

Driving forces behind the sectoral wage costs differentials in Europe*

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Abstract

In 2004 Eurostat began to publish new figures on hourly wage costs for all European countries. These figures are new in several dimensions: It is the first time that comparable hourly figures on this schemes are available and they cover a quite important time period, 1995-2005, so that not only cross-country comparisons are possible but also a dynamic analysis. Second, they are fairly detailed at the sectoral level, allowing therefore inter-sectoral comparisons.

In the German context, beside the usual ranking, these statistics show a quite unexpected result; The gap between wage costs in the manufacturing sectors and the (private & business) Services is much larger in Germany than in other countries. This study aims to explain why. Along theories various explanations are possible. First, the neo-classical tradition foresees factors affecting or indicating the level of individual productivity, as well as the firm or sectoral-productivity. Indicators for this view are tested. On the other hand, dropping the assumption of perfect competition on both labour and goods markets give way for others factors (mark-up, market power) to influence the wage costs levels. These factors are also tested here. And third, we think that demand could play a major role. Here not the level but the structure of demand in a country is meant (export-led or domestic-led). This composition feature should also be a determinant of the wage difference between Industry and Services, and indeed this factor seems to play an important role.

The paper is divided as follows: First, the new Eurostat statistics is presented with some interesting descriptive results. In a second part, from theory and literature a set of possible determinants of wage differentials between Industry and Services is listed. A bivariate analysis (correlation) is then performed and conclusions are drawn. In a third step, a multivariate analysis – a panel estimation – is performed. The last part concludes.

JEL: J31, C23, E24

Keywords: Wage differentials, Europe, sectoral level, macroeconomic panel.

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1 Introduction

In 2004 Eurostat began to publish new figures on hourly wage costs for all European countries. These figures are new in several dimensions: Comparable hourly figures on these schemes are available on the first time and they cover a quite important time period, 1995-2005, so that not only inter-countries comparisons are possible but also a dynamic analysis. Further more, they are fairly detailed at the sectoral level, so that inter-sectoral comparisons within and between countries are possible.

In the German context, these statistics are of particular interest because they shed new light on the ranking of Germany among other countries and the gap between wage costs in the manufacturing sectors and the (business) Services has been much larger in Germany than in other countries.

The paper is structured as follows: In the next section, the factors determining a possible wage costs differentials are enlightened on a theoretical point of view. Several empirical papers are thereby discussed. In the third section the data are described and a bivariate correlation analysis is performed. The fourth section will present the results from the multivariate estimations. The last section concludes.

2 Overview of the literature

2.1 Theory: several competing explanations

Various explanations of persisting wage differentials are possible. The neo-classical tradition puts ahead factors affecting or indicating the level of individual productivity, as well as the firm or sectoral productivity. Theories dropping the assumption of perfect competition on both labour and goods markets identify additional factors (mark-up, market power) influencing wage costs levels. Additionally, we think that the demand addressed to a sector plays at least as an important role in the wage determination as the relative competitiveness of this sector. Along these thoughts, the wage costs in a sector should not only reflect the (marginal) productivity of this sector net of the employer's rent due to imperfect competition but also the state of demand in that sector. Especially, the kind of demand (export-led or domestic-led) an economy is addressed with

could be a major determinant of the wage difference between Industry and Services.

Schramm (2004, chap. 3) divides explanations for cross-sectoral wage differentials in three groups; the neo-classical one along the assumption of perfect competition on the labour market explains them with different labour/job quality or compensation for non-monetary remunerations. The efficiency wage theory broadens the neo-classical thought with the idea that a wage level above the neo-classical equilibrium gives incentives to workers to work more productive and thereby to a worker rent-sharing. It is also rational for employers to pay a higher than equilibrium wage because of moral hazard problems. The last group gives attention to non-competitive features on the labour and good markets enabled from institutional set-ups that gives rise to rent-sharing from for sides, independently of the productivity level. Sociological aspects are also put forward to explain the persistency of the differences along the business cycles.

Schettkat (2006, chap. 2) lists the same explanations and puts more emphasis on the assumption of a monopsonistic labour market (Manning 2003). In this model (contrary to the efficiency wage) the actual wage is set below the optimal level. A lot of empirical case studies, esp. in relation with the introduction of a minimum wage in the UK (Metcalf 2007), show that several sub-branches of the service sector are better modeled as a monopsony rather than within a perfect competition framework (Card and Krueger 1994, Dickens and Katz 1986, Card 1996, Machin and Manning 2002). Thus not only the productivity differences can explain the wage differentials across sectors but also the structure of the labour market.

In the efficiency wage theory it is assumed that the wage level affects directly the labour efforts of workers and that the information about the size of this effort is asymmetrical; the worker knows, the employer can only guess (Shapiro and Stiglitz 1984, Krueger and Summers 1988) which gives rise to moral hazard problems. This is the reason why the employer has incentives to take into account the interests of workers. A higher wage than the optimal one (without efficiency wage consideration) produces involuntary unemployment but reduces turn-over (hiring/firing costs) and gives incentives for high-productive workers to apply and stay in the firm and to increase their work-effort. Cross-sectional wage differences are therefore explained with the different productivities/qualifications of workers between the sectors – as in the neo-classical theory – and the strength of these “moral effects” (sense for fair wage) is spread in the society (a strong effect means a tighter wage dispersion across sectors than the one that would be explained by the sole productivity/qualification dispersion).

The institutional factors are also put forward nowadays; especially the presence of a coordinated wage bargaining system should reduce the wage dispersion across sectors and qualifications. Thus a high union density or a high coverage of union agreements should go hand in hand with a smaller wage differential (Layard, Nickell, and Jackman 1991, “the battle of markups”). The market power of trade-unions is however probably dependent of the size of the firms; Very small firms may be more able to resist trade-unions demands than bigger ones (where strikes may be more likely and costly)¹. Not only the size of the firms may play a role but also the height of the producer-rent; A higher rent may give more incentive for workers to organize in a trade-union to force the employer to share it. In the insider-outsider theory the more institutions protect the insider, the higher the wage they can achieve (Lindbeck and Snower 1988, Lindbeck and Snower 2002).

2.2 Empirics: Strong evidence for productivity and rent-sharing factors

In the neo-classical theory only differences in the labour productivity or in the job-conditions can explain wage differences. Schramm (2004) reports however that empirical studies about job-conditions (health, ecological, hardness, job-security, working-time and vacations, non-monetary rewards, ...) find only a higher death probability as robust factor to explain wage differences. So only a persistent difference in the ability and productivity of workers in the Industry in comparison to those in Services can be put forward.

Regarding Europe, Genre, Momferatou, and Mourre (2005) brush in an occasional ECB-paper a broad descriptive analysis of the wage differentials within the Euro Area. Using essentially OECD-data, their wage data are not exactly defined as ours. Nevertheless they find similar results: the ranking of the countries did not change much across time. The Industry on average pays higher wages than the service sectors. This cannot be fully explained by part-time, self-employment or age effects nor by qualification effects (that even have a reverse effect). Gender appears to play no role. The individual productivity-approach however cannot fully explain the differences. The alternative theories provide variables as capital intensity, average firm size and sectoral labour productivity. This means that rent-sharing theories are in line with the observed

¹The idea is also that workers in smaller firms may be less attainable by trade-unions.

data.

Haisken-DeNew and Schmidt (1999) confirm with more recent data for Germany and the US that even after controlling for human capital components, job characteristics, status and geographical factors, the inter-industry wage structure is very persistent on both sides of the Atlantic.

Freeman and Schettkat (2001) compare the skill distributions among the unemployed and the employment in USA and Germany, as well as the wage distribution in these two countries and come to the conclusion that the productivity-theory, i.e. the neoclassical one, is not able to explain the better employment performance of the USA.

In most studies on the USA the inter-industry wage differentials are found to be stable over time, even after controlling for unionization and observable characteristics of the workers and job characteristics. Because the differences are so stable over time, they cannot be attributed to transitory supply or demand shocks affecting a specific industrial sector. Thus the competitive theories seem to be unable to explain these differentials. Some authors argue that non-standard theories do the job better like the efficiency wage theories, as the quit rate in high-wage-industries is lower (Krueger and Summers 1988), or like rent-sharing theories, as profitability seems to be higher in high-wage industries (Dickens and Katz 1986). On the other side, some authors argue that non-observed abilities of workers may persistently affect the inter-industry wage differentials, as these abilities may be valued or perceived differently across industries (Gibbons and Katz 1992). In this latter explanation the competitive model is not challenged anymore, however the empirical evidence is not so clear-cut.

Martins, Scarpetta, and Pilat (1996) find that market power exist in the studied industrial sectors and differ across products.

