When supply meets demand: Wage inequality in Portugal*

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Abstract

Wage inequality is high in Portugal and has increased during the last two decades and a half. During this period, the changes in the wage distribution are quite differentiated across skill and age groups, and over the wage distribution. We show that demand and supply shifts are responsible for these developments. The period covering 1982 to 1995 witnessed a strong increase in inequality at both ends of the wage distribution. This increase in inequality was generalized to all age and skill groups. It is explained by a trend of increasing demand for higher skills that was matched with only a limited supply of these skills. The wage setting institutions did not play any significant role during this period. The pattern substantially changed since 1995, with inequality increasing at a much slower pace and with polarized changes in the wage distribution. Upper-tail wage inequality increased, although at a slower pace, and lower-tail inequality decreased. Within skill and age groups inequality decreased in the lower-tail of the wage distribution, especially for low-skill and older workers. Also, more educated young workers experienced an extraordinary fall in their wage premium. Again, most of these developments are explained by market forces: a large supply shift for more skilled workers not matched by a sufficiently large increase in the demand for skills.

Keywords: Inequality; Polarization; Supply; Demand; Institutions

JEL Codes: J3; D3; O3

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1 Introduction

The debate over the trends in wage inequality in developed economies has evolved around a continental divide. In the US and other Anglo-Saxon countries observed an increase in inequality throughout the 80s and 90s (Autor, Katz and Kearney 2008). In most European continental countries inequality increased much less or even not at all during the 80s, but recent evidence for Germany suggests that it increased during the 90s (Schönberg, Dustmann and Ludsteck 2008).

The main explanations for the rising wage inequality in the US in the 80s are the skill-biased technological change matched with a slower pace of expansion in the labor supply of the high-skilled. In the 90s the wage distribution has been shaped by the market polarization, resulting in falling inequality at the lower-tail of the income distribution and increasing inequality at the upper-tail. In Europe, the continuous rise in the supply of high-skilled individuals and labor market institutions that contribute to the compression of the wage distribution (minimum wage, wage-setting through collective bargaining, public sector employment and unions) are frequently referred as the main explanations for the lower level of inequality.

Portugal appears as an outfit for the institutional view. It shares the institutional features of Continental Europe and the inequality outcomes of Anglo-Saxonic countries. We reconcile the Portuguese case with the European experience in the context of the supply, demand, and institutions framework.

This paper visits the changes in the wage structure in Portugal between 1982 and 2006. Throughout the 80s and until the mid-90s, wage inequality increased mainly at the upper-tail of the wage distribution. The subsequent period tells a different story with wage inequality falling at the lower-tail and stabilizing at the upper-tail. Supply and demand shifts explain most of these developments. The supply of skills remained quite low during the first period, but a large increase occurred during the 90s. The demand for skills increased throughout these 25 years. In general, the shifts in demand favored the more skilled, but since 1995 we observed a polarization of the wage distribution, with both employment and wages increasing in the lower- and upper-tail.

Previous studies of wage inequality in Portugal include Cardoso (1998), Machado and Mata (2001), Martins and Pereira (2004), and Cardoso (2007). These studies cover a smaller period and concentrate on the estimation of the college wage premium. Machado and Mata (2005) extends the analysis with counterfactual price and composition effects, using a quantile regression

decomposition method. For the corresponding period, the wage premium estimates are similar to the ones we obtain here with a different methodology.

The institutional framework of the Portuguese labor market did not change much throughout this period. Indeed, collective bargaining institutions, the minimum wage, and fixed-term contracts were in place before 1982. However, labor relationships went through significant changes. The starting years of our sample mark the end of the "revolutionary period" that started with the deposition of the Portuguese dictatorship in 1974. Indeed, 1982 marks the end of the last serious ideological confrontations in the Portuguese labor market, with general strikes and significant labor turmoil. After the deep 1983 economic crisis, labor confrontations subdued significantly and the number of days lost to strikes were reduced permanently. In 1986, there were 232 thousand workers involved in strikes, with 52 percent in the transportation sector and 28 percent in manufacturing, while in 2007 there were only 29 thousand workers in strikes.

We use data from several sources covering all salaried work in Portugal, both private and public. We use data from the *Quadros de Pessoal*, QP, (1982-2006), a comprehensive survey of private sector employment, the Social Security records, SSR, (2000-2007) and the Census of Public Administration, CPA (1996, 1999, and 2005). The QP include information on salaried workers employed in October of each year. The SSR database includes all year round employment spells, including shorter employment spells, more common at the bottom of the wage distribution. The CPA covers all civil servants working in December of the reference years.

We find a continuous increase in overall inequality during the whole period. This increase is stronger at the upper-tail of the distribution (90/50) especially until 1995. This can be explained by a slow increase in skills together with significant shifts in the demand for skills. The skill-biased technological change, common to most developed and open economies, is a good explanation for the rising college wage premium until mid 90s. Afterwards, there is a strong shift in the supply of skills, but not strong signs of a deceleration in the demand for skills. On the contrary, the demand for skills matched the extraordinary supply shift observed during this period, leading to a rather less sharper increase in the 90/50 inequality. A more in-depth analysis shows, however, that the increase in the wage gap was not common to all experience levels. Indeed, the wage gap decreased for individuals with less experience. The college premium fell for the younger cohort, those born since the late 60s.

The evolution of inequality at the lower-tail of the wage distribution is much more dichotomous across periods. There is a strong increase in 50/10 inequality in the first period, but since

the late 90s the polarization of work favored low-skill jobs, contributing to the compression of the wage distribution lower-tail. The minimum wage may have also played a (minor) role in the reduction of lower-tail inequality.

The level of inequality increased with the skill level and, within each skill level, with experience. The 90/50 and 50/10 ratios for high-skill workers are almost twice those for low-skill workers. Within skill level the 90/50 and 50/10 wage ratios for young individuals (those aged less than 36 years) are, on average, half of those observed for older workers (aged more than 45). Over time and within skill levels the compression of the lower-tail inequality is stronger among the low- and intermediate-skills and older workers.

The contrasting changes in lower- and upper-tail inequality since 1995 were the result of the polarization of work. Indeed, the wage gains for the lowest percentiles in the post-1995 period were matched with employment gains for low-skill jobs. The same occurred at the other end of the skill and wage distribution. This can be interpreted as the results of demand shifts favoring these two types of skills.

The results of the counterfactual analysis suggest that demand factors resulted in positive price effects in the initial period. The compositional change (larger supply of educated workers) in the second period resulted in negative price effects countervailed by positive composition effects.

There are some differences between the private and public sector wage inequality evolution. Overall male upper-tail inequality in the public sector remained mostly unchanged between 1996 and 2005, increasing only 0.1 log points. The effect of changing prices from 1996 to 2005 while holding the composition of the male labor force in 1996 would result in lower upper-tail inequality, -3.7 log points. In contrast with the private sector, male lower-tail inequality increased in the public sector from 1996 to 2005. Again, holding the composition constant at its 1996 level, inequality would have increased substantially more, a price effect of 20.1 log points, which implies a strong countervailing composition effect. Overall, public sector price effects seem to have favored median-wage workers.

The bias introduced in wage inequality measures by the sampling procedure in QP is also explored. As a result of sampling only salaried workers in a specific month, QP oversamples longer employment spells. This may introduce more severe biases at the bottom of the wage distribution, where employment attachment is lower. The full-year measures of wages are available from the Social Security records. Our computation of lower- and upper-tail inequality show

that both measures are higher when we include all annual wage gains, but that the difference is much larger at the bottom of the income distribution. The 50/10 wage ratio increases by almost one-third (or 10 log wage points) when compared with single-month earnings.

Overall, demand and supply conditions do a great job explaining shifts in the Portuguese wage distribution. The evolution of the demand for skills since 1995 is consistent with a trend of polarization of work. However, the strong increase of relative supply of skills for the cohorts born after the late 60s is associated with a reduction of the college wage premium. Institutions play a minor role; the minimum wage helps in explaining the time series variation in the 50/10 wage gap, but only for female, and public sector unions fail to compress the lower-tail of the wage distribution.

2 Data

The empirical analysis is based on three data sets: Quadros de Pessoal, covers all firms with more than 5 workers and a large fraction of those with less than 5 workers outside the agricultural and public administration; Social Security records, covering all private sector salaried workers in Portugal; and the Census of Public Administration, covers all civil servants in Portugal. We describe these data sets in greater detail below.

2.1 Quadros de Pessoal (QP)

The QP is a dataset created by the administrative information collected on an annual basis (reported to October of each year) by the Portuguese Labor Ministry with mandatory coverage for all firms with at least five workers. Coverage is voluntary for firms with less than five workers, but nonetheless it includes a large fraction of these small firms. QP does not cover government workers, entities that employ non-permanent rural workers and domestic workers. The QP is a source of information of great importance in the microeconomic analysis of employment in Portugal and has been extensively used (see Centeno, Machado and Novo (2008) for a more detailed description of the dataset).

The data is available from 1982 to 2006, with the exception of the years of 1990 and 2001. For the purpose of this study, we collect the monthly (basis) wage, the age, and the education of workers. In 2006, the data cover nearly 3 million employees. This dataset has been used to study different aspects of the Portuguese labor market, among which wage inequality, (Cardoso 1998,

Machado and Mata 2001, Martins and Pereira 2004, Machado and Mata 2005, Cardoso 2006).

2.2 Social Security Records (SSR)

The SSR is also an administrative source, with monthly frequency and constantly updated. It is an important source of information of the short-term behavior of the labor market.

Social Security data have been increasingly used in country studies for labor market analysis, including issues related with mobility and wage determination process (for example, Schönberg et al. (2008)). The nature of the information, firm-declared earnings subject to mandatory contributions to the Portuguese social security system, makes the SSR a unique source of information on labor market developments.

The SSR covers the period from March 2000 to March 2007. The dataset includes all pairs worker-employer for which there is at least one month of wages declared to the Social Security. For each of these pairs, the dataset has the information on the first and last month in which there are wage payments and the number of months in which, during that period, a payment is reported. The dataset covers about 14 million jobs.

2.3 Census of Public Administration (CPA)

Data for general government workers come from the Census of Public Administration (CPA). The Census is available for 1996, 1999, and 2005. It encompasses the whole public employment in Portugal, with the exception of the military personnel. The dataset comprises information about the gender, education, age, monthly wage, hours worked, years of service in the public sector, occupation, and geographic location of the workplace. The wage was measured as the base salary, to make it comparable with the private sector datasets. Experience was proxied by the age, taking into account the years of schooling. Only full-time workers (in general, defined as those who work at least 35 hours per week) have been considered in the study. Due to incomplete coverage in local and regional government in the early years, we consider only central government workers (about 75% of all civil servants).

3 The Portuguese wage structure in the last 25 years

Figure 1 displays the basic wage structure changes in the Portuguese economy, plotting the log real wage change for male and female from 1982 to 2006. It illustrates the widening of

the wage distribution over the past two decades and a half. It shows a large increase in wage inequality, with the 90th percentile wages rising approximately by 50 log points relative to the 10th percentile and by close to 40 log points relative to the 50th percentile, for both male and female. The figure shows a non-monotone spreading out of the income distribution. For males, it remains flat below the 50th percentile and increases dramatically above the median, whereas for females it shows a small increase in the lower-tail of the distribution and a sizeable increase above the 60th percentile.

[FIGURE 1 HERE (see page 34)]

The two panels in Figure 2 decompose this evolution in two periods, 1982-1996 and 1997-2006. In the two periods, the trends in inequality are quite different, both for males and females. For men, the first period witnessed a strong increase in upper-tail inequality, and only a modest one at the lower-tail. For females, lower-tail inequality remained constant, whereas there was a sizeable increase at the upper-tail. In the second period, the increase in lower-tail inequality for females is negligible, and for males there was actually a reduction in inequality; low wage males clearly gained over median wages. In the upper-tail, the increase in inequality is stronger for males than for females, but yet modest in comparison with the previous period.

