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concepts and first results**

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## The distribution of employees' labour earnings in the European Union: Data, concepts and first results<sup>\*</sup>

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### Abstract

This paper studies the distribution of labour earnings among employees within the EU using data from Wave 2007-1 of the Community Statistics on Income and Living Conditions (EUSILC). The review of available information and the comparisons with external sources show that the EU-SILC data are not exempt from problems, particularly in some countries, yet can be fruitfully used to study the distribution of earnings in the EU; they also allow researchers to assess the sensitivity of results to various concepts of labour earnings. The ranking of countries by median full-time equivalent monthly gross earnings shows Eastern European nations at the bottom and Luxembourg at the top; earnings differences are sizeable, both across and within countries. Taking the euro area and the EU-25 (excluding Malta, for which data are unavailable) as a whole, inequality is higher when earnings are measured in euro at market rates rather than at purchasing power parities. The wage distribution is wider in the EU-25 than in the euro area, which is not surprising given that the former includes the poorer Eastern European countries that joined the Union in 2004. The higher inequality observed in the EU-25 is largely attributable to differences between countries, which are essentially due to the returns to individual attributes rather than to a different composition of the workforce with respect to these attributes.

**Keywords:** wage inequality, EU and euro area labour markets.

**JEL Classification:** J31, D33.

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## 1. Introduction

Easing the movements of workers and creating a more integrated labour market have been long-standing aims of the European unification process. These objectives have been recently reiterated in the proposed new EU strategy “Europe 2020”, which assigns the Commission the responsibility “to facilitate and promote intra-EU labour mobility and better match labour supply with demand with appropriate financial support from the structural funds, ... and to promote a forward-looking and comprehensive labour migration policy which would respond in a flexible way to the priorities and needs of labour markets” (European Commission 2010, page 17). The importance of these policy objectives can hardly be overestimated for both the social cohesion and the macroeconomic stability of the Union, as the financial turmoil in Europe of Spring 2010 has dramatically confirmed.

The integration process has been constantly monitored by EU institutions, especially since the Lisbon strategy set targets for the European Union (EU) as a whole, and has stimulated a thriving body of academic and institutional research.<sup>2</sup> Yet, our knowledge of the structure and the determinants of wages and salaries at the microeconomic level is surprisingly limited for the EU. How different are pay entry levels across EU countries? How important is tenure for wage progression in Member States? Which countries pay the highest returns to education? How has the EU-wide wage distribution changed over time? These and similar questions are difficult to answer, despite their analytical importance for assessing the actual integration of EU labour markets and their practical relevance for people who decide to move within the Union.<sup>3</sup>

The main reason for this gap in our knowledge is the paucity of suitable data. While great progress has been achieved in improving cross-country comparability of microeconomic information on household incomes,<sup>4</sup> advancement has been much slower for wages. Even within Europe, where the joint effort of Eurostat and national statistical offices has greatly enhanced data standardisation, sources of comparable individual data on earnings are scant.<sup>5</sup> Data from administrative archives for multiple countries are virtually impossible to access, and in any case they would reflect national practices calling for a painstaking process of harmonisation. The collection of earnings data in the Labour Force Survey is mandatory only

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<sup>2</sup> Throughout, we indicate by EU the European Union in general, and by EU-27, EU-25 and EU-15 the current union comprising 27 members, the Union as of 2006 (even where Malta is missing) and the union before the enlargement in 2004, respectively. The euro area comprises all 12 member countries of the monetary union in 2006 (AT, BE, DE, EL, ES, FI, FR, IE, IT, LU, NL, PT).

<sup>3</sup> This compares with a greater attention for the distribution of household incomes. For instance, the area-wide income distribution is examined by Atkinson (1996), Beblo and Knaus (2001), Boix (2004) and Brandolini (2007), while the impact of the monetary union on within-country income inequality is investigated by Bertola (2010).

<sup>4</sup> Progress concerns both the availability of microdata, and the setting of methodological guidelines. Two examples of influential international data collection enterprises are the Luxembourg Income Study (LIS) and the European Community Household Panel (ECHP). The LIS project has made available to researchers since 1983 a micro-database containing social and economic data collected in household surveys from different countries and harmonised ex post (<http://www.lisproject.org>). The ECHP was a fully harmonised annual longitudinal survey conducted by national statistical offices from 1994 to 2001 under Eurostat coordination; it has been subsequently replaced by the EU-SILC. On the methodological side, mention should be made of the report published in 2001 by the Expert Group on Household Income Statistics, known as the Canberra Group, which provides guidance to compilers and data analysts on how to prepare comparable statistics on income distribution.