3 Univariate analysis: A correlation assessment

3.1 The data to explain

3.1.1 Sources and definitions

The source for our labour costs variable is the Eurostat-Labour cost statistics².

The wage costs per hour include the social security contributions of both the employee and employer, as well as the personal income tax paid by the employee. Some additional and quite negligible costs paid by the employers are also included in the statistics (working clothes, ...)

The countries covered are the EU-27 countries; i.e. EU-25+2: Euro Area(12) + UK, Denmark, Sweden and the new 10 Eastern countries + Romania and Bulgaria³. While Ireland is completely missing, others have very few data (Hungary, Malta and Italy for example).

Note that not all employees are covered: for the EU-15, only those working in firms employing at least 10 employees are considered, whereas for the new member states all are considered. This means that the wages costs levels are probably over-estimated in the EU-15, as small firms pay smaller wages in average (as can be seen on the detailed Eurostat-statistics for the NMS-10 along the firm size).

The sectors covered are the sectors C to K along the national accounts partition, whereas CDE = Industry (without construction) and GHIJK = business Services (without state and near-state services like health care or education)⁴.

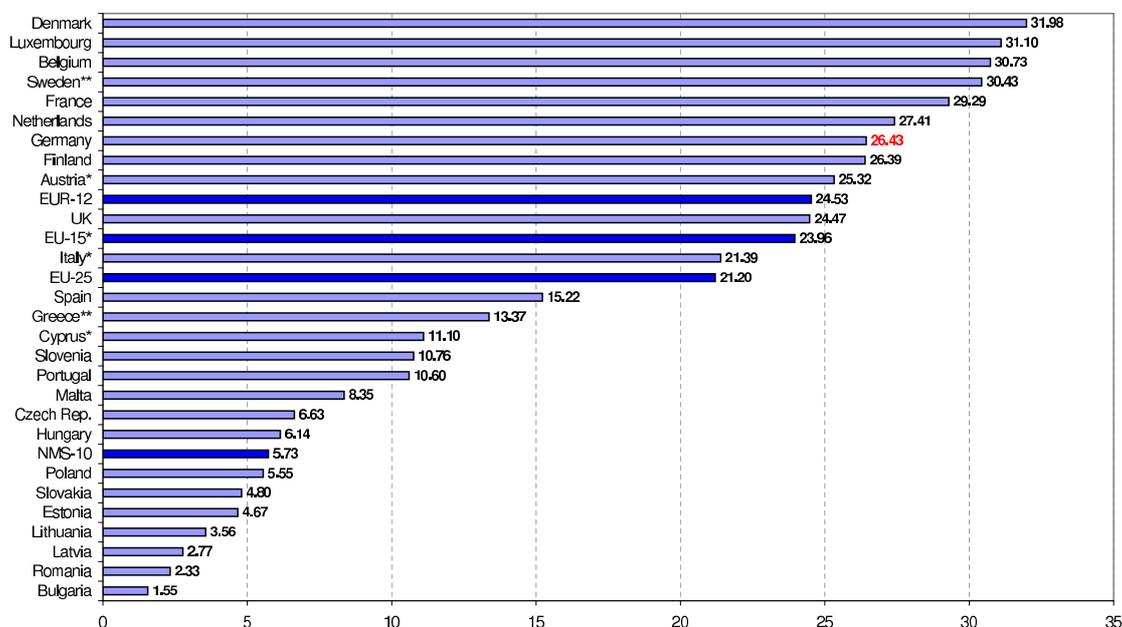
The data are annual and cover the years 1995 to 2005. Not all data are complete over this sample, i.e. we face an unbalanced panel.

²See: <http://epp.eurostat.ec.europa.eu/> → Data → Labour Market → Labour costs → Labour costs annual data → hourly labour costs.

³As the data ends in 2005, Slovenia is not part of the Euro Area but counted among the 10 new Member states.

⁴More and more data for the other sectors (AB and LMNO) are available. However these sectors are either negligible in size or cannot be considered as market-driven and are thus not considered in this study.

Chart 1: EU-27-Country ranking for the hourly wage costs in €, in 2005 and for the market economy (C-K) (Data-update: Aug. 2007).



*: data of 2004; **: data of 2003. No data for Ireland. NMS-10=New Member States.
Source: Eurostat.

3.1.2 Two interesting results

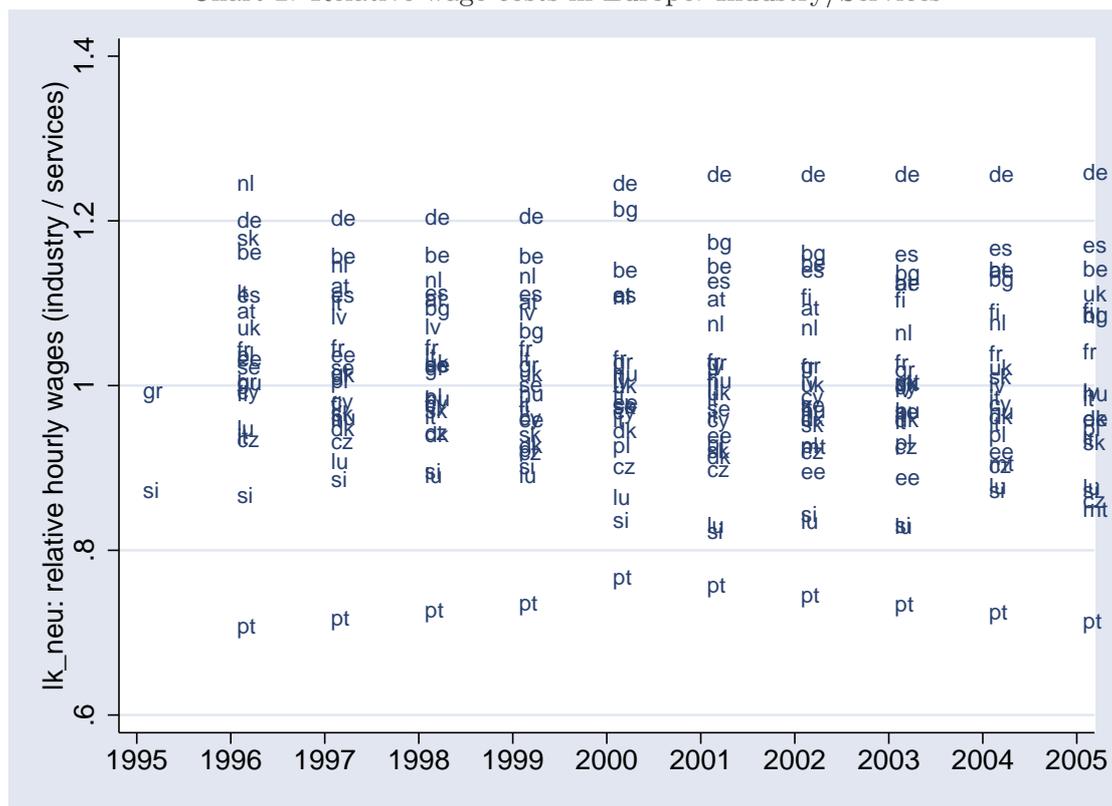
1. Germany is against a still broadly accepted view (Sinn 2007, Schröder 2007) not the country with the highest wages. On the contrary, the northern Western European countries form a bulk of high-wage countries, while Germany takes a rather middle position within EU-15. The Southern countries and especially the New Member States are well below the Western average. See Chart 1 and detailed descriptive analysis in Dütthmann, Hohlfeld, Horn, Logeay, Rietzler, Stephan, and Zwiener (2006) and Horn, Logeay, Stephan, and Zwiener (2007).

2. The second interesting result is the German outlier when one compares the wage costs differential between Industry and Services. Explaining this puzzling feature is the object of this paper

Therefore the dependent variable in the following empirical study is the hourly wage costs in the Industry (CDE) in relation to those in the market Services (GHIJK). A value above 1 indicates that the average wage costs in the Industry are higher than

those in the Services. Germany has the highest value with 1.25, meaning that industry sectors pays on average 25% more than service sectors! At the opposite the Portuguese wage costs in Services are on average by 20 to 30% higher than those in the Industry⁵. As we can see in Chart 2, this feature is persistent over the available years. A distinction between the “old” European countries (EU-15) and the others (EU-27) is made.

Chart 2: Relative wage costs in Europe: Industry/Services



Source: Eurostat, own calculations. Some countries are missing (Ireland for example).

3.2 Individual factors

As introduced above, we focus on different categories of explanatory variables. The first set compatible with all theories are the individual features. These variables are indicators for the individual productivity (steaming from experience or education), or

⁵Interestingly the contribution of domestic demand to GDP growth was 0.8%-points in Germany and 3.7%-points in Portugal between 1995-2005!

for some inherent social discrimination (that per se says nothing about the individual productivity but rather how high social discrimination is or may indicate some hidden specific job characteristics). The correlations are shown in Table 1 (p. 13).

