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Declining returns to skill and the distribution of wages: Spain 1995-2006[1]

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Abstract

In contrast to the pattern observed in other developed countries, Spanish wage inequality did not increase during the period from 1995-2006. In this paper we analyse the relative role of supply and demand factors when accounting for this "atypical" fact. Because noticeable changes in both labour supply and labour demand - such as educational upgrading of the labour force, huge immigration flows, and a boom in the construction sector - took place during these years, we start by decomposing observed wage changes into changes in the composition of the labour force and changes in the prices of workers' and jobs' characteristics. The results indicate that the compression of the wage distribution is largely explained by a decrease in the returns to education. We also provide some evidence of the relative impact of labour supply and labour demand factors on the changes of these returns, showing that both the increase in the supply of high-skilled workers and the increasing weight of low-skilled occupations are related to the decreasing trend in the skill premium over this period.

Keywords: *Wage Structure, Quantile Regressions, Composition Effects, Polarization.*
JEL Codes: J31, J21.

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1. Introduction

There is a wide consensus that the wage distribution widened during recent decades in most advanced countries (Autor et al., 2008, Dutsman, et al., 2009); this trend is usually associated with skill-biased technological progress that results in higher wage premia for education and experience. Additionally, other factors may have contributed to increasing wage inequality; in particular, there were institutional changes in the labour market from labour market reforms that were mostly oriented towards increasing wage and employment flexibility.

Within this context, the Spanish experience is something of a puzzle. As seen in Figure 1[2], between 1995 and 2002, wages decreased throughout the entire distribution, except in the lowest percentiles, while between 2002 and 2006 there was only a slight wage increase up to the median and a decrease among the top deciles. Using Social Security data covering a longer period, Bonhomme and Hospido (2012) found that wage inequality in Spain decreased at a rate similar to that of the observed rise in other countries since the early 1990s up to the beginning of the current crisis.

Figure 1. Wage distributions in 1995, 2002 and 2006 and wage changes by decile[3]

Source: Structure of Earnings Survey (SES), hourly wages in 2002 Euros.

In this paper we investigate several possible explanations for the atypical evolution of the Spanish wage structure during the period 1995-2006. Because there were noticeable changes in both labour supply and labour demand along many dimensions, a question that needs to be addressed is to what extent changes in the composition of employment, rather than changes in returns to specific workers' and jobs' characteristics, explain the observed wage changes. Among the most relevant factors that might imply significant composition effects on the supply side are the educational upgrade of the labour force (see Lacuesta, Puente and Cuadrado, 2011) and huge immigration flows (see Carrasco, Jimeno and Ortega, 2008).[4] On the demand side, major factors include the increasing importance of the construction sector, which leads to an increasing share of low-paid workers (see González and Ortega, 2011).[5]

[2] During the period from 1995-2006, the Spanish economy experienced a long and strong expansion with significant real GDP growth (an annual growth rate of approximately 4%), a decreasing unemployment rate (14 percentage points over the period), and increasing employment creation. However, despite the large increase in labour demand, wage pressures remained subdued with aggregate real wages decreasing at annual rates of -0.5% and -0.3% in 1995-2000 and 2000-2005, respectively (OECD, 2007).

[3] Wages refer to real hourly wages. In Section 2 below we describe in detail the data source and the construction of the wage variable.

[4] Another important change over this period is the variation in the gender composition of the labour force. In this paper we follow a long-standing tradition in the analysis of the wage structure and focus on male wage distributions to abstract from fertility decisions which mainly affect female labour supply. Moreover, the increase in the female labour force participation rate is likely to have changed the selection of women into work, which may have had an independent impact on the female wage structure.

[5] Low real interest rates and lax credit conditions, together with some changes in the regulation of urban land, contributed to a boom in the construction sector (see Arce, Campa, and Gavilán, 2012).

To that end, we use the quantile decomposition technique proposed by Machado and Mata (2005) to analyse whether the evolution of the wage distribution is explained by changes in workers' and jobs' characteristics or whether it reflects changes in returns to those characteristics. Our results show that it is mainly the decrease in returns to education across all deciles, except for the first two, that explains the lack of wage growth and the compression of the wage distribution.

This leads us to further investigate why returns to education decreased. First, using a CES production framework based on Katz and Murphy (1992), we show that the increase in the high-skilled employment supply is related to the evolution of the wage differential between medium- and high-skilled workers. We also demonstrate that those occupations at the bottom of the wage distribution experienced the largest growth rates, while the employment share of occupations in the middle and the top of the wage distribution declined or experienced smaller gains.

In sum, our results contrast with previous findings in the literature for countries such as the US, Germany, or the UK, for which technological change seems to have been the main cause of the widening of the wage distribution.[6] Our results therefore call into question the applicability of the theory of skill-biased technological change to the Spanish labour market; this theory implies that technological changes are likely to decrease the demand for jobs that require routine manual skills (found typically in the middle of the wage distribution) and to increase the demand for jobs that require non-routine skills (found at the top and at the bottom of the wage distribution). On the contrary, we conclude that the observed compression of the wage distribution in Spain is related to the higher supply of highly educated workers earning lower returns to schooling combined with a growth in the demand for less educated workers, driven by a boom in the construction sector.

The paper is organised as follows. After describing the data set in Section 2, we analyse whether the changes in the wage structure are due to changes in the composition of the labour force or to changes in the returns of the workforce characteristics in Section 3. Sections 4 and 5 analyse the role of relative skill supply fluctuations and technological change, respectively, at accounting for the decline in the returns to skill. Section 6 concludes.

2. Data Description

We use data from the *Structure of Earnings Survey* for the years 1995, 2002, and 2006. This survey consists of a random sample of workers from private-sector firms of at least 10 employees in the manufacturing, construction, and service sectors.[7] It only includes workers who were on the payroll of a firm on 31st October of the corresponding year and whose main source of income is their salary. This means that the members of the Board of Directors were not surveyed.

