Changes in the Wage Structure in EU countries

Rebekka Christopoulou (Hellenic Observatory, LSE)
Juan F. Jimeno (Banco de España)
Ana Lamo (ECB)

19 December 2008
Preliminary and incomplete

Abstract

This paper documents changes in the wage structures in nine EU countries (Austria, Belgium, Germany, Greece, Hungary, Italy, Ireland, the Netherlands and Spain) over the period 1995-2002 for which comparable cross-country microeconomic data (from the *Structure of Earnings Survey*) are available. We compute, at each decile of the wage distribution, the part of the observed wage changes that is due to changes in the composition of workers' and jobs characteristics and the part of wage changes that is due to changes in the returns to these characteristics, i.e. the so called composition and returns (or price) effects. We find that real wages in the Netherlands, Germany, Greece, Italy and Belgium have increased more the higher the initial wage level (i.e. wage growth rates trend upwards along the wage distribution), with the consequent widening of the wage distribution and an increase in wage inequality. In the case of Netherlands, Germany and Greece, this apparent widening of the wage distribution is exclusively due to compositional effects. In Belgium, and Italy the observed widening of the distribution is less pronounced and holds after controlling for compositional affects. In Austria changes in real wages have been very small and constant along the wage distribution. In contrast, in Hungary, Ireland and Spain the wage distribution has become more compressed, as the larger wage increases have taken place for low paid jobs. This finding is strengthened when looking at returns(or price effects) effects. We also provide evidence suggesting that the wage structure in EU countries has responded to macroeconomic and structural trends. In particular, observed changes in technology are positively associated with wage increases, which are larger for very high and very low paid jobs. Globalisation is associated with wage increases, but less so for the lowest wages. Finally, increases in migration are associated with declines in wages.

Keywords: *Wage Structure, Quantile Regressions.*
JEL Codes: J31

This paper is part of the Wage Dynamic Network (WDN) research. We are very grateful to our WDN colleagues for their comments and support. The support and help of Frank Smets and of our ECB colleagues in DG-Statistic were essential to gain access to five of the SES data sets used in the paper. We are grateful to Andrew McCallum for initial help with the data. We would also like to thank Eurostat for the hospitality and the National Statistical Institutes of each one of the countries studied in this paper for granting us with the SES data access and assisting with clarifications. Opinions expressed in this article do not necessarily reflect the views of the European Central Bank or of the Banco de España. Errors and omissions are responsibility of the authors.

1. Introduction

The determinants of relative wages, wage inequality and, in general, the wage structure are among the most recurrent themes in Labour Economics. Over the last two decades, studies on these topics have proliferated taking advantages of the wealth of microeconomic data sets that are becoming available, including those that contain matched employer-employee characteristics. This literature has provided relevant insights on the reasons for wage differentials among workers of different skills (i.e. returns to education, etc.), among similar workers performing different jobs (i.e. compensating differentials), theories of wage determination, the impact of labour market institutions on the wage structure, the nature of complementarities among production factors, or, most recently, wage dispersion within firms of some particular characteristics.[1]

Many of these studies have concluded that in the US and the UK, the wage distribution has been widening since the 1980s, but there is an open debate about its nature, causes and timing. Some authors claim that the widening of the US wage distribution was an one-time event associated with changes in labour market institutions (de-unionisation, changes in the minimum wages) and compositional effects (changes in labour force features), while others claim that it has continued throughout the 1990s and 2000s and was due to skill-biased technological change.[2] Regarding Europe, the conventional wisdom was that changes in the wage structure have been less marked than in the US (with the exception perhaps of the UK), and that the lack of wage flexibility and some labour market institutions have resulted in wage compression, which is in turn responsible of the increase in unemployment among unskilled workers in the 1980s and early 1990s (Krugman, 1994). More recently, some studies start showing changes in the wage structure of some European countries that seem similar to those observed in the US but happening a few years later. For example, the 2007 OECD employment outlook shows that in all OECD countries with the exception of Ireland, Japan and Spain, the earning of the 10% best paid workers increased more than that of the 10% least paid workers from 1994 to 2005 with the consequent widening of the wage distribution. Another study that documents increasing inequality for a number of OECD countries using macro data is Koeniger, Leonardi and Nunziata, (2007). Some empirical studies

[1] This literature is too wide to be adequately quoted here. For a comprehensive survey see Autor, Katz and Autor (1999). The seminal reference on the returns to education is Mincer (1974). As for some interpretation of wage differentials as non-competitive features of the labour market, see Krueger and Summers (1988). On the impact of technology on the wages structure and skill-biases, see Machin and van Reenen (1998) and Chennells and van Reenen (1999); on the impact of labour market institutions, Di Nardo et al. (1996). Regarding wage dispersion within firms, see Lazear and Shaw (forthcoming).

[2] For evidence on the first view see Di Nardo et al. (1996) and Lemieux (2006); for evidence on the second, see Autor, Katz and Kearney (2008), for the UK see for example Machin and van Reenen (1998) and their references.

using micro data have very recently documented changes in the wage structure in some European countries see for example, Dustmann (2008) for Germany and Machado and Mata (2005) for Portugal. However, there is no systematic accounting of cross-country differences in changes in the structure of wages in EU countries over the past decade.[3]

The current paper is an attempt at filling this gap. We first, document the magnitude and characteristics of changes in the wage structure of some EU countries, Second, we investigate to what extent they are due to mechanical changes in the composition of labour force and jobs, or to changes in returns due demand and supply shifts. Finally, we exploit cross-country heterogeneity in our sample to draw some conclusions about the influences of macroeconomic or structural developments as well as institutions in shaping the wage changes along the wage distribution. We are particularly interested in learning about rigidities constraining wage adjustments. How relative wages adjust to macroeconomic developments affects the level and composition of unemployment; moreover, the degree of price inertia depends upon the adjustment of the wage structure and relative wages in response to macroeconomic shocks, so that price setting and inflation persistence are not immune to changes in the wage structure.[4] Our analysis contributes to unveiling whether wages in the countries of our sample respond to market forces or are explained by more or less mechanical changes in workers characteristics (age structure, education, etc.) or changes in jobs characteristics (type of contract, sector, etc.). More generally, adjustment of relative wage is informative about wage determination, for instance, the fact that there exist sizeable wage differentials across workers of similar characteristics in different jobs (sectors, regions, etc.) and that these differentials are relatively stable through time and across countries is typically interpreted as the result of non-competitive features of the labour markets, such as efficiency wages (Krueger and Summers, 1988) or rent-sharing. Hence, changes in these differentials are usually read as changes in the degree of competition of the labour market (see, for instance, Saint-Paul, 2005, Koeniger, Leonardi and Nunziata, 2007). Finally, cross-country comparisons allow gauging the impact of technological changes, globalization and other macro trends and institutions on the wage distribution, thus helping to understanding their relevance as sources of the declining wage share observed in many EU

[3] Recent work on wage differentials for European countries includes several papers produced within the Pay Inequality and Economic Performance project (PIEP) which used 1995 data (see Marsden, 2005). Currently, several studies within the Wage Dynamic Network (WDN) analyse relative wages across industries using 1995 and 2002 data. Du Caju et al (2008) summarise the WDN evidence on industry wage differentials for a sample of 8 EU countries. In addition a number of detailed country specific projects that look at changes in the wage distribution along deciles are ongoing work within the WDN (see Pointner and Stiglbauer, 2008, for Austria, Dybczak and Galuscak, 2008 for Czech Republic, and Christopoulou and Kosma, 2008 for Greece).

[4] On the sources of inflation persistence in countries of the euro area, see Altissimo, Ehrmann and Smets (2007), Rumler (2005), etc.

countries, and to identifying reforms that have significant impact on the wage structure and facilitate the adjustment of relative wages.

Cross-country comparisons of changes in the wage structure face one main difficulty, namely, the lack of comparable cross-country microeconomic data that could allow the computation of wage variables controlling for workers and job characteristics. Without a proper accounting of the impact of these characteristics, cross-country comparisons of wages are contaminated by employment compositional effects that blur the observation of how the wage structure has been adjusting in response to macroeconomic shocks and institutional changes.

Our sample is composed of nine countries (Austria, Belgium, Germany, Greece, Hungary, Italy, Ireland, the Netherlands and Spain) over the period 1995-2002 (with some exception) for which comparable cross-country microeconomic data (from the *Structure of Earnings Survey*) are available. The period of analysis, although imposed by data availability, is very interesting as in many EU countries over this period there have been substantial labour demand shocks, as derived, for instance, from technological change and globalisation, and significant labour supply shocks, as those coming from demographic trends (e.g. immigration, population ageing, and changes in female participation and in the composition of the labour force by educational levels, etc.). Deregulation in product markets and labour market reforms have also been prevalent, affecting the way labour markets operate.

By using Mincerian (quantile) wage regressions and the Machado and Mata (2005) procedure, we compute for each of the nine countries in our sample, the part of the observed wage changes at each decile of the wage distribution, that is due to changes in the composition of workers' and jobs characteristics and the part of wage changes that is due to changes in the returns to these characteristics (i.e. the composition and price component of wage changes).

We find substantial differences across countries regarding changes in the wage structure. In the Netherlands, Germany, Greece, Italy and Belgium wage growth rates trend upwards along the wage distribution (i.e. wages have increased more the higher the initial wage level), with the consequent widening of the wage distribution and an increase in wage inequality. This widening of the wage distribution in Netherlands, Germany and Greece is fully explained by the so called composition effects (changes in wages due to changes in jobs and worker's characteristics). In Belgium and Italy the observed widening of the distribution is less pronounced and holds after controlling for compositional affects. In contrast, in Hungary, Ireland and Spain the wage distribution has become

more compressed, as the larger wage increases have taken place for low paid jobs. This is mostly due to changes in the so called returns effects (changes in the returns to jobs and worker's characteristics). In addition, we show that observed changes in technology are positively associated with wage increases, and that the effect of technology seems to be stronger for very high and very low paid jobs. Globalisation is associated with wage increases, but less so for the lowest wages. Finally, increases in migration are associated with declines in wages.

The paper has the following structure. Section 2 describes the data and the methodological approach for measuring changes in the wage distribution. Section 3 displays the main results regarding the changes in wage structures in EU countries, and the component of these changes. Section 4 interprets these changes in relationship with institutions and macroeconomic and structural trends. Finally, Section 5 concludes.

2. Data and methodology

The analysis in this paper uses microdata from the *Structure of Earnings Survey* (SES henceforth) of nine countries. This is a survey at the firm level, that involves interviewing a large sample of firms randomly selected from the Social Security General Register records or similar firm registers in the country, and obtaining information on both the firm as such and a random sample (ca. 20%, depending on the size of the firm) of their employees. Information obtained about the workers includes several measures of the pay and hours of work, age, gender, and educational attainment and some characteristics that are job specific as type of contract, sector, and occupation. Information obtained about the firm includes number of employees, whether it is privately owned, the nature of the pay bargaining regime etc. The SES is uniquely suitable for our study as (i) It is comparable across countries: this survey has been run by the national statistical office of 20 European countries on comparable basis, first occasionally and now every four years. Currently two harmonised waves exist, 1995 and 2002, with some exceptions.[5] (ii) The SES is a matched employer-employee database and, therefore, will allow us to control for individual, job-specific and firm-specific features when estimating a comparable measure of (residual wages) and "conditioning out" composition effects from both workers and firms. (iii) The data is collected at the firm level, which gives us more accurate information on pay and earnings, variables that are usually very noisy in household surveys.

[5] See table 1 for detailed sample period by country.