[FIGURE 2 HERE (see page 35)]

An alternative way to present these trends is shown in Figure 3, which displays the evolution of the standard deviation of log-wages and log-wage residuals. The top panel presents the data for males and the bottom panel for females. The standard deviation of log-wage residuals is obtained from OLS regressions on wages, estimated separately for each year. The control variables included were five education dummies, eight age categories, and all possible interactions between these two variables. For males the results show a continuous rise in inequality, although faster during the 1982-1995 period. Between 1996 and 2001 the observed and residual standard deviations flatten out, and resume increasing after that date. For females the results are similar, except that in the second period the increase is much smaller.

[FIGURE 3 HERE (see page 36)]

Age and education explain a smaller portion of the overall variance of log-wages for males than for females. The increase in inequality over this period occurred within age and education

groups, as the residual inequality mimics pretty close the evolution of overall inequality, although with a small decoupling at the end of the period (in the final years, age and education explain a little more of the inequality level).

Next, we analyse in greater detail changes in lower- and upper-tail inequality. We will also consider Social Security and civil servants data. Figures 4 and 5 display the log-wage ratios 90/50 and 50/10 computed using all three datasets. The evolution of inequality has been strikingly different at the top and bottom of the wage distribution.

[FIGURE 4 HERE (see page 37)]

Overall upper-tail inequality (90/50) increased throughout the period, although at a much faster pace before 1995. If we consider the information of all employment spells over the course of the year, something we can do with Social Security data for the 2000-2006 period, we obtain a quite similar trend for upper-tail inequality, despite being at a slightly higher level (an increase of 6 log points). The restriction imposed by QP on the type of employment spells observed (a stock sampling bias, meaning that we tend to over sample long spells) does not have a large impact on our assessment of upper-tail inequality. The inclusion of public sector workers has a larger impact on the level of upper-tail inequality (but not on its path between 1996 and 2005). Indeed, the 90/50 ratio increases by 21 log points when we compute it for the sample of private and public employees. This is the result of a higher degree of (unconditional) wage inequality in the public sector and the fact that the wage distribution of the public sector is centered to the right of the private sector distribution.

[FIGURE 5 HERE (see page 37)]

The results for lower-tail inequality are quite interesting as well. For the private sector (male and female) the 50/10 wage ratio increases until 1995 and falls since that date until 2001, when it started to increase again. The most striking result in Figure 5 is the behavior of lower-tail inequality for the Social Security data. The ratio 50/10 increases by 10 log points (from 0.35 to 0.45) on average during the 2000-2006 period, and remained basically stable over the whole period. This behavior is associated with the prevalence of short employment spells, with intervening non-employment spells for low-wage individuals. Also impressive is the increase in measured (unconditional) inequality when we add public sector workers to those in the private sector (QP dataset). Contrary to what one would have expected, the importance of unions in

the public sector does not generate a more compressed lower-tail distribution. Indeed, lower-tail inequality is 8 log points higher for the sample of all (public + private) salaried workers, compared with the sample with private workers only.

Finally, we consider the evolution of within-group inequality. Table 1 takes a first look at the evolution of wage dispersion among age and education groups for private sector workers. We use the 50/10 and 90/50 wage gaps and employment shares to identify price and quantity trends. Three main conclusions can be drawn from this table. First, as in other countries, wage dispersion fans out with age and education. This is true within all education and age groups. Secondly, there is an impressive shift in the supply of skills. The share of low-skill individuals (those with 6 or less years of schooling) decreased by 45 percentage points, while the share of high-skilled workers rose from 2.5 percent in 1982 to 12.9 percent in 2006. The age composition of the working population also changed during this period. The share of young workers decreased from 53.6 percent in 1982 to 45.5 in 2006, and among them the share of high-skilled increased increased from 2 percent to close to 18 percent. Finally, Table 1 highlights the changes in inequality over time. The lower-tail inequality decreased among the low- and medium-skill, and also for the high-skilled in the second period. The upper-tail inequality increased in all skill levels, but more clearly for those aged above 36 years. The rise in inequality was much stronger in the first period, especially among the high-skilled, while in the second period there was a decrease in lower-tail inequality, more pronounced for low- and medium-skill workers. This is preliminary evidence of the role of the supply and demand shifts observed during these 25 years, that may help in explaining the evolution of the Portuguese wage distribution. These shifts will be explored in a more structured way in the next sections.

[TABLE 1 HERE (see page 29)]

4 The sources of rising (and falling) inequality

The wage distribution in Portugal has widened at the top, more strongly until the mid-90s. The returns to education are quite high in the Portuguese economy. However, there has been a huge increase in the supply of skills, namely of college graduates. In the U.S., Autor et al. (2008) show that the increase in the return to education is an important component of the rise in inequality.

The supply of skills in the Portuguese economy is characterized by a large shift in the rate

of college graduates during the second half of the 90s. This large supply shift matched, in part, with the demand for skills in the Portuguese labor market, but created a significant cohort effect that may have generated a reduction in the wage premium for education since the second half of the 90s. We analyze this issue by computing the college/noncollege gap by experience group.

Another important issue is the role of the minimum wage to inequality. The debate for the U.S. is large, and the evidence mixed. Autor et al. (2008) report no systematic role for the minimum wage to explain lower-tail wage inequality. In part this result is in contradiction with Lee (1999), Card and DiNardo (2002) and Lemieux (2006). We follow this line of research and try to evaluate the role of the minimum wage in explaining wage inequality in Portugal.

4.1 Sources of the rising college/noncollege wage premium

We follow Goldin and Katz (2007) and use a formal supply-demand framework that helps us understand the evolution of the returns to education during the last two decades and a half. The framework uses a two-level CES production function framework to explain the educational wage differentials by fluctuations in labor supply and smooth trends in relative demand growth.

In this setup aggregate production depends only on the quantities of skilled and unskilled workers. We take skilled workers as those with a college degree and unskilled workers as those without a college degree. The CES function stipulates an aggregate elasticity of substitution between the two types of labor, given by σ. Aggregate output can by written as:

$$Q_t = \left[\alpha_t \left(a_t N_{ct}\right)^{\rho} + \left(1-\alpha_t\right)\left(b_t N_{nt}\right)^{\rho}\right]^{\frac{1}{\rho}}, \tag{1}$$

where N_{ct} and N_{nt} are the quantities employed of college equivalents and noncollege equivalents, a_t and b_t are the college and noncollege labor augmenting technological change, α_t is a technology parameter and ρ is the production parameter. Skill-biased technological changes imply an increase in $\frac{a_t}{b_t}$ or α_t. The aggregate elasticity of substitution can be computed as $\sigma = 1/(1-\rho)$.

Under the assumption that college and noncollege equivalents are paid their marginal products, we can use the expression for aggregate output to solve for the college wage differentials:

$$ln\left(\frac{w_{ct}}{w_{nt}}\right) = \left(\frac{1}{\sigma}\right)\left[D_t - ln\left(\frac{N_{ct}}{N_{nt}}\right)\right], \tag{2}$$

where D_t indexes relative demand shifts favoring college graduates equivalents. The greater is σ the smaller the impact of shifts in relative supplies on relative wages and the greater must be

the fluctuations in demand shifts to explain the time series variation of relative wages for given time series variation of relative quantities.

Table 2 presents the estimates of a version of equation (2). This follows a tradition in this literature originating in Katz and Murphy (1992). To capture the demand shifts, we use a simple time trend, t, and a measure of the labor market conditions, the unemployment rate, UR_t. The model also includes the log real minimum wage, W_t^{min}, and the average unemployment insurance per unemployed, UI_t, specifically:

$$ln\left(\frac{w_{ct}}{w_{ht}}\right) = \alpha_0 + \alpha_1 t + \alpha_2 ln\left(\frac{N_{ct}}{N_{ht}}\right) + \alpha_3 W_t^{min} + \alpha_4 UR_t + \alpha_5 UI_t + \epsilon_t. \quad (3)$$

An important component of the rise in inequality in the U.S. is the increase in the return to education. In European countries the pattern is somewhat different, either because the demand pressure on high-skill wages was not as strong as in the U.S. or due to a stronger supply shift in college educated workers. We focus on the wage differential between college and noncollege graduates.

The top panel of Figure 6 presents college relative supply and wage premium series over 1982 to 2006 deviated from a linear trend. This figure reveals an acceleration in relative supply of college graduates since 1995. The opposite occurred during the 80s and early 90s. These fluctuations in the relative supply of college graduates, paired with a constant trend growth in relative college demand, do a great deal in explaining the evolution of the wage gap. Figure 6 shows that the wage gap increased over the 80s and early 90s (when relative supply was below trend levels) and decreased thereafter, again in an opposite move with relative supply.

[FIGURE 6 HERE (see page 38)]

Table 2 presents the OLS regressions of model (3). The implied elasticity of substitution from columns (4) and (5) is around 1.7, slightly higher than the 1.6 estimates for the U.S. in Autor et al. (2008), but less than half the estimates of 5 for Germany in Schönberg et al. (2008). This points to a substantive responsiveness of wages to supply and demand shocks in Portugal.[1] The model can explain a large share of the time variation in the wage premium.

[1]This result is in line with the macro and micro economic evidence of the Portuguese economy, obtained for example in Carneiro, Guimarães and Portugal (2009).

[TABLE 2 HERE (see page 30)]

The lower panel of Figure 6 uses the results in column (4) to predict the evolution of the college wage premium and compares it with the actual college wage differential. The model does an excellent job of predicting the growth of the wage differential since 1995, but it underestimates the college wage gap during the first half of the 90s. This fits with the evidence of a significant supply shift to explain the post-95 evidence. The slowdown in labor supply in the second half of the 80s lead the model to overpredict the wage gap and the subsequent stabilization during the first half of the 90s implies an underestimation of the gap. For the first period, demand shifts were more important, and those are captured in the model through the trend (smooth) variable. These demand shifts generated in the first period a large price-effect.

Table 2 considers also the possibility of a slowdown in demand shifts since 1995. In column (3), we interact the time trend with a post-1995 dummy, which proves to be non-significant. The same conclusion holds for the impact of changes in labor market conditions and the minimum wage, which seem to have a minor effect on the wage gap.

4.2 The college/noncollege gap by experience group

As shown in Table 1, the evolution of wage inequality differed significantly across and within age/skill groups. The increase in the inequality was concentrated in older workers, especially among those more educated. We take a closer look at this pattern in Figure 7 comparing the evolution of the college premium and college relative supply for younger and older workers. The college wage gap increased in a similar way until the first half of the 90s, and after that the college premium jumped almost 0.3 log points for the more experienced and fell by almost 0.2 log points for the young college graduates. If workers with the same education but different levels of experience are imperfect substitutes in production, we may expect these developments to be related with differences in the relative skill supplies in each experience-group (see Card and Lemieux (2001)). Consistent with this view, Figure 7 also shows a much more rapid increase in the supply of college graduates among the less experienced workers after 1995 (1.0 log points, which compares with 0.4 log points for the older group).

[FIGURE 7 HERE (see page 39)]

We use the same framework of Table 2 to take into account these different trends, and estimate a model for the college wage gap by experience group that includes the own experience

group relative skill supplies. The shifts in the relative supply of skills presented in Table 1 and Figure 7 show important differences among different age (and potential experience cohorts). The intercohort shifts in the relative supply of higher educated workers is the result of the extraordinary increase in the rate of growth of educational attainment that characterizes the cohorts born after the late 60s.