The sampling takes place in two stages. In the first stage, firms are randomly selected from the Social Security General Register of Payments records, which are stratified by region and firm size. In the second stage, a sample of workers is randomly sampled from each of the selected firms.[8] The survey collects detailed information on workers' wages; personal characteristics such as gender, age, educational attainment, and nationality; and job characteristics, including sector, occupation, contract and job type, firm size and ownership, and region.

[6] See Autor et al (2006) for the US, Dustman et al (2009) for Germany, or Goos et al (2007) for the UK.

[7] This accounts for approximately 70% of the working population in Spain. Given that firms of 10 or more employees are not a random sample of all firms in Spain, we should be cautious in drawing inferences from our results for the full Spanish working population.

[8] An average of 5 workers are interviewed in firms with 10-20 employees, 7 workers in firms with 21-50 employees, 12 workers in firms with 51-100 employees, 20 workers in firms with 100-200 employees, and 25 workers in firms with more than 200 employees.

We compute workers' real hourly wage by taking the ratio of the gross annual salary to the total number of hours actually worked and converting it into 2002 Euros. The salary figure includes extraordinary payments. In 2002, the coverage of the survey was extended to include some non-market services (educational, health, and social services sectors) that were not included in the 1995 wave. For comparisons between these two periods, these sectors are omitted in order to obtain a homogenous sample. When we make comparisons across the 2002 and 2006 waves, we use the full sample, including the non-market sectors.[9] We restrict the sample to men between 16 and 64 years of age. Table A1 presents the descriptive statistics of our sample. Tables A2a and A2b present several individual and job characteristics for each quartile of the wage distribution.

Descriptive statistics are sufficient to reveal large changes in the composition of employment, even over short periods of time. On the supply side, these changes were mostly related to the increase in the educational level of workers, large immigration flows, and the ageing of the labour force: average years of schooling increased by 0.8 between 1995 and 2006 (the proportion of university degree-holders increased by 8 percentage points in these years), the share of immigrants in the labour force grew from 2.7% in 2002 to 6.2% in 2006, and the share of workers older than 45 years increased from 15% to 24% (Table A1).

Not surprisingly, the changes in the composition of employment are rather dissimilar as we move through the wage distribution. Immigrants are more prevalent in the lowest quartile, accounting for approximately 5% of the lowest-wage workers in 2002 and 12% in 2006. Young (old) workers are also more (less) present in the lowest quartiles. University-degree holders are more and more prevalent as we move from the lowest to the highest quartile (Table A2a). As for labour demand, there has also been a significant increase in the share of the construction sector from 9.4% of total male employment in 1995 to 13.2% in 2006, and a decrease in the share of the manufacturing sector from 17.8% in 1995 to 11.7% in 2006.[10] The increase in the share of the construction sector is largest at the two lowest quartiles of the wage distribution (Table A2b).

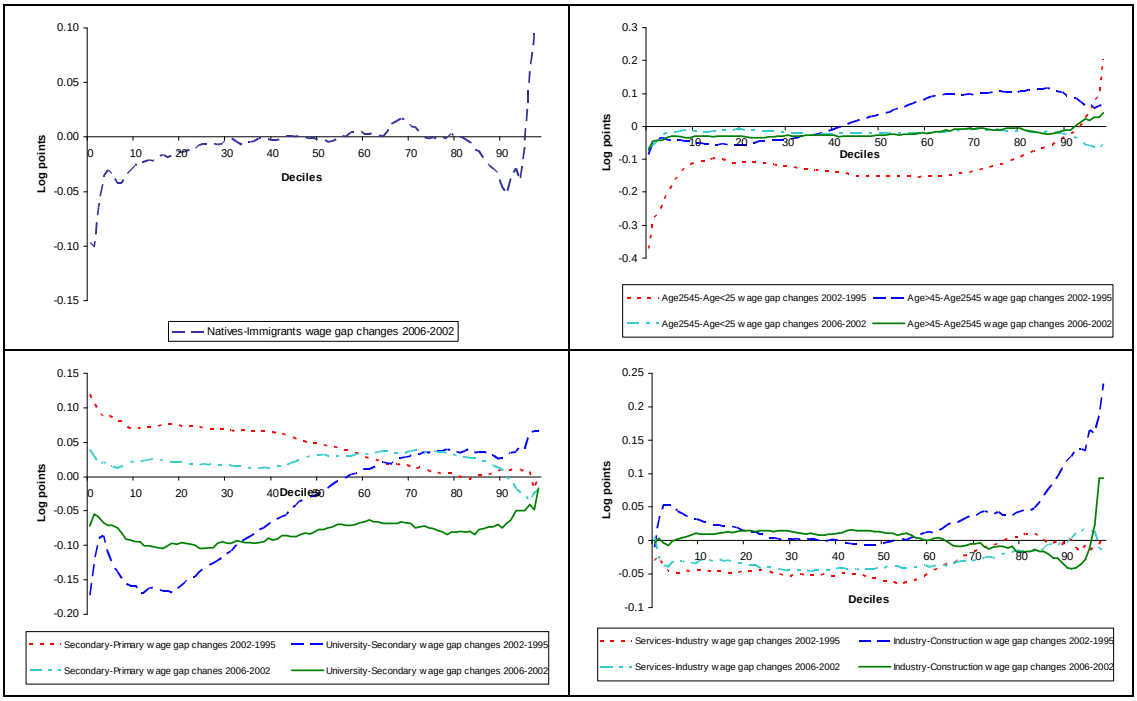
Obviously, the more sizable the wage differentials are across these dimensions, the more sizeable will be the impact of compositional effects. In Spain, wage differentials across worker and job characteristics most affected by changes in the sample period are rather large, as our results from quantile regressions demonstrate below. Moreover, these differentials have not remained constant throughout the sample period. As seen in Figure 2, the wage gap between natives and immigrants increased at the very top of the wage distribution between 2002 and 2006, and decreased for the three lowest deciles, with minor changes in the rest of the distribution.[11] As for wage differentials across workers of different age groups, there was a decrease in the relative wages of medium age workers during the period from 1995-2002. Regarding educational groups, there was a decrease in the wage gap between individuals with university and secondary education during the period from 1995-2006; this decrease was more pronounced up to 2002 for the bottom of the wage distribution and similar along all the percentiles after 2002. On the contrary, the wage gap between secondary and primary education increased during the period from 1995-2006 throughout the whole distribution. Across sectors, wages in manufacturing increased relative to services throughout the whole distribution, while manufacturing wages only increased relative to construction wages at the very top deciles.