Not all the data for EU countries and waves are made available for research. So far, we have been able to gain access to data for nine countries (Austria, Belgium, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, and Spain).[6] After excluding outliers, the top and bottom 1% wages, workers with missing/not accurate observations for some relevant variables, and those in sectors that were missing for most of the countries and or waves (mainly education, health and recreational activities), we end up with the country-samples sizes shown in Table 1.

Table 1. Sample size per country and wave

	1st wave			2nd wave		
	1995	**1996**	**1999**	**2001**	**2002**	**2005**
Austria		93,941			85,481	
Belgium			101,302			97,409
Germany	652,676			467,932		
Greece	38,071				41,449	
Hungary		91,578			119,019	
Ireland	36,727				16,359	
Italy	79,501				73,692	
Netherlands	66,196				37,860	
Spain	170,697				173,487	

The information available in the SES allows us to construct detailed measures of earnings including or excluding several kinds of wage components. For the analysis in the present paper we have used three different measures of wages: basic hourly wage excluding payment for overtime, hourly wage including regular bonuses and payment for overtime, and hourly wage including irregular bonuses and other complements. We only show here results for hourly wage including regular bonuses and payment for overtime. We choose this variable for the sake of comparability with other SES studies that have also used it, and because we can construct it for practically all the countries and waves of our sample.[7]

Observed wage changes can be thought as the result of the changes due to the different characteristics of workers and jobs and the changes in the returns to those characteristics. To separate these two components we rely on the estimation of extended Mincer equations for log (real) hourly wages using quantile regressions, as follows:

[6] Results for Greece have been borrowed from Christopoulou & Kosma (2008), which is also a WDN research paper, follows the same methodology and uses same data and codes as this paper. Estimations for Italy, Ireland and Spain were done at the Safe Center in Eurostat and the ones for Germany via remote access at Statistics Germany. Alfred Stiglbauer, Philip Du Caju, Steven Poelhekke and Gabor Katay were kind enough to run our codes on the Austrian, Belgian, Dutch and Hungarian SES data available at their respective national central banks.

[7] Except for Hungary, for which we cannot calculate the payment for overtime in the first wave (1996) and we use a measure that excludes that payments, nevertheless we believe that this is a good proxy as paid overtime is very low in Hungary and the variables with and without overtime payment in 2002 in Hungary are very similar.

$$\ln w_{it}^{\vartheta} = Q^{\theta}(\ln w_{it} / X'_{it}) + \varepsilon_{it} = a_{it}^{\vartheta} + \sum_j \beta_{jt}^{\vartheta} X_{jit}^{\vartheta} + \varepsilon_{ti} \ , \quad Q^{\theta}(\varepsilon_t / X'_{it}) = 0 \tag{1}$$

where w_{it} is the wage of individual i in year t, $Q^{\theta}(\ln w_{it} / X'_{it})$ refers to the quantile of wages conditional on the vector of characteristics X_{it} and ϑ denotes the quantile. α is a constant, and ε is the stochastic error. The covariates, x_{jit}, include workers' and job observable features (education, tenure, type of contact, sector, region etc., in most occasions captured by dummies). We apply the procedure proposed by Machado and Mata (2005) that partitions the observed changes in the distribution of wages into quantity (changes in characteristics) and price (changes in returns) components and calculates the impact of each one of these components on changes in overall wage dispersion. Machado and Mata (2005) do this via simulations based on mean characteristics of the individuals who are in each one of the quantiles of the wage distribution.[8] Taking averages by quantile and subtracting between two periods equation (1) yields:

$$\ln w_{t_1}^{\vartheta} - \ln w_{t_0}^{\vartheta} = (a_{t_1}^{\vartheta} - a_{t_0}^{\vartheta}) + \sum_j \beta_{t_1}^{\vartheta}(\overline{X}_{jt_1}^{\vartheta} - \overline{X}_{jt_0}^{\vartheta}) + \sum_j (\beta_{t_1}^{\vartheta} - \beta_{t_0}^{\vartheta})\overline{X}_{jt_0}^{\vartheta} + (\overline{\varepsilon}_{t_1}^{\vartheta} - \overline{\varepsilon}_{t_0}^{\vartheta}) \tag{2}$$

where w_t^{ϑ} is the ϑ^{th} quantile of the wage distribution in year t, $\overline{X}_{jt}^{\vartheta}$ is the vector of mean characteristics of quantile ϑ and year t, and $\overline{\varepsilon}_t^{\vartheta}$ is the mean of the unobserved component. From this, the wage change for each quantile can be decomposed into:

- A quantity component: the so-called composition effect: $\sum \beta_{t_1}^{\vartheta}(\overline{X}_{jt_1}^{\vartheta} - \overline{X}_{jt_0}^{\vartheta})$. This is exclusively due to changes in employer or employee observable characteristics if the returns to these characteristics would have remained unchanged. Composition effects reflect mechanical changes that do not respond to market forces.
- A price component: the so-called returns effect: $(a_{t_1}^{\vartheta} - a_{t_0}^{\vartheta}) + \sum (\beta_{t_1}^{\vartheta} - \beta_{t_0}^{\vartheta})\overline{X}_{jt_0}^{\vartheta}$. This is due to changes in the returns to the characteristics only. Specifically, under the assumption that the characteristics remained unchanged, this term includes changes in the constant (i.e due to changes in unobservable features common among all employees that have not being included in the regression and/or changes in the coefficients of the omitted dummies) and changes in

[8] The Machado and Mata method is an extension of the canonical Oxaca (1973) decomposition of effects on mean wages to the entire wage distribution. Autor, Katz and Kearney (2005) show that the Machado- Mata decomposition corrects shortcomings of the original Juhn, Murphy and Pierce (1993) decomposition and nests the kernel reweighing in DiNardo, Fortin and Lemieux (1996), and Lemieux (2002, 2005).

the returns to the observable characteristics. Price or returns effects arise from shifts in supply demand and institutional factors and therefore respond to market forces.

- An unobserved or residual component: $(\bar{\varepsilon}_{t_1}^{g} - \bar{\varepsilon}_{t_0}^{g})$. This is due to changes in the remaining unobserved factors determining wages, which are not common among employees.

These counterfactual decompositions are accounting decompositions based on the estimated model (1), and their validity relies on the partial equilibrium assumption that prices and quantities can be seen as independent. This could introduce some bias in the estimation of the components as it ignores the feedback between composition and returns.

2. Observed wage changes and the role of composition and returns (price) effects

Figure 1a provides an overview of the magnitude and pattern of the changes observed in (log) hourly wage at each decile of the wage (hourly wage including overtime) distribution for the whole worker population (navy line). Figure 1b and 1c refer to the males and females population respectively. In addition, a set of summary indicators of changes in the wage distribution by country is presented in table A1 in the appendix.

Looking first at the observed changes in real wages during the sample period, they have been mostly positive along the whole range of wage levels in the nine countries of our sample, with the only exceptions of wages of the lowest paid jobs in Germany and wages in the middle part of the wage distribution in Spain. Both the magnitude and shape of the changes observed in real wages differ substantially across countries.

Observed real wages in the Netherlands, Germany, and Greece have increased more the higher the wage level i.e. real wages changes trend upwards along the wage distribution, with the consequent widening of the wage distribution and an increase in wage inequality. A widening of the observed wage distribution is also observed in Belgium and Italy, but less pronounced. In contrast, the wage distribution in Hungary, Ireland and to a lesser extent in Spain has become more compressed. The observed increase in real wages has been lowest in the middle part of the wage distribution while the largest increases have taken place for low paid jobs. This "U shape" of the wage changes along the wage distribution has been typically identified as being driven by technological changes that replace routine jobs or jobs that require intermediate skills, typically found in middle-wage jobs. This is known as the "routinization" hypothesis; a variant of the skill biased technical change hypothesis (see for example Autor, Levy and Murnane 2003). It is due to demand and supply shifts

and, therefore, if technological change is indeed the main driving force of wage changes we will expect returns effects to be responsible for the observed U shape.[9] Finally, in Austria wage changes from 1996 to 2002 are positive, very small and similar along the whole distribution with no noticeable effect on the wage distribution.

When breaking down the observed wage changes, into the part due to changes in characteristics of workers and jobs on the one hand (compositional effects), and changes in the returns to those characteristics on the other side (return effects), the estimated models work, overall, rather well, so the residuals explain a very small proportion of the total change. [10] From this exercise it turns out that compositional effects have been responsible for the observed widening of the distribution in the Netherlands, Germany and Greece. In fact, the return effects in these countries are roughly constant (red dotted line Figure 1a-c) along the whole wage distribution, which generally remains unaffected by them in terms of dispersion. Return effects even trend slightly downwards in Germany, where composition effects fully account for the negative increase of wages at the lowest end of the distribution (least-paid jobs). Composition effects have been negative for the low and middle wage jobs in all the three countries, mostly due to change sin tenure levels for Greece; change in firm size and indefinite contracts composition for Germany; and changes in education, indefinite contracts and sector for the Netherlands. In short the widening observed in the wage distribution of Germany, Greece and the Netherlands is largely due to non-market forces and mechanical effects of changes in labour force and jobs composition –without any noteworthy underlying change in market prices. These composition effects have not only shaped the changes in the wage distribution but also contributed to lower observed wage growth in the low and middle wage jobs. In contrast, in Belgium and Italy the predominant force explaining the slight widening of the observed wage distribution are the return effects. Composition effects have been positive and small in both countries having no impact on the shape of the wage distribution. Return effects turn out to be negative for the low paid jobs in Italy.

In Ireland, Hungary and Spain the return effects display a U-shape similar to the one of observed wage changes or even strengthened. Return effects are then the predominant force explaining the

[9] Recently, Autor, Katz and Kearney (2008) emphasize the complexity of the pattern of wage changes in the US and advocate for a modified version of the skill biased technical change hypothesis that emphasizes the role of information technology, observed in the UK and the U.S (see also Goos and Manning (2007) for the UK). They argue that computers most strongly complement the non-routine tasks of high-wage jobs, and substitute for the routine tasks typical of middle-wage jobs, and may have little direct impact on non-routine manual tasks in relatively low-wage jobs can help explain the observed polarization of the U.S. labour market characterized by patterns in which the middle range wages growth least but high-wages growth most, with low wages remaining basically unchanged.

[10] See tables A2a-A2c and figures A1a-A1c in the Appendix for the some break down of the wage change by country, more detailed decomposition is available from the authors.

compression of the wage distribution in these countries. Composition effects have not effects on the shape of the wage distribution, but in Spain and Hungary they have been sizeable enough across the distribution to keep wages subdued, while in Ireland composition effects account for some improvement of wages at the top of the distribution. The finding that the U shape is mainly driven by changes in returns to characteristic is compatible with the above discussed hypothesis of technological change as a skill-biased demand shift.

Finally, in Austria, the very small wage changes from 1996 to 2002 do not hide any composition and return effects working in opposite directions, but simply these return and composition components hardly change along the wage distribution.

Interestingly, while composition effects have been negative in Ireland, Belgium, Italy and Austria (very small in the last three cases), returns effects have been positive for all the nine countries of our sample, except for Italy at the lower end of the wage distribution. This result for Italy is consistent with the opening wage gap between younger new entrants and older workers in Italy as documented in Rosolia and Torrini (2008).