<sup>5</sup> The problems affecting the cross-country comparability of earnings data are further discussed by Atkinson and Brandolini (2007) and Atkinson (2008).

since the end of 2007,<sup>6</sup> and data have not been released yet. The Structure of Earnings Survey (SES) provides, every four years, harmonised data on gross earnings and hours paid used by Eurostat to estimate statistics on the distribution of earnings (e.g. Casali and Alvarez Gonzalez 2010), but its coverage of sectors and firms is partial and the access to microdata highly restricted.<sup>7</sup> Only recently a suitable source has become available with the release of the Community Statistics on Income and Living Conditions (EU-SILC) (Clemenceau and Museux 2007).<sup>8</sup>

Problems are however not confined to data availability. Three conceptual issues arise in the analysis of the EU-wide distribution of labour earnings. First, we need to identify the population which is the object of the analysis. The major distinction is between employees and the self-employed, but other distinctions may relate to the type of work contract or to the sex and age of workers. Second, we have to fix the concept of labour income as regards the treatment of social security contributions and income taxes. For employees, we may distinguish *total compensation*, a measure of the overall cost incurred by employers, *gross earnings*, obtained after deducing social security contributions paid by employers from the total compensation, and *net earnings*, that is the take-home pay, or the part of labour remuneration that employees can actually spend after income taxes and social insurance contributions are paid out of their earnings.<sup>9</sup> The first concept is the most pertinent in the analysis of labour demand, for instance to assess the comparative costs of hiring people across EU countries, whereas the last concept has obvious bearings on the decision of people to move within the Union. Third, we must choose how to convert nominal values into “real” values which are expressed in a common unit, for countries outside the euro area, and may be adjusted for differences in the cost of living across, and perhaps within, countries.

Our aim in this paper is to deal with these questions in order to estimate the EU-wide distribution of labour earnings on the basis of the EU-SILC data. We focus on employees only, largely because the information collected on wages and salaries tends to be more reliable than that on income from self-employment. This is common in the labour literature, but the resulting picture is necessarily incomplete and possibly biased by the varying importance of self-employment in the different EU countries.<sup>10</sup> In the next two Sections we review in some depth the EU-SILC information on employees’ earnings and summarily assess its quality by means of a comparison with the national accounts and the average tax wedge calculated by Eurostat. In Section 4 we deal with two further measurement issues: the time unit of earnings (annual vs. monthly), and the rates of conversion from national currencies into euro. In Section 5 we present statistics for the wage distribution in EU countries and exploit the rich

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<sup>6</sup> See Regulation (EC) No 1372/2007 of the European Parliament and of the Council of 23 October 2007 amending Council Regulation (EC) No 577/98 on the organisation of a labour force sample survey in the Community.

<sup>7</sup> The SES excludes agriculture, fishing, public administration, private households and extra-territorial organizations as well as enterprises with less than 10 employees. Access to microdata is “in principle” allowed for 14 EU countries plus Norway, and is currently only possible through the SAFE Centre at the Eurostat premises in Luxembourg (Eurostat 2010). Unsurprisingly, country coverage is limited to less than ten countries in the analyses of the wage distribution based on this survey (e.g. Christopoulou, Jimeno and Lamo 2010; Lallemand, Plasman and Rycx 2007; Simón 2005, 2010).

<sup>8</sup> Analysis for the EU-15 in the 1990s could be performed using the ECHP data. See Behr and Pötter (2010) for an example.

<sup>9</sup> In the national accounts, the first two concepts correspond to “Compensation of employees” and “Gross wages and salaries”, while the third concept has no counterpart.

<sup>10</sup> According to labour force statistics, in 2009 the share in total employment of the self-employed (including family workers) ranged from 8-9 per cent in Denmark, Estonia and Luxembourg to 25 per cent in Italy and 33-36 per cent in Greece and Romania. On the determinants of the self-employment share see Torrini (2005).

information collected in the EU-SILC to show the sensitivity of the results to the various concepts of labour earnings. We finally provide the first estimates of the EU-wide wage distribution in 2006 (excluding Malta, for which data are unavailable) in Section 6, together with a first analysis of its determinants in Section 7. We end by drawing our conclusions and some recommendations in Section 8.

## 2. Earnings in the EU-SILC

Wave 2007-1 of the EU-SILC users' database, which we use throughout the paper, contains information on current gross monthly earnings (PY200G) for the month in which the interview is conducted and five different variables for the whole calendar year preceding the interview:<sup>11</sup> *i*) net employee cash or near cash income (PY010N); *ii*) gross employee cash or near cash income (PY010G); *iii*) net non-cash employee income (PY020N); *iv*) gross non-cash employee income (PY020G); *v*) employer's social insurance contribution (PY030G) (in all cases, gross and net refer to taxes and social contributions deducted at source).<sup>12</sup> In our analysis, we concentrate on monetary incomes and we do not generally consider in-kind payments (PY020N, PY020G).

