 1950s and much of the 1960s, several evidences suggest the level of education at the high-school level and above stagnated.[13] From 1962 to 1968, most of the increase in education is concentrated on secondary schooling but there is no large change in high-school graduation rates. Afterward, two major periods of acceleration in the supply of workers with a level of education superior or equal to high-school are clearly distinguishable during the beginning of the 1970s and during the 1990s. These accelerations are the results of two major turning points in the French educational policy.[14] The first policy change occurred in 1959 and increased by law the age limit of compulsory schooling from 14 to 16 years but only for cohorts born after 1953 and which implies that the increase in the number of students related to the reform occurred only after 1967. As a result, the share of high-school graduates and university graduates increased rapidly from 1968 to 1975. Following this expansion of high-school graduation rates, a slowdown in the increase in education supply can be observed between 1975 and 1990, where the share of workers with a level superior or equal to high-school increased only annually by 0.5 percentage points from 1975 to 1990 compared to 0.8 percentage points from 1968 to 1975 according to the last lines of table 1.

Finally, unlike in the US where there has been a slowdown of the educational achievements of the labor force during the 1990s (Card and Lemieux, 2001; Goldin and Katz, 2008), another major acceleration of educational expansion occurred in France during this period. In 1985, the government declared as official objective a high-school graduation rate per cohort of 80% in the next 10 years and created new high-school diploma, the so called "technological" and "professional" *Baccalauréats* degrees. These new degrees provided unrestricted access to univer-

[13] According to the estimates from Estrade and Minni (1996), the share of of the population aged 25-35 with a level of education superior or equal to high-school graduation increased only from about 8% to 10% from 1945 to 1965 while it increases in the next decade by ten percentage point to reach 20% in 1975.

[14] The impact of policy changes on the increase in aggregate education levels is confirmed by Magnac and Thesmar (2002) who estimate that a decrease in selectivity is responsible for most the increase in educational levels in France. See also Maurin (2007, chapter 5), Gurgand and Maurin (2006) and for a detailed presentation of the policy changes in France.

sity studies to but had less stringent academic requirements than other traditional high-school graduation diploma.[15] Following these changes, the number of post-baccalaureate students increased massively by 26% from 1990 to 2000 as compared with only 3.4% from 2000 to 2008 (Vitry, 2010, p.165). As a result, the share of university graduates in the population increased annually by 1.1 percentage points between 1990 and 1999 and by 0.8 percentage points between 1999 and 2008.

An interesting consequence of these accelerations is that there is a larger difference in the educational attaintment between cohorts during these two periods of expansion. The difference between the average number of years of education between workers with age 26-35 with 46-55 is reported in the last line of table 1[16] while figure 3 shows the evolution of our estimates of the log of the relative fraction of university equivalent versus secondary equivalent in three representative age groups: 26-30, 36-40 and 46-50 years old. The figures indicate a similar level of supply across age groups both in 1968 and 1990. The evolution differs across groups during the 1970s and after 1990. For young workers relative supplies trended upward fairly steadily after 1990 while for old workers relative supply stagnated throughout the 1990s. Notice that these variations are larger than the one documented in the US: from 1959 to 1995, Card and Lemieux (2001, Figure III, p. 723) indicate a change from -1.1 to -0.4 for 26-30 year old and from -1.7 to -0.1 for 46-50 year old men who experienced the largest change. In France, the relative supply index for these age groups increase respectively from -2.5 to 0 and -2.5 to -1 from 1969 to 2008.

3 Econometric Models

We use several approaches to determine the causes of recent changes in the French wage structure. The first subsection present the decomposition method we use in the first part of the analysis to separate changes in prices from changes in quantity of different type of labor. The second subsection presents the more structural approach used in the second part of the analysis

[15] This decision had quite large consequences because in practice, in 2010, about 70% and 22% of respectively technological and professional *Baccalauréats* graduates continue to study in higher education (Vitry, 2010, p.199).

[16] We impute 5, 9, 12 and 16 years of education for primary, secondary, high-school and university education.

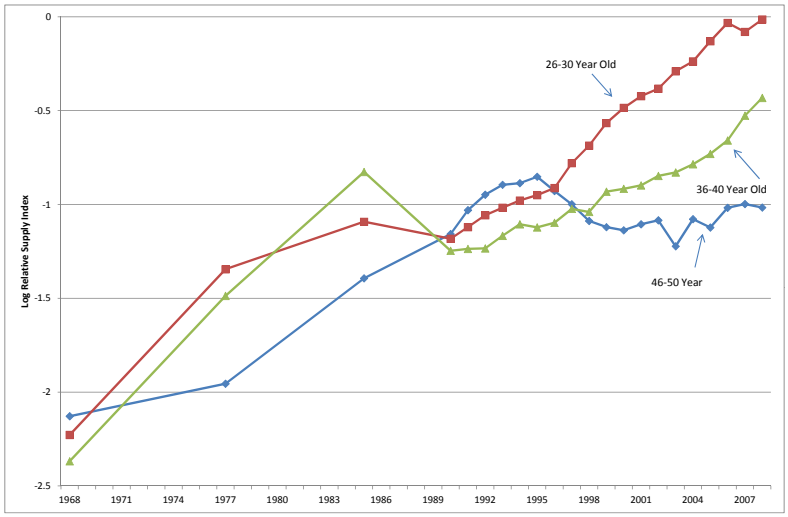


Figure 3: Age-Group Specific Relative Supply of University Equivalent-Less than High School Equivalent Educated Labor

Sources and Notes: 1968 Census data, 1977 and 1985 FQP, 1990-2008 LFS. The figure indicates the ratio University Equivalent over less than High-School Equivalent across three age groups.

which aim to identify the impact of changes in education supply on the relative price of labor.

3.1 Wage Decomposition Model

We decompose the impact of changes in price from changes in quantity on the wage distribution with the method of DiNardo et al. (1996) (DFL). This method can be interpreted as a practical generalization of a classic Oaxaca-Blinder decomposition applied to the construction of counterfactual densities.[17] Because the French labor market is characterized during the period by a large unemployment rate, especially during the 1990s, we follow Chiquiar and Hanson (2005) and distinguish between changes in employment probability and changes in the supply of workers across education and experience cells in the population. While changes in employment probabilities account for the variation in the probability of being employed over time

[17]Recently, several alternative decomposition methods to estimate counterfactual wage densities have been developed using quantile regressions (see e.g. Mata and Machado (2005) or Chernozhukov et al. (Forthcoming)). One drawback of these methods is that they require to estimate separate models for a very large number of points in the distribution and to make several parametrical hypothesis potentially not valid. As argued by Fortin et al. (2010), one advantage of DFL is its simplicity. Moreover, results from Hirano et al. (2003) and Firpo (2007) show this method is asymptotically efficient.

which might vary widely from some groups across the business cycle, changes in quantities capture the evolution of the composition of the population which may result of the increased level of education or changes in the average age of the population. In practice, we reweight the observed density using a weight θ which adjusts both for observable differences and employment probabilities. This weight can be decomposed as the product of two other weights, $\theta = k\theta^P\theta^Q$, where θ^P adjusts the density of wages for the differences in employment probabilities between years and capture the change in probability of being employed for a given group of workers over time. The second weight θ^Q adjusts the density of wages to reflect the differences in observable characteristics of the population in the reference year. Details on the theoretical framework underlying this decomposition can be found in the appendix.