3.2.1 Age/Experience

Data for the age composition of the sectoral labour force is available in the Labour Force Survey of Eurostat. Two variables are constructed: a variable for young employees (15-24 years old: *alter_1524*) and one for elder employees (more than 50 years: *alter_50+*). The variables are constructed similar to the wage costs: a value above one means that the proportion of younger resp. elder employees in Industry is higher than in Services.

$$alter_{1524} = \frac{\text{Young employees in the Industry/All employees in the Industry}}{\text{Young employees in the Services/All employees in the Services}} \quad (1)$$

$$alter_{50+} = \frac{\text{Elder employees in the Industry/All employees in the Industry}}{\text{Elder employees in the Services/All employees in the Services}} \quad (2)$$

The age can be seen as a proxy variable for the working experience and thus the acquired qualification of the employee. Usually a hump-shaped productivity-age-curve is assumed. However in empirical studies the curve is rather flat at the end, so that a real decline at higher ages is probably not significant. Therefore a negative sign for the 15-24-variable is expected and a presumably negative albeit not significant correlation for the 50+-variable.

The correlations are actually not significant, an indication that either the age plays no role, or it is a rather poor indicator for acquired qualification or of course other counter-acting effects linked to the age are off-setting the presumed effects. However it is worth noting that from the scatter-plots in the annex (p. 32), Luxembourg seems to follow another logic than the rest of the EU. If we exclude this country, the correlation between *alter_50+* and the relative wage costs is significantly negative for both the EU-15 and EU-27 with ca. -35%. Therefore the hypothesis of an hump-shaped age-productivity-curve is not true or there are strong institutional features (seniority clauses) of the wage bargaining inducing higher wages for elder, independently of their productivity.

3.2.2 Gender

Data for the gender composition of the sectoral labour force is available in the Labour Force Survey of Eurostat. The variable (*gender*) is constructed similar to the wage costs: a value above one means that the proportion of men in Industry is higher than the proportion of men in Services.

$$gender = \frac{\text{Male employees in the Industry/All employees in the Industry}}{\text{Male employees in the Services/All employees in the Services}} \quad (3)$$

There is no “theoretical” explanation – along the productivity-theories – why women should earn less than men. But it is a stylized fact reported in various and numerous gender studies, that women are discriminated with respect to wages. Thus omitting this variable could yield a severe bias in quantifying the effects of the other variables. This variable is correlated with the part-time proportion, indicating a probable difference of job quality between men and women.

The sign of the expected effect is positive. And indeed the correlation is strong and positive.

3.2.3 Qualification

Data for the formal qualification composition of the sectoral labour force are available in the Labour Force Survey of Eurostat, according to the ISCED-classification. The employed persons are divided into three groups according to the highest level of education attained: low, medium and high qualifications⁶. For each sub-sectoral group, a weighted mean was built. Again, if the variable (*qualification*) is above one it means that on average the employees in Industry are better (formally) qualified than those in Services.

$$qualification = \frac{\text{Weighted mean of the qualification categorical variable in the Industry}}{\text{Weighted mean of the qualification categorical variable in the Services}} \quad (4)$$

⁶Low: At most lower secondary (ISCED 0-2); Medium: Upper secondary (ISCED 3-4); High: Tertiary (ISCED 5-6). See: http://forum.europa.eu.int/irc/dsis/employment/info/data/eu_lfs/f_lfs_statistical_classifications.htm.

As for the acquired qualification, a positive effect (more qualification should induce better wages and thus higher wage costs) is expected here. On the other side, as for the acquired qualification, only the very individual qualification is taken into account here. The labour productivity gains induced by the use of certain technologies or capital inputs in a broad sense may not be well approximated by this variable.

Actually the correlations are significantly negative, which is very at odd with standard theory. This result was also found by the ECB (Genre, Momferatou, and Mourre 2005). We interpret this as an indication that either this variable is a poor indicator for individual and formal qualification, or this variable is correlated with some sectoral specific features that fraught the true (positive) presumed correlation. In any case, this remains puzzling because one would expect that the necessary bias induced by these bivariate considerations should not be so severe as to even produce a counter-intuitive sign.

Table 1: Correlation between individual factors and the wage costs differential between Industry and Services for the EU-27 and the EU-15.

	EU-27	EU-15
	1995-2005	
	Relative wage costs	
ALTER_1524 <i>(15-24 years/all employees)</i>	-4.2%	-2.2%
	53.5%	80.2%
	219	135
ALTER_50+* <i>(50+/all employees)</i>	28.2%	31.8%
	0.0%	0.0%
	209	125
GENDER <i>(Men/all employees)</i>	42.0%	59.0%
	0.0%	0.0%
	225	135
QUALIFICATION <i>(weighted mean: 1-low, 2-mid, 3-high)</i>	-33.5%	-27.9%
	0.0%	0.1%
	216	132

Bold figures are significant at the 1%-level. The first number is the correlation coefficient (ρ), the second the probability associated with $H_0: \rho = 0$ and the last number is the number of observations.

*: w/0 Luxembourg due to big outlier.

3.3 Firm and sectoral factors

The second set of possible explanatory variables are the firm and sector-specific variables. They are also indicators of productivity in the sense that they are in fact not linked to the personal abilities of the workers, but through capital-intensity still affect the overall labour productivity. They also can be interpreted in line with the rent-sharing theories; the bigger the firm, the more likely it possesses some market power and therefore monopolistic rent that can be shared with the workers, leading to wage differences that cannot be explained along the productivity differences. The correlations are shown in Table 2 on p. 17.

3.3.1 Firm size/capital intensity

Data on firm size are very difficult to obtain and are even more difficult to get for a long time period. Data from Eurostat could be collected essentially for the middle of the sample (1999-2001; Eurostat, annual structural Business Statistics – SBS). Because of a lack of data, some reconstructions from the national account statistics were performed. Therefore, not too much confidence should be put on this variable as the measurement error is likely to be important. The variable (*firmsize*) is also constructed similar to the wage costs variable. A value above one means that firms in Industry are larger on average than those in Services.

$$firmsize = \frac{\text{Average number of employees per firm in Industry}}{\text{Average number of employees per firm in Services}} \quad (5)$$

This variable is a proxy for the capital intensity or degree of market power in the sector: the larger a firm, the bigger the economies of scale, and thus the larger the amount of capital per head but also the more likely the firm possesses market power. The first explanation yields a positive effect on labour productivity and hence on wages, the second through the rent-sharing between the employers and the workers a positive effect on wages too. Thus, in both cases, a positive correlation is expected but cannot be shown for the EU-15. Due to the small number of observations, it is difficult to draw significance at all.

For Germany however, the Federal Statistical Office (Destatis 2006, p. 15, Chart 4) shows that the size of firms and the wage costs are positively correlated and that this

is a long-term feature (1992-2004). Capital intensity (measured as GCF/head) is also positively correlated through the German branches in 2004 with the height of the wage costs.

3.3.2 Self-employment ratio/capital intensity

Data on self-employment and employment in a sectoral disaggregation can be taken from the national account statistics from Eurostat but we choose the labour force survey as it is more complete (at least for the EU-15 countries). The variable (*selfemploy*) takes a value above one if the proportion of self-employed in industrial sectors is larger than those in Services.

$$selfemploy = \frac{\text{Self-employed/All employment, in the Industry}}{\text{Self-employed/All employment, in the Services}} \quad (6)$$

This variable is also a proxy for the firm size (the correlation between the two variables is indeed significant negative with around -65%) and consequently for the capital intensity and/or for the market power of the firms. Because the link is reversed (a larger proportion of self-employed goes with a smaller average firm size), we expect a negative sign.

Indeed the correlation is negative, however not significant.

3.3.3 Part-time

Data for part-time jobs on a sectoral level are available from Eurostat only for the year 2000 and from the labour costs statistics. Thus this variable is quite restricted. Again the variable takes values above one if the part-time ratio is higher in Industry than in Services⁷.

$$teilzeit = \frac{\text{Part-time employees/All employees, in the Industry}}{\text{Part-time employees/All employees, in the Services}} \quad (7)$$

Similar to gender, there is no “theoretical” justification for an influence of this vari-

⁷This was calculated for employees of firms which employ at least ten employees.

able, as the labor costs are already corrected for the hours worked. However, like for the gender, it is a stylized fact that the hourly wages for part-time employees are smaller than those of full-time employees (OECD 1999, p. 22-25). Thus one should take this into account. This variable is negatively correlated with the gender variable (-30%, meaning that where women are more numerous, part-time jobs too) as mentioned above, so that this variable may be an indicator for social discrimination and for job quality. This would yield a negative correlation.