Figure 1a. (log) wage changes by decile, all

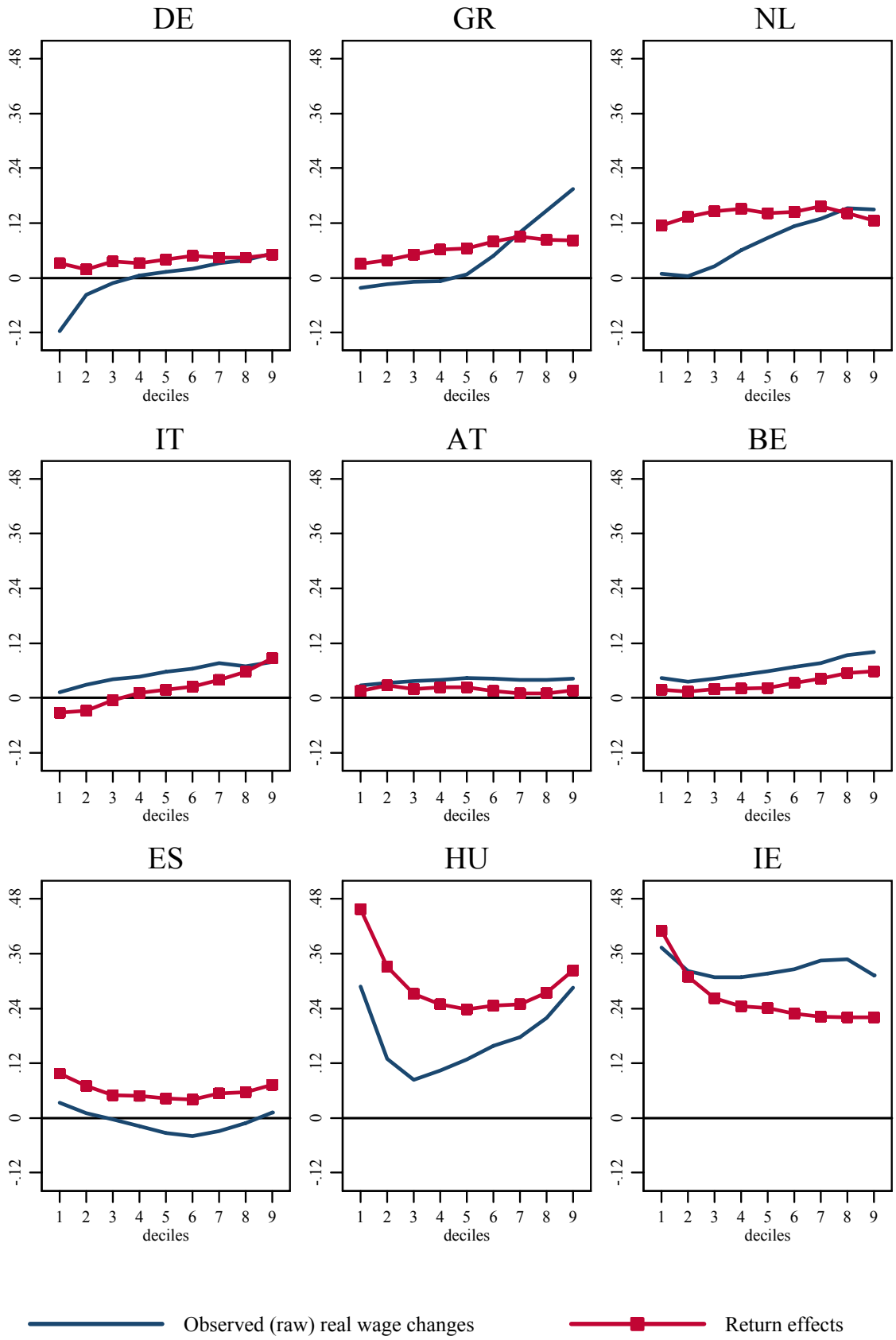

Figure 1b. (log) wage changes by decile, males

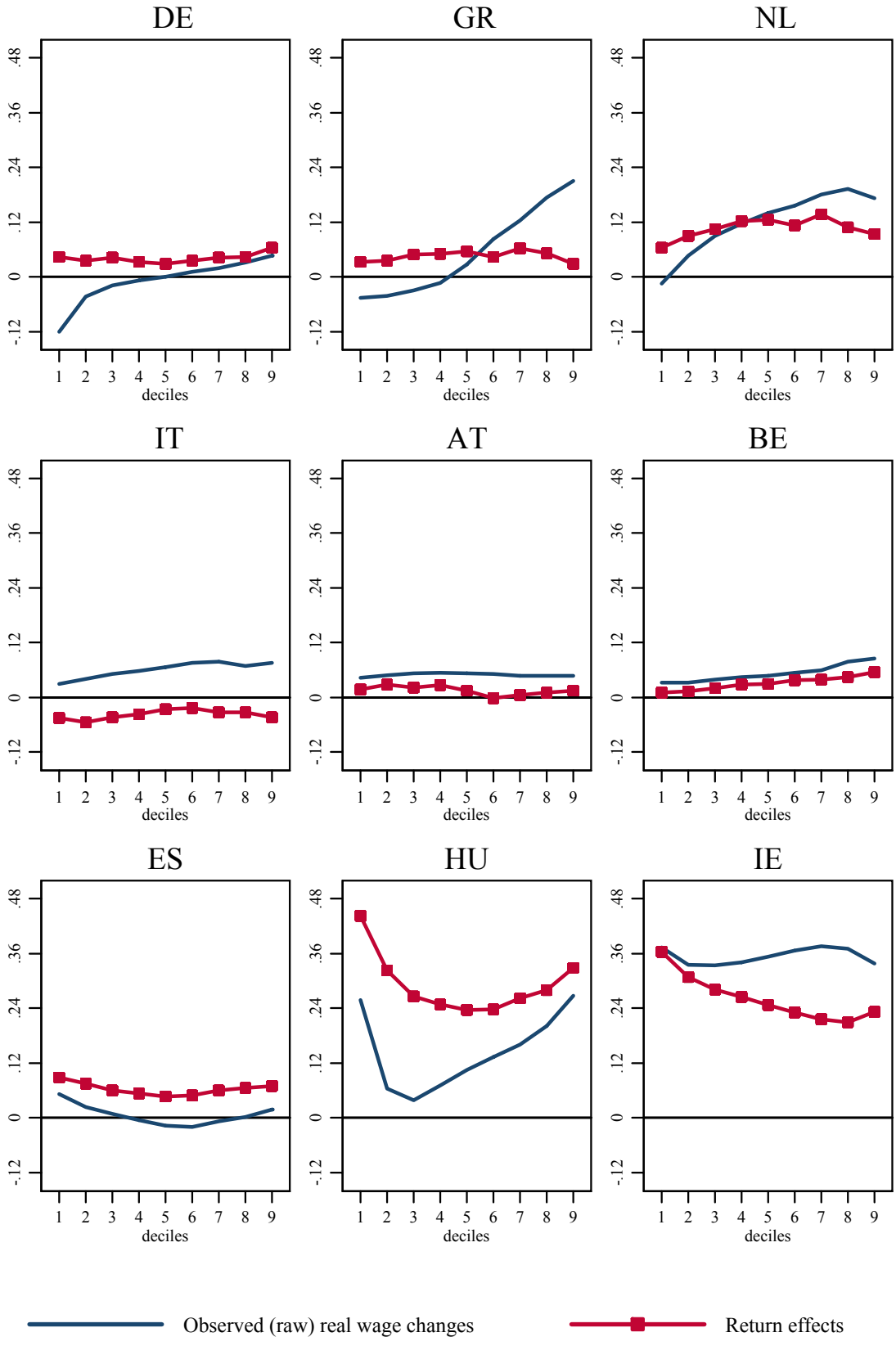

Figure 1c. (log) wage changes by decile, females

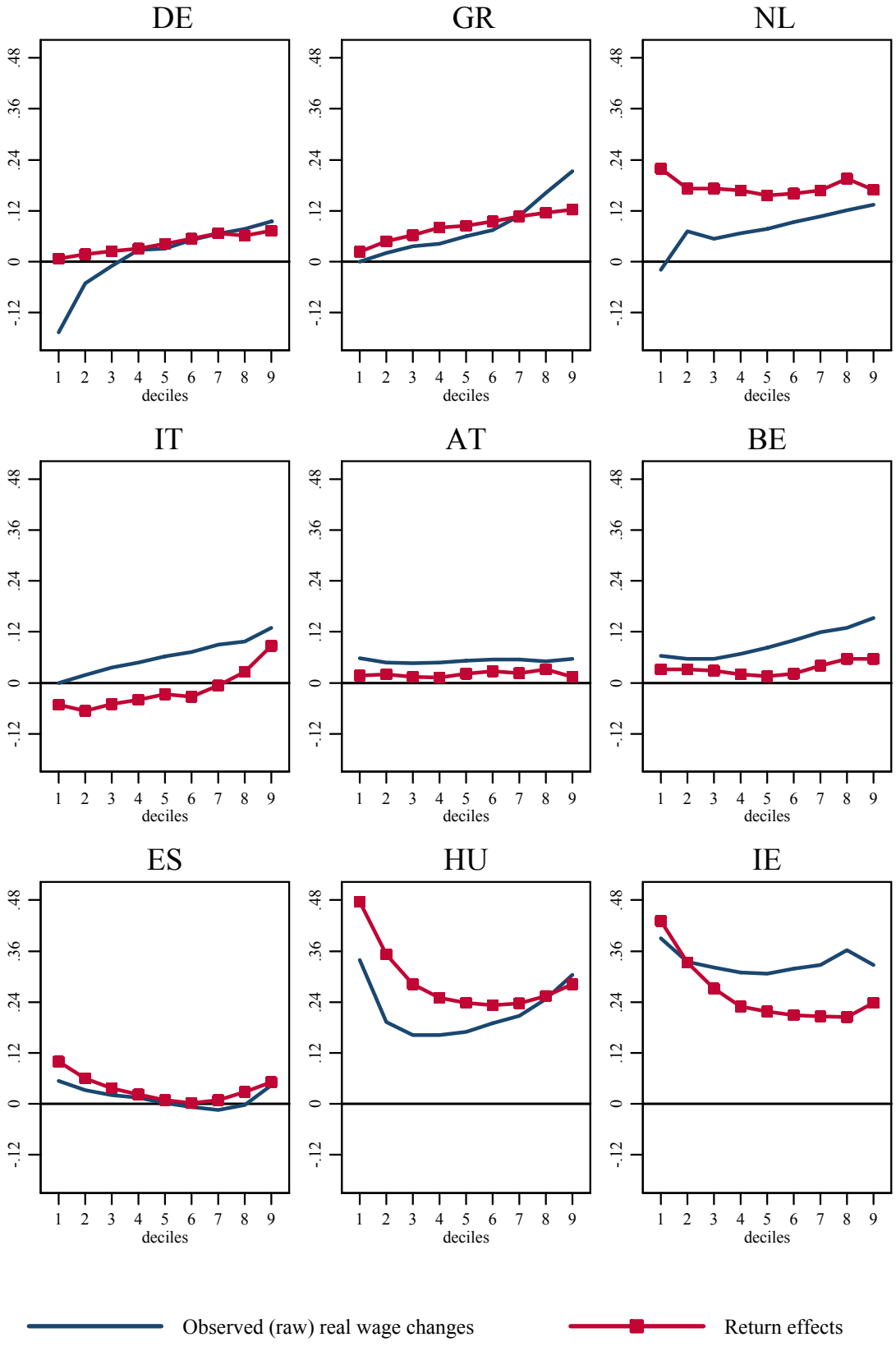

Table 2 collapses mean observed wage changes and mean changes in returns across countries, in three segments of the wage distribution, the three lowest, middle, and top deciles (conditional on country effects). For observed wages, regardless of the sample used (all, males, and females) the changes are increasing along the distribution. However, once compositional effects and any unobservables are "purged out" there is clear evidence of some "polarisation" in the distribution of wage changes, with highest increases at the three lowest and the three top deciles.[11]

Table 2. Mean Observed Wage Changes and Mean Changes in Returns

	ALL		MALES		FEMALES	
	Observed	Returns	Observed	Returns	Observed	Returns
3 Lowest Deciles	-0.031	0.038	-0.04	0.046	-0.033	0.041
	[0.021]	[0.007]***	[0.020]*	[0.005]***	[0.032]	[0.011]***
3 Middle Deciles	-0.001	0.032	-0.01	0.032	0.016	0.031
	[0.009]	[0.005]***	[0.009]	[0.003]***	[0.013]	[0.008]***
3 Top Deciles	0.032	0.045	0.023	0.046	0.056	0.055
	[0.009]***	[0.004]***	[0.009]**	[0.005]***	[0.015]***	[0.007]***
R-squared	0.84	0.95	0.83	0.96	0.82	0.92

Note: Regressions include country fixed effect. Country omitted: Germany. Total observations: 81. Heteroskedasticity-Robust Standard Errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1% . Weighted by the average sample size of the regressions used to compute changes in returns.