We estimate the probability to participate using a logit model on the probability to be employed full time for each year T conditional on characteristics x. To estimate θ^Q, we combine the observations of year T and T' in the sample sample and run a logit on the probability that an individual with characteristics x is in the population in year T with respect to year T'. After these models have been estimated, we calculate the weights for each individual in the sample. The covariates included in the logit models are all possible two-way interactions and fixed effects between six groups of education and nine age groups.[18] The six groups of education we can consistently distinguish in the LFS during the period are used: there are workers without diploma/primary education, basic vocational (*BEPC*), advanced vocational (*CAP*), high-school graduates (*Bac*), two or three years of university (*Bac+2/3*) and university graduates (*Bac+5*) while the nine age groups are 16-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-65. By allowing for interactions between education and age, these models allows for possible cohort effects or variations in the returns to experience between education groups. Separate models are estimated for each year using the population included in the employment survey in age between 16 and 65.[19]

An important limitation of the decomposition is that the counterfactuals constructed take

[18]It is traditional to introduce socio-demographic variables in wage regressions such as marital status. Following Lemieux (2006) or Autor et al. (2008), we only use education and age or experience in the reference model to first estimate the impact of basic skills.

[19]The potential experience is most of the time calculated using the diploma and and age. Since our basic model includes interactions between age and diploma, it allows for the specific effect of experience between educational groups.

contemporary prices as given. Our counterfactual density uses the contemporary price of labor in the observed year, which is by definition the equilibrium price in this year, and not the equilibrium price which would be observed with other quantities. To account for the relationship between supply and demand and the wage structure, we present in the next subsection more "structural" which can be used to identify the elasticity of substitution between groups and thus estimate the impact of change in supply on between-group wage inequality.[20]

3.2 Supply and Demand Models

The decomposition model of the previous section is useful to separate the effect of changes in the distribution of observables and changes in price without making strong assumptions. However, to measure the impact of changes in supply on the wage structure, we need a more structural model to estimate the elasticity of relative wages to change in relative supply. To do so, we build on the standard supply-demand framework of Katz and Murphy (1992), Card and Lemieux (2001) and Goldin and Katz (2008). We estimate both an aggregate model explaining overall changes in the skill premium, following Katz and Murphy (1992), and a model allowing for imperfect substitution between age or experience groups as in Card and Lemieux (2001).

The underlying economic model for the empirical estimates is relatively simple. Assume the economy can be represented by using a nested constant elasticity of substitution (CES) production function and there are various education groups numbered $d = 1, ..., D$:

$$Y_t = \left(\sum_{d=1}^{D} \lambda_{dt} N_{dt}^{\rho} \right)^{\frac{1}{\rho}} \tag{1}$$

where Y is the output and $\rho = 1 - \frac{1}{\sigma}$. The parameter σ is the elasticity of substitution between each type of labor while λ_d is the relative skill technological progress so that $\sum_d \lambda_d = 1$. Assume first, following Katz and Murphy (1992), they are only two groups such that N_H is the high skill labor input and N_L the low skill labor input. If wages are set competitively and the

[20] A second well known limitation is that the counterfactuals have a "causal" interpretation, in the sense that they identify separately the impact of change in prices from the impact of changes in observables, only if the changes in prices are not confounded by changes in the distribution of other unobserved factors affecting wages. If the distribution of unobserved individual ability varies by educational attainment over time, then changes in the conventional measures of returns to education may be driven in part by changes in the distribution or the payoff to unobserved ability.

economy operates on the demand curve, by using the first order conditions, we can rewrite the expression for wage inequality as:

$$ln\left(\frac{W_{H,t}}{W_{L,t}}\right) = \ln\left(\frac{\lambda_t}{1-\lambda_t}\right) - \frac{1}{\sigma}\ln\left(\frac{N_{H,t}}{N_{L,t}}\right). \tag{2}$$

To estimate the previous model, some hypothesis must be made to absorb the effect of the technology parameter. We first follow Katz and Murphy (1992) by including a time trend to capture the evolution of the relative productivity of skilled workers while the unemployment rate is added as an additional control variable to absorb potential effect of a change in labor market conditions on the skill premium. A second issue is that some wages might not be set competitively for some groups of workers, for which market equilibrium wages might be below the minimum wage. It is not straightforward how to control for the impact of the minimum wage in such model given the impact is likely to be heterogenous across different types of workers, especially within the low skill group. Moreover, equilibrium wages of workers above the minimum wages might also be influenced through spillover effects. To keep things simple, our full model follows Autor et al. (2008) and simply includes the log real minimum wage as a control to account for the fact that part of the wages of unskilled workers might not be set competitively. Our final regression model can thus be written:

$$ln\left(\frac{W_H}{W_L}\right) = \gamma_0 + \gamma_1 t + \gamma_2 \ln\left(\frac{N_H}{N_L}\right) + \gamma_3 RealMinWage_t + \gamma_4 Unemp_t + \epsilon_t \tag{3}$$

where ϵ_t is an error term. As in Goldin and Katz (2008, p.295) among others, we assume that the relative skill supplies are predetermined in the short run so we can estimate the previous model with OLS.[21]

An important issue is that $N_{H,t}$ and $N_{L,t}$ are aggregates of different types of labor. Therefore, we must find a method to take into account the effect of changes composition in terms of experience and education *within* these groups on the relative quantity and prices. We follow Autor et al. (2008) and construct aggregate indexes of relative price and supply in "*efficiency units*" to adjust for change in labor composition by experience groups. In practice, this means

[21] Heckman et al. (1998) and Ciccone and Peri (2006) find similar results with 2SLS and OLS using various instrumental variable strategy.

that we construct indexes of supply taking into account the fact that workers with different experience and education groups are aggregated in the index. Similarly, our relative wage index is a fixed-weighted average of the relevant cell means using a fixed set of weights that are equal to the mean share of workers by each group over 1990 to 2005. Details on the construction of this index are given in the appendix.

As highlighted by Card and Lemieux (2001), one potential concern regarding the previous model is that it assumes that workers from different experience groups are perfect substitute. However, differences in graduation rates and in the return to education by cohorts are large as we detail below. Allowing for imperfect substitution between groups of education and experience might be particularly important in France given there appear to be larger cross-cohort differences in graduation rates over time than in the US since the 1960s, especially for young cohorts. To do so, the previous model can be simply extended to incorporate imperfect substitutability between younger and older workers. Theoretically, this amount simply to assuming that aggregate labor supply depends on CES subaggregates such that $N_{d,t} = \left[\sum_{jt} \left(\alpha_{dj} N_{djt}^{\eta}\right)\right]^{\frac{1}{\eta}}$ between different age or experience group j with the same level of education where $\eta = 1 - \frac{1}{\sigma_x}$ and σ_x is the elasticity of substitution between groups of experience assumed similar across groups and α_j are assumed fixed across groups (they do not vary across cohorts over time). Assuming wages are set competitively, that the economy operates on the demand curve and taking the log, one obtains:

$$\ln\left(\frac{W_{Ht}^{j}}{W_{Lt}^{j}}\right) = \ln\left(\frac{\lambda_t}{1-\lambda_t}\right) + (\rho - \eta)\ln\left(\frac{N_{Ht}}{N_{Lt}}\right) + \ln\left(\frac{\alpha_{Hj}}{\alpha_{Lj}}\right) + (\eta - 1)\ln\left(\frac{N_{Ht}^{j}}{N_{Lt}^{j}}\right). \quad (4)$$

To estimate the elasticity of substitution σ_x, a natural strategy is to absorb the effect of of the common factors affecting the skill premium between groups of education and experience by a year fixed effect for the first two terms and by a group fixed effect for the third term:

$$ln\left(\frac{W_{Ht}^{j}}{W_{Lt}^{j}}\right) = \gamma_j + \gamma_t + \gamma_2 \ln\left(\frac{N_{Ht}^{j}}{N_{Lt}^{j}}\right) + \epsilon_{jt} \quad (5)$$

where γ_j and γ_t are the age and year effects. The previous model is thus estimated using variations over a set of age-group specific university wage premiums, rather than over a set of

aggregate premiums for all age groups.[22]

Finally, we define the two skill groups by using *university equivalent* and *less than high school equivalent*. University equivalent designate high-school graduates and university graduates while less than high school equivalent are individuals with secondary or primary education. We experimented alternative specifications by imputing half of the high-school graduates to each group following Autor et al. (2008) and found that most results were qualitatively unaffected.