Current gross monthly earnings are comprehensively defined as the monthly amount earned by an employee in the main job, including usual paid overtime, tips, commissions and a proportionate share of supplementary payments like the 13th month payment or an annual bonus. By referring to the current period, this variable may be more precisely estimated by respondents in surveys than variables referring to the previous year, which require them to remember earnings received several months earlier, although it may imperfectly represent one twelfth of the annual labour earnings whenever payments vary significantly from month to month. On the other hand, data on earnings received in the previous year may be matched and corrected with administrative records, when collected in surveys, and may be the only available information in countries relying on register data. All in all, the relative quality of the two variables depends on the country considered, and it is not possible to decide a priori which one is to be preferred. In this paper we do not further consider current monthly earnings, because they are available only gross of taxes and social contributions for nine countries (AT, EL, ES, HU, IE, IT, PL, PT, UK).<sup>13</sup>

The cash income earned in the previous year refers to the monetary component of the compensation of employees, including wages and salaries and any other payment in cash,<sup>14</sup> with the exception of reimbursements for business travel, severance, termination and

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<sup>11</sup> Two countries adopt a different income reference period: Ireland takes the twelve months immediately prior the date of interview; the United Kingdom takes the calendar year of the interview. There is no straightforward solution for the Irish data, but we could merge British data from wave *T*-1 with data from wave *T* for the other countries. Despite the implied inconsistency, we stick to Eurostat practice of reporting information from the same wave. In the estimation of the EU earnings distribution, however, we adjust nominal values for the increase in the harmonised index of consumer prices, between 2006 and 2007 in the United Kingdom (2.3 per cent) and between 2006 and the 2007 average of the twelve-month moving averages of the index in Ireland (1.3 per cent).

<sup>12</sup> PY030G includes all payments made by employers for the benefits of their employees to insurers (social security funds and private funded schemes) covering statutory, conventional or contractual contributions, on a mandatory or optional basis, in respect of insurance against social risks (retirement, health, disability, etc.).

<sup>13</sup> In a study of the British household income distribution in the 1990s, Böheim and Jenkins (2006) find that current income measures and annual income measures provide, in practice, similar results.

<sup>14</sup> It includes holiday payments, overtime pay, fees paid to directors of incorporated enterprises, piece rate payments, payments for fostering children, commissions, tips and gratuities, supplementary payments like the 13th month payment, bonuses and performance premia, allowances for working in remote locations, and allowances for transport to or from work.

redundancy payments, and union strike pay. It should be recorded both gross and net of the value of any social contributions and income taxes payable by an employee, or by the employer on behalf of the employee, to social insurance schemes or tax authorities. As shown in Figure 1, which is reconstructed from the tabulation of the flag variables for PY010N and PY010G (Table A1), the situation is better than for current monthly income, but coverage and definitions are not fully homogenous across countries. Gross earnings are available for all countries, but only in thirteen countries they are collected as such (AT, CY, DE, DK, FI, HU, IE, LU, LV, NL, SI, SK, UK); in five countries they are all calculated using the information collected on wages net of tax on income at source and social contributions (EL, IT, PL) or net of tax on social contributions (FR, SE); in the remaining six countries, they are partly collected and partly calculated from net earnings (BE, CZ, EE, ES, LT, PT). Net earnings are missing in eight countries (CY, DE, DK, FI, HU, NL, SK, UK); in fourteen countries they are available net of tax on income at source and social contributions, in nine of them as recorded at data collection (AT, BE, EL, ES, IT, LU, LV, PL, SI) and in five after estimation (CZ, EE, IE, LT, SE); in two countries they are available wholly (FR) or in a significant proportion (PT) net of tax on social contributions.<sup>15</sup>

Figure 1: Map of available net and gross employee cash or near cash income in EU-SILC, Survey Year 2007

		Net earnings			
		Net of tax on income at source and social contributions		Net of tax on social contributions	Missing
		Collected	Imputed	Collected	
Gross earnings	Collected	BE <sub>90%</sub> IE <sub>51%</sub> ES <sub>54%</sub> LV LU AT SI	CZ <sub>74%</sub> EE <sub>11%</sub> IE <sub>49%</sub> LT <sub>15%</sub> PT <sub>8%</sub>	PT <sub>3%</sub>	CY DE DK FI HU NL SK UK
	Imputed	BE <sub>10%</sub> CZ <sub>26%</sub> IT EE <sub>89%</sub> EL ES <sub>46%</sub> LT <sub>85%</sub> PL PT <sub>73%</sub>	SE	FR PT <sub>16%</sub>	–

Notes: subscripts indicate the fraction of data with the indicated characteristics. The few cases where data at collection are classified as “unknown” (2.2 per cent in EE, 3.0 in LT, and 0.4 in PT) are included together with those classified as “gross”.