[9]The 2006 survey was enlarged to include smaller firms. To make the dataset consistent our final sample only includes firms with more than ten employees.

[10]The 1995 survey does not cover non-market sectors, such as education, health, and social services. When excluding these sectors from the other two years of data, the qualitative results generally hold.

[11]Simón, Sanromá, and Ramos (2008) find that disparities in the wage distributions for natives and immigrants are largely explained by their different observed characteristics, mostly due to occupational and workplace segregation. Canal-Dominguez and Rodríguez-Gutiérrez (2008) conclude that the unexplained component of the wage differences between native and immigrant workers is decreasing along the wage distribution, even becoming negative at the end.

Figure 2. Wage gap changes across various individual and job characteristics



3. Labour Force Composition and Labour Market Prices

We now decompose observed wage changes into changes in the composition of employment along several worker and job characteristics, and changes in the returns to these characteristics. To do so, we apply the quantile decomposition technique proposed by Machado and Mata (2005, "MM" hereafter), which delivers counterfactual wage distributions that would have been observed had individual and job characteristics remained constant.[12]

3.1 Computing counterfactual wage distributions

The MM technique uses quantile regressions (QR) to partition the observed distribution of wages into "price" components (wage coefficients) and "quantity" components (labour force composition) and calculates, through simulation, the impact of each of these components on aggregate wage changes.[13] Thus, the first step is to examine the distribution of log wages each year, conditional on covariates. A conditional distribution can be described in terms of its quantiles. Following Koenker and Bassett (1978) and Buchinsky (1998), we assume that the θ^{th} quantile of the log wage distribution in year *t* conditional on characteristics is linear in characteristics:

$$Q_\theta(w_t \mid X_t = x_t) = \beta_t(\theta)x_t \qquad \textbf{(1)}$$

[12]Applications and extensions of the MM methodology can be found in Albrecht et al. (2003, 2011), Melly (2005), Arulampalam et al. (2007) or Martínez-Sanchís et al. (2011).

[13]There are other techniques for decomposing differences in distributions. For instance, Dinardo, Fortin, and Lemieux (1996) use nonparametric weighted-kernel methods to assess the extent to which the observed changes in the marginal distribution of wages may be ascribed to changes in the distribution of individual attributes. The MM approach is parametric, but avoids the curse of dimensionality and enables the identification in the changes in the wage density that is not explained by the change in the distribution of the covariates.

where $\theta \in (0,1)$, w_t and x_t are individual (log) wages and a vector of characteristics, respectively, for year *t*, and $Q_\theta(.)$ is the conditional θth-order quantile of the distribution of log wages given x_t. $\beta_t(\theta)$ is a vector of QR coefficients.

The next step is the estimation of the marginal density of wages. Notice that this estimation could be made directly from the data on wages. The problem is that the density would not necessarily be consistent with the conditional distribution previously estimated. To obtain the marginal distribution of wages which conforms to the estimated conditional distribution, MM propose the following resampling procedure: (i) draw a random θ from the uniform (0,1) distribution and estimate $\hat{\beta}(\theta)$, (ii) draw a value of *x* at random from the empirical distribution of the covariates, (iii) multiply the two to generate a simulated value of *w*, which is a draw from the wage density implied by the model. By applying this procedure repeatedly, we can draw an arbitrarily large random sample from the desired distribution. Then, by applying the labour force composition data from period *t*, x_t, to the estimated coefficients from period *s*, $\hat{\beta}_s(\theta)$, it is possible to simulate the counterfactual distribution of wages that would have prevailed if labour force composition were as observed in time period *t* and labour market prices were as observed in time period *s*.[14] Thus, the decomposition of wage changes takes the form of

$$w_t(\theta) - w_s(\theta) = [\hat{w}_t(\theta) - \hat{w}_{t,s}(\theta)] + [\hat{w}_{t,s}(\theta) - \hat{w}_s(\theta)] + residual, \qquad (2)$$

where $w_t(\theta)$ denotes the observed log wages at time *t*, $\hat{w}_t(\theta)$ denotes the estimator of the log wages at time *t* based on the observed sample, and $\hat{w}_{t,s}(\theta)$ denotes the estimator of the log wages that would have resulted in *t* if all covariates had their distributions as observed at time *s*. Thus, the first bracketed term represents the effect of changes in the distribution of covariates, while the second bracketed term represents the effect of changes in coefficients. The residual term captures the changes unaccounted for by the estimation method.

We are also interested in the marginal distribution of wages in one year, *t*, if only one covariate was distributed as in other year, *s*. To generate a random sample from that marginal distribution of wages, the steps in the MM algorithm are similar to the previous ones. For instance, suppose that we are interested in the distribution of wages in *t* if only the proportion of immigrants was as in *s*. We just have to notice that the *t* marginal distribution of wages is a mixture of the wage distribution for natives and of the wage distribution for immigrants with weights that equal the proportions of natives and immigrants in the *t* workforce. Then, the MM procedure amounts to a change of the weights in that mixture to the proportions in the *s* workforce.

3.2 Quantile Regression Results

We estimate QR models using two alternative specifications. In the first specification (model 1) only workers' age (and its square), three educational dummies, and worker's nationality are included as regressors. In the second specification (model 2), some job characteristics such as occupation (seven occupational dummies) and sector of activity (twelve sectoral dummies in 1995 and thirteen in 2002 and 2006), type of contract (permanent or temporal), and dummies for part-time employment and tenure (lower than four years) are also included. Note that the interpretation of the coefficients in these models should not be causal but merely descriptive because of the problems involved with the estimation of the effects of variables such as schooling or experience.[15] Our motivation for

[14]It is important to stress that this decomposition ignores general equilibrium effects, as it is based on the assumption that changes in quantities do not affect changes in prices.