4 Key Facts on the French Wage Structure Changes over the Past Four Decades

4.1 Trends in Overall Inequality

Following the literature, we focus on two inequality concepts: changes in overall inequality in the upper and lower halves of the wage distribution, captured by log wage differences between P90-P50 and P50-P10 to study the evolution of wage dispersion at the top and the bottom of the wage distribution (which we refer to as upper-tail and lower-tail inequality).[23] These latter measures provide a simple way of distinguishing what happens at the top and bottom end of the wage distribution.

Figure 5 presents the evolution of upper and lower tail inequality from 1950 to 2008 estimated with DADS by the French Statistical Institute while table 2 reports lower and upper tail inequality measures from LFS/FQP and DADS since 1964 in selected years where both DADS data and data from LFS or FQP are available.[24] For the two last decades where annual

[22] Some papers in this literature use estimates α_{Hj} and α_{Lj} from the fixed effects of model (5) to calculate the aggregate quantities of skilled and unskilled labor. Then, they use the specification of model 3 to estimate σ with the estimated aggregate quantities of labor using the model (5). In practice, we have found that this method gives estimates of σ similar to the one obtained using the method of efficiency indexes from Autor et al. (2008) we have described above. Alternative estimates of σ obtained from these two-step estimates of the Card and Lemieux model are available upon request.

[23] Results using the standard deviation of log wages are qualitatively similar to the evolution of the P90-P10 log wage gap and are available upon request.

[24] We start during the 1960s because the first annual data available to document changes in wage inequality start in 1960. See however Piketty (2001) for figures before 1960 in France using DADS and Goldin and Margo (1992) and Goldin and Katz (2008) for the long run evolution of the wage structure in the US.

micro-data from LFS are available, Figure 4a to 4d display annual changes across quantiles of several observed measures of wage dispersion. In this panel, the value of the 90th, 50th and 10th percentile are normalized to zero in the start year of 1990, with subsequent data point measuring log changes from this initial level.

Reassuringly, series from both FQP/LFS and DADS, while reporting slightly different measures of inequality levels in absolute value, indicate very similar trends.[25] On the whole, the measured wage dispersion is nonetheless higher in DADS for the upper tail during the whole period. The differences between the two series probably simply reflect the exclusion from the DADS sample of civil servants and large public firms which are heavily unionized and where wages are more compressed. When we exclude workers from the public sector (civil servants and workers from public firms) from LFS to match the composition of the population in DADS, we actually find very similar levels of upper tail inequality in both sources, with LFS estimates giving for example 0.70 in 2000 and 0.72 in 1990 for the P90-P50 log wage gap.

During this period, wage inequality varies widely in France. The figures in table 2 and figure 5 indicate that lower tail inequality has decreased widely from 1964 to 2005, from 0.64 to 0.42 according to the DADS data, while upper tail inequality remains remarkably stable over the period. Lower tail inequality decreases rapidly during the 1970s and the 2000s but much more slowly between 1983 and much of the 1990s. On the other hand, upper tail inequality increases from 1980 to 1990, and remains broadly constant during the first part of the 1990s and after 2002. This stability of the wage structure during the 1990s has led several authors to conclude that France did not experienced skill-biased technological change during that period (Goux and Maurin, 2000; Card et al., 1999).

The figures in 4a and 4d also suggest that the 2000s are a period of much more rapid wage growth for the first decile than the median or the ninth decile which even declines after 2004, which suggest there was a compression in wage inequality during the 2000s. Figure 4c and 4d indicate that both upper and lower tail inequality decrease by 5 log points in total between 1990 and 2008.

On a longer run, figure 5 indicates that the relatively high level of inequality of the 1960s

[25] We do not report wage dispersion figures for the year 1970 using FQP given that original sampling weights are not available with this data as discussed above.

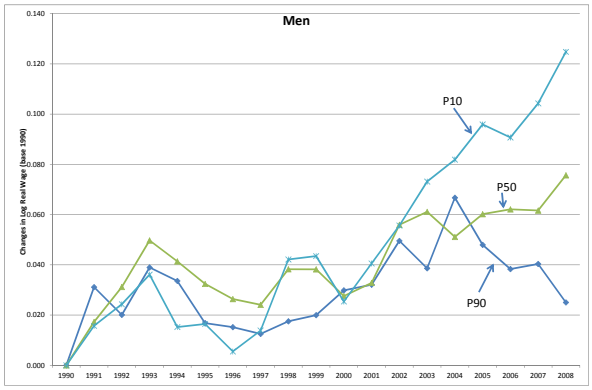
followed a rapid increase in wage inequality from 1950 until the middle of the 1960s. In 15 years from 1950 to 1965, both upper and lower wage inequality increased widely by 12 and 15 log points respectively. Notice that during this period, the economy grew rapidly from 1950 to 1974 at a 5.6% average annual growth rate.[26] Interestingly, even if we do not have enough data to fully test that hypothesis for the period from 1950 until 1970[27], this suggest that inequalities increased widely during a period in which the economy grew very rapidly, while the supply of education in the population stayed barely the same until the end of the 1970s as discussed before. Overall, the observed postwar increase in inequality while education supply remained nearly constant is consistent with the mechanisms described by the basic supply and demand models that we explore in the next section.

4.2 The Role of Composition and Prices

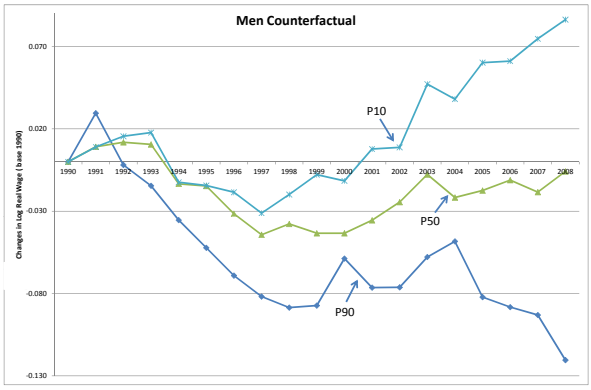
The relative stability of the wage structure during the 1990s or the 1970s, particularly for upper tail inequality, does not mean that the relative price of labor between groups did not change in France during these periods. As a matter of fact, the large increase in the educational attainment of the labor force during the 1990s suggests that between groups wage inequality must have changed in order to maintain a constant over time level of upper tail inequality. To take into account the change in composition of the labor force over the period, table 3 documents trends in observed wage inequality between 1970 and 2008 holding labor force composition at the indicated year level. Due to the length of time of the period under study and the magnitude of the changes of the education levels of the population during the period, we use as alternative reference years 1977, 1990 and 2005 in table 3 and 1990 and 2008 in figure 4c and 4d to check if the results are sensitive to the choice of the reference year. Notice that to use 1977 is equivalent to put more weight on less educated individuals in the distribution while conversely, using

[26]The postwar economic miracle is usually remembered today as a period of relative economic prosperity (see e.g. Fourastié, 1979) but not as a period of rapid increase in wage inequality where concerns for inequality were widespread. Such lack of concern for increasing inequality in a period in which wages increased for all in the population is consistent with the views defended by Friedman (2005) on the relationship between social cohesion and economic growth.