Sources: authors’ elaboration on EU-SILC users’ database (Version 2007-1, March 2009).

<sup>15</sup> For gross and net earnings, it is also available the information on “imputation factors”, which are the ratios of the values collected during the interview to the values recorded in the database. These variables (PY010G\_I, PY010N\_I) integrate the flag variables used for Figure 1 by allowing users to assess the extent of the imputation process, distinguishing partial imputation (positive factor different from 1) from full imputation (factor equal to 0). However, the coding of these variables is inconsistent. For net earnings, the imputation factor is correctly missing for the eight countries where this variable is not recorded (CY, DE, DK, FI, HU, NL, SK, UK), and its values suggest that virtually no imputation was applied in two countries (EL, IT), while it affected 10 to 25 per cent of observations in five countries (AT, BE, FR, LU, SI) and all observations in one country (CZ). However, in SE the fact that no observation was imputed according to PY010N\_I is at odds with the information from the corresponding flag variable that wages were collected “net of tax on social contributions” but were then recorded “net of tax on income at source and social contributions”: we would rather expect to find most values above 1. The remaining seven countries show values well above 1, which are implausible: they range from 20 to 21 in one case (LV), they are equal to either 2,000 or 2,100 in another (ES), or they are frequently or entirely above 2,000 in the others (EE, IE, LT, PL, PT). The coding problems are similar for gross earnings; for the countries where the comparison is possible, the occurrence of imputation seems to be larger than for net earnings.

As regards total compensations, employers' social insurance contributions are supposed to be collected since 2007, but they are not yet available for Germany and are missing in 82 per cent of the cases in the United Kingdom; almost 4 per cent of the observations is also missing in Belgium. Moreover, a large number of nil values is present in several countries: it happens for all individuals with positive gross earnings in Lithuania, and for 44 per cent of them in Poland, 25 per cent in France, 21 per cent in Slovenia, and between 10 and 15 per cent in Ireland, Spain and Cyprus. Nil values are difficult to interpret for the user: they might correspond to cases where the employer was not required to pay any insurance contribution, but they might also indicate situations where the employer evaded these obligations. They might also represent misclassified missing values, which appears to be the case for Lithuania (see below).

To sum up, in the EU-SILC users' database the net wage is not available for some countries and is not fully comparable in the others, because of the different items subtracted from the gross value. Comparisons of employees' total compensations are also unfeasible, as employers' social insurance contributions are virtually unavailable in two major countries and puzzlingly characterised by large proportions of nil values in several other countries. Gross earnings represent the only indicator available for all countries.

### **3. How does the EU-SILC compare to other sources?**

At the aggregate level, national accounts constitute the primary basis for the evaluation of differences in the level and dynamics of wages across countries. Hence, they provide a natural benchmark for assessing the information collected in household surveys. In Table 1, we compare the grossed-up EU-SILC values for gross wages and salaries (PY010G+PY020G) and the compensation of employees (PY010G+PY020G+PY030G) with the corresponding amounts in the annual sector accounts.<sup>16</sup> The latter are the most comparable aggregates, as they refer to the amounts received by the household sector and are net of compensations paid to non-residents; on the other hand, they include the labour earnings of people living permanently in institutions (hostels, boarding houses, prisons, military installations, etc.) as well as of illegal immigrants, which are not covered by the EU-SILC. As generally found in similar comparisons (e.g. Atkinson and Micklewright 1983, for the UK; Brandolini 1999, for Italy), the matching between the two sources tends to be fairly good: the discrepancy is around 10 per cent or less in 15 (out of 23) countries for gross wages and salaries and in 10 (out of 20) countries for the compensation of employees. Yet, other discrepancies are more worrying: gross earnings appear to be between a fifth and a third lower in the EU-SILC than in national accounts in Hungary, Ireland and France; the shortfall for the compensation of employees exceeds 20 per cent in the same three countries and in Lithuania and Portugal; conversely, Cyprus exhibits EU-SILC values well above the corresponding national accounts aggregates. This comparison provides a useful validation exercise of the EU-SILC data. First, it confirms that employers do pay social insurance contributions in Lithuania, so that the nil values in the EU-SILC users' database are actually misclassified missing values.<sup>17</sup> Second, it allows us to single out countries where some work is needed to reconcile the EU-SILC evidence with the corresponding aggregate figures. Third, it warns that the picture drawn from

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<sup>16</sup> We include both cash and in-kind earnings to match national accounts definitions. All statistics discussed in this and subsequent sections are calculated using personal cross-sectional weights (PB040) which sum to the country population of household members aged 16 and over. These weights ensure that grossed-up values and area-wide aggregation are meaningful.