The basic models of education-related wage differentials ignore differences in the experience distribution of educational attainment. However, the introduction of imperfect substitutability between younger (less exprienced) and older (more experienced) workers yields the prediction that an increase in the intercohort trend in educational attainment will lead to a relative fall in the college wage premium for younger workers that will make its way through the experience distribution as the cohort ages.

The Card and Lemieux (2001) model relaxes the hyothesis that different experience groups with the same education are perfect substitutes in production. It uses a production function similar to equation (1), but assumes that aggregate output depends on two CES subaggregates of college and noncollege labor, in which the elasticity of substitution is a function of the partial elasticity of substitution between different experience groups with the same level of education (σ_E).

In the model, shifts in the experience-group-specific relative supply are expected to shift the experience profile of the college wage gap, with an effect that depends on the size of $1/\sigma_E$. The model estimated is:

$$ln\left(\frac{w_{cjt}}{w_{njt}}\right) = \beta_1\left[ln\left(\frac{N_{cjt}}{N_{njt}}\right) - ln\left(\frac{N_{ct}}{N_{nt}}\right)\right] + \beta_2 ln\left(\frac{N_{ct}}{N_{nt}}\right) + \beta_3 X_t + \gamma_j + \epsilon_{jt}, \qquad (4)$$

where j indexes the experience groups, the γ_j are the experience group fixed effects and X_t include the same covariates as in Table 2. Under the assumptions of Card and Lemieux (2001) we can interpret $1/\beta_2$ as an estimate of σ, and $1/\beta_1$ as an estimate of σ_E, the partial elasticity of substitution between different experience groups within the same education group.

The results are presented in Table 3. The first two columns present pooled estimates for the four experience groups allowing for group specific intercepts. These estimates point to significant effects of both own-group and aggregate supplies on the college wage gap by experience group. The aggregate elasticity in column (1) is close to -2, similar to the one obtained in Table 2. The implied partial elasticity of substitution between experience groups is closer to -3. This

is a smaller elasticity than the one reported in Autor et al. (2008) for the U.S. (-3.6) and the estimates by Card and Lemieux (2001) for the U.S., U.K., and Canada. The Portuguese labor market shows a great deal of wages sensitivity to supply conditions, even if somewhat lower than the more flexible Anglo-Saxon labor markets.

[TABLE 3 HERE (see page 30)]

These estimates allow us to conclude that the differences in own-group relative college supply growth can explain part of the evolution of the college wage premium in the last couple of decades. For example, college wage premium increased 10 log points for the less experienced and 45 log points for the group with 20-29 years of experience (see bottom panel of Figure 7). Over the same period the difference in own-group relative supply between the two groups was 52 log points (with a faster increase for the less experienced). Thus, using the implied own-group inverse elasticity of column (1) we find that the quicker increase in college supply for the younger group explains 18 log points of the difference in wage gap, this is, about half of the total difference in wage premium changes.

These results point to the potential importance of different sensitivities of the wage gap to own-group and aggregate supply across the experience groups. That is what we found in the remaining columns of Table 3. The demand shifts are more important for prime-age individuals, those with experience between 10 and 29 years. The sensitivity of the wage gap to own-group supply decreases with experience; it is higher for younger individuals (-3.9 for those with less than 10 years of experience and -1.8 for those with experience between 10 and 19 years). On the contrary, the sensitivity to aggregate supply increases with the experience level. The less sensitive are the youngest individuals; the elasticity is very low (less than 2) for the less experienced workers, and non-significant for those with 10-19 years of experience. Interestingly enough, and as expected, the older workers' wage gap is not sensitive to changes in supply (either own-group or aggregate). The minimum wage does not play an important role in explaining the wage gap, and the unemployment rate decreases the wage premium for all groups except the older one.

The shifts in cohort-specific supply of highly educated workers, matched with a steady increase in relative demand for skills, provide a good explanation for the observed changes in education-related wage gaps. Indeed, the simple supply-demand framework used in this section can account for some of the evolution of between-group inequality. The rise in the wage premium

during the 80s and first half of the 90s and the slowdown observed since that date, are partially associated with the differential rise in the wage gap by experience groups. In particular, the reversal trend in the wage gap of less experienced workers is associated with both a significant increase in own-group supply and a higher sensitivity of this groups wage gap to the aggregate supply of skills.

4.3 The role of the minimum wage

The impact of the minimum wage on wage inequality in Portugal remains pretty much unexplored. The importance of the minimum wage in the Portuguese labor market is not fully described by the simple share of workers that earn exactly its euro amount. Indeed, there is some evidence that minimum wage increases generate a "wave" effect on wage growth that goes well beyond the lower-tail of the wage distribution and goes up to the growth of median wages. This is shown in Figure 8. As expected this behavior is more pronounced in sectors with a stronger influence of the minimum wage (for example, textiles and clothing). As displayed in the Figure, the wage growth falls below the minimum wage increase in wage percentiles just above the minimum wage and starts recovering only above the 40th percentile for the total of salaried workers. This effect is sharper for the textile sector, where the growth rate of wages falls until the 70th percentile. As in Autor et al. (2008), this "wave" effect could be explained by a negative spillover of the minimum wage.

[FIGURE 8 HERE (see page 40)]

The minimum wage is usually considered an important feature of the wage-setting institutions in the Portuguese economy (see Cardoso (1998)). It affects directly a sizeable portion of salaried workers. Thus, the minimum wage should primarily affect inequality in the lower-tail of the wage distribution.

The research into the impact of the minimum wage in employment outcomes in Portugal is not conclusive, but shows that it may increase employment duration for young workers Portugal and Cardoso (2006).

The results from Table 2 show that the impact of the minimum wage is not quite strong, although it has the expected sign. However, the minimum wage is more likely to have a larger impact on the lower-tail of the wage distribution and among female workers, those with a higher incidence of minimum wage jobs. To analyze this potentially different impacts we run simple

OLS regressions of the 90/10, 90/50 and 50/10 wage differentials on the log real minimum wage, a time trend and the other variables included in Table 2. These results are displayed in Table 4. They show a negative coefficient for the minimum wage that is non-significant for both males and females in the 90/50 wage ratio regressions. However, the coefficient is -0.431, and significant, for lower-tail inequality in the case of females, being smaller, -0.338, but non-significant for males.

[TABLE 4 HERE (see page 31)]

We cannot commit, however, to a causal interpretation of these coefficients. This issue deserves further analysis, namely in line with the results of Autor et al. (2008), but they are nevertheless reassuring that there is some scope for a limited impact of the minimum wage in lower-tail inequality.

5 Inequality: the role of composition and prices

The evidence presented hitherto as made a clear point that there were significant changes in the composition of the Portuguese labor force, particularly in terms of its qualifications. Thus, it is possible that a fraction of the rise in inequality is attributable to composition effects; a larger share of more educated individuals, holding prices (wages) constant, would typically lead to higher inequality. One must not, however, play down price effects that come about through the standard impact of supply, demand, and institutions factors in relative prices. Machado and Mata (2005) apply a counterfactual decomposition of price and quantities to changes in the wage distribution of the Portuguese economy. As we will see, their results for the 1986-1995 period are quite similar to the ones reported here.

Albeit in a partial equilibrium framework, we explore these effects by using the kernel re-weighting method developed by DiNardo, Fortin and Lemieux (1996), widely used in this literature. The observed wage density at time t, $f(w|t)$, can be decomposed into the product of the density of observable wages conditional on observable attributes x at time t, $g(w|x, T = t)$, and the density of the same attributes, $h(x|T = t)$. Formally,

$$f(w|T = t) = \int g(w|x, T = t)h(x|T = t)dx \tag{5}$$

and similarly for time $T = t'$.

In order to compute the counterfactual wage distribution in year t that would have prevailed if the workforce attributes were the same as in year t', one needs to re-weight the "price" function, $g(w|x, T = t)$, by the ratio of the "composition" functions, $h(x|T = t')/h(x|T = t)$. As shown by DiNardo et al. (1996), this ratio can be easily calculated by noting that $h(x|T = t')/h(x|T = t) = \Pr(T = t'|x)/\Pr(T = t|x) \times (1 - \Pr(T = t'))/\Pr(T = t')$. Notice that the reweighting function can be computed by using a dichotomous variable model – logit or probit – in the pooled data for years t and t'. In our case, the set of conditioning variables includes dummy variables for 5 levels of schooling (4 or less years; 6 years; 9 years; high school; and college), 8 age groups (less than 25; 25-29; 30-34; 35-39; 40-44; 45-49; 50-54; and more than 54), and all possible interaction terms between education and age dummies.

The same principle can be applied to decompose residual inequality; the price function $g(w|x, T = t)$ is replaced with the residual price function $g(\epsilon|x, T = t)$. The residuals, ϵ, are obtained from a regression of log wages on the same set of attributes listed above.

A caveat emptor common in this literature is the partial equilibrium nature of the decomposition proposed, as it assumes that prices and quantities (characteristics) are independent. In the current setting with large changes in the composition of qualifications and experience (age), this assumption of independence is likely to be violated. Nevertheless, we carry out the exercise as it is worth for comparison with other results in the literature, but we interpret the results carefully.

Price and composition effects: Estimates

Figure 9 plots observed and counterfactual overall inequality. Table 5 complements this information with the rates of change (in log points) for particular years. The three counterfactual curves plotted hold prices constant at their 1982, 1996, and 2006 levels, while labor force composition is allowed to evolve as observed over the full sample, 1982 to 2006. Thus, in these figures, a vertical difference between the curves identifies the price effect at each year, i.e., the composition is held constant at that year's level while the prices change across counterfactual curves. Movements along each counterfactual curve identify composition effects.

[FIGURE 9 HERE (see page 41)]

[TABLE 5 HERE (see page 32)]

There are two distinct periods of inequality growth. Inequality grew at a faster pace from 1982 to 1996 than in the subsequent period, 1996-2006. In the upper-tail (90/50), overall male wage inequality grew by 25 log points in the first sub-period, and after 1996 grew 14.2 log points. But while the change of prices from 1982 to 1996 explain a substantial part of the observed increase in inequality, the same is not true afterwards. Indeed, the price changes from 1996 to 2006 yielded negative or tiny positive price effects. A tentative explanation for this change of pattern between periods rests on the substantive compositional changes that occurred in the latter period. Thus, one might speculate that demand factors explain the positive and substantial price effect of the early period, while supply effects counterbalanced the increase in demand to yielded rather paltry price effects in the more recent period. All these effects are evident in Figure 9, where it is clear that the counterfactual curves for 1996 and 2006 are closer, resulting in smaller price effects (vertical distances), and the composition effects are also slightly bigger at the end of the period (moving along each counterfactual curve).

In the lower-tail (50/10), the first period is characterized by an increase in overall inequality of 8.2 log points, while in the period afterward this increase is almost wiped out, -6.2 log points. The changes in prices from 1982 to 1996 explain again a substantial part of the increase in inequality. In the second period, the price changes (1996-2006) would have resulted in even larger reductions in lower-tail male inequality. The composition effect must have cancelled out part of the price effect. Although maybe not as pronounced as in the upper-tail, composition effects play a larger role in the later part of sample, which is consistent with the evidence gather for the educational and age changes that characterized the Portuguese economy.

In Machado and Mata (2005) the contributions of increasing returns to education and of workforce composition have a similar contribution to the increase in wage inequality over the 1986-1995 period. In our results we split the analysis by gender and obtain a larger price effect for men in upper- and lower-tail inequality, but a larger composition effect for women, over the same period. Thus, the results seem to be consistent in both methodologies.