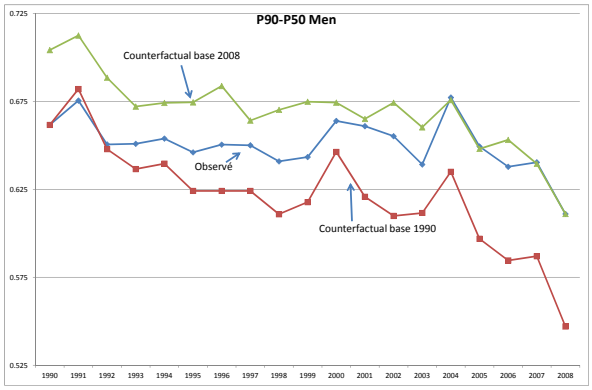
[27]As discussed, we do not have annual micro-data on wages before the 1970s either from FQP, LFS or the DADS. Moreover, it is also difficult to construct yearly series of the changes in educational attainment of the population from 1946 to 1962. The 1946 census did not contain information on education while information on education in the 1954 census are incomplete (Estrade and Minni, 1996) and the LFS is only available after 1968.



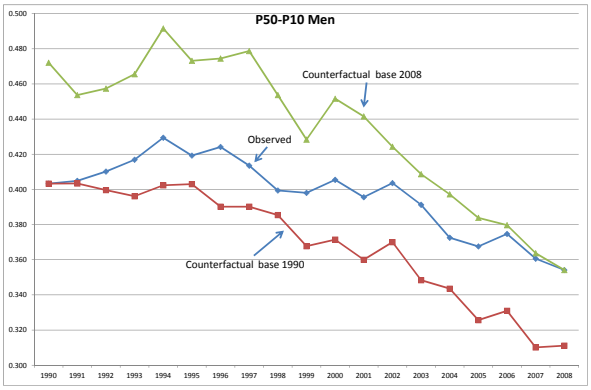
(a) Observed Quantiles



(b) CF Quantiles base 1990



(c) Upper tail: P90-P50



(d) Lower Tail: P50-P10

Figure 4: Recent Changes in Wage Structure 1990-2008

Sources and Notes: LFS 1990-2008. The figure shows the changes in log real wages of men full-time workers, normalized with respect to 1990 in 4a and 4b. Counterfactual changes are calculated with the kernel reweighting approach of DFL with respect to the distribution of education and experience across cells in the reference year. See text for details.

Table 2: Wage Inequality in France, US, UK and Germany

	Men					
	France DADS	France LFS-FQP	US	UK	Germany	France LFS-FQP
		P90-P50			P85-50	
2005	0.74	0.65	0.86	0.73		
2000	0.73	0.66	0.76	0.71	0.44	0.51
1990	0.76	0.67	0.66	0.65	0.39	0.50
1985	0.73	0.66	0.61	0.63	0.37	0.51
1977	0.72	0.66	0.55	0.52		0.51
1970	0.74		0.55	0.54		
1964	0.73		0.51	0.59		
		P50-P10			P50-15	
2005	0.42	0.38	0.83	0.61		
2000	0.46	0.42	0.80	0.62	0.32	0.34
1990	0.48	0.43	0.80	0.58	0.27	0.34
1985	0.47	0.51	0.84	0.47	0.26	0.39
1977	0.52	0.55	0.69	0.39		0.42
1970	0.57		0.58	0.39		
1964	0.64		0.61	0.39		

Sources: For France, *FQP* 1970, 1977, 1985, 1985 and *LFS* after 1990. Tabulations from the author; DADS data from the French Statistical Institute website. Full time workers in both sources ages 16-65, full-year in FQP surveys, The population in DADS excludes civil servants and public firm workers. For the other countries, the figures for the US are taken from Autor et al. (2008, p.304) using *CPS March Weekly* with full time, full-year workers. For Germany, Dustmann et al. (2009, online appendix, table A4, A5, p22.) with *IABS*, full time ages 21-60, the sample excludes self-employed and civil servants. For the UK, Gosling et al. (1994, p.65) with *Family Expenditure Surveys* from 1966 à 1990, ages 23-59 years, Machin and Van Reenen (2007, p.14) and 2000 et 2005 with *New Earning Survey*.

Table 3: Observed and Counterfactual Evolution of Wage Inequality in France

Overall Wage Inequality								
		P90-P50				P50-P10		
	Observed	Counterfactual Base			Observed	Counterfactual Base		
		2005	1985	1977		2005	1985	1977
1977	0.66	0.80	0.72	0.66	0.55	0.60	0.53	0.55
1985	0.66	0.71	0.66	0.59	0.51	0.55	0.51	0.55
1990	0.66	0.71	0.67	0.59	0.40	0.48	0.41	0.41
2000	0.66	0.67	0.62	0.53	0.41	0.43	0.39	0.35
2005	0.65	0.65	0.59	0.52	0.36	0.38	0.34	0.33
Residual Wage Inequality								
		P90-P50				P50-P10		
	Observed	Counterfactual Base			Observed	Counterfactual Base		
		2005	1985	1977		2005	1985	1977
1977	0.44	0.49	0.46	0.44	0.39	0.44	0.41	0.39
1985	0.44	0.47	0.44	0.41	0.33	0.38	0.33	0.30
1990	0.45	0.49	0.45	0.41	0.35	0.38	0.35	0.32
2000	0.44	0.45	0.41	0.38	0.35	0.36	0.32	0.30
2005	0.46	0.46	0.42	0.40	0.34	0.34	0.31	0.29

Sources and Notes: FQP 1970, 1977, 1985 and LFS 1990-2008. The upper panel shows changes in overall inequality while the lower panel shows changes in residual inequality. The residual are calculated using separate OLS regressions for each year with fixed effects and interactions for each group of education and experience. The first column of each panel shows the observed upper and lower wage inequality of men full-year full-time workers. Other columns show the counterfactual changes in upper and lower wage inequality calculated with the kernel reweighting approach of DFL which would have been observed if the distribution of education and experience had remained the one of the indicated reference year. See text for details.

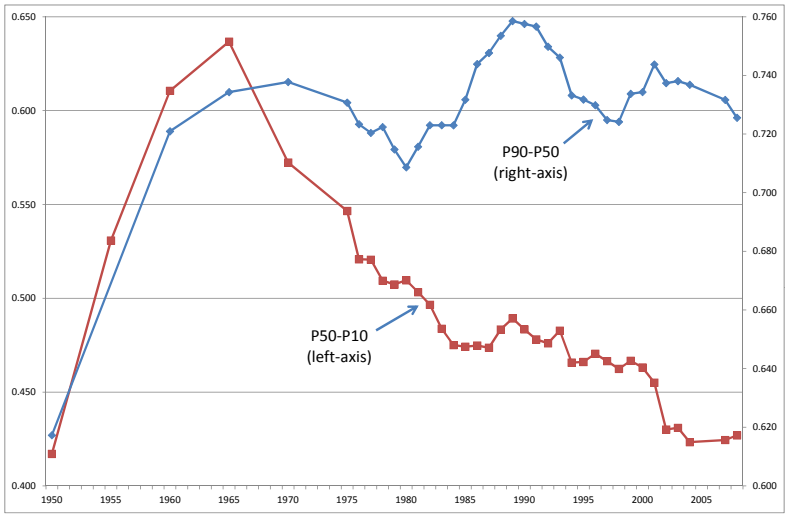


Figure 5: Upper and Lower Tail Wage Inequality 1950-2008 from DADS

Sources: Tabulations by the French Statistical Institute from net wage data from DADS 1950-2008. The population includes full time employed of private sectors workers and does not include civil servants or workers in public firms.

2005 puts more weight on educated individuals.