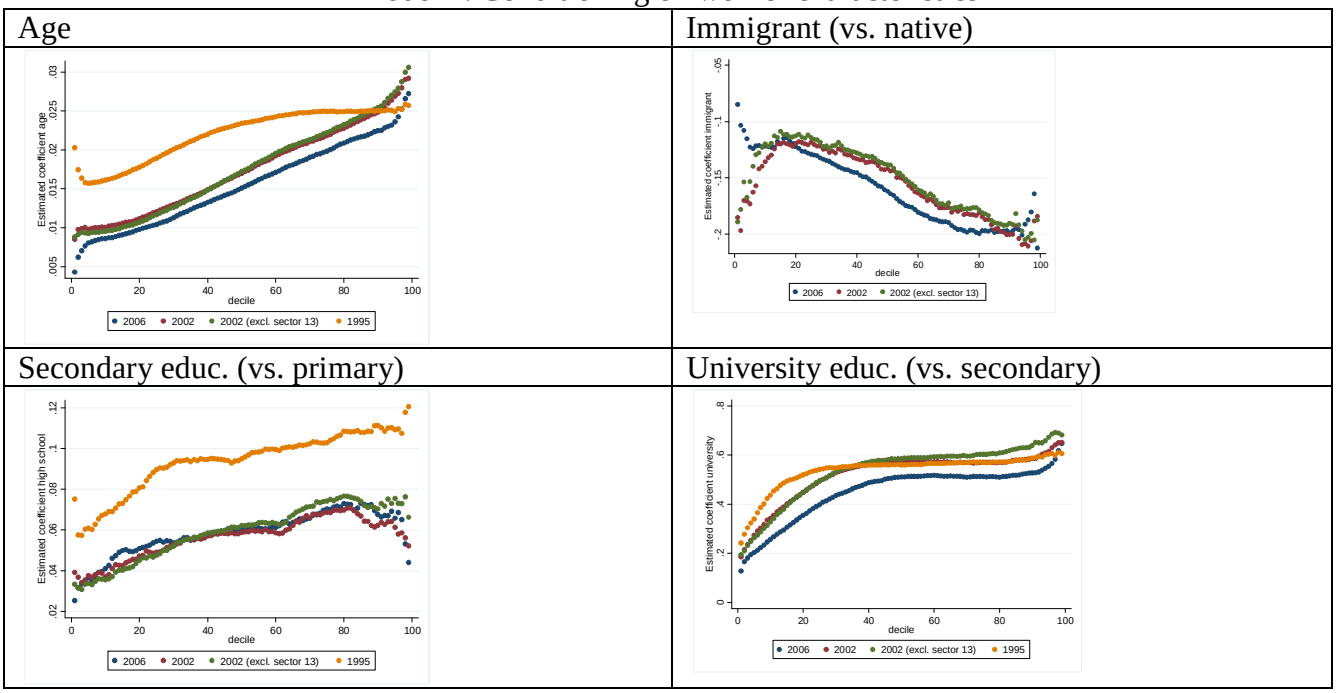
[15]For instance, the presence of unobserved individual ability might cause us to overstate the causal effect of education on wages due to the potential positive correlation between ability and schooling and the positive effect of ability on wages. On the other hand, measurement error in schooling variables would lead us to understate its effect on wages. Martinez-Sanchis et al. (2012) account for the endogeneity of schooling in the construction of counterfactual distributions.

estimating both specifications is to draw conclusions about the sources of wage changes when returns to worker characteristics include the consequences of occupational and sectoral matching (model 1) and, alternatively, when those returns are computed across jobs of similar characteristics (model 2).

Figure 3 presents the coefficient estimates, $\hat{\beta}_t(\theta)$, for θ = 0.01, 0.02,..., 0.99, for selected variables. In the case of age, older workers earn between 1.5 and 2.5% more per year at the median and top deciles, although returns to age significantly decreased from 1995 to 2002, especially at the lowest deciles of the distribution. Immigrants earn less than natives (approximately 15% less at the median), with this gap increasing along the wage distribution and over time. Finally, the positive effect of education on wages is more important at the top than at the bottom of the wage distribution, and has decreased over time.[16] In particular, we observe a decrease in the returns to secondary versus primary education between 1995 and 2002, and a decrease in the returns to university versus secondary education between 2002 and 2006.[17] When we include job characteristics among the regressors (model 2), we find that the magnitudes of these effects are smaller, although the main qualitative conclusions are unchanged.

Figure 3. Quantile regression coefficients

Model 1. Conditioning on worker characteristics



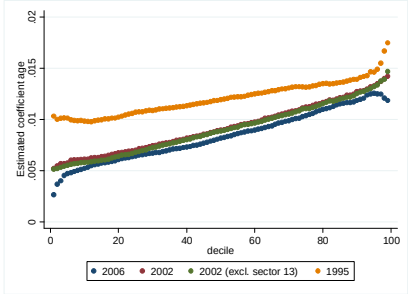
[16] This result is also reported by Felgueroso, Hidalgo and Jimenez-Martin (2010).

[17] Our results are in line with those of previous studies who have looked specifically at the wage returns to education in Spain. De la Fuente and Jimeno (2009) show that Spain has low returns to education compared with many European countries. For further evidence on decreasing returns to education in Spain, see Abadie (1997), Izquierdo and Lacuesta (2012) and Lacuesta, Puente and Cuadrado (forthcoming).

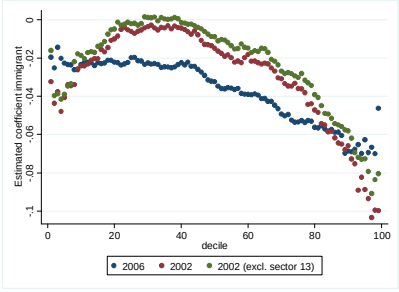
Figure 3 (continued)

Model 2. Conditioning on both worker and job characteristics

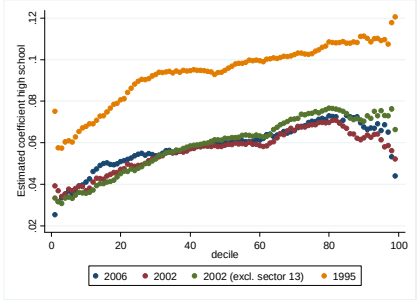
Age



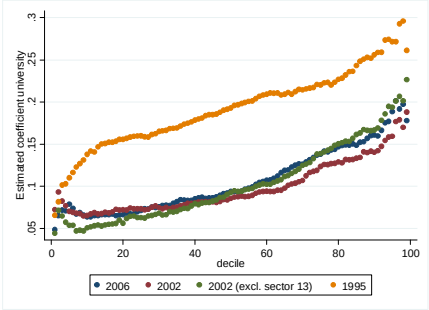
Immigrant (vs. native)



Secondary educ. (vs. primary)



University educ. (vs. secondary)



Note: The first panel represents the effect of age evaluated at its mean value in 1995.