3. Explaining changes in the wage structure

As briefly mentioned in the introduction, there are several theories about the causes of the changes in the wage distribution observed recently. Most of the empirical literature refers to the US, with some authors claiming that it was due to a one-time event associated to changes in labour market institutions (deunionisation, changes in the minimum wages) and compositional effects, while others claiming that it has continued throughout the 1990s and 2000s and was due to skill-biased technological change. As for Europe, conventional wisdom was that changes in the wage structure have been less acute and that this lack of wage flexibility, originated in labour market institutions prone to wage compression, explained the increase in unemployment among unskilled workers in the 1980s and early 1990s (Krugman, 1994).

Indeed, apart from the changes in employment composition across different dimensions that blur international comparisons of changes in wage distributions, European countries have been subject in different degrees, to both technological changes and some other transformations (e.g. to monetary integration, or increasing competition and international mobility of labour). Table A3 in the appendix gives some indication of the cross-country variability of a globalisation index, computed

[11] This is likely to be driven by Hungary and Ireland; when dropping these countries from our sample the U shape turns into an upward sloping pattern.

from data on goods and capital flows (international trade, FDI, portfolio investments and income payments to foreign nationals) and restrictions (import barriers, tariffs, taxes on international trade and capital account restrictions),[12] and of the proportion of foreigners in the labour force. Every country in our sample has experienced an increase in international exposure, as indicated by the increasing trend in globalization and the rise in the weight of foreigners in the labour force. The largest increase in globalization took place in Austria, Germany, Poland and Spain, while the largest increase in migration inflows in the countries of our sample took place in Spain, Ireland and Greece.

Facing these changes, European product and labour markets have been under stress, and regulatory reforms have been at the core of the political agendas in Europe. As seen in Table A4, there is substantial cross-country heterogeneity in labour and product market institutions in EU countries and, although the process of reform has reduced this heterogeneity to some extent, not all the countries have progressed at the same pace. According to the intensity of the reform indicator by Brandt, Burniaux, and Duval (2005), which give a measure of the closeness to the ideal of labour market competition as recommended by the OECD Jobs Strategy, the leaders in reforming are, the Netherlands, Germany and Belgium, with Italy, Greece, Ireland Spain lagging behind.

Typically, in international comparisons of changes in wage structures, the number of countries for which data are available is much lower than the number of potential candidates to explain changes in some single indicators of wage dispersion. We face similar problem here. Nevertheless, we take advantage of the wealth of microeconomic data used for the measurement of wage changes in the nine countries in our sample and i) we use alternative measures of wage changes, either observed ones or some of their components identified from the extended Mincer equations using the Machado Mata (2005) decomposition, so that we can investigate to what extent changes in the returns to labour force or job/employer characteristics are relevant when searching for the relationship between macroeconomic and institutional developments and wage changes; and ii) we use wages changes at different positions of the wage distribution, so that we can investigate if macroeconomic and institutional developments had a differential impact along the wage distribution. Thus, we estimate the following set of regressions:

$$\Delta w_s^{\theta} = \lambda_s + \lambda_{\vartheta'} + \sum_{j=1}^{3} \beta_j \lambda_{\vartheta'} x_s + \varepsilon_s$$

where Δw^{θ}_s are alternative measures of the wage change at decile θ in country s, λ_s is a country dummy, $\lambda_{\theta'}$ is a dummy for position at the wage distribution (three lowest, middle and top deciles) and x_s is a variable representing either demographic, macroeconomic or institutional changes. As

[12] For details see, Dreher (2006).

for these covariates (included separately in alternative regressions) we choose some demographic variables (change in the female participation rate and change in the stock of foreigners in the labour force from the OECD datasets), some representing changes in the international economy (changes in trade balance in goods and services as a percentage of GDP, from the OECD, and change in the globalisation index, as computed by Dreher, 2006), some technological variables (change in Total Factor Productivity and change in the contribution of ICT capital to GDP growth from the EU KLEMS database), and some indicators of product and labour markets reforms (changes in indexes for administrative regulation, product market regulation, economic regulations, as computed by Conway et al.(2005), levels of centralisation and coordination of collective bargaining in 2000, and changes in union density as computed by the OECD).

Some results are displayed in Tables 3 to 6 below. As can be seen, the relationships between macro or institutional variables and wage changes often differ substantially depending on whether we consider observed wage changes or changes due to returns; this confirms that composition effects may blur cross-country comparisons of changes in the wage structure and identification of the magnitude and causes of relative wage changes. Overall, there is some evidence in support of the technological bias hypothesis. Variables capturing technological changes, such as the change in the contribution of ICT capital to GDP growth, are positively associated with wage changes, with a larger coefficient at the top and bottom of the distribution (U shape). This holds both for the observed wage changes and for the changes in wages once the compositional effects (and unobservable effects) have been controlled for (see table 5). Indicators of globalisation and migration are also found to play a role in determining wage changes. Globalisation is associated with wage increases, but less so for the lowest wages (see table 4). Increases in migration are associated with declines in wages (see table 3). Finally, regarding the role of institutions, preliminary results suggest that there is a negative relationship between changes in union density and changes in wages and this relation is uniform across the wage distribution (see table 6).

[Incomplete, to be extended]

Table 3. Regressions on demographic variables

Dependent variable	Observed wage changes	Total returns or price effects

Independent variable	Change in female labour force part. rates	Change in the proportion of foreign labour force	Change in female labour force part. rates	Change in the proportion of foreign labour force
	All			
Interacted with three lower deciles	0.0446 [0.0055]***	-0.003 [0.0056]	0.0289 [0.0042]***	-0.0155 [0.0041]***
Interacted with three middle deciles	0.0341 [0.0027]***	-0.0329 [0.0036]***	0.0262 [0.0021]***	-0.0256 [0.0019]***
Interacted with three highest deciles	0.034 [0.0017]***	-0.0369 [0.0044]***	0.0264 [0.0021]***	-0.0241 [0.0023]***
R-squared	0.85	0.88	0.95	0.95
	Males			
Interacted with three lower deciles	0.0458 [0.0056]***	-0.0103 [0.0066]	0.0281 [0.0033]***	-0.0073 [0.0036]**
Interacted with three middle deciles	0.0383 [0.0028]***	-0.0386 [0.0040]***	0.0296 [0.0020]***	-0.0131 [0.0025]***
Interacted with three highest deciles	0.0363 [0.0017]***	-0.0436 [0.0043]***	0.0251 [0.0016]***	-0.0148 [0.0027]***
R-squared	0.84	0.86	0.96	0.96
	Females			
Interacted with three lower deciles	0.0532 [0.0076]***	0.0103 [0.0083]	0.0354 [0.0047]***	-0.0251 [0.0060]***
Interacted with three middle deciles	0.0363 [0.0033]***	-0.0247 [0.0052]***	0.0251 [0.0025]***	-0.0434 [0.0032]***
Interacted with three highest deciles	0.0327 [0.0020]***	-0.0364 [0.0067]***	0.0253 [0.0022]***	-0.0454 [0.0043]***
R-squared	0.84	0.86	0.92	0.93
Decile fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Observations	81	81	81	81

Notes: Heteroskedasticity-Robust Standard Errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1% . Weighted by the average sample size of the regressions used to compute changes in returns.

Table 4. Regressions on trade openness variables

Dependent variable	Observed wage changes		Total returns or price effects	
Independent variable	Change in Dreher globalization index	Change in trade balance of goods and services as a percentage of GDP	Change in Dreher globalization index	Change in trade balance of goods and services as a percentage of GDP
	All			
Interacted with three lower deciles	0.0026	0.0228	0.004	0.0175
	[0.0031]	[0.0038]***	[0.0017]**	[0.0032]***
Interacted with three middle deciles	0.0081	0.0313	0.0071	0.0218
	[0.0021]***	[0.0029]***	[0.0011]***	[0.0025]***
Interacted with three highest deciles	0.0072	0.0274	0.006	0.0182
	[0.0018]***	[0.0032]***	[0.0005]***	[0.0026]***
R-squared	0.85	0.86	0.95	0.95
	Males			
Interacted with three lower deciles	0.0033	0.0257	0.0037	0.0199
	[0.0034]	[0.0040]***	[0.0015]**	[0.0025]***
Interacted with three middle deciles	0.0079	0.0327	0.0039	0.0222
	[0.0024]***	[0.0031]***	[0.0010]***	[0.0020]***
Interacted with three highest deciles	0.0076	0.029	0.0043	0.0209
	[0.0021]***	[0.0035]***	[0.0005]***	[0.0021]***
R-squared	0.84	0.84	0.96	0.96
	Females			
Interacted with three lower deciles	0.0006	0.017	0.0016	0.0124
	[0.0041]	[0.0050]***	[0.0021]	[0.0044]***
Interacted with three middle deciles	0.0113	0.029	0.0083	0.0205
	[0.0023]***	[0.0037]***	[0.0013]***	[0.0035]***
Interacted with three highest deciles	0.0114	0.0277	0.0087	0.0189
	[0.0017]***	[0.0040]***	[0.0006]***	[0.0037]***
R-squared	0.85	0.84	0.93	0.93
Decile fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Observations	81	81	81	81

Notes: As in table 3

Table 5. Regressions on technical change indicators

Dependent variable	Observed wage changes		Total returns or price effects	
Independent variable	Change in TFP (value added based) growth	Change in contribution of ICT capital services to output growth	Change in TFP (value added based) growth	Change in contribution of ICT capital services to output growth
	All			
Interacted with three lower deciles	0.0052 [0.0026]*	0.0542 [0.0285]*	0.0162 [0.0023]***	0.1538 [0.0249]***
Interacted with three middle deciles	0.0051 [0.0012]***	0.03 [0.0096]***	0.0122 [0.0008]***	0.0962 [0.0053]***
Interacted with three highest deciles	0.0078 [0.0013]***	0.0663 [0.0147]***	0.0124 [0.0011]***	0.1053 [0.0099]***
R-squared	0.85	0.79	0.96	0.96
	Males			
Interacted with three lower deciles	0.0026 [0.0028]	0.0357 [0.0315]	0.0185 [0.0020]***	0.1487 [0.0233]***
Interacted with three middle deciles	0.0033 [0.0012]***	0.0223 [0.0102]**	0.0146 [0.0006]***	0.0921 [0.0032]***
Interacted with three highest deciles	0.0066 [0.0013]***	0.0662 [0.0146]***	0.0158 [0.0008]***	0.1126 [0.0092]***
R-squared	0.85	0.77	0.97	0.97
	Females			
Interacted with three lower deciles	0.0079 [0.0028]***	0.0752 [0.0275]***	0.018 [0.0026]***	0.1564 [0.0273]***
Interacted with three middle deciles	0.0066 [0.0012]***	0.0373 [0.0103]***	0.0142 [0.0010]***	0.0983 [0.0063]***
Interacted with three highest deciles	0.009 [0.0016]***	0.0602 [0.0142]***	0.0135 [0.0012]***	0.0924 [0.0082]***
R-squared	0.82	0.78	0.93	0.94
Decile fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Observations	72	63	72	63