The correlation is indeed negative for the EU-27 (albeit not significant) but is unexpectedly positive for the EU-15 (but not significant either). These correlations should be taken with caution because of the very small sample size.

3.3.4 (Labour) Productivity

Productivity measures are only available on a per-capita basis, because figures for hours are not available for all countries. Working time reductions have reduced the productivity per head but increased wages per hour in the past. Besides, taking the ratio of sectoral gross value added to the sectoral employment levels is thought to be highly endogenous and may yield to strong endogeneity problems. Therefore productivity per capita cannot be used here.

3.4 Country specific factors: institutional settings

The third set of possible explanatory variables are the country-specific variables. Clearly, they are indicators for failures of the neo-classical framework, as they indicate some institutional features of the labour market and show if market power plays a significant role. The correlations are shown in Table 3.

3.4.1 Unemployment rate/strength of workers

Data on the standardized unemployment rate are provided by Eurostat (ILO-concept). The unemployment rate here is the national-wide rate (no sectoral differences are available). This should be an indicator for the market power or relation between employers

Table 2: Correlation between firm-specific factors and the wage costs differential between Industry and Services for the EU-27 and the EU-15.

	EU-27	EU-15
	1995-2005	
	Relative wage costs	
FIRMSIZE	12.0%	-13.1%
	31.9%	42.8%
	71	39
SELFEMPLOY* (<i>Selfemployed/all employment</i>)	-15.8%	-33.9%
	2.3%	0.0%
	207	125
TEILZEIT (<i>Part-time/all employees</i>)	-12.1%	15.9%
	57.3%	58.7%
	24	14

Bold figures are significant at the 1%-level. The first number is the correlation coefficient (ρ), the second the probability associated with $H_0: \rho = 0$ and the last Number is the number of observations.

*: w/0 Luxembourg due to big outlier.

and employees as predicted by the insider/outsider theory: A higher unemployment rate goes with a weaker bargaining position of employees. By which extent this should affect employees in industrial sectors more than in Services is an open question. But if no other indicators are included, as in the years observed (1995-2004), the structural change operates in favor of Services: A higher unemployment rate should weaken the Industry employees more than those in the Services on the one hand (negative effect), on the other hand a higher unemployment rate may be rather an indication of poor macroeconomic performance, which could weaken the service sector more than the Industry⁸ (positive effect).

The correlation is significantly positive which gives more evidence for the second explanation.

⁸Industry-firms are thought to be more likely to export their products than Services in general. This is confirmed by the Input-Output tables for Belgium, Germany, Ireland, Spain, France, Italy, Netherlands, Austria, Portugal, Finland, Denmark, Sweden, UK, Lithuania, Hungary, Slovenia and Slovakia for the available years between 1995 and 2004. By this way, industrial firms may compensate domestic slackness through better foreign demand more significantly than firms in the Services.

3.4.2 Minimum wage/institutional factors

A dummy variable takes value 1 if the country has a minimum wage and 0 else. There are only seven countries without legal national minimum wage throughout the sample (Austria, Germany, Finland, Italy, Denmark, Sweden and Cyprus), the UK having adopted a minimum wage in 1999.

Another interesting variable would be the proportion of employees covered by minimum wage(s); as we exclude civil servants and employees of the social services, for countries where the minimum wage is legal and national, this coverage rate will be 100%⁹. More interesting is the proportion covered in the North-South axis of countries that do have minimum wages only at sectoral levels and set by collective agreements (Italy, Germany, Austria, Denmark and the three scandinavian countries). From Funk and Lesch (2005) and Husson (2006) some figures are available for some years. It appears that Austria, Denmark, Finland and Italy have high coverage rates (above 85%) whereas Germany and Norway have low coverage rates (around 70% in 2004, but here we suspect that this concerns only West-Germany¹⁰). A specific look at low-pay sectors that are all in the Services (textile/clothing, retail, hotel/restaurants, hairdressing) also shows that the coverage of the minimum wages set by the collective agreements are much smaller in those two countries than in the others. Due to lack of data however, the will to construct such a variable was abandoned.

A national-wide minimum wage affects (almost) all employees. It should reduce the wage differentials because it reduces the very low wages in all sectors. It increases wage compression. Thus the absence of a minimum wage should be associated with more extreme values of our dependent variable and the presence of a national minimum wage with values concentrated around one. This non-linear effect can be caught if we divide the sample in two (countries/years with a value of the dependent below one and countries/years with a value above one). In the first group a positive coefficient is expected and in the second a negative one.

⁹In Belgium the minimum wage concerns only the employees in the private sector. As we only look at the private sector, excluding construction and the primary sectors, the coverage rate is 100%. In Cyprus, the minimum wage concerns only some professions; sales staff, clerical workers, auxiliary health care staff and auxiliary staff in nursery schools, crèches and schools. Thus the coverage rate is not 100%.

¹⁰From the WSI-Tarifarchiv (2006) figures, the coverage rate by collective agreements, where minimum wages are normally defined, varied from 76% to 67% between 1998 and 2005 in West-Germany and from 63% to 53% in the East.

For the whole (undivided sample), a significant negative correlation for both variables can be observed: the presence of a minimum wage is significant. The higher its level, the lower the Industry/Services wage gap. For the parted sample, the expected non-linear effect is not met. Even counter-intuitive, the negative correlation in the first sub-sample appears to be twice to three times higher than in the second sub-sample (see Table 4).

3.4.3 Union density rate/institutional factors

The union density rate is taken from the OECD-database (Bassanini and Duval 2006). The data set ends in 2003 and covers only Western European countries.

One would expect that the union density is especially low in service sector, as mentioned above. Thus a higher union density would rather go with less difference between union coverages between the Services and the Industry. This would support a negative effect in the labour cost relation between Industry and Services. The correlation here is negative but not significant.

Interestingly, a non-linear effect can be found (the correlation coefficient is significant positive for values of the dependent below one and significant negative for values of the dependent above one; See Table 4). The explanation is quite straightforward and follows the arguments for a hump-shaped wage/centralization degree of wage bargaining à la Calmfors and Driffill (1988). The stronger the trade-unions, the more likely they coordinate their actions and promote wage compression over all sectors. On the other hand, the less representative, the more firm-specific the trade-unions demands will be, yielding a higher wage dispersion across sectors. This means that values well above and below one in our dependent variable should be associated with low values of union density and values around one of our dependent variable should be associated with high values of union density. This means that the correlation should be positive for values of the dependent below one and negative for values above one.

3.5 Growth composition indicators

The idea for this fourth and last set of variables is that demand addressed to a sector plays at least as an important role in the wage determination as the relative competitiveness of this sector. Thus we think that the wage costs in a sector are not only reflecting

Table 3: Correlation between country-specific factors and the wage costs differential between Industry and Services for the EU-25 and the EU-15.

	EU-27	EU-15
	1995-2005	
	Relative wage costs	
ALQ	14.4%	27.9%
<i>(Unemployment rate)</i>	3.0%	0.1%
	226	135
MINWAGE.IS	-20.1%	-15.7%
<i>(0: no minimum wage, 1: national MW)</i>	0.2%	6.9%
	242	135
UDENS		-13.5%
<i>(Union Density)</i>		19.2%
		95

Bold figures are significant at the 1%-level. The first number is the correlation coefficient (ρ), the second the probability associated with $H_0: \rho = 0$ and the last number is the number of observations.

Table 4: Non-linear correlation between country-specific factors and the wage costs differential between Industry and Services for the EU-25 and the EU-15.

	EU-27			EU-15		
	All	w < 1	w > 1	All	w < 1	w > 1
ALQ	14.4%	28.5%	-4.8%	27.9%	36.3%	-2.4%
	3.0%	0.2%	62.1%	0.1%	1.0%	82.5%
	226	114	110	135	50	84
MINWAGE.IS	-20.1%	-41.7%	-30.9%	-15.7%	-75.2%	-26.4%
	0.2%	0.0%	0.1%	6.9%	0.0%	1.5%
	242	122	118	135	50	84
UDENS				-13.5%	66.3%	-12.2%
				19.2%	0.0%	34.8%
				95	33	61

Bold figures are significant at the 1%-level. The first number is the correlation coefficient (ρ), the second the probability associated with $H_0: \rho = 0$ and the last number is the number of observations.

the (marginal) productivity of this sector net of the employer's rent due to imperfect competition but also the state of the demand in that sector.