The differences with the observed series are striking and illustrate that the stability of the upper tail of the wage distribution since 1977 masks important changes in the returns to education and experience, particularly at the top of the wage distribution. At constant composition, each counterfactual series reported in table 3 suggest that inequalities in the upper tail distribution decrease from 1970 to 2008, more or less strongly depending on the chosen base year, while they remain constant in the observed series. In the last two decades, the figures in 4b indicate a *decline* from 1993 to 1997 across all quantiles which is particularly large for the upper quantiles. Finally, during the 2000s, the wage growth across counterfactual quantiles are inversely proportional to their rank in the wage distribution and almost symmetrical between the first and last decile: the counterfactual ninth decile *declines* by 13 log points while the first decile *increases* by 7 log points over the period. Taking the evolution of prices as given, these evidence suggest that the increase in the educational level of the population during this period has actually helped to maintain a roughly constant upper tail wage inequality, which would

have strongly decreased if the level of education of the population had not changed.[28]

4.3 Changes in Residual Inequality

During the last thirty years, the educational attainment of the labor force rose substantially in France, particularly during the 1990s, while the midcareer of large "baby boom" cohorts was reached during the 1990s. As discussed by Lemieux (2006), changes in labor force composition might play a role in changes in wage distribution. Since more educated or more experienced workers tend to have a higher wage dispersion than less educated or less experienced workers, changes in the distribution of education and experience could mechanically raise or lower residual wage dispersion simply by changing the share of workers with different levels of wage dispersion.

We document in this section how much the changes in wage inequality documented in the previous subsection reflects changes in wage dispersion *within* demographic groups, that is changes in *residual* wage inequality. The lower panel of table 3 displays changes in within group (residual) inequality conditioning on usual groups of education and experience from 1975 to 2005. The figures indicate that residual upper tail inequality remains broadly constant over the period. However, unlike observed inequality, the counterfactual series estimated using DFL with various reference year does not change widely. This suggest that change in composition of the labor force affected much less residual wage inequality than overall wage inequality during the period. Finally, lower tail inequality decreases much less than observed lower tail inequality (4 log points for residual versus 19 log points for overall from 1977 to 2005). In sum, these last results suggest that most changes in the lowest part of the distribution come from changes in prices between groups.

[28] We have investigated the robustness of the various decomposition results to the inclusion of additional factors such as the distribution of workers across industries, the share in the public sector, the share of immigrants and the share of temporary or fixed term contract workers in a sequential decomposition. The results clearly suggest that changes in the distribution of education and experience are the most important factors related with the variations of the wage distribution and that other factors play only a residual role. These results are available upon request.

4.4 Changes in Average Return to Schooling and Between-Group Inequality

Finally, as in the US (Goldin and Katz, 2008), we find that most of changes in wage inequality can be traced to changes in educational wage differentials.[29] Figure 6 the evolution of the estimated return to one year of additional education estimated using FQP/LFS and the 90-10 log wage gap from DADS. Both measures decline in tandem until the beginning of the 1980S and then expand simultaneously until the beginning of the 1990s while, during the 2000s, both measures decline.

However, we find that the skill premium did not change similarly for all experience groups. We illustrate this pattern through figure 7 which plots the University over High-School wage gap for experience groups 1 to 5, 11 to 15, 21 to 25, 31 to 35 years. The figure shows that changes in skill premium differed substantially by experienced groups over the recent decades. While the earning gap decreased for all groups, the decrease started much more earlier, after 1990, for lower experience groups from 1 to 5 years of experience than for other groups. The graphs also report the evolution of the relative supply index for each groups. Consistent with the view that there is a relationship between the relative wage and the relative supply of each group, we observe a much more rapid acceleration in relative university supply among younger than older workers during the 1990s.

4.5 International Comparisons

For the sake of comparison, table 2 also reports inequality measures from recent academic studies for Germany, UK and the US.[30] As argued by Atkinson (2008), cross-country differences in wage dispersion must be interpreted with caution given the construction of the sample often differ in important ways across countries. In order to enhance the comparability of the findings, the note of the table documents precisely the main differences in definitions which

[29] By "*returns to education*", we mean the coefficient on years of education in a log wage regression controlling for experience and experience squared. See e.g. Card (1999) on the well known problems of "ability bias" and other issues involved in providing a causal interpretation of OLS estimates of the returns to education.

[30] Due a censoring of high-wage in the data available, Dustmann et al. (2009) report the P85-P50 gap for Germany instead of the P90-P10 gap. Additional series can also be found for many other countries and from alternative sources in Atkinson (2008).

Figure 6: Two Measures of Wage Inequality: Overall 90/10 Inequality and Average Returns to Education

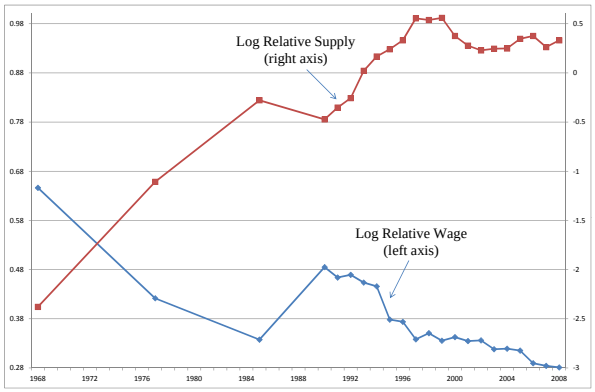
Sources: Data of Wage Inequality from DADS. See notes of figure 5. Data on Returns to Education from FQP before 1990, LFS thereafter. Returns to education are the estimated wage increase of an additional year of education estimated using separate OLS regressions including controls for experience and experience squared.

must be taken into account when interpreting the cross-country differences. Most of the series presented refer to full-time employees but figures from Germany and DADS data from France are calculated using administrative data which exclude part of the population.

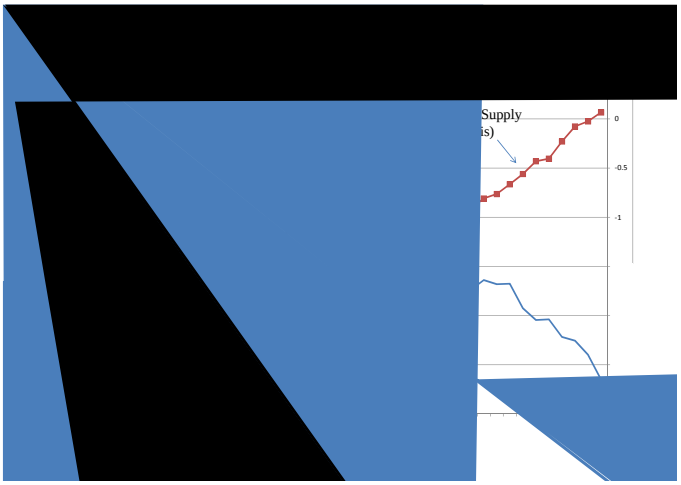
The figures in table 2 reflect the well known fact that the last thirty years have been a period of rising wage inequality both at the top and the bottom of the wage distribution in the US and the UK. As emphasized more recently by Dustmann et al. (2009), Germany and the US experienced similar changes at the top of the distribution during the 1980s and the 1990s.[31] As described above, the evolution of overall wage inequality in France reported in table 2 and in figure 5 goes in the opposite direction to what is observed in other countries.

Even if we need to interpret cross-section differences with caution, the previous figures nonetheless suggest that the relative rankings of wage inequality measures across countries are not fixed over time. When comparing the *levels* of wage inequality across these countries, the

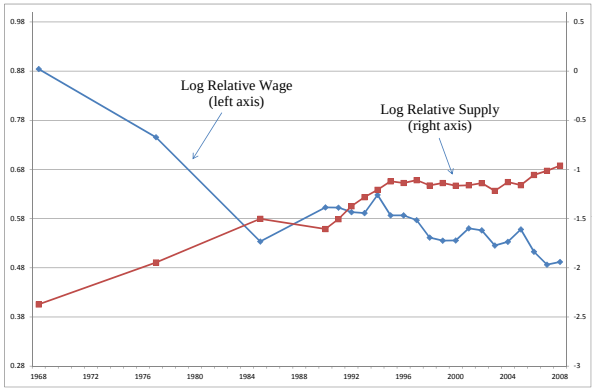
[31]This is a recent finding which had challenged the previous consensus that the German wage structure had been remarkably stable since the 1980s: previous papers using other data sources (mainly GSOEP) found much less dispersion (see e.g. Prasad, 2004).