[FIGURE 10 HERE (see page 42)]

We have not yet discussed residual inequality, but the broad messages drawn for the overall inequality carry over. Residual inequality slowed down in the final period, 1996-2006 at both ends of the distribution (see Figure 10 and 5). Price effects are more important in the early period, where they account for at least 56 percent of the raise in inequality. In the final period,

composition effects play a larger role than in the previous period, and for lower-tail inequality a countervailing composition effect ends up cancelling the reduction in inequality implied by the price effect.

Keeping in mind the caveats raised, the results suggest that demand factors resulted in positive price effects in the initial period. The compositional change (larger supply of educated workers) in the second period resulted in negative price effects countervailed by positive composition effects. Furthermore, these results are in line with the evidence obtained in the previous section.

6 Facts and explanations of polarization

The evolution of wage inequality in Portugal shows a strong increase in upper- and lower-tail inequalities until the mid-nineties. However, after that period the wage distribution polarizes, with a continuous increase in the upper half and a clear reversal in the lower half of the distribution. This polarization is observed in overall inequality, residual inequality and in educational wage gaps, a result also obtained for the U.S., Germany, and the U.K.

What can account for this differentiated evolution at both ends of the wage distribution? Autor et al. (2008) discuss a number of possible events that may help explain the polarization of wage changes. We discussed in the previous sections some reasons for these developments. We follow Goos and Manning (2007) and look for shifts in employment structure consistent with the "polarization of work", in which the increased demand for skills of the higher-educated workers is matched with a reduced demand for middle-educated workers, while the demand in occupations with low levels of education was left untouched.

These shifts in the demand for skills characterize the process of international division of labor, in which the international outsourcing plays a relevant role. The Portuguese economy is particularly sensitive to this process, as it undertook a significant increase in the level of skills, but that leaves it in the middle of the road, between the more developed OECD countries and the fast-growing countries from Eastern Europe, with a much better educated workforce. This makes the Portuguese experience interesting to study the "polarization of work", as both demand and supply evolved in the same direction.

The polarization of work is a demand side phenomenon, with rising relative demand for the high - and low-skill occupations. The implications are testable, and were carried out in

previous work for the U.K., U.S., and Germany. We apply a methodology similar to the one in Goos and Manning (2007) to our QP annual data, using the educational levels to proxy for the occupational skill level.

The hypothesis we want to test is as follows: if the wage distribution changes observed before and after 1995 are explained by demand shifts, the employment changes by skill level and the corresponding wage changes should be positively associated in both periods.

Figure 11 present the change in the share of total employment from 1982 to 1994 and 1996 to 2006 by occupation skill percentile, using the average level of education. It shows strikingly different patterns in the change in employment composition during the first period (1982-1994) and the second (1996-2006). In the first period, there was a significant reduction in the share of employment in occupations with lower level of average education and an increase for occupations with higher education level. This is in sharp contrast to the post-1995 period, in which employment growth seems to have polarized. There is a strong employment growth in occupations with higher skill levels, a reduction in middle-skill jobs and rising employment in low-skill jobs.

[FIGURE 11 HERE (see page 43)]

This evolution of employment growth was matched with similar changes in the wage distribution, as shown in Figure 12. The real wage growth was monotone during the first period, although sharpest above the median, being negative below the 20th percentile. In the post-1995 period wage growth follows a U-shaped pattern. It was stronger below the 30th percentile and above the 60th percentile. This means that labor market prices and quantities appear to positively covary in each of these two periods.

[FIGURE 12 HERE (see page 43)]

Overall we take these observations as evidence that labor market demand shifts have favored low- and high-skill jobs relative to middle-skill jobs over the last 12 years, a pattern that is at odds with what we observe during the 80s and first half of the 90s in which shifts in demand seem to have been rising in skill.

7 The public sector's role in wage inequality

The initial discussion of the impact of the public sector showed that it contributes to higher levels of inequality in the Portuguese economy. This impact comes about not only because it has higher levels of inequality, but also because its wage distribution is centered to the right of the private sector's one. In this section, we perform a counterfactual analysis similar to the one conducted in section 5 for the private sector.

Since the data are only available for 1996, 1999, and 2005, we consider only two counterfactual wage distributions, namely using as (prices) basis years 1996 and 2005. The reweighting function and the wage equation to compute the residual inequality follow the same specification as above, namely 5 age dummies, 8 education levels dummies, and all interaction terms. It is worth noticing that civil servants have always had higher levels of education. Thus, changes in the share of more educated workers are not as dramatic as those observed in the private sector. For instance, the share of public sector workers with college education increased from 47 percent in 1996 to 52 percent in 2005, while the share of workers with 6 or less years of formal education dropped from 24 percent in 1996 to 18 percent in 2005.

Table 6 reports the changes to upper- and lower-tail inequality in overall and counterfactual inequality only for the public sector in the left panel and for the public and private sector pooled together in the right panel.

[TABLE 6 HERE (see page 33)]

Within the public sector price effects seem to have favored median-wage workers. Indeed, overall male upper-tail inequality in the public sector remained mostly unchanged between 1996 and 2005, increasing only 0.1 log points. The effect of changing prices from 1996 to 2005 while holding the composition of the male labor force at its 1996 level would result in lower upper-tail inequality, -3.7 log points.

Male lower-tail inequality increased in the public sector from 1996 to 2005, a development that also indicates in relative terms a better positioning of median-wage workers. Again, holding the composition constant at its 1996 level, inequality would have increased substantially more, a price effect of 20.1 log points, which implies a strong countervailing composition effect.

These results for upper- and lower-tail inequality in the public sector may seem at odds with a highly unionized sector. For instance, Schönberg et al. (2008) report that 2004's German lower-tail inequality would have decrease more than upper-tail inequality if the unionization

levels had remained at the higher levels of 1995. In the case of the Portuguese public sector the results are the opposite. Upper-tail counterfactual inequality would decrease slightly, while lower-tail counterfactual inequality would be higher. One must, however, consider that the vast majority of public employment is highly educated and, therefore, the bargaining power of public sector unions is concentrated more towards the upper-tail of the wage distribution. But although within the public sector low-skilled workers were "let down" by unions, when the comparison is made across sectors, public sector low-skill workers have a higher wage premium than the corresponding private sector counterparts (Portugal and Centeno 2001).

The right panel of Table 6 reports overall and counterfactual inequality changes for the public and private sectors together; columns (3) and (5) report the counterfactuals holding constant only the proportion of public sector employment, while columns (4) and (6) consider also other labor force characteristics, namely education, age, and all interactions with the public sector dummy.

Holding only the proportion of public sector employment constant at its 1996, 1999, and 2005 levels, but allowing prices to change from 1996 to 2005 would have resulted in slightly higher levels of upper-tail male inequality; the price effect is the main driver in the observed increase in wage inequality. Given that in the private sector the price effect was negative, one can gauge that this positive price effect is due mainly to the public sector wage distribution properties. Lower-tail male inequality decreases, but holding constant only the proportion of public sector employment would have resulted in a more contained decrease.

When the range of labor force characteristics held constant is broaden (column (4)), the relative importance of the price effect changes, decreasing for upper-tail, but increasing for lower-tail. The composition effects start playing an important role, contributing to the increase in inequality. The price effect for male upper-tail inequality is positive, but at times accounts for only 30 percent of the inequality increase. Thus, composition effects are positive and somewhat important in explaining the trend in wage inequality. In the lower-tail, the price effects would have lead to a strong decrease in inequality, which did not occur because composition effects had a strong countervailing effect. This may be explained by a supply shift that reduces the price effect. And also with a composition effect that increases the share of more educated workers, which have a higher degree of inequality.

The results for residual inequality are remarkably similar to those reported for overall inequality. Note, however, that the increase in residual wage inequality is slightly higher than

overall inequality. For instance, residual upper-tail inequality increased by 8.3 log points, while overall inequality increased by 7 log points, leading to a more substantial percentual increase in residual inequality, which has lower levels of inequality. This contrasts with private sector upper-tail residual inequality, which increased less than overall inequality for the same period.

8 Conclusion

This paper challenges the view that the institutional settings common in Europe and shared by the Portuguese labor market prevented rises in wage inequality in Portugal. In fact, we were able to explain most of the developments in overall and residual inequality in Portugal using a simple supply and demand framework.

The Portuguese labor market is an extraordinary setting to test the predictions from such a simple model. In the last two decades and a half, we can easily identify relative supply and demand shifts and interpret their impact on relative wages. There are two important shifts in the relative supply of skills. First, from 1982 to 1995, there is an unprecedented increase in intermediate-skills. Later on, there is yet another impressive increase in the supply of skills, but this time of college graduates. The demand shifts in the Portuguese economy are characteristics of a period of increasing economic integration with the European Union that started in the first half of the 80s.

The result of these market forces in the wage distribution was a general increase in wage inequality, both at the top and bottom of the wage distribution. The upper-tail inequality increase was much stronger during the first half of the period (until mid-90s) than afterwards. We interpret this slowdown, not as a reduction in demand pressure, but as the result of an extraordinary increase in the supply of skills. Two results are particularly important to draw this conclusion. First, we observe a polarization of work in the post-95 period. The polarization of work increased demand for low- and high-skill jobs. It is a demand phenomenon, characterized by relative employment and wage gains for low- and high-skill workers. Second, more skilled and younger cohorts experience a reduction of the college wage gap since the increase in high-skills was concentrated in this younger group. Older cohorts witnessed large increases in wage inequality.

The lower-tail inequality increased in the pre-95 period (especially in the 1987-1995 period) and declined (or at best remained stable) subsequently. The behavior of lower-tail wage changes

is mainly explained by negative demand shocks during the first period and by the polarization of work, which benefited low-wage jobs (against middle-skilled jobs) and helped in reducing inequality after 1995. The wage setting institutions in the Portuguese economy play only a minor role in promoting wage compression, and this role is limited to the minimum wage. The minimum wage is shown to have a relevant impact in reducing lower-tail inequality for female workers. Thus, it can be associated with the initial strong increase in lower-tail inequality and the gains in wages of females in the second half of the period.

Unions in Portugal fail to promote a reduction in wage inequality, contrary to what happens in other countries. We take the case of public administration, the most unionized sector in Portugal and show that it delivers a higher level of wage inequality than the virtually non-unionized private sector. This calls for further research into the role of unions in Portugal, in particular those of the public sector. Our tentative explanation points to the importance of sectoral and professional unions (teachers, doctors, judges, etc.) that represent more skilled workers and tend to have more bargaining power.

Another important labor market development in the Portuguese economy was the advent of segmentation. Since 1995 the share of fixed-term contracts has been increasing steadily in Portugal. This led to an increase in labor market flows and to an increase in employment instability among the low-wage and low-educated workers, with a large impact in the level of wage inequality. When we correct our measures to take into account the degree of employment instability using Social Security data we observe an increase of almost 1/3 in lower-tail wage inequality (the 50/10 ratio) and a significant increase in upper-tail inequality, although not that expressive.

Portugal and the U.S. experienced similar patterns in inequality evolution in the 80s and up to mid-90s, with rising upper- and lower-tail inequality. This changed in the second period as upper-tail inequality in Portugal was much more subdued, while lower-tail inequality remained stable in both economies. The reason at the root of the lower-tail similarity are common: the polarization trend, although in Portugal the minimum wage claims some role in the process as well. The trend in lower-tail inequality is the opposite in Germany, where inequality at the bottom of the distribution increased only in the 90s. Also upper-tail inequality in Germany increased throughout the 80s and 90s, contrary to what happened in Portugal in the last decade. The shifts in relative supply go a long way in explaining the trends in the skill premium. As Card and Lemieux (2001) show for the U.S., Canada, and the U.K., the experience group-

specific relative supply of skills also explain a great deal of within-group inequality. We show that the elasticity of substitution between individuals with the same education, but different experience levels, is not perfect, which helps in explaining the divergent paths of the wage skill premium for younger and older workers.