<sup>17</sup> This is confirmed by the Euromod country report for Lithuania (Ivaskaite-Tamosiune, Lazutka and Salanauskaite 2010).

the EU-SILC may deviate from that derived from national accounts: for instance, France accounts for 16 per cent of gross earnings in national accounts, but for only 13 per cent in the EU-SILC aggregates, while the Italian share goes up from 10 to 11 per cent.

Table 1: Earnings in the EU-SILC and in national accounts in 2006 (millions of euro and per cent)

Country	Wages and salaries			Compensation of employees		
	EU-SILC	National accounts	Ratio (%)	EU-SILC	National accounts	Ratio (%)
	[1]	[2]	[3]=[1]:[2]	[4]	[5]	[6]=[4]:[5]
BE	119,793	122,499	97.8	163,457	163,944	99.7
CZ	30,888	37,021	83.4	41,600	48,943	85.0
DK	97,861	105,998	92.3	109,048	116,187	93.9
DE	897,097	926,210	96.9	–	1,148,990	–
EE	4,577	4,770	96.0	6,017	6,194	97.1
IE	51,612	67,392	76.6	57,530	71,955	80.0
EL	56,580	56,027	101.0	72,571	71,910	100.9
ES	325,009	360,220	90.2	405,164	464,266	87.3
FR	557,621	695,771	80.1	739,743	944,904	78.3
IT	446,592	444,766	100.4	575,211	608,547	94.5
CY	6,593	5,648	116.7	7,413	6,455	114.8
LV	5,488	6,299	87.1	6,545	7,417	88.2
LT	8,027	8,289	96.8	8,027	10,432	76.9
LU	9,051	–	–	10,300	–	–
HU	21,605	32,989	65.5	27,838	42,327	65.8
NL	216,255	206,548	104.7	265,790	263,652	100.8
AT	90,579	101,338	89.4	108,151	125,508	86.2
PL	84,230	87,357	96.4	92,729	100,427	92.3
PT	54,277	60,524	89.7	56,433	77,630	72.7
SI	12,056	13,823	87.2	14,631	15,783	92.7
SK	12,033	13,941	86.3	15,741	17,669	89.1
FI	64,259	64,864	99.1	80,274	80,944	99.2
SE	118,684	124,932	95.0	146,538	168,134	87.2
UK	885,562	919,280	96.3	–	1,089,590	–

Notes: The EU-SILC totals include cash and non-cash components of wages and salaries. The national accounts figures refer to incomes received by the household sector; those for the UK refer to 2007 instead of 2006 in order to improve comparability with the EU-SILC totals.

Sources: authors' elaboration on EU-SILC users' database (Version 2007-1, March 2009) and Eurostat data [[http://epp.eurostat.ec.europa.eu/portal/page/portal/national\\_accounts/data/database](http://epp.eurostat.ec.europa.eu/portal/page/portal/national_accounts/data/database), downloaded on 24 June 2010].

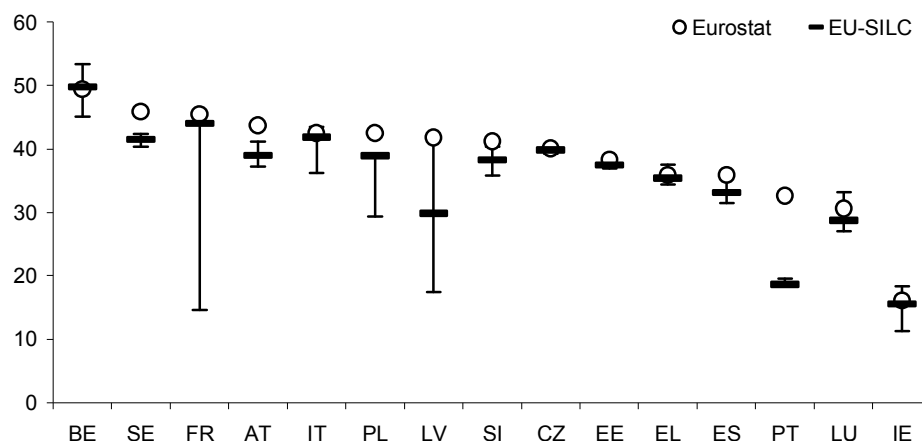
A second instructive exercise is to compare the tax wedge as estimated from the EU-SILC data with that computed by Eurostat on the basis of a well-established methodology developed by the Organisation for Economic Co-operation and Development (e.g. OECD 2008). While the former relates to the actual amount of taxes and social contributions paid by people, the latter refers to the amount that a representative taxpayer would pay under existing legislation. The tax wedge on labour costs is defined by Eurostat (2010a) as the percentage ratio of the sum of the income tax on gross wage earnings and the employee's and the employer's social security contributions to the total compensation of the earner (excluding in-kind payments). Eurostat computes this indicator only for single persons without children earning 67 per cent of the average wage.<sup>18</sup> To match as closely as possible these estimates, we restrict the EU-SILC sample to full-time wage-earners employed throughout the year, whose