Notes: As in table 3

Table 6. Regressions on labour market institutions

Dependent variable	Observed wage changes			Total price effects		
Independent variable	Change in union density	Bargaining coordination (2000 levels)	Bargaining centralization (2000 levels)	Change in union density	Bargaining Coordination (2000 levels)	Bargaining centralization (2000 levels)
	All					
Interacted with three lower deciles	-0.0038 [0.0016]**	0.0064 [0.0315]	0.1444 [0.0230]***	-0.0078 [0.0013]***	0.0848 [0.0225]***	0.0718 [0.0278]**
Interacted with three middle deciles	-0.0022 [0.0007]***	0.1068 [0.0173]***	0.1237 [0.0103]***	-0.0049 [0.0002]***	0.1039 [0.0122]***	0.0748 [0.0140]***
Interacted with three highest deciles	-0.004 [0.0009]***	0.1296 [0.0087]***	0.1157 [0.0031]***	-0.0056 [0.0005]***	0.0894 [0.0077]***	0.0943 [0.0092]***
R-squared	0.85	0.87	0.83	0.96	0.94	0.94
	Males					
Interacted with three lower deciles	-0.0024 [0.0018]	0.0055 [0.0303]	0.1545 [0.0213]***	-0.0079 [0.0012]***	0.0899 [0.0170]***	0.1086 [0.0165]***
Interacted with three middle deciles	-0.0013 [0.0008]	0.1162 [0.0144]***	0.1396 [0.0100]***	-0.0054 [0.0002]***	0.098 [0.0106]***	0.1103 [0.0094]***
Interacted wih three highest deciles	-0.0034 [0.0010]***	0.138 [0.0081]***	0.1222 [0.0024]***	-0.0064 [0.0005]***	0.0882 [0.0063]***	0.0838 [0.0052]***
R-squared	0.84	0.9	0.85	0.97	0.96	0.96
	Females					
Interacted with three lower deciles	-0.0051 [0.0014]***	-0.0123 [0.0496]	0.1568 [0.0353]***	-0.0078 [0.0014]***	0.0579 [0.0328]*	0.086 [0.0343]**
Interacted with three middle deciles	-0.0024 [0.0005]***	0.1039 [0.0260]***	0.1158 [0.0168]***	-0.0045 [0.0003]***	0.0891 [0.0187]***	0.0679 [0.0205]***
Interacted with three highest deciles	-0.0036 [0.0008]***	0.1382 [0.0127]***	0.1224 [0.0052]***	-0.0043 [0.0004]***	0.0954 [0.0107]***	0.0962 [0.0112]***
R-squared	0.82	0.8	0.76	0.94	0.9	0.89
Decile fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	72	63	63	72	63	63

Notes: As in table 3

6. Conclusions

In this paper we document changes in the wage structure of nine EU countries over the 1995-2002 using micro data on wages and on workers and jobs characteristics that are comparable across countries. We disentangle the composition effects and the returns effects that are behind observed wage changes and relate observed wage changes and returns component to structural and macro developments.

Real wages have increased from 1995 to 2002 along the whole range of wage levels in the nine countries of our sample, with the only exceptions of wages of the lowest paid jobs in Germany and wages in the middle part of the wage distribution in Spain. Both the magnitude and shape of the changes observed in real wages differ substantially across countries.

Observed real wages in the Netherlands, Germany, Greece, Italy and Belgium trend upwards along the distribution, what leads to a widening of the wage distribution and an increase in wage inequality. In contrast, the wage distribution in Hungary, Ireland and Spain has become more compressed. The magnitude of the changes is relatively small in Italy, Belgium and Spain, and there is virtually no change in Austria.

Changes in the workers and job characteristics, the so-called composition effects, that do no respond to market forces, are responsible for the widening of the wage distribution in Netherlands, Greece and Germany, while market forces in the form of changes in returns to workers and jobs characteristics explain the compression of the wage distribution in Hungary, Ireland and Spain and the (slight) increase in inequality in Italy and Belgium.

Overall, there are relevant differences across countries regarding the size of wage changes and their components along the wage distribution. We have related these differences to some demographic, macroeconomic, and institutional variables. Our preliminary and incomplete results suggest that the wage structure in EU countries has responded to macroeconomic and structural trends. In particular, observed changes in technology are positively associated with wage increases, the effect of technology seems to be stronger for very high and very low paid jobs. Globalisation is associated with wage increases, but less so for the lowest wages. Finally, increases in migration are associated with declines in wages. *[on going work]*

References

Altissimo F, M. Ehrmann and F. Smets (2006) "Inflation and Price-setting Behaviour in the Euro Area", ECB Occasional paper No. 46.

Autor, David H., Katz, Lawrence F. and Melissa S. Kearney, (2005a): "Trends in U.S. Wage Inequality: Re-Assessing the Revisionists," NBER Working Papers No. 11627.

Autor, David H., Lawrence F. Katz, and Melissa S. Kearney (2005b): "Residual Wage Inequality: The Role of Composition and Prices." NBER Working Paper No. 11628, September.

Autor, David H., Lawrence F. Katz, and Melissa S. Kearney (2006): "The Polarization of the U.S. Labor Market." *American Economic Review*, 96:2 (May), 189-194.

Autor, David H., Lawrence F. Katz and Melissa S. Kearney, (2008): "Trends in US Wage Inequality: Revising the Revisionists", *Review of Economics and Statistics* 90:2, 300-323.

Autor, D. H., F. Levy, and R. J.Murnane (2003) .The Skill Content of Recent Technological Change: An Empirical Exploration., *Quarterly Journal of Economics*, CXVIII, pp. 1279-1333.

Biagi, Federico and Claudio Lucifora (2005): "Demographic and Education Effects on Unemployment in Europe: Economic Factors and Labour Market Institutions" IZA WP 1806.

Blanchard, Olivier and Jordi Galí (2008): "Labor Markets and Monetary Policy: A New-Keynesian Model with Unemployment", mimeo.

Boudarbat, Brahim, Thomas Lemieux and W. Craig Ridell (2003): "Recent Trends in Wage Inequality and the Wage Structure in Canada", mimeo.

Brandt, Nicola, Jean-Marc Burniaux, and Romain Duval (2005): "Assessing the OECD Jobs Strategy: Past Developments and Reforms", OECD, Economics Department, working paper no. 429.

Carrasco, Raquel, Juan F. Jimeno, and A.Carolina Ortega (2007):" The Impact of Immigration on the Wage Structure: Spain 1995-2002" mimeo.

Checchi D. and L. Pagani (2005) "The Effects of Unions on Wage Inequality. The Italian case in the 1990s" *Politica Economica,* 2005 (1), 41-68.

Chennells, Lucy and John van Reenen (1999): "Has technology hurt less skilled workers? A survey of the micro-econometric evidence". IFS Working Papers, W99/27, January 1999.

Christoffel, Kai and Tobias Linzert (2005): "The role of real wage rigidity and labor market frictions for unemployment and inflation dynamics" ECB working paper num. 556.

Christopoulou, Rebekka and Theodora Kosma (2008): "Greek wage change decomposition: 1995-2002", Paper presented at the WDN meeting, 9 April, Paris.

Dell'Aringa Carlo, Claudio Lucifora and N. Orlando (2006): "Intra-firm Wage Dispersion and Collective Bargaining: in Italy" *Rivista Internazionale di Scienze Sociali.*

DiNardo, John, Nicole Fortin and Thomas Lemieux (1996): "Labor Market Institutions, and the Distribution of Wages, 1973-1992: A Semiparametric Approach." *Econometrica* 64 (September), 1001-1044.

Dreher, Axel (2006): "Does Globalisation Affect Growth? Empirical Evidence from a New Index", *Applied Economics*, 38, 10:1091-1110.

Du Caju, Philip, Gabor Katay, Ana Lamo, Daphne Nicolitsas and Steven Poelhekke (2008): " Inter-industry wage differentials in EU countries: what do cross-country time varying data add to the picture?" WDN mimeo

Dustmann, Christian, Johannes Ludsteck and Uta Schönberg (2007): "Revisiting the German Wage Structure." Mimeograph, University of Rochester, February.

Goldin, Claudiaand Lawrence F. Katz (2007): "Long-Run Changes in the US Wage Structure: Narrowing, Widening, Polarizing", NBER , working paper 13568.

Goos, M. and A. Manning (2007) .Lousy and Lovely Jobs: the Rising Polarization of Work in Britain, *The Review of Economics and Statistics*, 89 (1), pp. 118-133.

Izquierdo M. and A. Lacuesta (2006) "Wage Inequality in Spain: Recent Developments" Bank of Spain WP no. 0615.

Katz Lawrence F. and David H. Autor (1999) "Changes in the Wage Structure and Earnings Inequality." In O. Ashenfelter and D. Card, eds. *Handbook of Labor Economics*, volume 3.

Katz, Law Juhn, Chinhui, Kevin M. Murphy and Brooks Pierce (1993): "Wage Inequality and the Rise in Returns to Skill." *Journal of Political Economy*, 101(3), 410 – 442.

Koeniger, W., M. Leonardi, and L. Nunziata (2007): "Labor Market Institutions and Wage Inequality", *Industrial & Labor Relations Review*, vol. 6, 3, 340-356.

Krueger A.B. and Summers L. H. (1988), "Efficiency Wages and Inter-Industry Wage Structure", *Econometrica*, Vol. 56, No. 2, 259-93.

Krugman, Paul (1994): "Past and prospective causes of high unemployment", in *Reducing unemployment: Current issues and policy options*, ed. Federal Reserve Bank of Kansas City, 68–81. Washington, DC: U.S. Government Printing Office.

Lazear, Edward P. and Kathryn L. Shaw (forthcoming), *An International Comparisons of the Structure of Wages, University of Chicago Press*, NBER.

Lemieux, Thomas, W. Bentley MacLeod, and Daniel Parent (2005): "Bonus Pay and Wage Inequality." University of British Columbia, April.

Lemieux, Thomas(2002): "Decomposing Changes in Wage Distributions: A Unified Approach," *Canadian Journal of Economics*, 35(4), November, 646-688.

Lemieux, Thomas (2005): "Increasing Residual Wage Inequality: Composition Effects, Noisy Data, or Rising Demand for Skill?" University of British Columbia, May.

Lemieux, Thomas (2006a):"Post-Secondary Education and Increasing Wage Inequality." NBER Working Paper No. 12077, March.

Lemieux, Thomas (2006b): "Increased Residual Wage Inequality: Composition Effects, Noisy Data, or Rising Demand for Skill." *American Economic Review*, 96(June), 461–498.

Machado, José and José Mata (2005) "Counterfactual Decompositions of Changes in Wage Distributions Using Quantile Regression." *Journal of Applied Econometrics*, 20(4), 445-65.