We see these results a evidence in favor of the view that market forces are the main explanations for the changes in the wage distribution in Portugal. The combination of supply-demand shifts and institutions in Portugal make for a great case-study to the applicability of the supply, demand and institutions model. The late increase in the supply of skills in Portugal is the result of a poorly educated population, with mandatory school levels unparalleled in Western Countries (4 years until 1974, 6 years in the first phase of the democratic period and 9 years since 1987, but with a delayed implementation). The weakness of wage setting institutions in generating wage compression in Portugal is the result of a poor union representation, a fragmented collective bargaining system, and a minimum wage that is updated with social policy purposes.

Appendix

Sample selection

The selection criteria applied to our samples consisted in keeping all wage spells corresponding to full-time workers earning at least the minimum wage.

Our wage variable consists of permanent base wage. All non-permanent wage components were not included in the computation of inequality measures.

Education

The education variable distinguishes five groups. This number of categories aimed at capturing the changes in mandatory schooling that were in faced by workers in our sample. The five catogories are: less than 4 years of schooling, more than 4 through 6 years of schooling, 9 years of schooling, 12 years of schooling, and college degree. Whenever necessary these categories are aggregated in broader groups.

Relative supply measures

We calculate the quantities supplied of college and noncollege graduates using the QP samples. We construct a labor quantity sample measured in efficiency units for all workers with 0 to 39 years of potential experience. These workers are split into 400 gender X education X potential experience cells. Experience groups are single-year categories of 0 to 39 years; education groups are "less than 4 years", "between 4 and 6 years", "6 to 9 years of schooling", "secondary school completed (12 yeas)" and "college graduates". The quantity data are merged with price sample containing mean real wage by year, gender, potential experience and education. To compute the efficiency units, we use mean real wage by year, gender, education and age.

Education wage differentials

The data are sorted into gender-education-potential experience groups, based on a breakdown of the data into two gender, five education (less than 4 years of education, between 4 and 6 years of education, between 6 and 9 years of education, 12 years of education, college graduate), and four potential expererience categories (0-9, 10-19, 20-29, and 30 or more years). Log monthly base wages of full-time workers are regressed in each year separately by gender on the dummy variables for four education categories, a quartic in experience and interactions of the experience quartic with the education dummies. The composition adjusted mean log wage for each of the forty groups in a given year is the predicted log wage from these regressions

evaluated ate the relevant experience level (5, 15, 25 and 35 years for each of the four experience groups). Mean log wages for broader groups in each year represent weighted averages of the relevant cell means using a fixed set of weights, equal to the mean share of total employment by each group over 1982 through 2006.

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Table 1: Whithin-group wage dispersion by age and education, 1982:2006

		Within-group wage dispersion			Worker share		
		1982	1995	2006	1982	1995	2006
				Low skill			
Age $<$ 36	50/10	0.260	0.217	0.185	0.334	0.158	0.037
	90/50	0.389	0.422	0.459			
Age 36-45	50/10	0.403	0.341	0.247	0.160	0.132	0.068
	90/50	0.453	0.616	0.508			
Age $>$ 45	50/10	0.378	0.434	0.321	0.193	0.153	0.130
	90/50	0.488	0.666	0.717			
All	50/10	0.332	0.358	0.265	0.688	0.442	0.235
	90/50	0.448	0.639	0.664			
				Medium skill			
Age $<$ 36	50/10	0.466	0.391	0.305	0.190	0.340	0.338
	90/50	0.547	0.771	0.686			
Age 36-45	50/10	0.562	0.785	0.429	0.058	0.101	0.183
	90/50	0.538	0.780	1.083			
Age $>$ 45	50/10	0.618	1.003	0.643	0.040	0.065	0.115
	90/50	0.749	0.784	1.255			
All	50/10	0.550	0.528	0.400	0.287	0.506	0.636
	90/50	0.723	1.100	1.046			
				High skill			
Age $<$ 36	50/10	0.639	0.983	0.756	0.012	0.028	0.080
	90/50	0.639	0.920	0.927			
Age 36-45	50/10	0.764	1.220	1.213	0.007	0.014	0.031
	90/50	0.610	0.877	1.174			
Age $>$ 45	50/10	2.159	2.308	2.797	0.005	0.010	0.018
	90/50	0.633	1.000	1.233			
All	50/10	0.850	1.194	1.000	0.025	0.051	0.129
	90/50	0.784	1.082	1.380			

Notes: See note to Figure 1 in p.34. Low skill - 6 or less years of schooling; Medium skill - 9 to 12 years of schooling; High skill - college degree.

Table 2: Regression models for the college/noncollege log wage gap

	1982-2006			1984-2006				
College/Noncollege relative supply	-0.472	-0.724	-0.678	-0.769	-0.605	-0.587	-0.616	
	0.151	*0.154*	*0.165*	*0.162*	*0.193*	*0.200*	*0.198*	
Log real minimum wage				-0.433	-0.719	-0.691	-0.626	-0.704
				0.461	*0.488*	*0.502*	*0.521*	*0.646*
Unemployment rate					-0.014	-0.013	-0.012	-0.031
					0.010	*0.010*	*0.010*	*0.010*
Log unemp. insurance per unemp'ed							0.042	0.021
							0.068	*0.085*
Time	0.027	0.032	0.034	0.037	0.035	0.037	0.034	0.021
	0.004	*0.003*	*0.004*	*0.006*	*0.006*	*0.006*	*0.007*	*0.006*
Time*1995			-0.002			-0.001		
			0.002			*0.002*		
Constant	0.031	-0.269	-0.229	1.272	2.611	2.508	1.992	3.274
	0.189	*0.191*	*0.199*	*1.65*	*1.847*	*1.897*	*2.143*	*2.611*
No. of observations	23	21	21	21	21	21	21	21
R^2	0.906	0.919	0.923	0.924	0.933	0.934	0.934	0.892

Notes: Standard errors in *italic*. Each column presents an OLS regression of the fixed-weighted college wage premium on the indicated variables. The minimum wage is deflated by the consumers price index. The sources for labor supply and wages are the Quadros de Pessoal, 1984-2006.

Table 3: Regression models for the college/noncollege log wage gap by experience group, 1984-2006

			Potential experience groups							
	All groups		0-9 years		10-19 years		20-29 years		30-39 years	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Own minus aggregate supply	-0.338	-0.331	-0.260	-0.234	-0.569	-0.612	0.037	0.017	0.325	0.284
	0.044	*0.040*	*0.124*	*0.134*	*0.083*	*0.098*	*0.095*	*0.099*	*0.230*	*0.258*
Aggregate supply	-0.485	-0.373	-0.581	-0.469	-0.150	-0.159	-0.473	-0.362	-0.208	-0.163
	0.108	*0.137*	*0.315*	*0.354*	*0.142*	*0.147*	*0.208*	*0.234*	*0.135*	*0.181*
Log real minimum wage		-0.302		-0.271		-0.081		-0.174		-0.151
		0.339		*0.507*		*0.273*		*0.462*		*0.387*
Unemployment rate		-0.010		-0.014		0.005		-0.012		-0.003
		0.006		*0.009*		*0.005*		*0.009*		*0.007*
Time	0.038	0.038	0.030	0.029	0.038	0.040	0.036	0.035	0.026	0.027
	0.003	*0.004*	*0.004*	*0.007*	*0.002*	*0.003*	*0.006*	*0.008*	*0.003*	*0.004*
Constant	-0.156	1.157	-0.149	1.083	-0.064	0.149	0.190	1.009	1.085	1.639
	0.132	*1.285*	*0.345*	*1.811*	*0.113*	*1.031*	*0.368*	*1.696*	*0.342*	*1.397*
No. of observations	84	84	21	21	21	21	21	21	21	21
R^2	0.941	0.943	0.865	0.934	0.983	0.984	0.974	0.977	0.981	0.981

Notes: Standard errors in *italic*. Each column presents an OLS regression of the fixed-weighted college wage premium on the indicated variables. The college/noncollege wage premium is calculated at the mid-point of each potential experience group. The minimum wage is deflated by the consumer price index. Columns (1) and (2) also include dummy variables for the four potential experience groups used in the Table. The sources for labor supply and wages is the Quadros de Pessoal, 1984-2006.

Table 4: Regression models for the college/noncollege 90/50 ad 50/10 wage ratios, QP 1984-2006

	Male		Female	
	90/50	50/10	90/50	50/10
College/Noncollege relative supply	-0.056	-0.452	-0.453	-0.055
	0.068	*0.099*	*0.116*	*0.043*
Log real minimum wage	-0.064	-0.338	-0.251	-0.431
	0.171	*0.25*	*0.276*	*0.111*
Unemployment rate	-0.001	-0.004	0.002	0.003
	0.003	*0.004*	*0.006*	*0.001*
Time	0.017	0.017	0.027	0.008
	0.002	*0.003*	*0.004*	*0.001*
Constant	0.706	1.044	0.881	1.681
	0.645	*0.948*	*1.109*	*0.418*
No. of observations	21	21	21	21
R^2	0.989	0.827	0.968	0.932

Notes: See notes of Table 2. The dependent variables are those reported in Figures 4 and 5.

Table 5: Observed and composition-constant changes in overall and residual inequality, log points ×100

	Overall Inequality			Residual Inequality		
	1982-1996	1996-2006	1982-2006	1982-1996	1996-2006	1982-2006
			Δ90/50			
			Males			
Observed	25.0	14.2	39.2	12.0	8.8	20.7
1982's composition	15.2	-3.1	12.1	9.9	2.5	12.4
1996's composition	15.0	-2.6	12.4	9.4	3.2	12.6
2006's composition	22.8	0.2	23.0	10.7	4.8	15.5
			Females			
Observed	25.8	9.2	35.0	10.7	3.8	14.5
1982's composition	2.9	-14.0	-11.1	3.4	-4.3	-0.9
1996's composition	20.3	-18.2	2.2	6.7	-6.3	0.4
2006's composition	35.7	-0.7	35.0	12.5	-4.7	7.8
			Δ50/10			
			Males			
Observed	8.2	-6.2	2.0	6.9	0.0	6.9
1982's composition	2.7	-7.5	-4.8	3.9	-6.1	-2.2
1996's composition	5.8	-9.1	-3.3	4.7	-5.8	-1.1
2006's composition	6.4	-12.4	-6.0	8.0	-6.9	1.1
			Females			
Observed	6.1	2.8	8.9	6.4	4.6	11.0
1982's composition	-2.5	-2.3	-4.9	0.6	-4.7	-4.1
1996's composition	-6.4	-7.2	-13.7	1.1	-5.6	-4.5
2006's composition	-5.4	-14.5	-19.9	5.9	-9.1	-3.2
			Δ90/10			
			Males			
Observed	50.1	41.8	58.1	24.3	19.3	33.1
1982's composition	17.9	-10.5	41.1	13.8	-3.6	30.3
1996's composition	20.8	-11.7	49.4	14.0	-2.5	31.1
2006's composition	29.1	-12.2	71.0	18.7	-2.1	35.9
			Females			
Observed	65.3	65.1	77.4	31.8	27.4	40.2
1982's composition	0.4	-16.3	-15.9	4.0	-9.1	-5.0
1996's composition	13.9	-25.4	-11.5	7.8	-11.9	-4.1
2006's composition	30.3	-15.2	15.1	18.4	-13.8	4.6

Table 6: Overall and residual inequality: Public sector and both private and public sector (change 1996-2005)