<sup>18</sup> The estimates by the OECD include other categories of employees, but do not cover the EU Member States that are not member of the OECD.



earnings are within a  $\pm 15$  per cent band around the average value utilised by Eurostat, and who do not have a partner, a child or a dependent co-habiting relative. For the 15 countries where this computation is possible (excluding LT for the reasons given earlier), Figure 2 compares the Eurostat figures in 2006 with the EU-SILC medians, first quartiles and third quartiles. As known, there is considerable variation in the level of the tax wedge, from around 50 per cent in Belgium to below 20 per cent in Ireland. This is consistently brought out by both Eurostat figures and EU-SILC medians, which are highly correlated (the Pearson correlation coefficient is 0.88). In nine countries (BE, CZ, EE, EL, ES, IE, IT, LU, SI) the EU-SILC values are narrowly distributed around the median and close to Eurostat estimates. In two countries (FR, LV) the tax wedge is for a sizeable proportion of employees well below that calculated by Eurostat: this could signal a problem in the data, but could also follow from employment subsidies entailing a reduction of social security contributions. The EU-SILC values appear to underestimate the Eurostat tax wedge by somewhat more than 4 percentage points in three countries (AT, PL, SE) and, rather more worryingly, by as much as 14 points in one country (PT).<sup>19</sup>

Figure 2: Tax wedge on labour costs for low wage earners in 15 EU countries in 2006 (per cent)



Notes: the tax wedge is defined as the percentage ratio of the sum of the income tax on gross wage earnings and the employee's and the employer's social security contributions to the total compensation of the employee; low wage earners are single persons without children earning 67 per cent of the average wage. The EU-SILC figures refer to median values; vertical bars around the median indicate the first and third quartiles. Countries are ranked in descending order of the Eurostat tax wedge from left to right.

Sources: authors' elaboration on EU-SILC users' database (Version 2007-1, March 2009) and Eurostat data [[http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=earn\\_nt\\_taxwedge&lang=en](http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=earn_nt_taxwedge&lang=en), downloaded on 31 May 2010].

The comparisons with national accounts aggregates and with independently calculated tax wedges help to detect areas needing further investigation in the EU-SILC data: for instance, the French data are somewhat at variance with external sources, whereas social security contributions paid by employers appear to be substantially understated in Portugal.

<sup>19</sup> Further examination of the EU-SILC values reveals that cross-country differences are substantial also in the breakdown of the tax wedge between the part paid by the employer and that paid by the employee (including income tax at source and social security contributions). In the whole sample, the latter is on average about a fifth of the total labour cost and ranges between 15 per cent (EE, ES, FR) and 26 per cent (AT, BE, PL, SE, SI). The range of variation is much larger for employers' social contributions, from 10-11 per cent of the labour cost (IE, LU, PL) to 28 per cent (BE); it is suspiciously below 3 per cent in Portugal. The diverse incidence of employers' social insurance contributions drives cross-country differences in the tax wedge.

Although more work is necessary to validate the data and to document legitimate discrepancies from external sources, overall these comparisons provide some reassuring evidence on the quality of the EU-SILC information on earnings.

#### 4. Time units and conversion rates

As just seen, annual (cash) gross earnings is the only variable which is available for all EU countries. Annual earnings are useful to study the contribution of labour income to total household income and, hence, to the (material) standard of living of individuals. However, annual earnings are an imperfect measure of the remuneration of labour as they reflect both the wage rate and the amount of time spent at work. The hourly or (part-time adjusted) monthly wage may be more revealing of how the price of labour varies across countries, especially since European labour markets have become more flexible.