Machin, Stephen and John Van Reenen (1998): "Technology and Changes in Skill Structure: Evidence from Seven OECD Countries", *The Quarterly Journal of Economics*, CXIII, 1215-1244.

Manacorda, Marco and Jonathan Wadsworth (2006): "The Impact of Immigration on the Structure of Male Wages: Theory and Evidence from Britain", mimeo.

Marsden D. (2005), PIEP Project Report, available at http://cep.lse.ac.uk/piep/ .

Martins P.S. (2004), "Industry Wage Premia: Evidence from the Wage Distribution", *Economics Letters*, Vol. 83, 157-163.

Melly, Blaise. (2005): "Decomposition of Differences in Distribution Using Quantile Regression," *Labour Economics,* Vol 12(4), pp. 577-590

Messina, Julián Philip Du Caju, Claudia Filipa Duarte, Mario Izquierdo and Niels Lynggård Hansen (2008): "The Causes and Consequences of Nominal and Real Wage Rigidity: a Sectoral Approach" WDN mimeo

Mincer J. (1974): *Schooling, Experience and Earnings*, New York: National Bureau of Economic Research.

Oaxaca, Ronald (1973): "Male-Female Wage *Economic Review*, 14, 693 – 709.

OECD (2007): OECD Economic Outlook

Prasad, Edmund (2006): "The Unbearable Stability of the German Wage Structure: Evidence and Interpretation", IMF Staff Papers, vol 51, no. 2, 354- 385.

Rosolia, A. and R. Torrini (2008), "The Generation Gap: Relative Earnings of Young and Old Workers in Italy", WDN mimeo

Rumler, F. (2005): "Estimates of the Open Economy Phillips Curve for Euro Area Countries", ECB working paper num. 496.

Saint-Paul, Gilles (2005): "Did European Labor Markets Become More Competitive during the 1990s? Evidence from Estimated Worker Rents", in J.E. Restrepo and A. Tokman eds., *Labor Markets and Institutions*, Banco Central de Chile, Series on Central Banking, Analysis, and Economic Policies, num.

APPENDIX

Table A1. Measures of wage inequality by country and sex-group

		All (Males & Females)					Males					Females				
		Std. Dev.	Median	P90/P10	P50/P10	P90/P50	Std. Dev.	Median	P90/P10	P50/P10	P90/P50	Std. Dev.	Median	P90/P10	P50/P10	P90/P50
AT	1996	0.36	2.23	1.52	1.22	1.24	0.34	2.30	1.46	1.18	1.24	0.35	2.07	1.53	1.21	1.26
	2002	0.37	2.28	1.52	1.23	1.24	0.35	2.35	1.45	1.18	1.23	0.36	2.13	1.51	1.20	1.25
	Change	0.01	0.04	0.00	0.01	-0.01	0.01	0.05	-0.01	0.00	-0.01	0.01	0.05	-0.02	-0.01	0.00
BE	1999	0.32	2.41	1.39	1.15	1.21	0.32	2.43	1.38	1.13	1.22	0.31	2.32	1.38	1.15	1.2
	2005	0.35	2.46	1.41	1.15	1.22	0.35	2.48	1.40	1.14	1.23	0.34	2.41	1.41	1.16	1.22
	Change	0.03	0.05	0.02	0.00	0.01	0.03	0.05	0.02	0.01	0.01	0.03	0.09	0.03	0.01	0.02
DE	1995	0.35	2.64	1.40	1.19	1.18	0.33	2.71	1.37	1.17	1.17	0.31	2.46	1.37	1.17	1.17
	2001	0.47	2.65	1.51	1.26	1.20	0.47	2.71	1.47	1.23	1.19	0.44	2.49	1.54	1.29	1.19
	Change	0.12	0.01	0.11	0.07	0.02	0.14	0.00	0.10	0.06	0.02	0.13	0.03	0.17	0.12	0.02
ES	1995	0.48	1.83	1.90	1.39	1.37	0.47	1.90	1.85	1.38	1.34	0.45	1.61	1.91	1.35	1.41
	2002	0.46	1.80	1.86	1.33	1.40	0.45	1.89	1.79	1.32	1.36	0.43	1.61	1.86	1.29	1.44
	Change	-0.02	-0.03	-0.04	-0.06	0.03	-0.02	-0.02	-0.05	-0.06	0.02	-0.02	0.00	-0.05	-0.06	0.03
GR	1995	0.38	1.88	1.69	1.30	1.30	0.38	1.98	1.67	1.32	1.27	0.32	1.67	1.59	1.21	1.31
	2002	0.47	1.89	1.85	1.33	1.40	0.48	2.01	1.86	1.37	1.36	0.41	1.73	1.74	1.25	1.39
	Change	0.09	0.01	0.16	0.02	0.10	0.10	0.03	0.20	0.06	0.09	0.09	0.06	0.15	0.04	0.08
HU	1996	0.53	5.82	1.27	1.12	1.13	0.53	5.89	1.27	1.13	1.12	0.51	5.74	1.26	1.12	1.12
	2002	0.53	5.95	1.25	1.09	1.15	0.55	5.99	1.26	1.10	1.15	0.50	5.91	1.23	1.08	1.14
	Change	0.00	0.13	-0.01	-0.04	0.02	0.01	0.11	-0.01	-0.03	0.02	-0.01	0.17	-0.02	-0.04	0.02
IE	1995	0.48[a]	2.11	1.84	1.36	1.35	0.50	2.20	1.79	1.34	1.34	0.45	1.98	1.78	1.35	1.32
	2002	0.47[a]	2.43	1.65	1.26	1.30	0.49	2.56	1.63	1.27	1.29	0.44	2.29	1.59	1.23	1.29
	Change	-0.01	0.32	-0.20	-0.10	-0.05	-0.01	0.35	-0.16	-0.07	-0.05	-0.02	0.31	-0.20	-0.12	-0.04
IT	1995	0.35	2.09	1.46	1.17	1.25	0.36	2.12	1.48	1.17	2.27	0.29	1.99	1.40	1.14	1.23
	2002	0.36	2.15	1.50	1.19	1.25	0.36	2.19	1.49	1.19	1.25	0.33	2.05	1.48	1.18	1.26
	Change	0.01	0.06	0.03	0.02	0.00	0.01	0.07	0.02	0.02	-1.01	0.04	0.06	0.08	0.04	0.03
NL	1995	0.43	2.41	1.50	1.24	1.22	0.40	2.47	1.44	1.19	1.21	0.43	2.20	1.55	1.28	1.21
	2002	0.49	2.49	1.57	1.28	1.23	0.47	2.61	1.54	1.27	1.21	0.47	2.28	1.64	1.34	1.23
	Change	0.07	0.09	0.07	0.04	0.02	0.07	0.14	0.09	0.08	0.00	0.04	0.08	0.10	0.06	0.02

Note: Median figures are in euros for al countries except for HU, for which they are measured in national currency (HUF). [a] indicates inferred number.

Table A2a. Basic decomposition of observed wage changes by country and decile, all

	10	20	30	40	50	60	70	80	90
AT									
Observed pay change (in logs)	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Composition effects	0.00	0.00	0.03	0.01	0.04	0.03	0.04	0.03	0.04
Return effects	0.01	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.02
Residual effects	0.01	0.01	-0.01	0.00	-0.02	-0.01	-0.01	0.00	-0.01
BE									
Observed pay change (in logs)	0.04	0.04	0.04	0.05	0.06	0.07	0.08	0.09	0.10
Composition effects	0.02	0.04	0.02	0.04	0.06	0.04	0.05	0.04	0.07
Return effects	0.02	0.01	0.02	0.02	0.02	0.03	0.04	0.05	0.06
Residual effects	0.01	-0.01	0.01	-0.01	-0.02	-0.01	-0.02	0.00	-0.02
DE									
Observed pay change (in logs)	-0.12	-0.04	-0.01	0.01	0.01	0.02	0.03	0.04	0.05
Composition effects	-0.13	-0.09	-0.07	-0.03	-0.01	-0.01	0.01	0.00	0.06
Return effects	0.09	0.07	0.08	0.08	0.08	0.08	0.08	0.07	0.07
Residual effects	-0.07	-0.01	-0.02	-0.05	-0.06	-0.06	-0.05	-0.03	-0.07
ES									
Observed pay change (in logs)	0.03	0.01	0.00	-0.02	-0.03	-0.04	-0.03	-0.01	0.01
Composition effects	-0.01	-0.01	-0.05	-0.07	-0.06	-0.07	-0.08	-0.07	-0.04
Return effects	0.10	0.07	0.05	0.05	0.04	0.04	0.05	0.06	0.07
Residual effects	-0.06	-0.05	0.00	0.00	-0.02	-0.01	0.00	0.01	-0.02
GR									
Observed pay change (in logs)	-0.02	-0.01	-0.01	-0.01	0.01	0.05	0.10	0.15	0.20
Composition effects	-0.08	-0.07	-0.08	-0.09	-0.09	-0.05	0.00	0.06	0.15
Return effects	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.08	0.08
Residual effects	0.03	0.01	0.02	0.02	0.03	0.02	0.01	0.00	-0.04
HU									
Observed pay change (in logs)	0.29	0.13	0.08	0.10	0.13	0.16	0.18	0.22	0.29
Composition effects	-0.07	-0.12	-0.14	-0.07	-0.06	-0.05	-0.07	-0.05	-0.03
Return effects	0.46	0.33	0.27	0.25	0.24	0.25	0.25	0.27	0.32
Residual effects	-0.10	-0.09	-0.05	-0.07	-0.05	-0.04	0.00	0.00	0.00
IE									
Observed pay change (in logs)	0.37	0.32	0.31	0.31	0.32	0.33	0.35	0.35	0.31
Composition effects	0.05	0.09	0.04	0.07	0.09	0.10	0.12	0.13	0.10
Return effects	0.41	0.31	0.26	0.25	0.24	0.23	0.22	0.22	0.22
Residual effects	-0.09	-0.07	0.00	0.00	-0.01	0.00	0.00	-0.01	-0.01
IT									
Observed pay change (in logs)	0.01	0.03	0.04	0.05	0.06	0.06	0.08	0.07	0.08
Composition effects	0.07	0.08	0.08	0.08	0.08	0.07	0.06	0.06	0.01
Return effects	-0.03	-0.03	0.00	0.01	0.02	0.02	0.04	0.06	0.09
Residual effects	-0.02	-0.02	-0.04	-0.04	-0.04	-0.03	-0.03	-0.04	-0.02
NL									
Observed pay change (in logs)	0.01	0.00	0.03	0.06	0.09	0.11	0.13	0.15	0.15
Composition effects	-0.20	-0.14	-0.14	-0.09	-0.02	0.01	0.03	0.07	0.07
Return effects	0.11	0.13	0.15	0.15	0.14	0.15	0.16	0.14	0.13
Residual effects	0.09	0.01	0.02	0.00	-0.03	-0.04	-0.06	-0.06	-0.05

Table A2b. Basic decomposition of observed wage changes by country and decile, males