Year	Public Sector		Public & Private Sectors			
	Overall	Residual	Overall		Residual	
	All X's	All X's	Public dummy	All X's	Public dummy	All X's
	(1)	(2)	(3)	(4)	(5)	(6)
			Δ90/50			
			Males			
Observed (1996-2005)	0.1	-8.8	7.0	7.0	9.5	8.3
1996	-3.7	-7.8	8.3	2.1	9.2	0.7
1999	0.5	-11.0	8.5	2.8	9.3	2.0
2005	6.4	-12.4	10.7	5.0	9.8	6.5
			Females			
Observed (1996-2005)	13.4	-1.3	5.5	5.5	9.2	1.6
1996	17.3	-7.6	4.6	11.5	13.9	-4.8
1999	10.4	-4.4	2.2	11.9	11.2	-4.0
2005	21.1	-0.3	4.7	12.3	5.1	-3.3
			Δ50/10			
			Males			
Observed (1996-2005)	5.6	7.7	-2.0	-2.0	-1.1	2.4
1996	20.1	4.6	-0.2	-6.6	-0.3	-3.5
1999	15.1	6.0	-0.4	-7.4	-0.4	-3.1
2005	5.7	6.2	-1.4	-8.5	-1.0	-1.8
			Females			
Observed (1996-2005)	9.6	-1.3	-0.6	-0.6	2.9	2.4
1996	-1.2	18.1	5.6	-10.5	5.8	2.9
1999	11.0	8.2	4.9	-11.9	1.8	-1.0
2005	10.1	-8.6	2.6	-15.5	0.2	-4.9

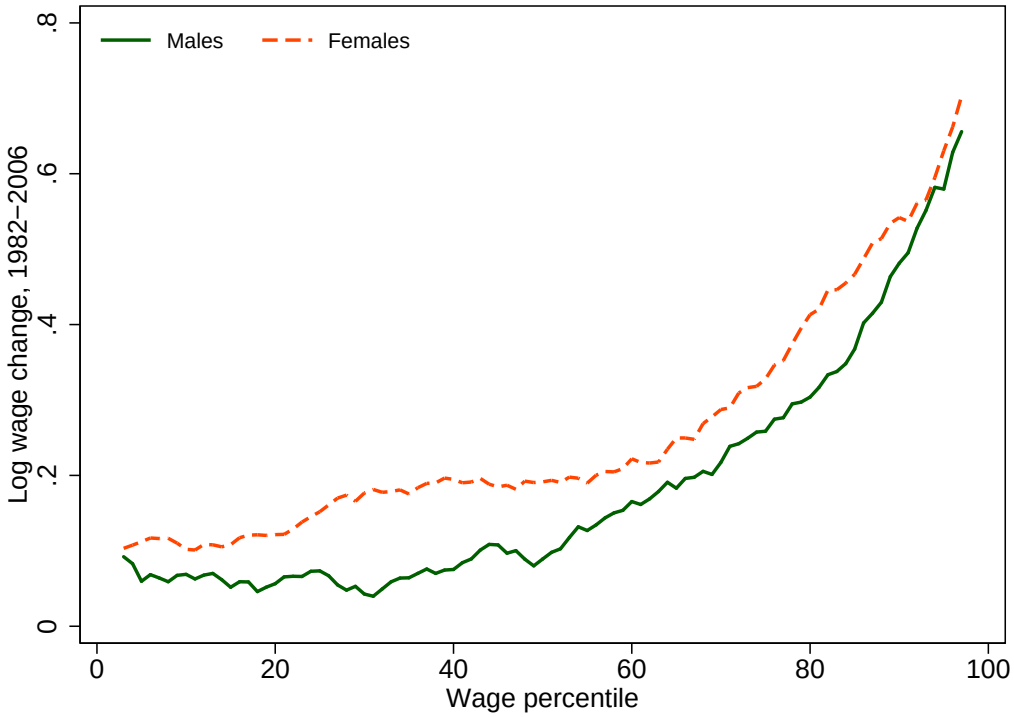


Figure 1: Log wage distribution percentile changes, 1982-2006 (M/F). Source: Quadros de Pessoal data for 1982 and 2006, full-time workers aged 16 to 65 with 0 to 39 years of potential experience. Full-time workers are those who worked 35-plus hours per week and earned at least the minimum wage. Calculations were deflated using the Consumer Price Index.

Figure 2: Log wage distribution percentile changes, Males (top-panel), Females (bottom-panel); 1982-1996 and 1997-2006. See also notes to Figure 1.

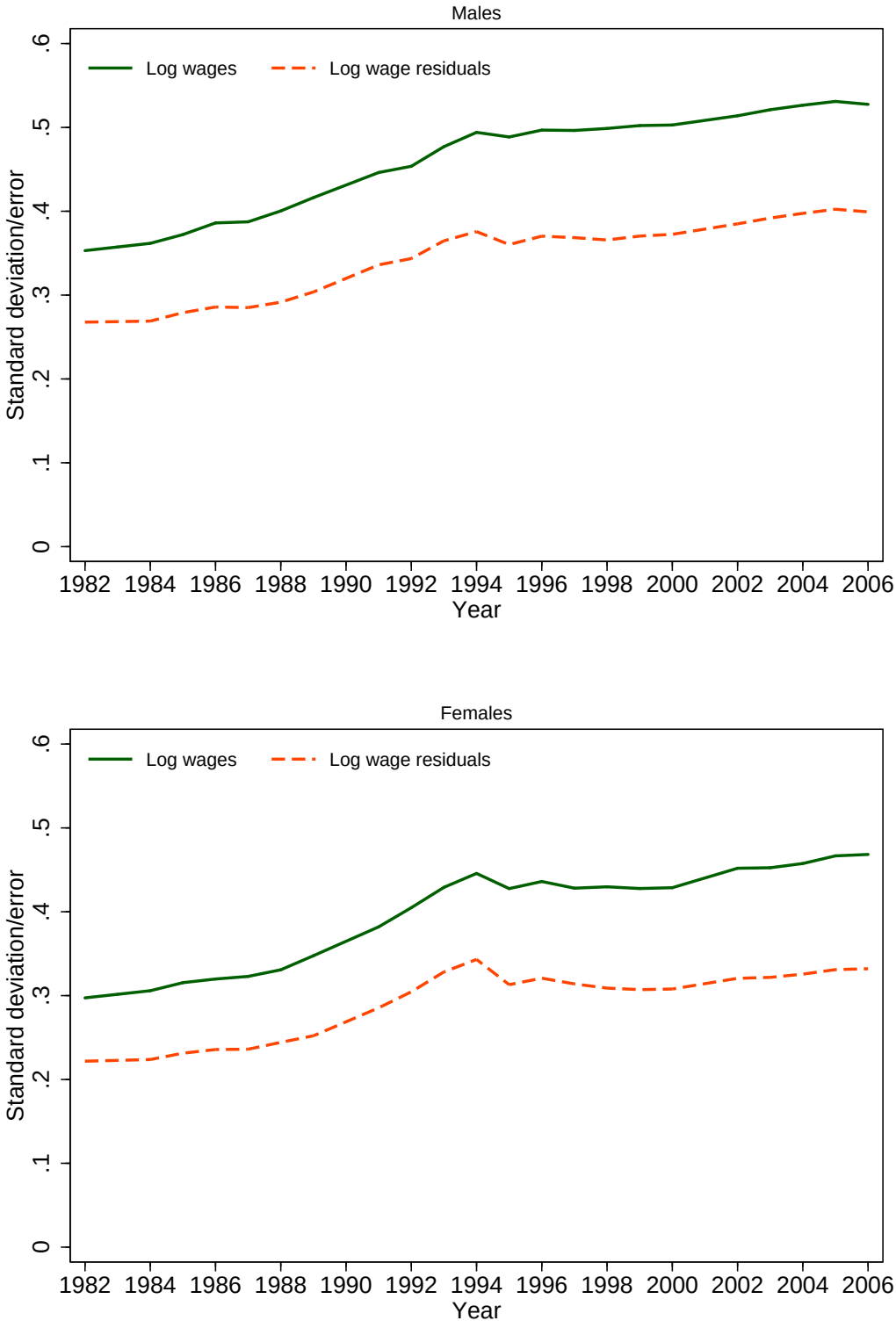


Figure 3: The evolution of the standard deviation of log-wages and log-wage residuals (M/F). Regressions control for five education categories, eight age categories, and all possible interactions between these two variables.

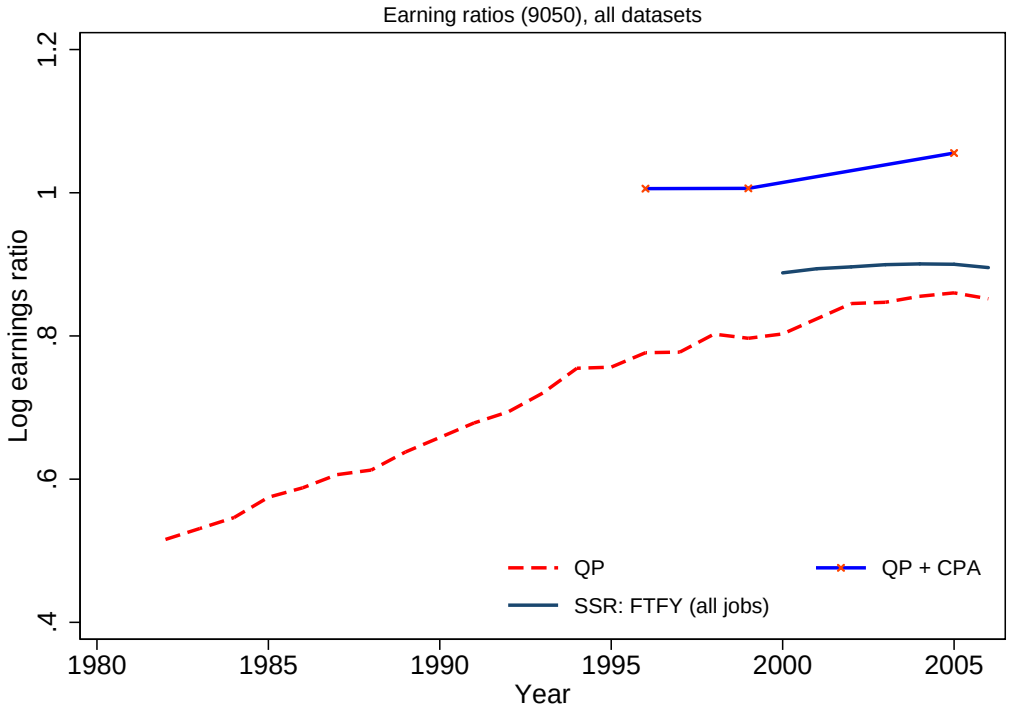


Figure 4: Log wage ratio 90/50: All data sets. The sample for each data set applies the same criteria as in Figure 1. The QP sample includes all private sector workers in October of each year. The SSR sample includes, for each individual, the sum of his/her annual wages from all employment spells over the year. The QP + CPA includes all private sector workers and all central government full-time civil servants. (about 75 percent of all civil servants).