Here however a precision has to be made; As the sectoral wage differentials are persistent over time i.e. over business cycles, the state of demand, reflected within traditional

business cycle indicators like the growth rate, cannot be an explanation of the wage gap. We think here more in terms of long-term structure or strategies; Germany for example has a long tradition of using external trade as motor of its growth, whereas in other European countries the focus on external trade was never such an important matter in economic policy. In that respect, it may well be that the participation to the Monetary Union has induced a change in preferences in economic policy in countries traditionally more introspective than in countries with a long experience of de facto monetary bindings like Germany, Netherlands or Austria.

In these respects, we thought that the indicator should be cumulative and relative, i.e. has a chance to persist over-business cycles, and reflects long-lasting differences in the demand addressed to the Industry and Services. We look at the composition of growth as explanatory factor for the wage differential; the Industry being historically more an export-oriented sector, whereas the Services are more dependent on the domestic market (with some exceptions of course). Growth will not have the same impact on the wage opportunities for workers in Industry and Services, depending on the driving forces; the German model of export-led growth should favour the Industry more than the Services whereas the Portuguese model of domestic demand-led growth should be more favourable to the Services. The correlation are shown in Table 5.

Along this idea, cumulative and relative growth variables for the exports and domestic demand are built: the growth rate in % of exports resp. of domestic demand resp. of GDP was cumulated from 1996 onward in an index taking the value of 100 in 1995 (Malta and Romania start only 1999 due to lack of data); This index is then put in relation to the one of the Euro Area. A value above 100 means therefore that the accumulated growth performance since 1995 is above average.

$$\text{growth_namek2}_{i,t} = \frac{\prod_{\tau=1996}^t \left(\frac{\text{name}_{i,\tau}}{\text{name}_{i,\tau-1}} \right)}{\prod_{\tau=1996}^t \left(\frac{\text{EUR12}_{i,\tau}}{\text{name}_{EUR12,\tau-1}} \right)} \times 100 \quad (8)$$

With $\text{name}=\text{exp}$, gdp or intdd for resp. exports, GDP and domestic demand in constant terms; i the country index and t the time index. The index starts in 1995 with the value 100.

We build this indicator for the exports, domestic demand and GDP at constant prices. The expected effects are positive for the first one, negative for the second one and depending of which effect dominates open for the last and third one.

The correlations have the expected signs and are significant for the domestic demand and GDP.

The results show that development of the domestic demand is much more important than export demand.

Table 5: Correlation between growth structure indicators factors and the wage-cost differential between Industry and Services for the EU-25 and the EU-15.

	EU-27	EU-15
	1995-2005	
	Relative wage costs	
GROWTH_EXPK2	-1.3%	22.5%
<i>(cumulated export-growth relative to EUR-12)</i>	<i>84.3%</i>	<i>0.9%</i>
	<i>242</i>	<i>135</i>
GROWTH_GDPK2	-24.6%	-29.7%
<i>(cumulated GDP-growth relative to EUR-12)</i>	<i>0.0%</i>	<i>0.1%</i>
	<i>242</i>	<i>135</i>
GROWTH_INTDDK2	-23.7%	-41.1%
<i>(cumulated domestic demand-growth relative to EUR-12)</i>	<i>0.0%</i>	<i>0.0%</i>
	<i>242</i>	<i>135</i>

Bold figures are significant at the 1%-level. The first number is the correlation coefficient (ρ), the second the probability associated with $H_0: \rho = 0$ and the last number is the number of observations.

4 Multivariate analysis

The advantage of doing a multivariate analysis which includes both dimensions (time and cross-sections) is twofold: first in increasing the number of observations, we expect to get more accurate estimates of the effects of individual variables on the relative wage differential and second – in the contrary of the bivariate correlations – in a multivariate analysis, one controls for different effects at the same time and should be able to isolate the genuine effect of a factor, reducing therefore potential omitted variable bias.

The regressors we use, summarized in X_{it} , are [*alter_1524*, *alter_50+*, *gender*, *qualification*, *selfemploy*, *alq*, *minwage_is*, *growth_expk2*, *growth_intdd2k*]. We dropped *firmsize*, *udens* and *teilzeit* because these variables had too few data. Still the data set remains unbalanced. All variables are time-variable, whereas the dummy *minwage_is* actually is

time-invariant for all countries but for the UK¹¹.

4.1 Static regressions

It is not obvious that the model should entitle a dynamic term, as the series are quite stable (they are all relative and thus do not have trends). Because our data set is a macro-panel with countries from the EU-27, it seems also sensible to rule out random-effects. At least a discussion about which variable may be correlated with country-specific unobserved characteristics should be done.

Possibly all variables may be correlated with the country-effects. But certainly the unemployment rate, the presence or not of a minimum wage may be very likely candidates. As we have only the minimum-wage dummy that may be considered as almost time-invariant, the fixed-effect estimator may be the most appropriate.

$$\text{lohnkosten}_{it} = X'_{it}\beta + \lambda'DT_t + \alpha_0 + \alpha_i + u_{it} \quad (9)$$

The results of the standard estimators are reported in Table 6. The Hausman-test (H0: Random Effects are present) is rejected and the Breusch-Pagan test (H0: Fixed effects are present) is consistently not rejected. This is in line with our intuition that a fixed-effect model would better describe a macro-panel. The pooled estimation is reported below:

Nb of obs.: 201. Nb of param.: 20. Using robust standard errors
Time dummies: 10; Nb of individuals: 25
longest time series: 11 [1995 - 2005]; shortest: 2 (unbalanced panel)

	coefficient	H-robust p-val
ALTER_1524	-4.58E-02	60.2%
ALTER_50PLUS	-2.51E-03	98.3%
GENDER	3.88E-01	1.5%
QUALIFICATION	-4.70E-02	11.2%
SELFEMPLOY	-3.21E-02	83.7%
ALQ	1.18E-02	3.7%
MINWAGE.IS	-2.60E-03	94.4%
GROWTH_EXPK2	5.70E-04	45.4%
GROWTH_INTDDK2	-1.46E-03	19.4%

Wald (X): $\chi^2(9) = 34.55$ [0.0%] ; Wald (time): $\chi^2(10) = 16.94$ [7.6%]
AR-1 & 2 rejected at 1%. with PcGive.

¹¹It takes the value 0 between 1995 and 1998 and 1 after.

Table 6: Static regressions: results of the standard estimators

Used program: STATA		Maximal Sample: 26 countries of the EU-27 available; 1995-2005 (11 years)											
Endogenous: Lohnkosten		xtreg				xtgee				xtgls		xtpcse	
Estimation method:	Fixed effects (within)	Random effects		Random effects		f(gauss), i(id) robust		panels(hetero) force		hetonly pairwise			
		GLS	MLE	GLS*	GLS	corr(exch)	corr(ar1)	corr(ar1)	corr(pсар1)	corr(ar1)	corr(pсар1)		
Alter_1524	38.6E-3	33.7E-3	33.5E-3	33.7E-3	36.0E-3	54.2E-3	52.7E-3 *	25.9E-3	36.0E-3	37.1E-3			
Alter_50plus	43.2E-3	39.2E-3	39.0E-3	39.1E-3	41.0E-3	115.6E-3 ***	74.9E-3 ***	65.3E-3 ***	34.5E-3	53.1E-3 **			
Gender	80.9E-3	112.4E-3*	113.6E-3*	112.9E-3*	98.3E-3	117.0E-3	208.9E-3 ***	173.2E-3 ***	244.4E-3 ***	208.1E-3 ***			
Qualification	-3.1E-3	-9.7E-3	-9.9E-3	-9.8E-3	-6.7E-3	-18.2E-3 **	-45.9E-3 ***	-50.6E-3 ***	-31.1E-3 **	-55.2E-3 ***			
Selfemploy	5.7E-3	-8.2E-3	-8.7E-3	-8.4E-3	-2.1E-3	-5.8E-3	-5.7E-3	15.7E-3	-10.4E-3	13.6E-3			
Alq	-3.6E-3 *	-2.0E-3	-1.9E-3	-2.0E-3	-2.7E-3	1.6E-3	3.2E-3 *	1.4E-3	7.2E-3 ***	397.7E-6			
Minwage.is	-8.6E-3	-9.4E-3	-9.4E-3	-9.4E-3	-8.9E-3	661.8E-6	21.0E-3	44.5E-3 ***	-32.5E-3 *	30.5E-3 **			
Growth_expk2	177.7E-6	212.1E-6	213.3E-6	212.5E-6	197.4E-6	-110.9E-6	-40.6E-6	-60.8E-6	187.9E-6	118.1E-6			
Growth_intddd2	-1.9E-3 ***	-1.7E-3 ***	-1.7E-3 ***	-1.7E-3 ***	-1.8E-3 ***	-320.0E-6	-238.2E-6	-998.7E-6	-583.7E-6	-509.2E-6			
Country effect	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes			
Time effect	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes			
nb.obs.	201	201	201	201	201	165	201	201	201	201			
nb.param.	19.4%	19.0%		19.0%			20	20	20	20			
R ² within	3.5%	8.5%		8.6%			0.0%	0.0%	0.0%	0.0%			
R ² between	6.7%	13.6%		13.7%			67.7%	53.5%	0.0%	0.0%			
R ² overall	1.2%												
Prob>F	25.3%	0.0%	0.0%	39.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
Prob>χ ²	0.0%	0.0%	32.2%	0.0%	0.0%	25.1%	0.0%	0.0%	0.0%	0.0%			
Prob>F (TD=0)													

xtreg: OLS estimator; xtgee: ML-estimator as in xtreg but handled unbalanced panel differently; xtgls: GLS-estimator with assumed heteroskedasticity but no correlation across panels and a ar(1)-structure across time; xtpcse: GLS-estimator with correlation in both dimensions (time and cross-sections) and heteroskedasticity across panels; psar: the assumed correlation is decreasing with the time distance.