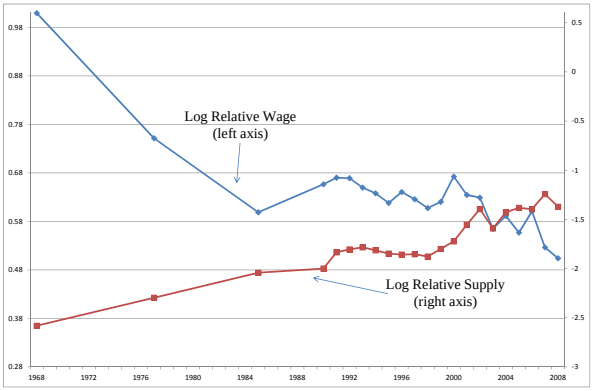
(a) 1 to 5 years of experience



(b) 11 to 15 years of experience



(c) 21 to 25 years of experience



(d) 31 to 35 years of experience

Figure 7: Relative Wages and Relative Supply of University Equivalent over Less than High School Equivalent per Experience Groups

Sources and Notes: Each graph represents the relative wage index and the relative supply index between university and high-school equivalents for the indicated experience groups.

figures indicate that upper tail wage inequality was *higher* in France than in the US or the UK until the beginning of the 1990s. On the other hand lower tail inequality is dramatically lower in France with respect to the US only after 1977.[32] In practice, the low levels of wage inequality observed in the US and the UK during the 1960s and 1970s were *not* observed during the same period in France, which was a period of higher wage inequality compared with today. The difference with the United States, where the gap is 0.83 in 2005, is particularly large. For the sake of comparison, the last column of the table also report upper and lower tail wage inequality in France using P85 and P15 as in Dustmann et al. (2009) for Germany. In spite of the fact that overall wage inequality increased after 1990 in Germany, upper tail wage inequality is actually lower in Germany than in France over the period. The recent simultaneous increase in Germany and decrease in France of lower tail inequality actually made its level similar between the two countries.

5 Proximate Causes of Changes in Wage Inequality since the 1970s

We now explore which institutional and economic factors are related with the changes in the wage dispersion between groups in the last four decades described in the previous section. We investigate in the next two subsections the role of changes in the minimum wage and education supply in explaining the evolution of the wage structure.

5.1 Changes in the Overall Skill Premium

The upper panel of table 4 presents several regression models based on Eq. (3) explaining the overall university equivalent/less than high school equivalent education wage gap calculated using LFS. Since the model is identified using aggregate annual variations in the wage premium over time, this imply that with 18 annual observations available for the period 1990-2008, we have been judicious in our inclusion of variables. Moreover, a further constraint to identifi-

[32] Blau and Kahn (1996) also find that during the 1980s much of the difference in wage dispersion between several OECD countries and the US come from differences in lower tail inequality while differences in upper tail inequality between are much smaller.

Table 4: Regression Models for the University/Less than High School Log Wage Gap 1990-2008

A. LFS Data: 1990-2008

	Log Wage Gap University/Less than High-School Workers						P50-P10		P90-P50	
Relative	-0.133***	0.024	-0.037	0.043				0.119		0.097
Supply	(0.011)	(0.146)	(0.042)	(0.134)				(0.077)		(0.142)
Log Real			-0.289**	-0.269*	-0.266*	-0.392***	-0.493***	-0.343**	-0.090	0.032
Min Wage			(0.124)	(0.130)	(0.126)	(0.030)	(0.096)	(0.133)	(0.168)	(0.248)
Unemp Rate			-0.000	-0.000	-0.000		0.003	0.002	-0.004	-0.005
			(0.002)	(0.002)	(0.002)		(0.002)	(0.002)	(0.003)	(0.003)
Time		-0.006		-0.003	-0.001		0.003**	-0.003	0.000	-0.005
		(0.006)		(0.005)	(0.002)		(0.001)	(0.004)	(0.002)	(0.008)
Observations	19	19	19	19	19	19	19	19	19	19
R2	0.88	0.89	0.91	0.92	0.92	0.90	0.90	0.92	0.09	0.27

B. DADS Data: 1975-2008

	P50-P10			P90-P50		
Relative	-0.069**	0.033	0.011	0.002	-0.077***	-0.086***
Supply Index	(0.006)	(0.020)	(0.016)	(0.004)	(0.016)	(0.019)
Log Real			-0.026**			0.009
Min Wage			(0.011)			(0.012)
Unemp Rate			-0.157			-0.508**
			(0.192)			(0.225)
Educ Gap			-0.030***			-0.021***
			(0.006)			(0.007)
Time		-0.004	-0.001		0.003***	0.004***
		(0.000)	(0.001)		(0.000)	(0.001)
Observations	35	35	35	35	35	35
R2	0.80	0.89	0.96	0.01	0.44	0.58

Sources and Notes: *Panel A:* Wage data and relative supply of workers were calculated using LFS 1990-2008. Column 1-6 present regressions results of the log ratio of the fixed-weighted university/less than high-school wage differential on the indicated variables. Column 7,8 and 9,10 regress respectively the P50-P10 and the P90-P50 log wage gap on the indicated variables. The relative supply index is the log of the ratio of university equivalent on less than high-school equivalent labor supply in efficiency units in each year. See the data appendix for details. *Panel B:* Wage inequality annual data come from DADS tabulation from the INSEE for male from 1975 to 2008. Relative supply variables and the educational gap were calculated using LFS 1975-2008 by the author. Each column present regression results of respectively the log wage gap between P50-P10, P90-P50 on the indicated variables. In both panel, unemployment rate and the value of the minimum wage come from INSEE data.

cation is that some variables are highly correlated. The first two columns report estimates of model following the basic specification of Katz and Murphy (1992) with a linear trend only in the second column. Assuming the technology parameter is constant over time, the results of the regression of the first column in table 4 suggest an estimate of γ_2 of -0.13 implying $\sigma = 7.69$, a relatively higher value than the one estimated recently for the US by Autor et al. (2008, p.307) which is around 1.6. Model in column 2 includes a linear trend. If this parameter is interpreted as representing changes in relative productivity, the negative trend predicts a *decrease* in the relative productivity of skilled workers while the estimate of the effect of the relative supply is still significant but has a different sign. The role of minimum wage and cyclical conditions are examined in models of column 3 to 6 of table 4. Controlling for the minimum wage decreases and renders insignificant the effect of the relative supply while the effect of the unemployment rate is also insignificant in all specifications. Column 5 presents regression results of a model including both the time trend and the minimum wage. Since the minimum wage closely follows a linear trend during this period, the previous results suggest that its effect cannot be clearly separated from the effect of the linear trend. Moreover, this indicates that the negative time trend reported in regression results of column 2 was probably capturing the evolution of the minimum wage and not the changes in relative productivity between each group of workers.

These results nonetheless indicate that the variations of the skill premium are well explained by the changes in the minimum wage during this period: column 6 shows that a model including only the minimum wage as a covariate explains 90% of the variance of the skill premium over time, suggesting that relatively few identifying variations are left to capture the effect of other factors once the impact of the minimum wage has been accounted for. Finally, the last four columns regress separately P50-P10 and P90-P50 log wage gap estimated with LFS on the unemployment rate, the minimum wage and the time trends. We expect the minimum wage to influence lower tail inequality but not upper tail inequality if changes in the minimum wages have no effect on the relative wages of skilled workers. The results confirm that lower tail inequality is strongly related with changes in the minimum wage while, reassuringly, we do not find any significant relationship between upper tail inequality and the minimum wage. Two additional specifications includes the index of relative supply of educated labor in the regres-

sion: the parameters of the relative supply are insignificant in explaining both lower or upper tail inequality.