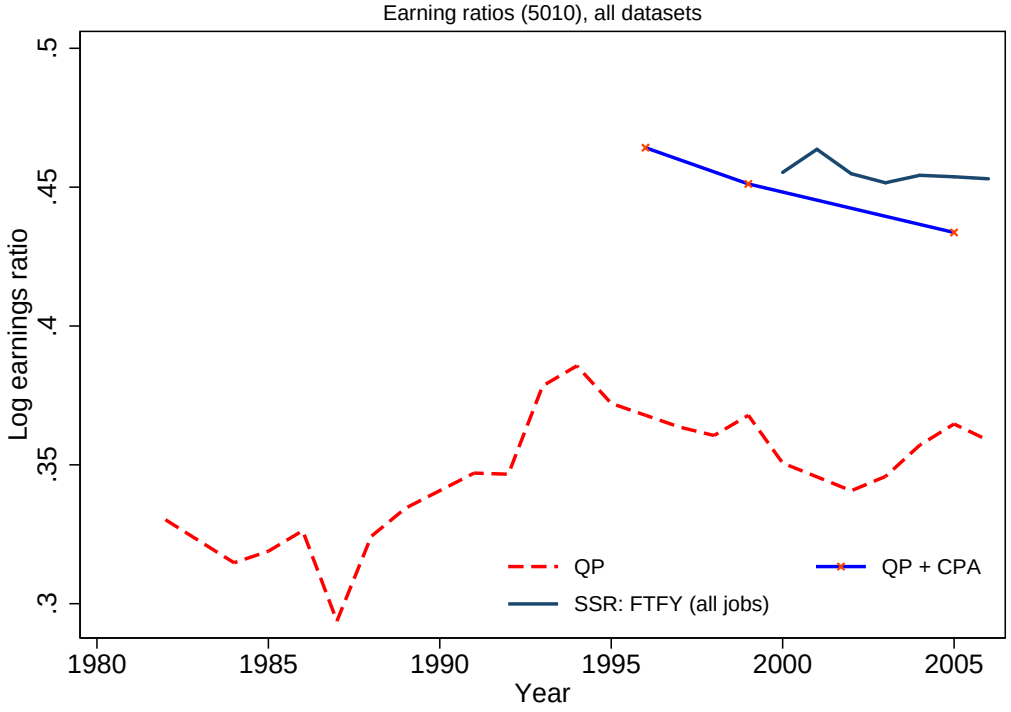
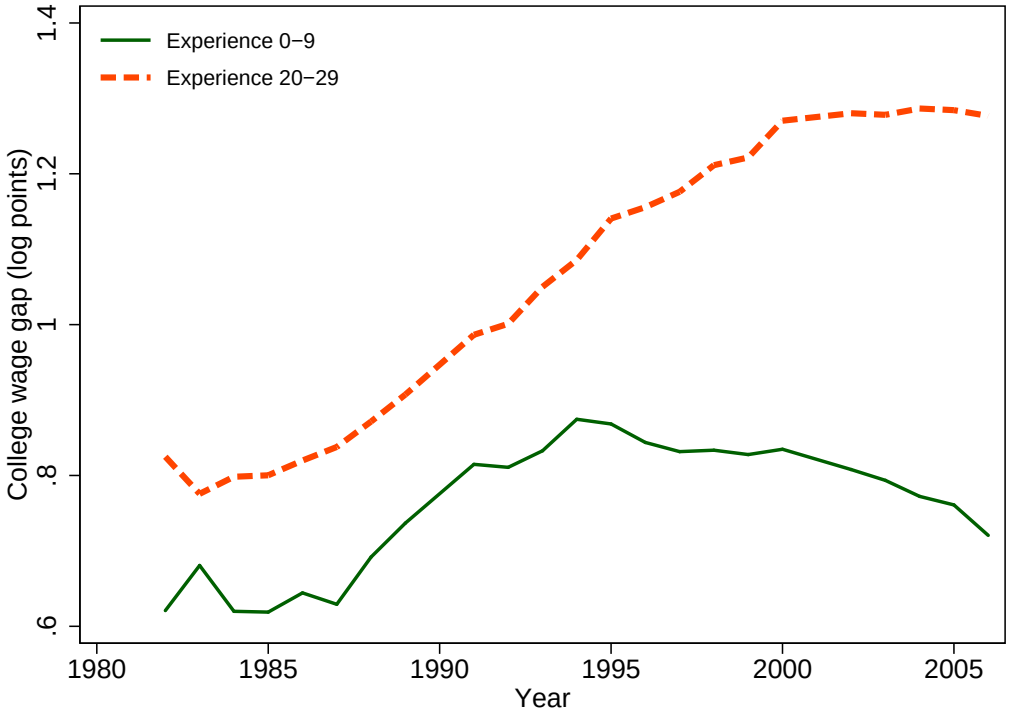


Figure 5: Log wage ratio 50/10: All data sets. See notes to Figure 4.

Figure 6: *Top panel*: College/noncollege relative supply and wage differential. The composition adjusted colege wage premium is calculated using QP data, sorted into gender-education-potential experience groups. We have two gender, five education and four potential experience groups. Mean log wages for broader groups in each year represent weighted averages of the relevant cell means using a fixed set of weights equal to the mean share of total employment by each group over 1982-2006. The detrended supply and wage series are the residuals from separate OLS regressions of the relative supply and relative wage measures on a constant and a linear trend. *Bottom panel*: Prediction for the College/Noncollege wage gap. The predicted wage gap is the fitted values from an OLS regression of the college/noncollege wage gap for the years 1984 to 2006 on a constant and the college/noncollege relative supply measure. The college/noncollege log relative supply index is the logarithm of the ratio of college-equivalent to noncollege equivalent labor supply in efficiency units in each year.



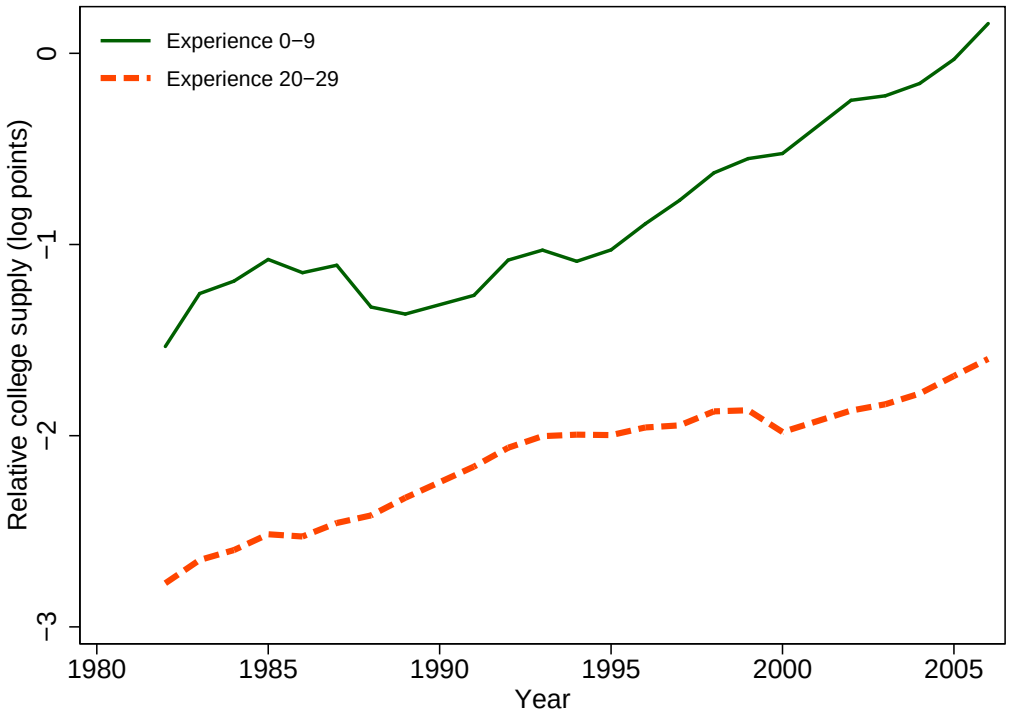


Figure 7: *Top panel*: Composition-adjusted log relative college/noncollege wage gap by potential experience. *Bottom panel*: Composition-adjusted log relative college/noncollege supply by potential experience. See notes to Figure 6 in p.38 for the details on the construction of supply and wage measures.

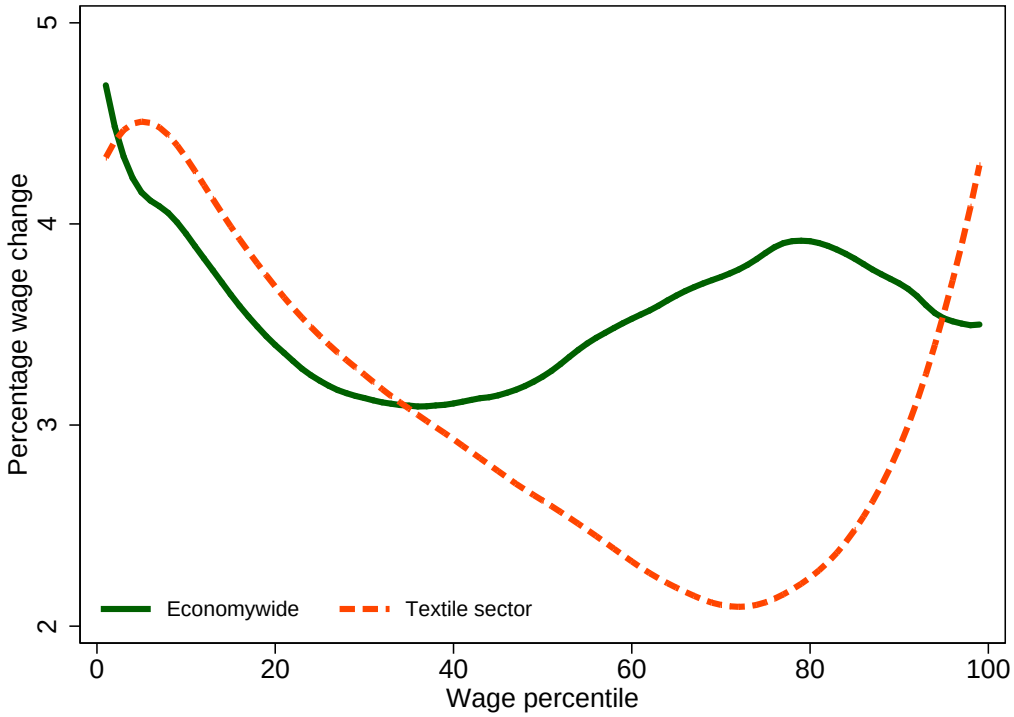


Figure 8: Wage growth rates by wage percentiles for the total of the economy and the textile sector. Source: SSR, 2005-2006. The percentiles were computed separately for each curve (all workers; only textile).