3.3 Counterfactual Distributions

Figure 4 summarises the decomposition of observed wage changes (solid lines) into changes in the coefficients (dashed lines) and changes in the composition of the labour force (dotted lines). The first panel shows that during 1995-2002 at the first two deciles, changes in the composition of the workforce would have generated a larger wage decrease than the observed decrease, while changes in the returns would have generated an increase. For the rest of the wage distribution, the effects of characteristics and coefficients are both negative, and the negative effect of returns is the larger of the two. Thus, had the distribution of returns not changed, the change in the distribution of characteristics would have generated only a "small" decrease in wages up to the 70th percentile (on the order of 4% at the median). As a result, negative wage growth was driven mostly by the decreasing effect of returns.

During the period from 2002-2006, wages slightly increased up to the 30th percentile and slightly decreased afterwards. This is the net result of two opposite effects: a positive effect due to changes in the composition of the labour force, and a negative effect due to changes in the price of the characteristics; this effect is most prominent from the 30th percentile upwards. Finally, note also that in the period from 1995-2002, there is a difference between the composition effects that account only for individual characteristics (model 1) and those that account for both individual and job characteristics (model 2). During this period, the combination of worker and job characteristics pushed wages down to a larger extent than when worker characteristics alone are accounted for. This discrepancy is especially evident at the top of the distribution.

Figure 4. Decomposition of wage changes by deciles

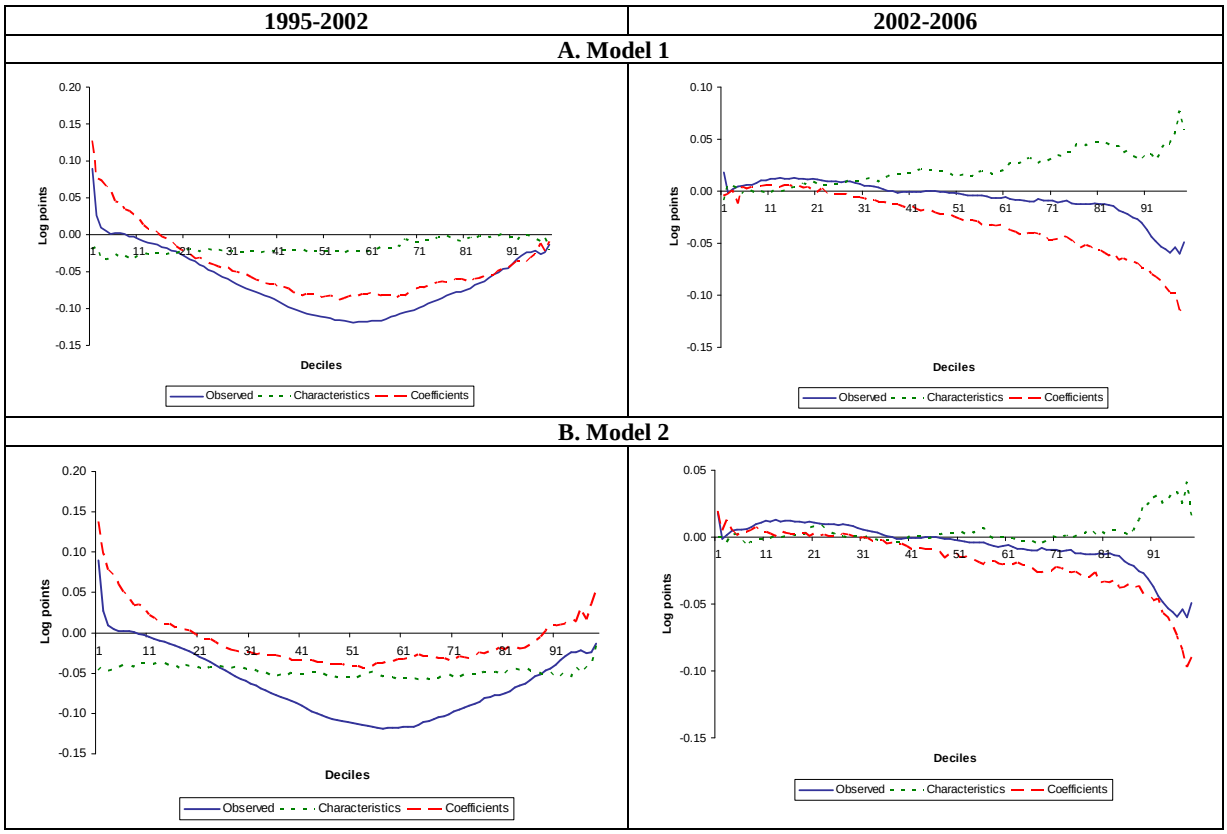


Table A3 in the Appendix details previous results for selected quantiles of the distribution. For each quantile, the first column presents the observed wage change. The second and third columns display the counterfactual wage change that we would have observed if only the returns and only the worker and job characteristics would have changed, respectively.[18] The rest of the columns report the wage changes that we would have observed if only a selected characteristic had changed (the returns are assigned the values observed in the final year of the sample).[19] In this regard, the most noticeable findings are that i) the contribution of educational upgrades to increasing wages was relatively small – especially at the bottom deciles - and did not compensate for the decrease in returns to schooling estimated above; ii) the negative effect of the decrease in tenure during the period from 1995-2002 was noticeable; and iii) the overall contribution of occupational and sectoral changes in employment composition was negative, especially in the period from 1995-2002.