To explore further the relationship between wage inequality, minimum wage and labor supply, the lower panel provides regression using upper and lower tail inequality using annual DADS data which are available without interruption after 1973. Using this longer period gives much more variations in the minimum wage changes over time at the cost of not being able to use an index of relative wages as in the upper panel. For this longer period, we also include in the model the educational gap between the number of years of education of workers 26-35 and 46-55 to test the hypothesis that periods in which the educational supply accelerate are characterized by a decrease in inequality.

As with LFS data, results indicate that lower tail inequality is strongly related with changes in the minimum wage while the effect of the relative supply is insignificant once the minimum wage is included in the model. On the other hand, in regressions explaining the P90-P50 log wage gap, we find a significant effect of the relative supply, even when the minimum wage and the unemployment rate are included in the model. On the quite restrictive interpretation of wages at P90 and P50 as approximating the wages of some skilled and unskilled groups of workers, the estimates of the parameters of the relative supply can be interpreted as the value an elasticity of substitution, indicating an estimate of σ between 11 and 14 across specifications. Moreover, the coefficient of the educational gap clearly suggests that periods in which the supply of education accelerate are characterized by an overall lower wage inequality, even when the impact of changes in the minimum wage and the relative supply have been included in the model. The correlation between changes in upper-tail inequality and changes in the educational gap between cohorts are particularly clear in Figure 1. Finally, regression results indicate that periods of higher-unemployment rates are periods of lower upper tail wage inequality.

On the whole, we find that the impact of minimum wage changes seems to predominate over the effect of the relative supply in the recent decades, particularly on lower tail inequality. Our results also suggest a relationship between wage inequality and the educational gap of young and old workers, which characterize periods in which the education supply accelerate. In the next section, we estimate a model allowing for imperfect substitution between groups

which is consistent with this relationship.

5.2 Relative Wages by Experience Group

We now explore the relationship between the relative supply and the wage differential within experience or age groups. We estimate alternatively the model using either experience groups as in Autor et al. (2008) and age groups as in Card and Lemieux (2001). Theoretically, experience groups appear to be more appropriate given that future university graduates aged 18-24 who may still be attending university are quite unlikely to be substitute with primary education workers of the same age.

We estimate various specifications of model of Eq. (5) using as previously two different time periods with either annual data from 1990 to 2008 or including only annual observations from 1969, 1977, 1985, 1990, 1995, 2000 and 2005 in the sample. We do not use all years after 1990 in this second sample to avoid giving too much weight to recent changes in the wage structure. Finally, to allow for a potential heterogenous effect of changes in the minimum wage across experience groups, we include an interaction between the minimum wage and each experience or age groups.

Results of estimates of models based on Eq. (5) are displayed in table 5. The first column estimates the basic model without including interactions between the minimum wage and age or experience groups. The first and the second columns are estimated with annual data from 1990 to 2008 while other columns use data from 1968-2005. An inspection of the results across columns suggests there are strong evidence of imperfect substitution between age or experience groups. Reassuringly, results are broadly similar across models estimated using different periods which suggests that the results are not only driven by recent or past changes in the wage structure. Models estimated using data since 1968 obtain a slightly higher elasticity of substitution than models from the first two columns. Elasticities of substitution across specifications indicate a value of σ between 10 and 22 depending on whether age or experience groups are used. Notice these values are much higher than the one of 3.55 and 5 for the US reported respectively by Autor et al. (2008) and Card and Lemieux (2001) in their preferred specification, but somewhat close to the one of 10 reported by Card and Lemieux (2001) in specifications

Table 5: Regression Models S/D across Cohorts 1990-2008

Dependant Variable: University/High-School Wage Gap, by Cohort and Year					
Period	1990-2008	1990-2008	1968-2005	1968-2005	1968-2005
Group Specific	-0.057***	-0.045**	-0.101***	-0.071***	-0.069***
Relative Supply	(0.016)	(0.020)	(0.033)	(0.025)	(0.025)
Trend					0.004
					(0.003)
$Trend^2$					0.008
					(0.006)
Agg. Supply					-0.206**
Index					(0.104)
Year Effects:					
1968			0.401***	0.341***	
			(0.042)	(0.053)	
1977			0.144***	0.145***	
			(0.029)	(0.032)	
1985			0.021	0.023	
			(0.021)	(0.022)	
1990			0.087***	0.073***	
			(0.021)	(0.022)	
1995			0.081***	0.068***	
			(0.019)	(0.020)	
2000			0.090***	0.044**	
			(0.017)	(0.018)	
N	152	152	56	42	42
R2	0.92	0.93	0.95	0.98	0.98
Year FE	Yes	Yes	Yes	Yes	No
Min W. x Group	No	Yes	Yes	Yes	Yes
Group Definition	Exp	Exp	Exp	Age	Age

Sources and Notes: LFS 1990-2008 and FQP 1970, 1977, 1985 and 1968 census. Each panel regress the log wage gap of workers with the same level of experience or age on the log of relative supply. Column (3) to (5) uses data from year 1969, 1977, 1985, 1990, 1995, 2000 and 2005 while columns (1) and (2) use annual data from 1990 to 2008. Relative supply indexes for the observation with wage gap in 1969 were calculated using the 1968 census. Each model includes fixed effects for each groups of experience or age. Standard errors are reported in parenthesis.

using experience groups instead of age groups.[33]

Since the changes in relative supply in France where large over the period, their effect on the relative wage within groups remain large in absolute value, even with smaller elasticities of substitution than in the US: for example, if the relative supply had not changed for workers aged 26-30 since 1990, and assuming the elasticity of substitution to be 10, our estimates suggest that the relative wage premium of university equivalent would have been 10 log points higher, and about 20 log points higher if the supply had stayed at the 1969 level. Existing estimates for the US of the effect of changes in the relative wage related to the changes in supply of education within groups are actually quite similar in magnitude: from 1975 to 1995, Figure III in Card and Lemieux (2001, p. 723) indicates there was approximately no change in relative supplies of college educated 26-30 year old during this period, while the index for age group 46-50 changed from -1.1 to -0.1. With an elasticity of 5, this implies a decrease of 20 log points of the wage premium from 1975 to 1995 for 46-50 year old men related to the increase in supply in college educated labor.[34] Overall, this suggests that even if the estimated wage elasticity is lower in France, the higher magnitude of the changes in relative supply in France with respect to the US implies that changes in relative education supply within age groups had a relatively similar effect on between group wages inequality in both countries.

Finally, the last column includes a trend, the squared trend and the aggregate supply index instead of the year effects. The R2 and the point estimate of the group specific relative supply are barely affected. On the other hand, the aggregate supply index is precisely estimated: equation 4 indicates that it can be interpreted as the difference between the inverse of the aggregate elasticity of substitution and the partial elasticity of substitution between age groups $\frac{1}{\sigma_x} - \frac{1}{\sigma}$. Given the estimate of σ_x in the regression, the results suggest an estimate of the overall elasticity of substitution σ of 3.6. This result is quite different from the one obtained with annual data from 1990 to 2008. This last result might suggest that over this longer period, the Katz and Murphy model might do a reasonable job in predicting changes in relative wages over time but that, in the recent period, most changes appear to be driven by changes in the minimum wage.

[33] In a different framework, Ottaviano and Peri (forthcoming, p. 21) report about 5 while Borjas (2003, p.1364) finds 3.5 for the US. For the UK, Manacorda et al. (forthcoming, Table 7) find an estimate of 5.