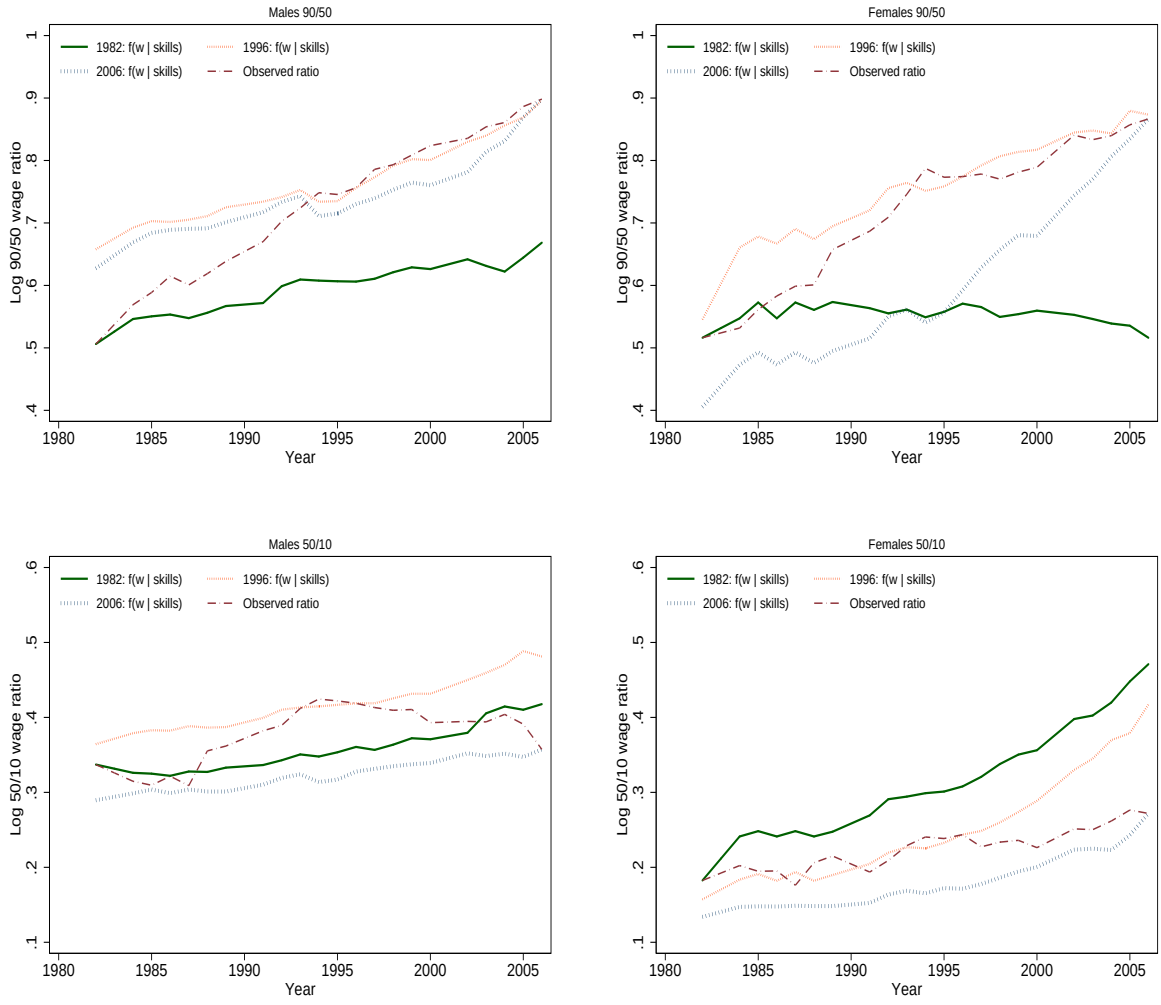


Figure 9: Actual and counterfactual 90/50 and 50/10 overall wage inequality, QP 1982-2006. The series labeled "Observed ratio" present the actual log difference between the percentiles in the data. The series labeled "Year: f(w — skills)" corresponds to the log difference of the percentiles of a reweighted (counterfactual) distribution of year "Year" where the weights are proportional to the distribution of skills (age, schooling, and interactions) in each year depicted in the x-axis and the distribution of skills in year "Year". See text for additional details.

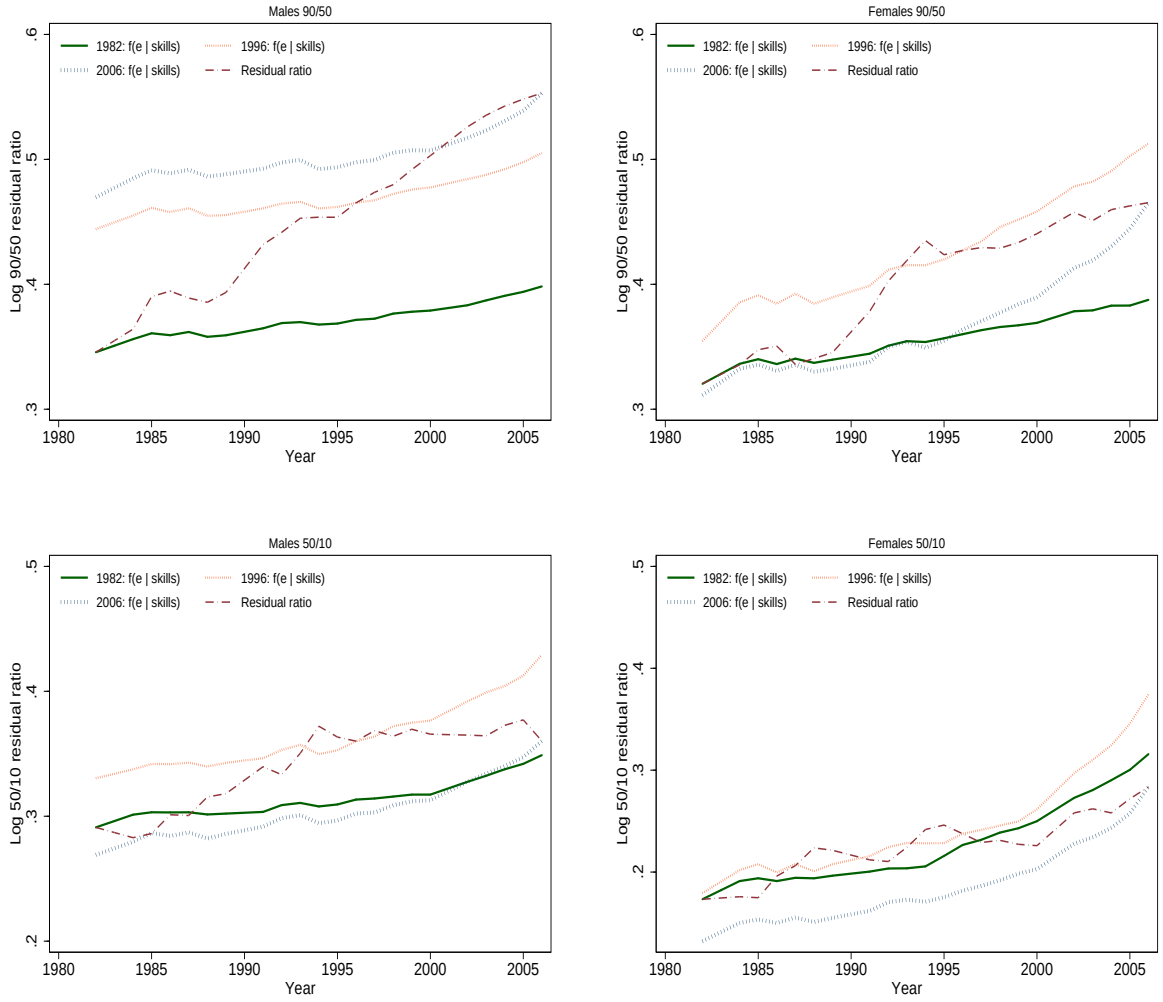


Figure 10: Actual and counterfactual 90/50 and 50/10 residual wage inequality, QP 1982-2006. The series labeled "Observed ratio" correspond to the difference between the percentiles of the residual distribution of an OLS regression of log wages on 8 age dummies, 5 education levels dummies, and all corresponding interaction terms. For the meaning of the remaining series see notes to Figure 9.

[FIGURE 9 HERE (see page 41)]

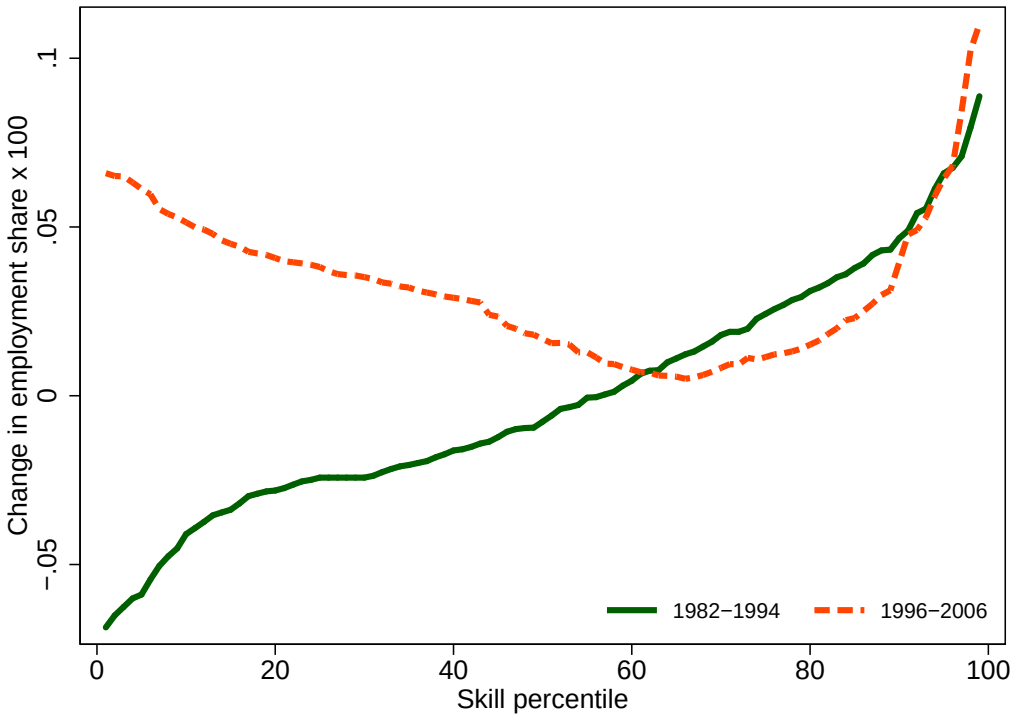


Figure 11: Change in occupation's employment shares by occupational skill percentile. The figure plots log changes in employment shares by 1982 and 1996 occupational skill percentile rank using a locally weighted smoothing regression (with bandwidth 0.8). Occupational skill is measured as the employment-weighted percentile rank of the occupation's mean years of education.

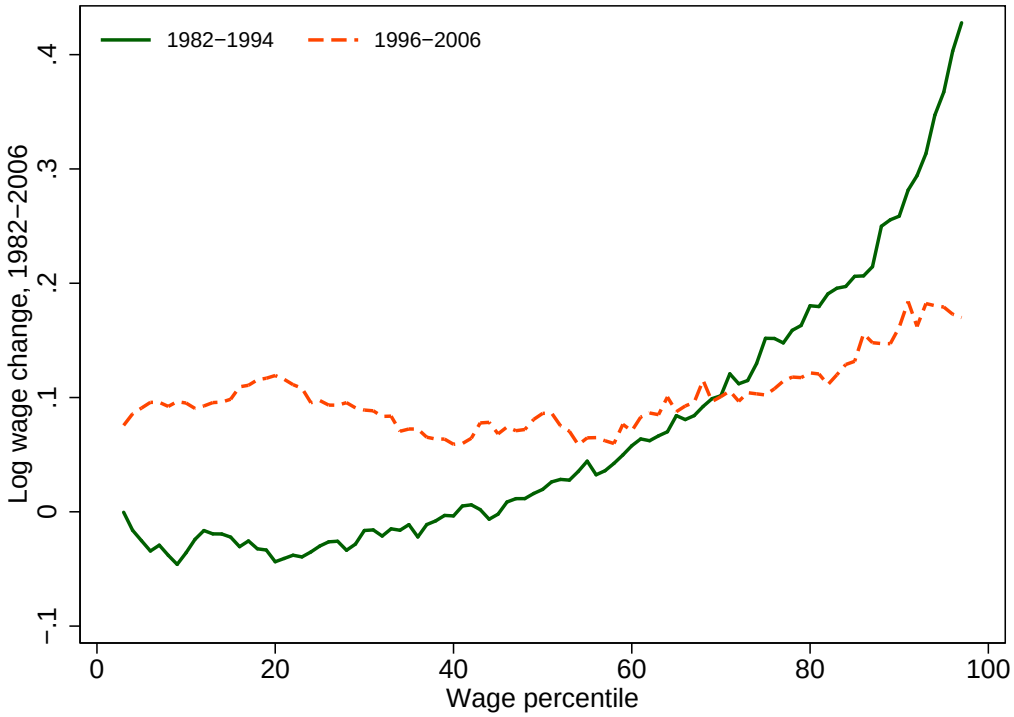


Figure 12: Change in real wages, by wage percentile. See notes to Figure 1.