Full-time equivalent monthly earnings can be calculated in the EU-SILC by dividing the annual value (PY010G) by the number of months worked in full-time jobs (PL070) plus the number of months worked in part-time jobs (PL071) scaled down by a country-sex specific factor equal to the ratio of median hours of work (PL060) in part-time jobs to median hours of work in full-time jobs (PL030). Here, we consider both annual and monthly earnings but restrict our attention to employees who report positive values for either of them. This implies that our sample is larger for annual wages, as monthly wages cannot be calculated where the number of months spent in part-time work or in full-time work is missing. Unfortunately, the difference between the two samples is significant, as overall 9 per cent of the observations is lost for the EU. More disturbingly, the pattern varies considerably across countries, with lost observations rising from 1 per cent (EL, ES, LT, LU, PT) to around 20 per cent (DK, SI). The overwhelming majority of these cases corresponds to observations where both the number of months worked in full-time jobs and the number of months worked in part-time jobs are coded as zero. It is conceivable that gross earnings are positive while no or limited work was made (e.g. arrears, very short temporary contracts),<sup>20</sup> but the joint occurrence of positive earnings and no month spent in work is suspiciously frequent: it concerns, for instance, 11-13 per cent of cases in Finland, Italy, Latvia, the Netherlands, Sweden and the United Kingdom. We do not make any adjustment for this difference in the sample, but it should be borne in mind that it is bound to affect the observed discrepancies between annual and monthly values.

In the EU-SILC, earnings are expressed, as all other income variables, in euro. For the 14 countries which were not part of the monetary union in 2006, the values collected in national currency are converted into euro at the average market exchange rates. These rates are influenced by many factors, such as the flows of international trade or speculative capital movements, and need not reflect the price structures that prevail in the various countries. In poorer countries labour-intensive non-tradable services are typically cheaper than in richer countries: since market exchange rates are unlikely to account for these price differences, their use would lead to understate real incomes in poorer countries. Purchasing Power Parities (PPP) obviate these problems by providing the relative values, in national currencies, of a fixed bundle of goods and services. As a consequence, PPP not only convert all values into a common standard (denominated Purchasing Power Standard, PPS, in Eurostat statistics) but also adjust them for differences in price levels across countries.

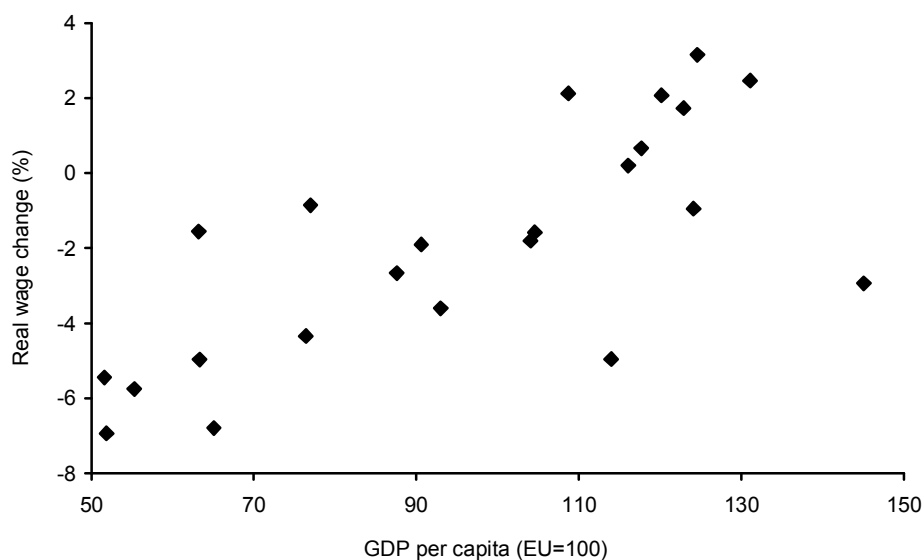
For European countries, annual PPP indices are available for gross domestic product (GDP) and for a number of expenditure components of GDP (Eurostat and Organisation for

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<sup>20</sup> A month is considered as spent at work if the respondent worked for two or more weeks.

Economic Co-operation and Development 2006). The choice of the index matters.<sup>21</sup> By deflating nominal wages by the PPP index for household final consumption expenditure (HFCE) rather than the PPP index for GDP, in 2006 real wages are 5 to 8 per cent lower in Poland, Latvia, Estonia, Lithuania, Slovakia, and Finland, but 2 to 3 per cent higher in Sweden, the United Kingdom, France, the Netherlands, and Austria (in either case the PPP index is normalised to 1 for the EU-27). As these differences are positively correlated with the level of GDP per capita in PPS (Figure 3), the use of the PPP index for GDP tends to narrow international differences in real wages relative to the PPP index for HFCE. The PPP-HFCE index (applied to net earnings) is preferable to derive the EU distribution of “consumer” wages, as it measures purchasing power in terms of consumption goods and services, but the PPP-GDP index (applied to total compensations) is more appropriate to study the distribution of “producer” wages, as it refers to the whole value added. Note that the PPP-GDP index is generally applied to derive all national accounts variables expressed in PPS.