[34] For simplicity, these simple counterfactuals do not take into account the impact of a change in supply within the age group on the overall supply index.

In sum, we found that wage differences between education groups within cohorts are significantly related with differences in relative supply of labor between groups. These evidence suggest that both the different timing of educational expansion and changes in the minimum wage between France and the US might explain the differences in the evolution of wage inequality between the two countries.

6 Conclusion

In this paper, we have documented the recent compression of the wage structure in France. Similar to conclusions reached by others for different countries, including Blau and Kahn (1996), we find that, in France, institutions such as the minimum wage were effective in compressing wage differentials at the bottom of the distribution. However, differences in the timing of educational expansions between France with US and UK also explain part of the differences in changes in wage inequality. Exploring the relationship of these changes with supply and demand mechanisms and minimum wage changes, we find support for a role of supply demand *within* cohorts while changes in the minimum wage value explain rather changes in the overall premium since 1990. Our results also confirm the explanatory power of simple CES models with imperfect substitution across experience or age groups to study changes in the wage structure allowing for adding to the evidence provided for other countries by among other Card and Lemieux (2001), Borjas (2003) and Ottaviano and Peri (forthcoming) for the US, Manacorda et al. (2010) for Latin America and Manacorda et al. (forthcoming) for the UK for example.

There are several limits to the previous analysis that must be underlined. First, we have not investigated the potential disemployment effects of the minimum wage of the large changes in the minimum wage. This is obviously an issue that must be kept in mind when evaluating the consequences of using changes in the minimum wage to reduce wage inequality. Notice that, to use the expression of Goldin and Katz (2008, p.85), "inequality anxieties" in France are remarkably high as highlighted recently by Maurin (2009) or Algan and Cahuc (2007) in spite of the relatively low level of wage inequality documented in this paper in France nowadays. Maurin (2009), for example, argues that a large part of current economic anxieties are related to

the risks of unemployment and long-term unemployment which have increased tremendously since the beginning of the 1970s.

We are also left with several questions. The fact that we obtain a much higher elasticity of substitution between education and experience groups than in other countries points toward the fact that market mechanisms might have a lower role in France than in other countries in the wage setting process, even in parts of the wage distribution where the minimum wage plays no role. We leave the answer to these questions for future research.

Appendix 1: Additional Details on the Construction of the LFS/FQP Sample

For FQP, we include in our sample respondents declaring to have worked full time during the whole year and we divide their annual earnings by twelve to obtain a monthly wage. Finally, despite our restriction to full-time workers, there are many observations with implausibly low wages which are likely to be measurement errors. These observations may have a significant impact on estimating the mean and variance of wages or in regressions estimating education returns. We follow the rest of the literature by removing these outliers. We eliminate individuals working full time whose salary is below the minimum wage minus 20%. In practice, this means removing up to 3% of individual annual observations over the period.[35] To obtain a real wage, we use the consumer price index to deflate wages in 2005 Euros. Following the tradition in labor economics, we focus on the log of real wages and the distribution of log wages. Sampling weights are used in all calculations using the weights provided either by the LFS or FQP when available.[36] Our final sample contains on average about 50 000 annual individual observations from 1990 until 2002 and then about 30 000 for the new LFS. For FQP, the number of observations is 18 500 in 1970, 21 600 in 1977 and 20 500 in 1985.

[35]Data on the minimum wage can be obtained directly on the French Statistical Institute website.

[36]The FQP 1970 survey (which relate to 1969 earnings) do not include individual weights and its sampling design oversample educated individuals. We have reweighed this latest survey was using a 25% extract of the 1968 census to match the distribution of education and experience with the one of the census population. Details on this procedure are available upon request.

Appendix 2: Kernel Reweighting Method

Let $h(x/t_x = T, D_i = 1)$ the density of observable characteristics x in year T and D_i a dummy variable equal to one if individual i is employed and zero otherwise. We define by $f(w/x, t_w = t)$ the wage density w in year t conditional on x. By definition, the observed unconditional wage density in year T is

$$g(w/t_{w,x} = T, D_i = 1) = \int f(w/x, t_w = T)h(x/t_x = T, D_i = 1)dx. \tag{6}$$

where $t_{w,x} = T$ indicates that the price function and the distribution of characteristics are those of year T. Consider two years denoted T et T'. By assumption, differences between densities can reflect two factors: first, they may be related to changes in the distribution of prices conditional on observable characteristics between the two periods, that is differences between $f(w/x, t_w = T)$ and $f(w/x, t_w = T')$. Second, they can also be related with differences in the distribution of observed characteristics x of workers $h(x/t_x = T, D_i = 1)$ and $h(x/t_x = T', D_i = 1)$. The counterfactual wage density using prices of period T with the distribution of characteristics of period T' denoted $g(w, t_x = T', t_w = T)$ is unobserved but can be rewritten as a function of the observed density:

$$g(w, t'_x = T, t_w = T) = \int \theta f(w/x, t_w = T)h(x/t_x = T, D_i = 1)dx \tag{7}$$

where $\theta = \frac{h(x/t_x=T',D_i=1)}{h(x/t_x=T,D_i=1)}$ by definition. Under some hypothesis, DiNardo et al. (1996) show that this counterfactual density can be estimated by simply reweighing the observed density such that the characteristics are identical to the characteristics of workers in T'. By using Bayes law, θ can be rewritten as: $\theta = \frac{\Pr(t_x=T',D_i=1/x)\Pr(t_x=T,D_i=1)}{\Pr(t_x=T,D_i=1/x)\Pr(t_x=T',D_i=1)}$. DiNardo et al. (1996) suggest to estimate these probabilities parametrically to compute θ, and then to use θ to estimate the counterfactual wage density.

It is possible to rewrite the joint probability of employment and being in the population in year T conditional on x as the product of: $\Pr(t_x = T, D_i = 1/x) = \Pr(D_i = 1/t_x = T, x)\Pr(t_x = T/x)$ and thus θ can be decomposed as $\theta = k\theta^P\theta^Q$, where the ratio $k = \frac{\Pr(t=T,D_i=1)}{\Pr(t=T',D_i=1)}$ is a constant which correspond to the ratio between the number of individuals

in the sample in T and T' and $\theta^P = \frac{\Pr(D_i=1/t_x=T',x)}{\Pr(D_i=1/t_x=T,x)}$ and $\theta^Q = \frac{\Pr(t_x=T'/x)}{\Pr(t_x=T/x)}$. The first ratio θ^P adjusts the density of wages for the differences in employment probabilities between years. It capture the change in probability of being employed for a given group of workers over time. The second ratio θ^Q adjusts the density of wages to reflect the differences in observable characteristics of the population in the reference year. The full weight θ adjusts both for observable differences and employment probabilities.

Appendix 3: Construction of Aggregate Wage and Supply Indexes

Relative Supply Measures: This follows closely Autor et al. (2008). Wages are first normalized to a relative wage measure by dividing each average wages across cells by the wage of high school graduates males with 10-15 years of experience. Next, we compute an "efficiency unit" measure for each experience-education cell as the arithmetic mean of the relative wage in that cell over 1990 to 2005. Efficiency units of labor supply in a cell of education, experience and year is then the efficiency unit wage measure of the group multiplied by the groups quantity of workers in a given year. Aggregate university equivalent are defined by summing the total efficiency units of labor supplied by university and high-school graduates. Aggregate unskilled equivalent are the total efficiency units supplied by primary and secondary education workers. The relative supply index is the log ratio of university equivalent to unskilled equivalent labor supply in efficiency unit in each year. ***Composition adjusted mean log wages***: Average university equivalent and unskilled equivalent wages are weighted averages across cells of education and experience using a fixed set of weights that is equal to the mean share of annual work supplied by each groups over 1990 to 2005.

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