4 Skill supply changes

The previous findings lead us to address the issue of the relative contribution of supply and demand of skills on wage changes. To do so, we follow Katz and Murphy (1992) and use a CES production function which relates aggregate output, Y, to three factors: low, medium, and high-skilled labour, denoted N_L, N_M, and N_H, respectively. Under the assumption that labour is paid its marginal product, the medium-low and high-medium wage differentials are given by

$$\begin{aligned} \log(w_{Mt}/w_{Lt}) &= 1/\sigma_{ML}(\lambda_t - \log(N_{Mt}/N_{Lt})], \\ \log(w_{Ht}/w_{Mt}) &= 1/\sigma_{HM}(\theta_t - \log(N_{Ht}/N_{Mt})], \end{aligned} \qquad (3)$$

where σ_{ML} and σ_{HM} are the aggregate elasticities of substitution for medium- versus low- and high- versus medium-skilled labour, respectively; $N_{Lt,}$ $N_{Mt,}$ and $N_{Ht,}$ are the quantities employed for low-,

[18] The coefficient term also includes the difference between the constants of the regressions for each of the two years being compared.
[19] When possible, in each cell we also report the percentage of the total observed change explained by the corresponding factor.

medium-, and high-skilled workers, respectively; and λ_t and θ_t are demand shifters. One problem that arises in estimating the pair of equations (3) is that we only have information on three time periods. Nonetheless, we take advantage of the geographical variation in our data and estimate these equations using OLS with time and region as our units of analysis; this approach results in 3*x*17=51 observations. We include regional and time dummies as control variables.

Table 1 reports the results. We find a significant coefficient of the relative supply of high- versus medium-skilled workers, which implies an elasticity of substitution of approximately 3.5 (1/0.284). This value is similar to that obtained by Dustman et al. (2009) and larger than the estimates typically found in the US (approximately 1.5); this difference may be explained by the fact that the US estimates typically refer to the elasticity of substitution between low- and high-skilled labour, which are most likely less substitutable than are the medium- and high-skilled labour that we consider in this paper.[20] Moreover, the model explains 89% of the variation in the wage premium of high-skilled relative to medium-skilled labour, while for the medium- versus low-skilled labour, the model performs worse; in this latter case, the relative supply coefficient estimate is not statistically significant.

Therefore, these results suggest that the increase in the high-skilled employment supply appears to play a role in explaining the evolution of the skill prices. Hence, in contrast to the overall findings for other countries, in Spain, the positive impact of skill-biased technological progress on the relative demand of high-skilled workers seems to have been small; in any case, this impact was lower than the impact of the increase in the supply of high-skilled labour. Given the large immigration flows, there was also a large increase in the supply of medium- and low-skilled workers that, as we show in the next section, was accommodated by changes in the composition of production not related to technological progress.

[20] Another explanation could be related to the fact that wages in Spain are less responsive to supply and demand shocks due to the large influence of collective bargaining.

Table 1. Regression models for the education wage gap

	Medium versus low		High versus Medium	
	Coeff.	**St. error**	**Coeff.**	**St. error**
Relative supply	-0.040	0.027	-0.284	0.055
2002 dummy	0.021	0.014	-0.003	0.022
2006 dummy	0.029	0.014	-0.053	0.022
constant	0.095	0.027	0.117	0.098
R^2	0.721		0.889	
Nº obs.	51		51	

Note: The table reports the coefficients from an OLS regression of the medium-low (high-medium) wage differential on the indicated variables. Time and regional dummies were included.

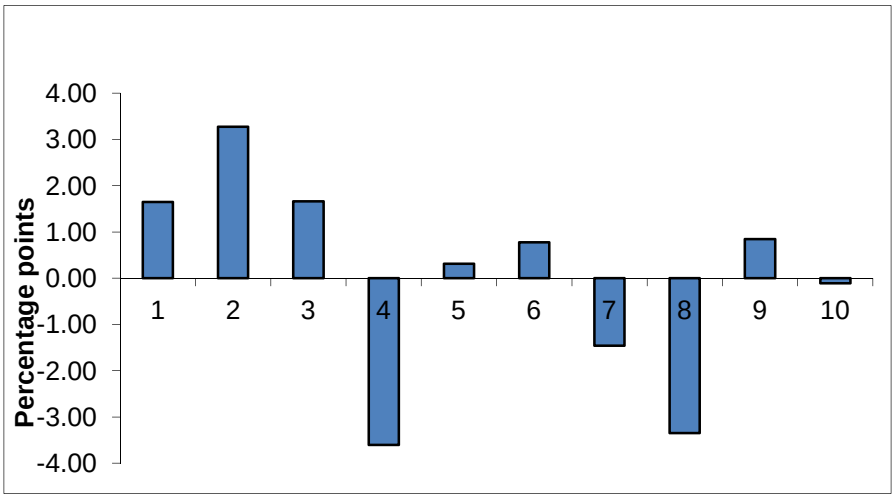
5. Demand shifts

So far, we have noted that there are differences between wage changes in the upper tail and the lower tail of the wage distribution, which, to a great extent, are related to the decrease in the returns to education. In this section, we investigate to what extent shifts in relative labour demand are compatible with this pattern. Some authors, such as Goss and Manning (2007) or Autor et al. (2008), provide a demand-based explanation for the evolution observed in the UK and the US, respectively, by arguing that technological change differentially affects the bottom and the top of the skill distribution, leading to a polarisation of the workforce. The idea is that if routine skills are mainly used in the middle of the wage distribution and manual and interactive skills are used at the bottom and top of the wage distribution, respectively, we would see that occupations in the middle of the wage distribution should have lower growth rates than occupations at the top and the bottom of the wage distribution.

To test this hypothesis, we follow Dustman et al. (2009) and rank the 57 occupational groups in our data according to their median wages in 1995. We then group the occupations into 10 groups of approximately equal size and calculate the percentage change in the employment share for the 10 groups. Figure 5 shows the results. We find that the employment share of occupations at the bottom of the wage distribution (up to the 3rd decile) has increased. In contrast, the employment share of occupations in the middle and the top of the wage distribution have either decreased or increased very slightly.[21] These results go against a simple theory of symmetric skill-biased technological change and are in accordance with the decrease in the skill premium that was previously documented.