*: with small-sample correction for the standard errors (Swamy-Arora) and non-constant theta.

***, **, *, significant at 10%, 5%, 1% level.

5 Conclusions

In this article we analyze the new data from Eurostat on hourly wage costs, that are comparable across all European countries. Among other interesting features, a surprising result is the outlier position of Germany regarding the relative low wage costs in service sectors. The aim of this paper is to explain this last fact.

In a first and descriptive step, a bivariate correlation analysis was performed and the following results were found: only gender is a significant factor at the individual level. Especially the (formal) qualification shows significant wrong-signed correlation, a contradiction with the widely asserted low productivity in Services. On the contrary firm specific factors indicating the importance of capital intensity in explaining wage differentials (self-employment share) do not seem to have a great explanatory power. Factors (country specific and demand indicators) that are in accordance with non-standard wage determination theories are found significant (unemployment rate, minimum wage, growth structure).

In a second step a multivariate analysis is performed, allowing to control for each effect. The signs found in bivariate correlations are so far confirmed for the elder-age-variable (+), gender (+), qualification (counter-intuitive -) and the domestic demand growth variable (-).

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6 Annex: Overview of the estimators used

6.1 Pooled OLS

In the pooled model, there is no country effects and the time effects are common to all individuals. The errors are supposed to be uncorrelated in the time dimension and across countries and homoskedastic in the cross-sectional dimension:

$$y_{it} = \alpha^* + X'_{it}\beta + u_{it} \quad (10)$$

In STATA, the command is `xtreg` with time dummies.

6.2 Static Fixed Effects (SFE)

In the fixed effects model, the error term is decomposed in a fixed unit-specific component (a country-specific intercept) and an observational error term. There exists several methods to estimate such a model; Either one adds individual dummies (LSDV-estimator):

$$y_{it} = \alpha'DI_i + \lambda'DT_t + X'_{it}\beta + u_{it} \quad (11)$$

Or one can transform the variables (subtract the group mean), so that the time-invariant variables are dropped from the model (WITHIN-estimator):

$$y_{it} - \bar{y}_i = (\alpha_t - \alpha_i) + \lambda'(DT_t - \overline{DT}) + (X_{it} - \bar{X}_i)' \beta + (u_{it} - \bar{u}_i) \quad (12)$$

This is achieved in Stata with the command `xtreg` and the option “fe”. In both cases (that yield exactly the same estimates for the β , as the OLS method is applied, we need to have homoskedastic and uncorrelated errors, and that they are unrelated to the α_i and the other exogenous factors, for the estimators to be consistent and BLUE.

6.3 Static Random Effects (SRE)

In the fixed effects model, the error term is decomposed in a random unit-specific component (a country-specific error term) and an observational error term. As now it is clear that the overall error term will not meet the assumption of autocorrelation and probably also not of homoskedasticity, the GLS-estimator is required. One can show further that the GLS reduce to OLS applied to the following transformed model:

$$y_{it} - \theta_i \bar{y}_i = (1 - \theta_i) \alpha^* + \lambda'(DT_t - \theta_i \overline{DT}) + (X_{it} - \theta_i \bar{X}_i)' \beta + \varepsilon_{it} - \theta_i \bar{\varepsilon}_i \quad (13)$$

θ_i stands for $1 - \sqrt{\frac{\sigma_u^2}{\sigma_u^2 + T_i \sigma_\alpha^2}}$ and $\varepsilon_{it} = \alpha_i + u_{it}$.

We need to estimate θ , and there exists therefore different estimators, as we can only perform F-GLS.

In Stata the commands `[xtreg, re]` and `[xtreg, re sa]` call the GLS estimator. In both cases the Swamy-Arora variance estimator based on the within and between regressions is implemented. The second specification has a small sample correction, that differ from the first one in unbalanced panels. Important to note here, is that the u_{it} -error term possess the usual properties: homoskedastic across individual, uncorrelated between the individuals and in the time-dimension. It is also unrelated to the individual-specific error α_i and to the other exogenous variables. As this is a F-GLS estimation, test-distributions hold only asymptotically (χ^2 rather than F).

It is possible to estimate the F-GLS also with maximum-likelihood `[xtreg, mle]`. In this case, the residual are assumed also to be normally distributed and an iterated regression is performed. In case the total number of observation (here 201) is smaller

than 300 and the data unbalanced (our case too) the [mle] and [re] regressions will yield different results.

If the correlation structure of u_{it} is not as simple as assumed above esp. if some time-autocorrelation is present, then the GLS estimator needs to be adapted. There is several ways to take account of richer variance structure.

[xtgee] is the first possibility embraced in the estimation part. It fits a population-averaged panel-data model; the option [f(gauss) i(id)] consider that the errors are normally distributed and the model linear in the coefficients. This estimator consider then the within-group correlation structure R_i :

$$\begin{pmatrix} \text{corr}(u_{i1}, u_{i1}) & \text{corr}(u_{i1}, u_{i2}) & \dots & \text{corr}(u_{i1}, u_{iT_i}) \\ \text{corr}(u_{i2}, u_{i1}) & \text{corr}(u_{i2}, u_{i2}) & \dots & \text{corr}(u_{i2}, u_{iT_i}) \\ \vdots & \vdots & \ddots & \vdots \\ \text{corr}(u_{iT_i}, u_{i1}) & \text{corr}(u_{iT_i}, u_{i2}) & \dots & \text{corr}(u_{iT_i}, u_{iT_i}) \end{pmatrix} = \begin{pmatrix} r_{11} & r_{12} & \dots & r_{1T_i} \\ r_{21} & r_{22} & \dots & r_{2T_i} \\ \vdots & \vdots & \ddots & \vdots \\ r_{T_i1} & r_{T_i2} & \dots & r_{T_iT_i} \end{pmatrix}$$

Then the within-group correlation structure R_i can take two forms:

- corr(exch): $r_{ts} = \begin{cases} 1 & \text{if } t = s \\ \rho & \text{if } t \neq s \end{cases}$. This equivalent to the [xtreg, re] and [xtreg, mle] commands if the data are balanced, with [xtreg, pa] otherwise.
- corr(ar1): $r_{ts} = \begin{cases} 1 & \text{if } t = s \\ \rho^{|t-s|} & \text{if } t \neq s \end{cases}$. This equivalent to the [xtreg, re] command.

[xtgls] is another possibility. It is a F-GLS estimator which allows for ar(1)-autocorrelation within panel, as [xtgee], and cross-sectional correlation and cross-sectional heteroskedasticity. The variance of the overall residuals ($\alpha_i + u_{it}$) can be written as the Kronecker product of the within-group variance (σ) and the cross-sectional variance (Ω):

$$E(\varepsilon\varepsilon') = \sigma \otimes \Omega = \begin{pmatrix} \sigma_{11} & \sigma_{12} & \dots & \sigma_{1N} \\ \sigma_{21} & \sigma_{22} & \dots & \sigma_{2N} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{N1} & \sigma_{N2} & \dots & \sigma_{NN} \end{pmatrix} \otimes \begin{pmatrix} \Omega_{11} & \Omega_{12} & \dots & \Omega_{1N} \\ \Omega_{21} & \Omega_{22} & \dots & \Omega_{2N} \\ \vdots & \vdots & \ddots & \vdots \\ \Omega_{N1} & \Omega_{N2} & \dots & \Omega_{NN} \end{pmatrix}$$

If the diagonal of the σ -matrix is filled with different numbers, the individuals do not

have the same overall variance (panel-heteroskedasticity). If the off-diagonals are not zero, the individuals are correlated with each other (panel-correlation). If the Ω -matrix is not identity, then the residuals are autocorrelated in the time dimension (within-group correlation). With this estimator several options are possible:

- `panels(hetero)`: state that the Ω -matrix is identity (default if no `corr-option` specified) and $\sigma =$

$$\sigma = \begin{pmatrix} \sigma_{11} & 0 & \dots & 0 \\ 0 & \sigma_{22} & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & \sigma_{NN} \end{pmatrix}$$

- `corr(ar1)`: state that the Ω -matrix is such that the serial correlation structure is

$$r_{ts} = \begin{cases} 1 & \text{if } t = s \\ \rho^{|t-s|} & \text{if } t \neq s \end{cases}$$

- `corr(psar1)`: state that this correlation factor can be different for each individual:

$$r_{ts,i} = \begin{cases} 1 & \text{if } t = s \\ \rho_i^{|t-s|} & \text{if } t \neq s \end{cases}$$

The last estimator used in this paper is `[xtpcse]`; it calculates a panel-corrected standard errors for the OLS-estimates (actually Prais-estimator that corrects for first order autoregression in the time-dimension, i.e. a GLS estimator!). We use the `[pairwise]` option that specifies that all information available for an individual should be used to calculate the covariance matrix. This has influence only when the data are unbalanced. The option `[hetonly]` is also selected implying that panel-heteroskedasticity is allowed (see above). Two sorts of within-group autocorrelation is then allowed as above, a common `ar(1)`-structure (`ar1`) or individual-specific one (`psar1`). `[xtgls]` and `[xtpcse]` are consistent, and under the correct assumption of the error structure F-GLS would be more efficient. But it is argued that with the typical small samples used in social science, `xtpcse` should be preferred, as it is more conservative.