	10	20	30	40	50	60	70	80	90
AT									
Observed pay change (in logs)	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Composition effects	0.01	0.00	0.04	0.05	0.02	0.03	0.04	0.03	0.04
Return effects	0.02	0.03	0.02	0.03	0.01	0.00	0.01	0.01	0.01
Residual effects	0.02	0.02	-0.01	-0.02	0.01	0.02	0.00	0.01	-0.01
BE									
Observed pay change (in logs)	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.08	0.09
Composition effects	0.00	0.01	0.03	0.01	0.02	0.00	0.05	0.05	0.02
Return effects	0.01	0.01	0.02	0.03	0.03	0.04	0.04	0.05	0.06
Residual effects	0.02	0.01	-0.01	0.00	0.00	0.01	-0.03	-0.02	0.01
DE									
Observed pay change (in logs)	-0.12	-0.04	-0.02	-0.01	0.00	0.01	0.02	0.03	0.05
Composition effects	-0.16	-0.08	-0.07	-0.05	-0.02	-0.02	-0.01	0.02	0.00
Return effects	0.10	0.08	0.08	0.07	0.07	0.07	0.09	0.09	0.10
Residual effects	-0.06	-0.05	-0.03	-0.03	-0.05	-0.04	-0.06	-0.08	-0.06
ES									
Observed pay change (in logs)	0.05	0.02	0.01	-0.01	-0.02	-0.02	-0.01	0.00	0.02
Composition effects	0.01	-0.01	-0.05	-0.04	-0.07	-0.06	-0.04	-0.03	-0.03
Return effects	0.09	0.07	0.06	0.05	0.05	0.05	0.06	0.07	0.07
Residual effects	-0.05	-0.04	0.00	-0.02	0.00	-0.01	-0.03	-0.03	-0.02
GR									
Observed pay change (in logs)	-0.05	-0.04	-0.03	-0.01	0.03	0.08	0.12	0.17	0.21
Composition effects	-0.11	-0.09	-0.09	-0.07	-0.08	0.04	0.05	0.14	0.19
Return effects	0.03	0.04	0.05	0.05	0.06	0.04	0.06	0.05	0.03
Residual effects	0.03	0.02	0.01	0.00	0.05	0.00	0.01	-0.02	0.00
HU									
Observed pay change (in logs)	0.26	0.06	0.04	0.07	0.11	0.13	0.16	0.20	0.27
Composition effects	-0.08	-0.14	-0.14	-0.11	-0.10	-0.08	-0.08	-0.02	-0.01
Return effects	0.44	0.32	0.27	0.25	0.24	0.24	0.26	0.28	0.33
Residual effects	-0.10	-0.11	-0.09	-0.07	-0.03	-0.02	-0.02	-0.06	-0.05
IE									
Observed pay change (in logs)	0.37	0.34	0.33	0.34	0.35	0.37	0.38	0.37	0.34
Composition effects	0.09	0.05	0.05	0.08	0.11	0.13	0.14	0.15	0.14
Return effects	0.36	0.31	0.28	0.26	0.25	0.23	0.22	0.21	0.23
Residual effects	-0.08	-0.03	0.00	-0.01	0.00	0.01	0.02	0.01	-0.03
IT									
Observed pay change (in logs)	0.03	0.04	0.05	0.06	0.07	0.08	0.08	0.07	0.08
Composition effects	0.08	0.09	0.10	0.10	0.09	0.09	0.10	0.06	0.07
Return effects	-0.04	-0.05	-0.04	-0.04	-0.03	-0.02	-0.03	-0.03	-0.04
Residual effects	-0.01	0.00	0.00	-0.01	0.00	0.01	0.01	0.04	0.05
NL									
Observed pay change (in logs)	-0.01	0.05	0.09	0.12	0.14	0.16	0.18	0.19	0.17
Composition effects	-0.16	-0.08	-0.01	0.03	0.05	0.07	0.07	0.11	0.11
Return effects	0.06	0.09	0.10	0.12	0.13	0.11	0.14	0.11	0.09
Residual effects	0.08	0.04	0.00	-0.03	-0.03	-0.03	-0.03	-0.02	-0.03

Table A2c. Basic decomposition of observed wage changes by country and decile, females

	10	20	30	40	50	60	70	80	90
AT									
Observed pay change (in logs)	0.05	0.00	0.06	0.04	0.03	0.03	0.01	0.00	0.02
Composition effects	0.02	0.02	0.01	0.01	0.02	0.03	0.02	0.03	0.01
Return effects	0.06	0.05	0.05	0.05	0.05	0.06	0.06	0.05	0.06
Residual effects	-0.01	0.02	-0.03	-0.01	0.00	-0.01	0.02	0.02	0.02
BE									
Observed pay change (in logs)	0.06	0.06	0.06	0.07	0.08	0.10	0.12	0.13	0.15
Composition effects	0.00	0.01	0.03	0.03	0.08	0.10	0.08	0.12	0.09
Return effects	0.03	0.03	0.03	0.02	0.01	0.02	0.04	0.06	0.06
Residual effects	0.03	0.01	-0.01	0.02	-0.01	-0.03	0.00	-0.05	0.01
DE									
Observed pay change (in logs)	-0.17	-0.05	-0.01	0.03	0.03	0.05	0.07	0.08	0.10
Composition effects	-0.15	-0.09	-0.06	-0.04	-0.02	0.00	0.02	0.04	0.05
Return effects	-0.02	0.00	0.01	0.01	0.03	0.04	0.05	0.04	0.04
Residual effects	0.00	0.04	0.04	0.05	0.02	0.01	-0.01	0.00	0.00
ES									
Observed pay change (in logs)	0.05	0.03	0.02	0.02	0.00	-0.01	-0.01	0.00	0.04
Composition effects	0.02	0.01	0.01	-0.01	-0.03	-0.02	-0.01	-0.02	0.04
Return effects	0.10	0.06	0.04	0.02	0.01	0.00	0.01	0.03	0.05
Residual effects	-0.06	-0.04	-0.02	0.01	0.02	0.01	-0.01	-0.01	-0.05
GR									
Observed pay change (in logs)	0.00	0.02	0.04	0.04	0.06	0.07	0.11	0.16	0.21
Composition effects	-0.06	-0.05	-0.04	-0.05	-0.04	-0.01	-0.01	0.07	0.13
Return effects	0.02	0.05	0.06	0.08	0.08	0.10	0.11	0.12	0.12
Residual effects	0.04	0.02	0.01	0.01	0.01	-0.01	0.01	-0.03	-0.04
HU									
Observed pay change (in logs)	0.34	0.19	0.16	0.16	0.17	0.19	0.21	0.25	0.30
Composition effects	-0.03	-0.07	-0.06	-0.03	-0.02	0.01	-0.02	0.00	0.04
Return effects	0.48	0.35	0.28	0.25	0.24	0.23	0.24	0.25	0.28
Residual effects	-0.10	-0.09	-0.06	-0.05	-0.05	-0.05	-0.01	-0.01	-0.02
IE									
Observed pay change (in logs)	0.39	0.33	0.32	0.31	0.31	0.32	0.33	0.36	0.33
Composition effects	0.02	0.06	0.09	0.09	0.09	0.12	0.13	0.14	0.16
Return effects	0.43	0.33	0.27	0.23	0.22	0.21	0.21	0.20	0.24
Residual effects	-0.06	-0.06	-0.04	-0.01	0.00	-0.01	-0.01	0.02	-0.07
IT									
Observed pay change (in logs)	0.00	0.02	0.04	0.05	0.06	0.07	0.09	0.10	0.13
Composition effects	0.07	0.09	0.10	0.10	0.10	0.13	0.12	0.06	0.04
Return effects	-0.05	-0.07	-0.05	-0.04	-0.03	-0.03	-0.01	0.03	0.09
Residual effects	-0.02	0.00	-0.02	-0.01	-0.01	-0.03	-0.02	0.01	0.00
NL									
Observed pay change (in logs)	-0.02	0.07	0.05	0.07	0.08	0.09	0.11	0.12	0.13
Composition effects	-0.30	-0.08	-0.10	-0.09	-0.05	-0.04	-0.01	0.00	0.06
Return effects	0.22	0.17	0.17	0.17	0.16	0.16	0.17	0.20	0.17
Residual effects	0.07	-0.02	-0.02	-0.01	-0.03	-0.03	-0.05	-0.08	-0.09

Figure A1a. Break down of observed wage changes by country and decile, all (males & females)