[21] Dustman et al. (2009) find opposite results for Germany: occupations at the top of the distribution are the only ones that experienced strong gains.

Figure 5. Percentage change in employment share by job quality decile, 2006-1995.



6. Conclusions

During the period from 1995-2006, the Spanish wage distribution was characterised as being highly stable. This is a period in which noticeable changes in both labour supply and labour demand took place in Spain, such as the educational upgrading of the labour force, huge immigration flows, and the boom in the construction sector. This paper analyses the role of supply and demand factors when accounting for the observed evolution of the wage distribution. We apply the quantile decomposition technique proposed by Machado and Mata (2005) to evaluate the effect of changes in the composition of the labour force and in the prices of worker and job characteristics in the evolution of the wage distribution. We find that over the full period, employment composition changes due to changes in education, age and immigrant composition of Spanish employees had no effects for roughly the bottom three quartiles and had a positive effect on real wages for the top quartile of the wage distribution. Changes in job characteristics explain lower real wages during the period from 1995-2002. We find that it is largely the decrease in returns to some individual characteristics, most notably education, that causes the wage compression.

Finally, we find that the increase in the supply of highly educated workers played a significant role in explaining the trends in the skill premium; this role was especially important in driving the wage differential between individuals with a university degree and those with only secondary education. Despite technological changes, labour demand shifted towards low-skilled occupations due to the sectoral change brought by the boom in construction. Additionally, the relative increase in the share of highly educated workers may be related to an increase in the educational opportunities in Spain, although more research is needed on this topic. However, this increase in opportunities may have been due partly to a reduction in the costs of schooling, which could have led to an increase in the proportion of individuals who are less skilled or who have less valued degrees. These individuals could be behind the reductions in the returns to schooling in Spain.

APPENDIX. Table A1. Sample means (standard dev. in cursive)

	1995	2002*	2002	2006
Log Hourly Wage	2.404	2.343	2.360	2.354
	0.525	*0.510*	*0.519*	*0.502*
Age<25	0.188	0.174	0.155	0.120
	0.390	*0.379*	*0.361*	*0.325*
25<=Age<=45	0.659	0.649	0.647	0.643
	0.474	*0.477*	*0.478*	*0.479*
Age>45	0.153	0.177	0.199	0.237
	0.360	*0.381*	*0.399*	*0.425*
Primary Education	0.363	0.311	0.296	0.285
	0.481	*0.463*	*0.456*	*0.452*
Secondary Education	0.530	0.567	0.550	0.533
	0.499	*0.495*	*0.497*	*0.499*
University Education	0.107	0.121	0.154	0.181
	0.310	*0.327*	*0.361*	*0.385*
Immigrant		0.029	0.028	0.062
		0.167	*0.164*	*0.241*
Tenure ≤ 3 years	0.309	0.453	0.448	0.434
	0.462	*0.498*	*0.497*	*0.496*
Part-time	0.016	0.032	0.045	0.066
	0.126	*0.177*	*0.208*	*0.249*
Temporary Contract	0.243	0.257	0.259	0.271
	0.429	*0.437*	*0.438*	*0.444*
Professionals	0.101	0.082	0.114	0.118
	0.302	*0.274*	*0.317*	*0.322*
Technicians	0.107	0.134	0.138	0.135
	0.310	*0.341*	*0.345*	*0.342*
Administrative workers	0.102	0.076	0.076	0.083
	0.302	*0.265*	*0.265*	*0.276*
Services and trade workers	0.060	0.073	0.076	0.062
	0.238	*0.261*	*0.264*	*0.241*
Skilled manual workers	0.240	0.261	0.241	0.258
	0.427	*0.439*	*0.427*	*0.437*
Machinery operators	0.274	0.265	0.246	0.215
	0.446	*0.442*	*0.431*	*0.411*
Unskilled workers	0.115	0.109	0.110	0.130
	0.319	*0.311*	*0.313*	*0.336*
Extraction industries	0.019	0.019	0.017	0.015
	0.137	*0.135*	*0.129*	*0.121*
Manufactures	0.178	0.153	0.139	0.117
	0.383	*0.360*	*0.345*	*0.321*
Chemical manufacturing	0.133	0.110	0.100	0.098
	0.340	*0.313*	*0.299*	*0.297*
Metal manufacturing	0.146	0.143	0.129	0.122
	0.353	*0.350*	*0.335*	*0.327*
Other manufacturing	0.087	0.076	0.069	0.065
	0.282	*0.265*	*0.253*	*0.246*
Electricity, water and gas	0.034	0.022	0.020	0.018
	0.181	*0.147*	*0.140*	*0.134*
Construction	0.094	0.135	0.122	0.132
	0.292	*0.342*	*0.328*	*0.339*
Trade	0.078	0.092	0.084	0.088
	0.268	*0.290*	*0.277*	*0.283*
Hotels and restaurants	0.044	0.046	0.042	0.040
	0.206	*0.210*	*0.200*	*0.196*
Transports	0.064	0.072	0.065	0.072
	0.245	*0.259*	*0.247*	*0.259*
Financial activities	0.076	0.055	0.050	0.047
	0.265	*0.229*	*0.218*	*0.211*
Real state	0.046	0.075	0.068	0.082
	0.209	*0.264*	*0.252*	*0.275*
Non-market sectors			0.096	0.104
			0.295	*0.305*
Number of observations	122476	95268	105380	104252

Table A2a. Individual characteristics by quartiles of the wage distribution.