7 Annex: Scatter diagrams of the data

Chart 3: Scatter diagram: Age (15-24) vs Wages, EU-27 and EU-15

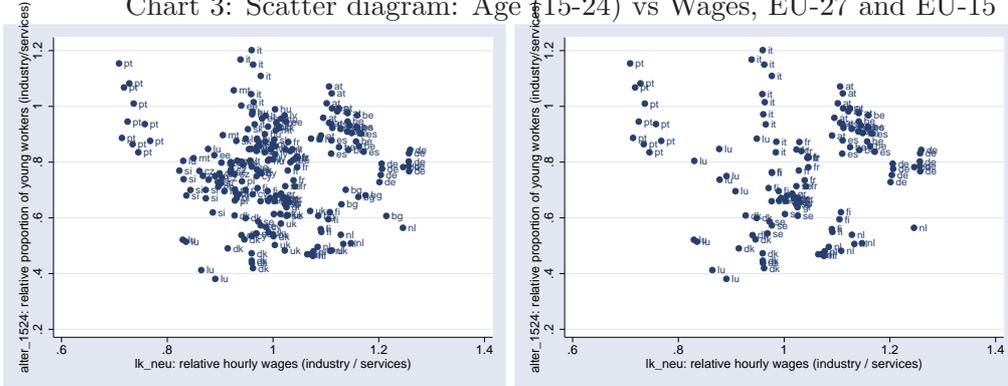


Chart 4: Scatter diagram: Age (50+) vs Wages, EU-27 and EU-15

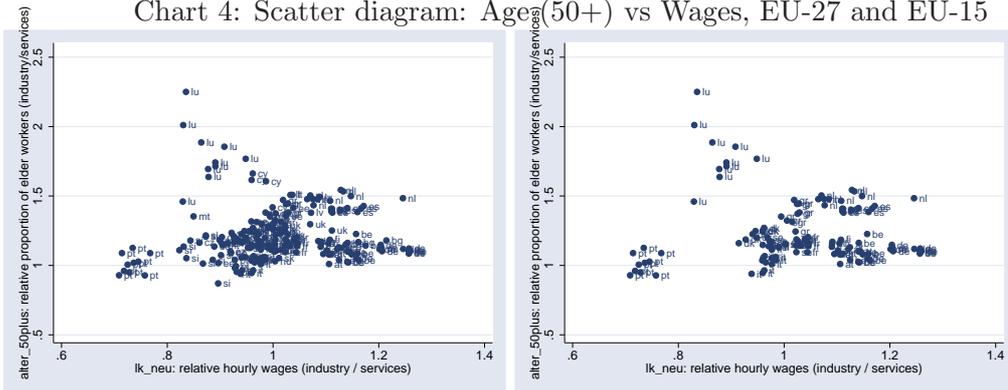


Chart 5: Scatter diagram: Gender vs Wages, EU-27 and EU-15

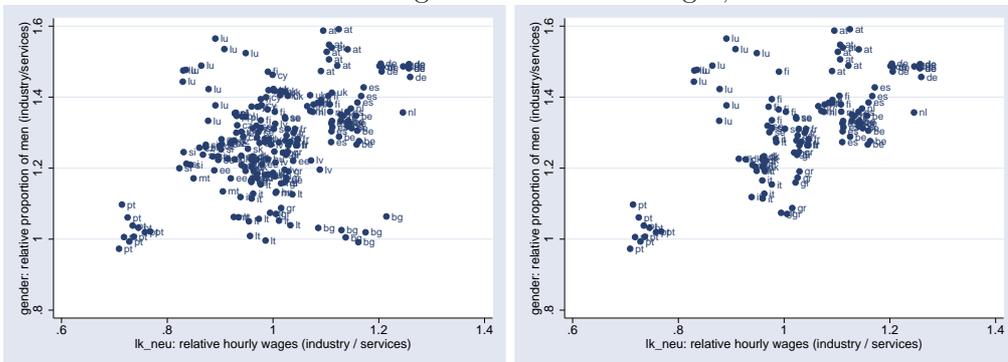


Chart 6: Scatter diagram: Qualification vs Wages, EU-27 and EU-15

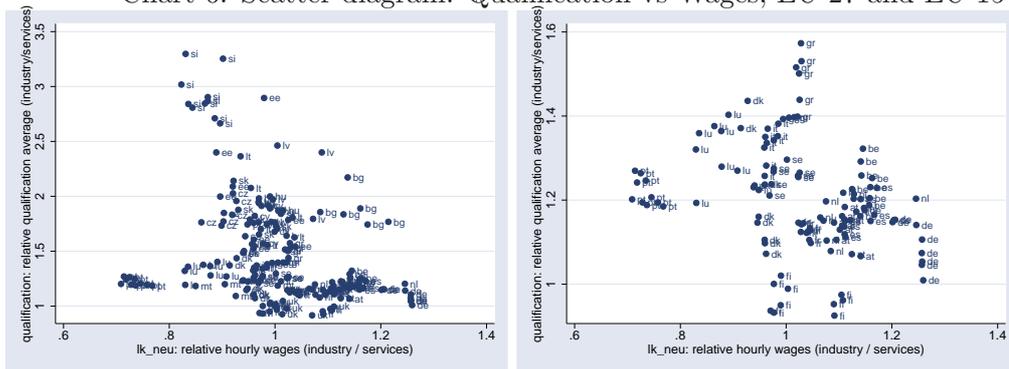


Chart 7: Scatter diagram: Firm size vs Wages, EU-27 and EU-15

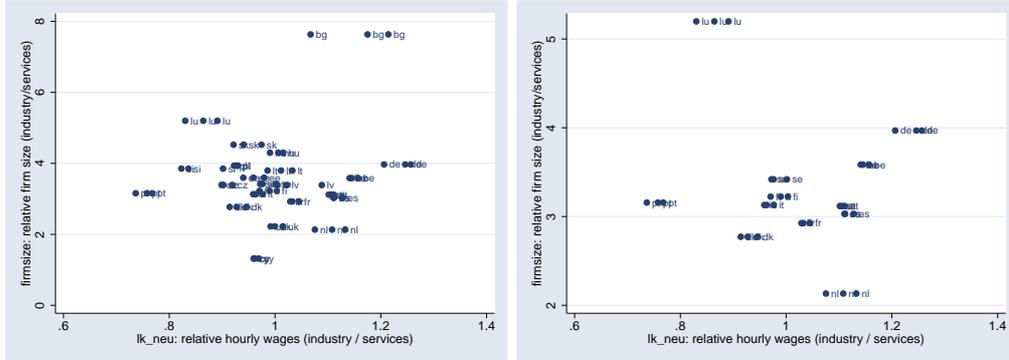


Chart 8: Scatter diagram: Self-employment vs Wages, EU-27 and EU-15

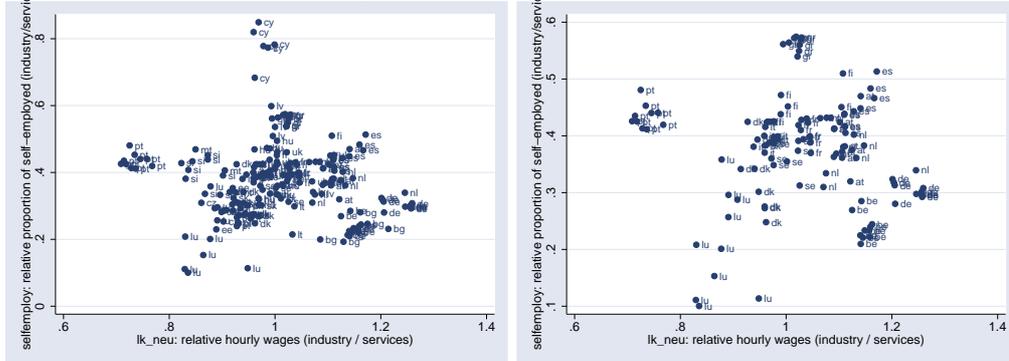


Chart 9: Scatter diagram: Part-time employment vs Wages, EU-27 and EU-15

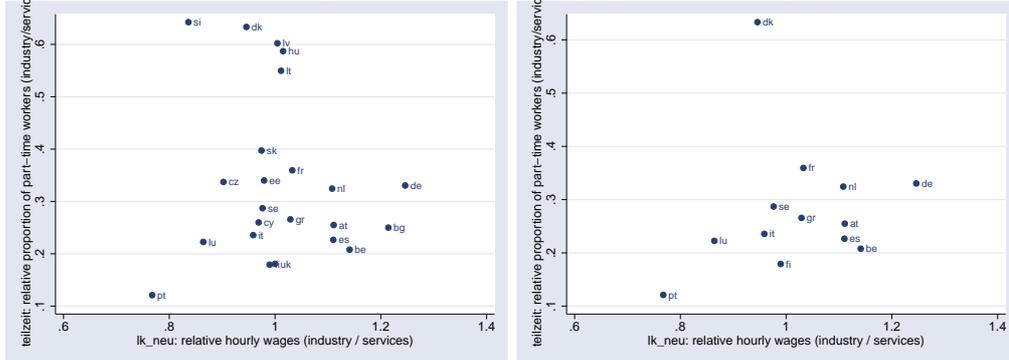


Chart 10: Scatter diagram: Unemployment rate vs Wages, EU-27 and EU-15

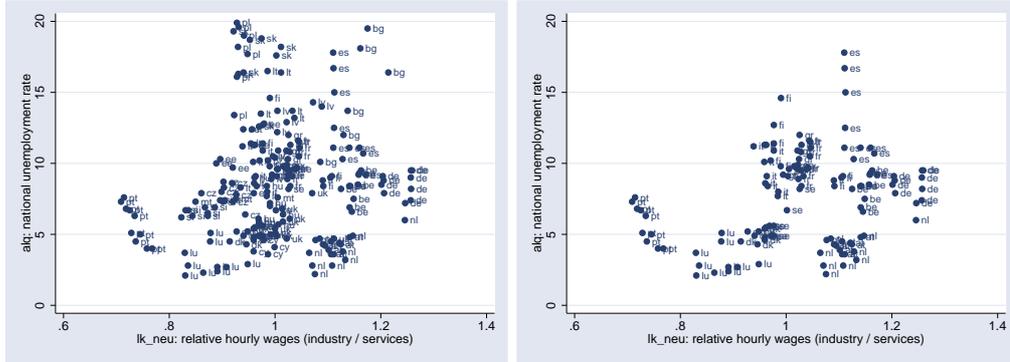


Chart 11: Scatter diagram: Minimum wage-dummy vs Wages, EU-27 and EU-15

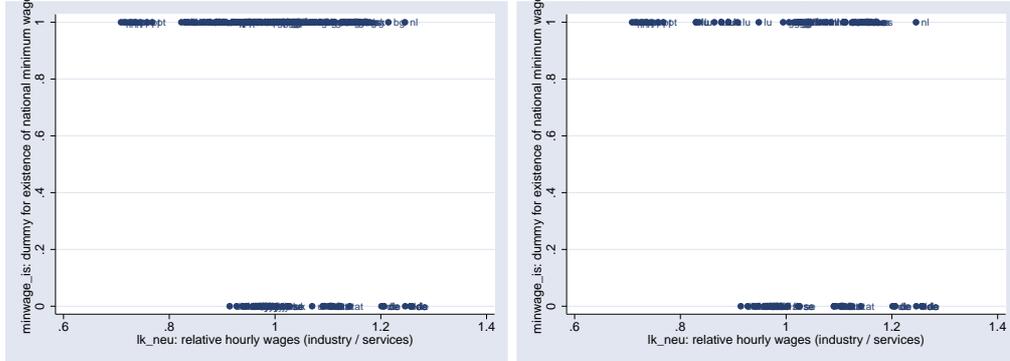


Chart 12: Scatter diagram: Union density vs Wages, EU-27 and EU-15

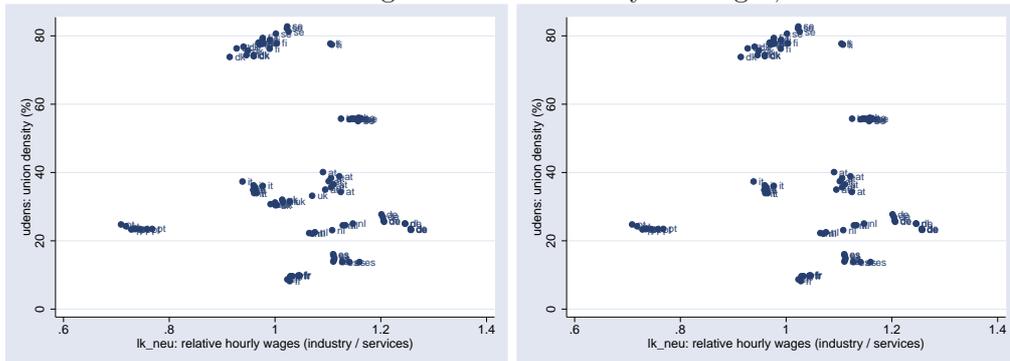


Chart 13: Scatter diagram: Relative export growth vs Wages, EU-27 and EU-15

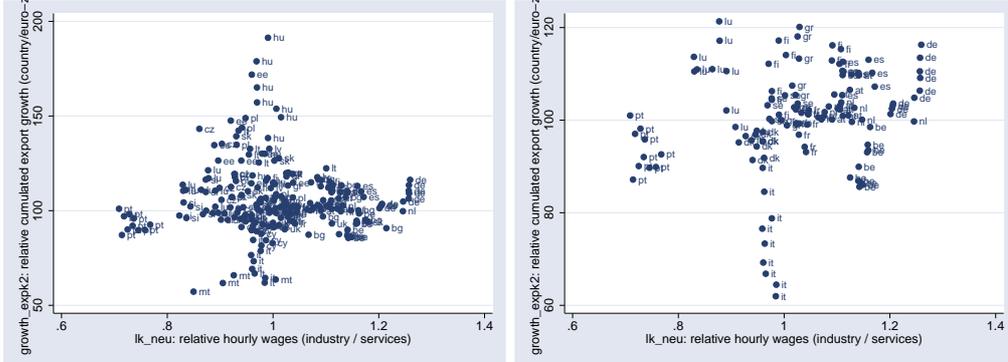


Chart 14: Scatter diagram: Relative GDP growth vs Wages, EU-27 and EU-15

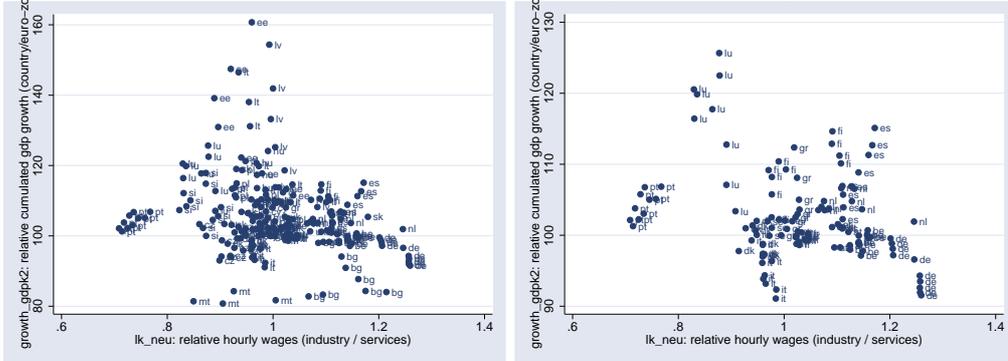


Chart 15: Scatter diagram: Relative internal demand growth vs Wages, EU-27 and EU-15