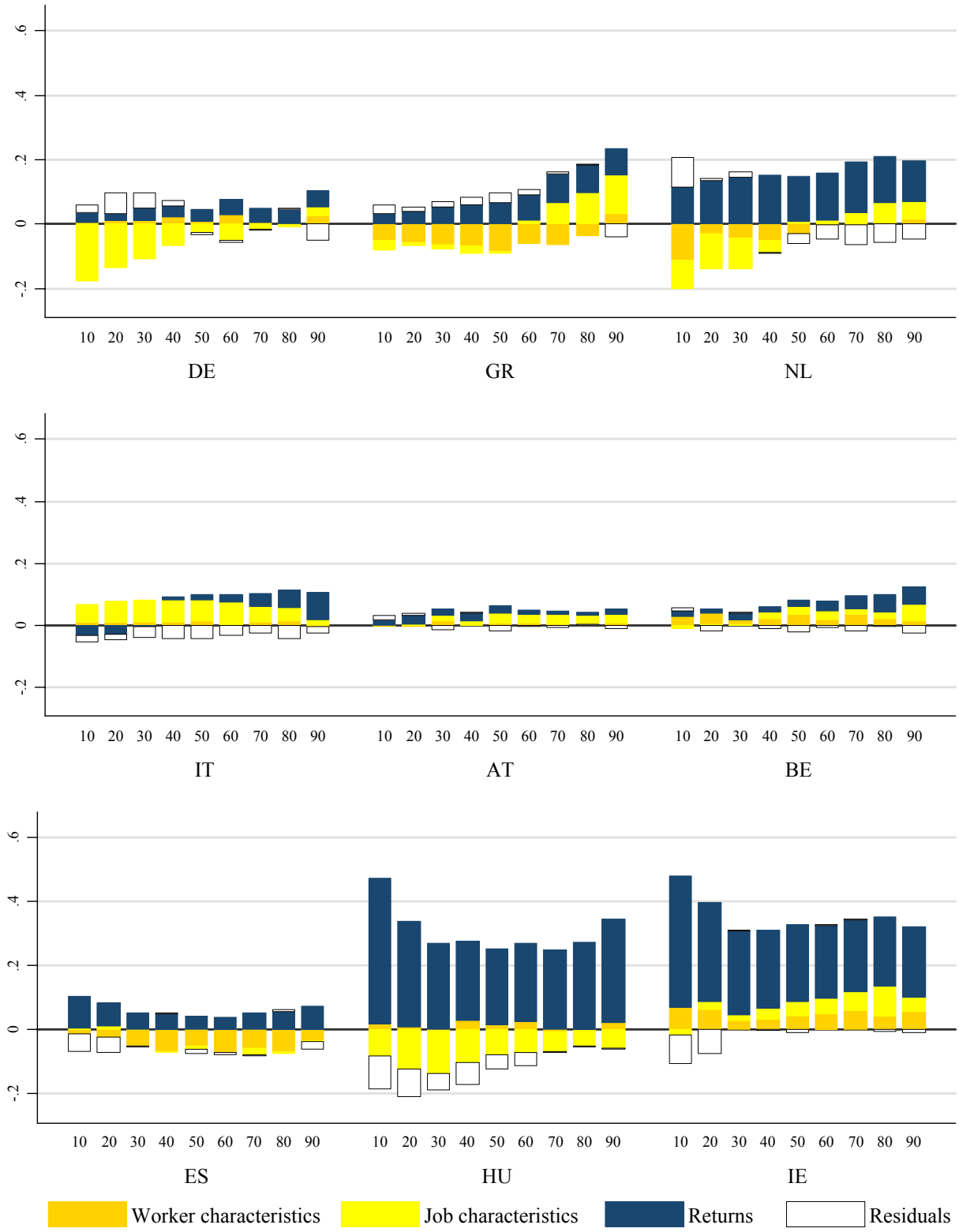

Figure A1b. Break down of observed wage changes by country and decile, males

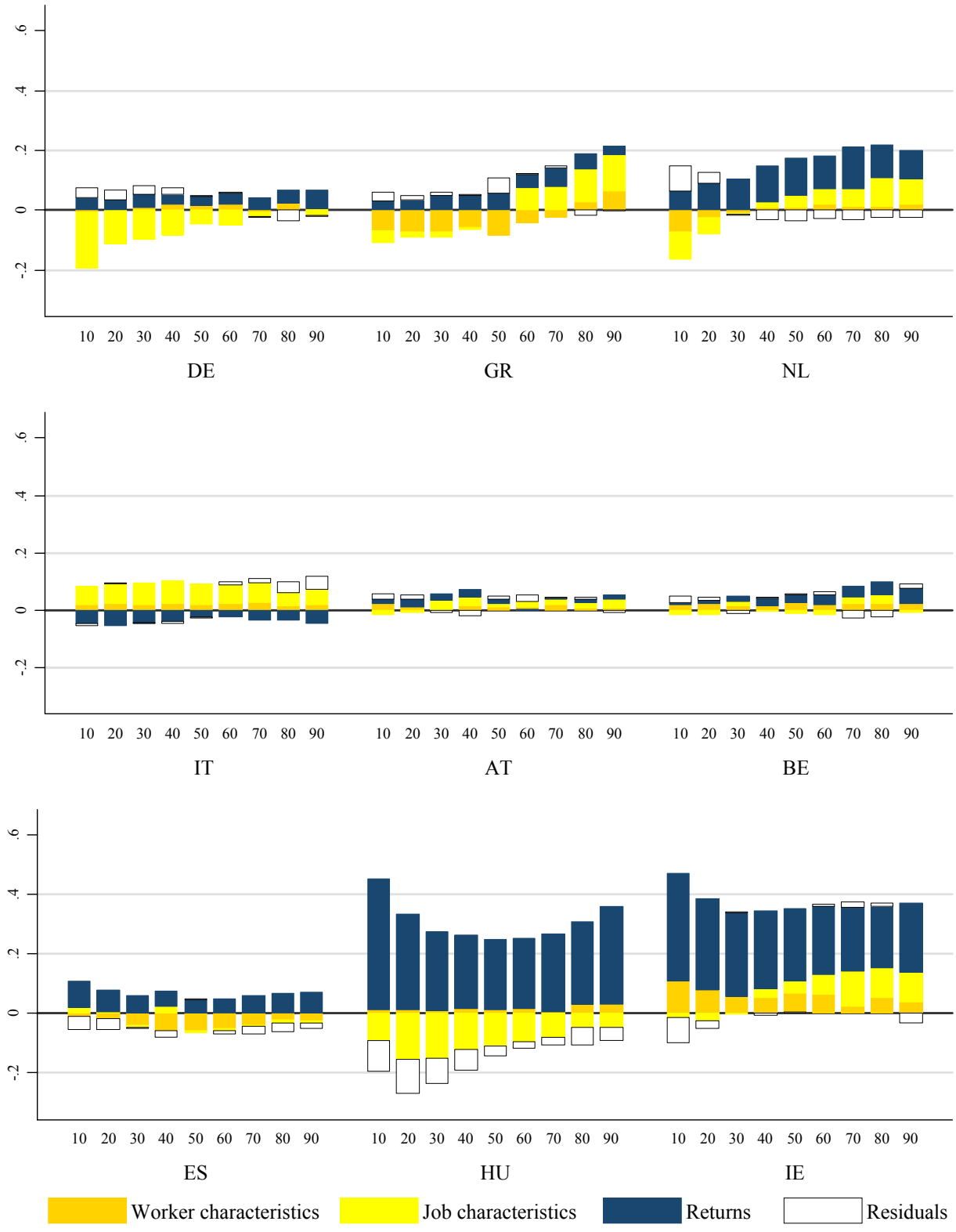

Figure A1c. Break down of observed wage changes by country and decile, females

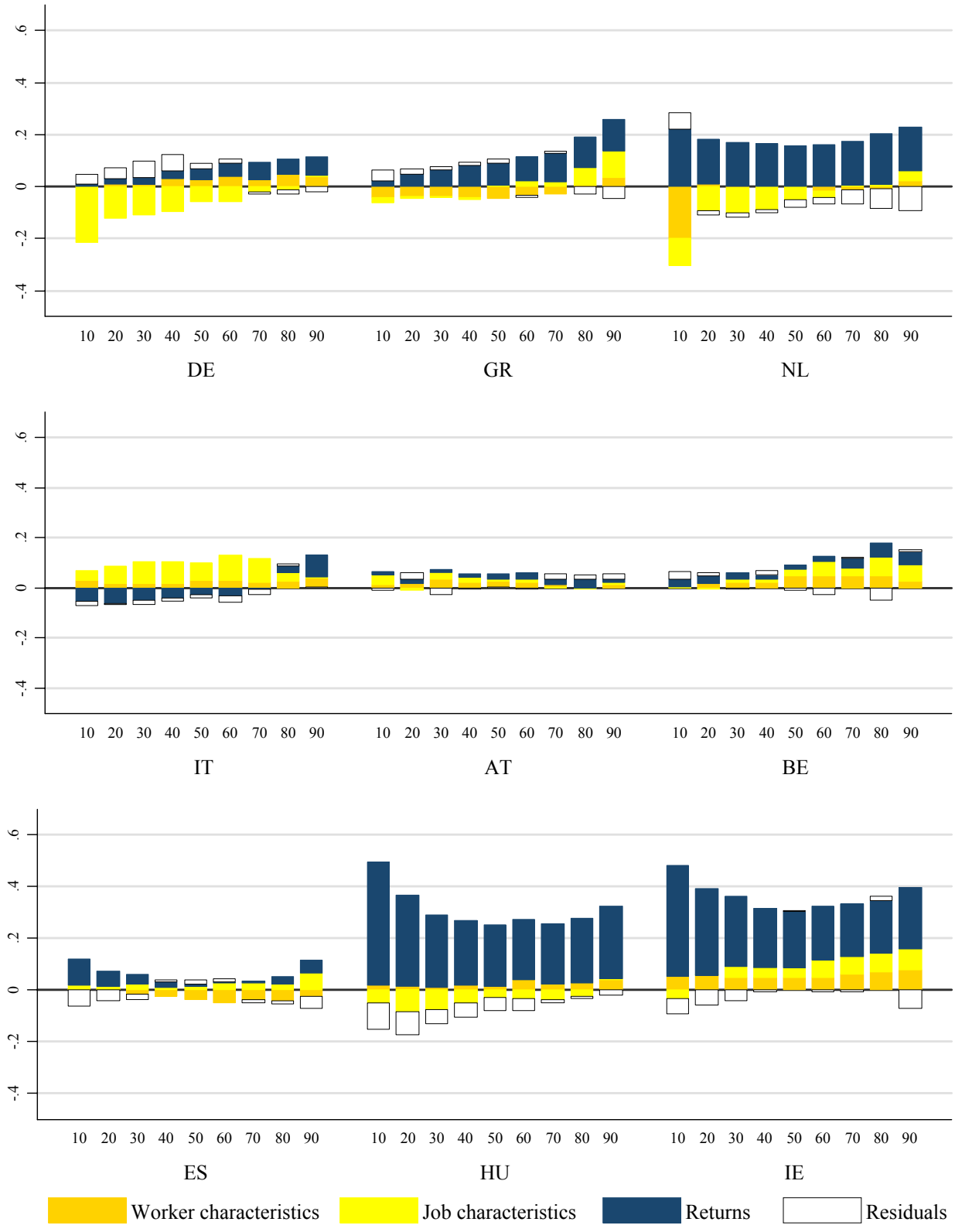

Table A3. Globalization and immigration

	Index of Globalisation[a]			Proportion of foreign labour force (%)[b]		
	1995	2002	Change	1996	2002	Change
	(1)	(2)	(2)-(1)	(4)	(5)	(5)-(4)
Austria	74.84	87.90	13.06	10.0	10.9	0.9
Belgium	90.71	94.00	3.29	8.4	8.6	0.2
Germany	63.78	76.56	12.78	8.9	9.2	0.3
Greece	63.66	69.72	6.06	3.7	5.5	1.8
Hungary	75.00	82.29	7.29	0.5	1.0	0.5
Ireland	91.89	95.06	3.17	3.5	5.5	2.0
Italy	66.07	75.04	8.97	2.9	3.8	0.9
Netherlands	89.36	92.95	3.59	3.9	3.7	-0.2
Spain	72.90	83.86	10.96	1.0	4.5	3.5
US	63.27	64.49	1.22			

Source: [a]Dreher (2006), [b]OECD.

Table A4. Labour market institutions and reforms

	Empl. protection legislation		Unemp. benefits indicator		Minimum relative to median wages		Bargaining coord/tion index	Bargaining centr/tion index	OECD Reform Intensity Indicator	Product Market Regulation indicator		Admin. Regulation indicator		Economic Regulation indicator	
	1995	2002	1995	2002	1995	2002	Constant in 1995-2000	Constant in 1995-2000	1994-2004	1998	2003	1998	2003	1998	2003
Austria	2.6	2.5	7.8	10.3	NA	NA	4	3	17.8	1.8	1.4	1.8	1.9	2.3	1.5
Belgium	2.7		10.2		0.51	0.47	4.5	3	21.4	2.1	1.4	2.1	1.9	2.6	1.8
Germany	2.6	2.1	20.0	23.2	NA	NA	4	3	23.9	1.9	1.4	2.5	1.9	2.2	1.8
Greece			12.7	10.7	0.53	0.49			13.8	2.8	2.0	2.5	2.0	3.4	1.9
Ireland	1.3	1.3	19.2	17.5		0.39	4	4	17.4	1.5	1.1	1.4	1.1	1.9	1.5
Italy	3.7	3.3	6.1	6.4	NA	NA	4	2	21.7	2.8	1.9	3.1	1.6	3.7	2.6
Netherlands	2.3	2.4	23.5	15.8	0.50	0.52	4	3	25.7	1.8	1.4	2.0	1.9	2.4	1.6
Spain	2.4	2.3	16.7	14.6	0.34	0.30	3	3	10.5	2.3	1.6	2.8	2.0	2.5	2.1
US	0.6	0.6	1.1	1.3	0.35	0.33	1	1	11.6	1.3	1.0	1.4	1.1	1.4	1.3

Notes: NA stands for Not Applicable. *Employment protection legislation* series is taken from Allard (2005a). This series uses the OECD methodology generating an index increasing on the range {0,5}. The series describing *unemployment benefits* is a new indicator which combines the amount of the subsidy with their tax treatment, their duration and the conditions that must be met in order to collect them, by Allard (2005b). The relevant numbers for Greece are unpublished and tentative. The *bargaining coordination* & *bargaining centralization* indicators are from OECD (2004), Table 3.5. They range from 1-5 and are increasing in the degree of coordination in the bargaining process on the employers' as well as the unions' side, and in the degree of centralization, respectively. The *Overall Product Market Regulation indicator* is from Conway *et al* (2005), Table 24. The indicator summarises information on 139 economy-wide or industry specific regulatory provisions and has a range {0,4}. The *Administrative Regulation Indicator* as well as the *Economic Regulation indicator* are also from Conway *et al* (2005), Table 24. All the above are available at the CEP – OECD Institutions Data Set (1960-2004). The *OECD reform intensity indicator* is from Brandt, Burniaux and Duval (2005).