	Year	0-25	25-50	50-75	75-100
	1995				
Immigrant (%)	**2002**	5.55	3.46	1.48	0.52
	2006	12.25	7.90	3.40	1.14
	1995	24.88	8.99	3.55	1.13
Age<25 (%)	**2002**	27.52	15.27	7.39	1.62
	2006	22.75	12.74	5.85	1.23
	1995	59.00	61.86	57.92	52.40
25<=Age<=45 (%)	**2002**	58.19	62.99	63.78	54.85
	2006	58.95	63.49	63.15	52.76
	1995	16.12	29.15	38.52	46.47
Age>45 (%)	**2002**	14.29	21.74	28.83	43.53
	2006	18.30	23.77	31.00	46.01
	1995	37.78	44.49	41.13	21.67
Primary education (%)	**2002**	37.61	35.12	29.73	15.95
	2006	38.45	34.72	27.11	13.86
	1995	59.97	51.76	50.88	49.39
Secondary education (%)	**2002**	58.61	59.15	57.37	45.03
	2006	55.61	57.50	56.50	43.73
	1995	2.25	3.75	8.00	28.94
University Education (%)	**2002**	3.78	5.73	12.90	39.02
	2006	5.94	7.78	16.39	42.41

Table A2b. Job characteristics by quartiles of the wage distribution.

	Year	0-25	25-50	50-75	75-100
	1995	59.25	60.63	62.73	56.60
Manufacturing (%)	**2002**	45.06	49.55	51.14	43.35
	2006	38.36	46.31	48.82	40.50
	1995	11.18	12.32	8.25	5.79
Construction (%)	**2002**	15.10	16.19	11.14	6.48
	2006	16.20	17.42	12.02	7.29
	1995	29.57	27.05	29.02	37.61
Services (%)	**2002**	39.84	34.26	37.72	50.17
	2006	45.44	36.27	39.16	52.21
	1995	11.23	16.79	31.53	64.50
High-skilled (%)	**2002**	13.38	17.57	29.71	70.37
	2006	15.49	18.09	31.72	68.96
	1995	54.29	62.59	57.45	31.39
Medium-skilled (%)	**2002**	51.25	60.99	56.83	25.61
	2006	48.7	59.1	54.2	27.0
	1995	34.48	20.62	11.02	4.11
Low-skilled (%)	**2002**	35.37	21.44	13.46	4.02
	2006	35.81	22.82	14.08	4.03

Note: High-skilled includes professionals, technicians and administrative workers. Medium-skilled includes skilled manual workers and machinery operators. Low-skilled includes services and trade workers and unskilled workers.

Table A3. Decomposition of the changes in the wage distribution.

2002-1995. Model 1

	Aggregate contributions	Individual covariates

	Observed changes	Coeff.	Charact.	Age	Educ.	Imm.
θ=10	-0.293	2.714	-3.245	-2.312	0.314	-1.711
θ=25	-4.301	-3.469 81%	-2.059 48%	-1.857	0.110	-1.713
θ=50	-11.106	-8.417 76%	-1.919 17%	-1.940	0.154	-1.719
θ=75	-8.792	-6.424 73%	-0.313 4%	-1.877	1.592	-1.951
θ=90	-4.496	-4.469 99%	-0.258 6%	-1.256	0.427	-1.892

2002-1995. Model 2

	Aggregate contributions			Individual covariates							
	Observed changes	**Coeff.**	**Charact.**	**Age**	**Educ.**	**Imm.**	**Tenure <=3**	**Full/Part empl.**	**Tem/Perm contract**	**Occup**	**Sector**
θ=10	-0.293	3.101	-3.720	-2.062	0.000	-1.116	-4.904	-1.434	0.189	-0.753	-1.204
θ=25	-4.301	-1.446 34%	-4.100 95%	-1.227	0.328	-1.589	-4.875	-0.219	0.114	-0.492	-1.756
θ=50	-11.106	-4.162 37%	-5.556 50%	-2.160	0.750	-2.359	-7.286	0.304	-0.063	-0.313	-2.636
θ=75	-8.792	-2.876 33%	-5.050 57%	-1.521	0.828	-1.252	-4.729	-0.005	-0.501	-1.517	-4.135
θ=90	-4.496	0.877	-4.878	-0.722	2.203	-1.377	-3.581	0.087	0.297	-1.787	-4.059

2006-2002. Model 1

		Aggregate contributions		Individual covariates		
	Observed changes	**Coeff.**	**Charact.**	**Age**	**Educ**	**Imm**
θ=10	1.050	0.625	-0.111	0.523	-0.165	-1.150
θ=25	0.944	-0.232	0.703	1.260	0.105	-1.574
θ=50	-0.209	-2.456	1.452	0.959	0.913	-2.500
θ=75	-1.188	-4.719	3.697	0.508	1.779	-3.659
θ=90	-3.085	-7.391	3.008	0.773	2.126	-1.313

2006-2002. Model 2

	Aggregate contributions			Individual covariates							
	Observed changes	**Coeff.**	**Charact.**	**Age**	**Educ**	**Imm**	**Tenure <=3**	**Full/Part empl.**	**Tem/Perm contract**	**Occup**	**Sector**
θ=10	1.050	0.334	-0.110	1.586	-0.402	-1.870	0.502	-0.256	0.019	-0.408	-1.060
θ=25	0.944	0.079 8.4%	0.289 30.6%	1.239	0.137	-1.792	0.438	-0.220	0.501	0.211	-1.780
θ=50	-0.209	-1.171	0.331	2.425	0.970	-1.727	0.142	-0.246	-0.154	-0.062	-1.282
θ=75	-1.188	-2.556	0.078	1.955	2.515	-2.101	-0.489	-0.227	-1.290	-0.996	-0.828
θ=90	-3.085	-4.407	2.438	1.684	3.509	-0.887	-0.134	0.587	-0.295	-1.729	0.748

Note: Column (1) reports the observed change in the difference between each percentile in 2002 compared to1995. Columns (2) and (3) report the estimated change explained by the indicated factor; that is, the change that would have prevailed if the corresponding factor had remained the same as in the base year. The second entry in each cell is the percentage of the total change explained by the indicated factor. Columns (4) to (6) report the wage change that we would have observed if only the corresponding characteristic had remained at the same level as in the base year. For instance, the column labelled age is obtained from the comparison of the estimated wages in 2002 versus the counterfactual 2002 wages if only age was distributed as in 1995, with the returns being those estimated for 2002.

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