Figure 3: Impact on measured real wages of the choice of the PPP index in 2006



Notes: The real wage change is the one that obtains by replacing the PPP index for GDP by the PPP index for HFCE in the wage deflation. Luxembourg is not included because of its extreme value of GDP per capita (272.1).

Sources: authors' elaboration on Eurostat data [[http://epp.eurostat.ec.europa.eu/portal/page/portal/purchasing\\_power\\_parities/introduction](http://epp.eurostat.ec.europa.eu/portal/page/portal/purchasing_power_parities/introduction), downloaded on 3 June 2010].

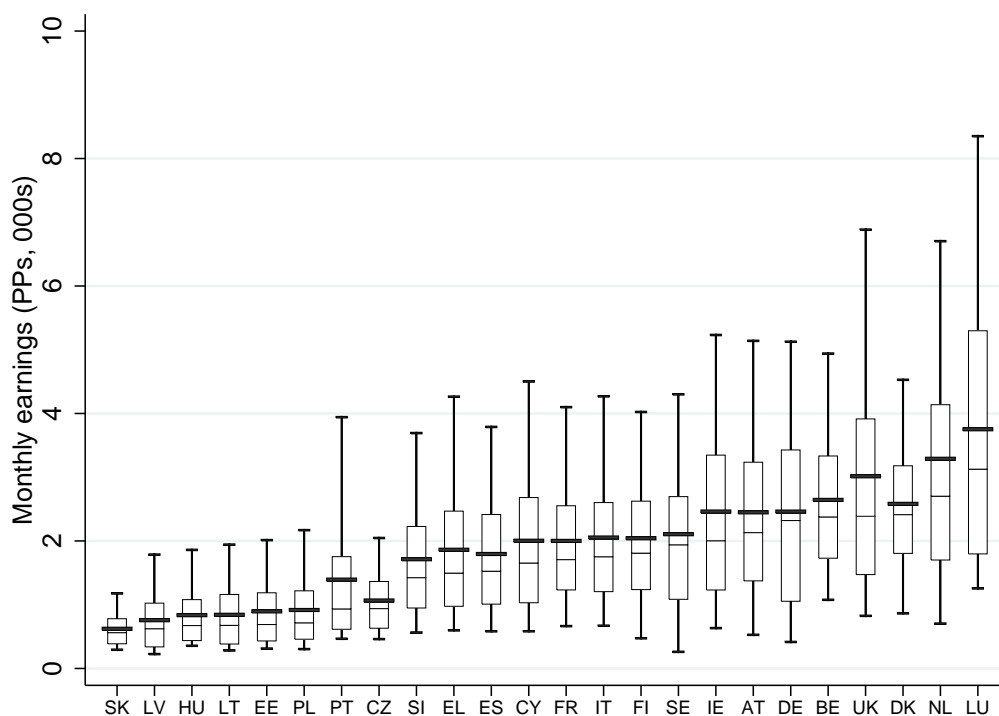
## 5. Earnings distributions in EU countries

The distribution of real monthly full-time equivalent gross earnings in 2006 in all EU-25 member countries (except for Malta) is shown in Figure 4. Gross earnings are here expressed in thousands of PPS using the PPP index for HFCE. The graph shows for each country the median value (the thick horizontal mark), the distance between the 20th and the 80th percentiles (the vertical box), and the 5th and 95th percentiles (the two extremes of the thin vertical bar). Countries are ranked in ascending order of median earnings from left to right. As expected, Eastern European nations precede Southern European countries and then the remaining EU countries, which are rather close to each other except for the outlier Luxembourg. Earnings differences are sizeable, both across and within countries. The Slovak

<sup>21</sup> A further problem, especially in analyses at the global level, is posed by the multiplicity of PPP indices differing by source and method. See Brandolini (2007) and Anand and Segal (2008) for a discussion.

median is only 18 per cent of the Luxembourg median, a gap that widens to 23 per cent if the comparison is made at the 5th percentile. For almost 80 per cent of Eastern Europeans labour incomes are below or at most comparable to those of the poorest 20 per cent of Europeans living in the richer Central and Nordic countries.

Figure 4: Distribution of real monthly full-time equivalent gross earnings in EU countries in 2006 (thousands of euro in PPS-HFCE)



Notes: Boxes span 20th to 80th percentiles; vertical bars span 5th to 95th percentile; light horizontal lines are median earnings; thick horizontal lines are average earnings. Countries are ranked in ascending order of median earnings from left to right.

Sources: authors' elaboration on EU-SILC users' database (Version 2007-1, March 2009).

The variable lengths of the vertical bars reveal some noticeable differences in within-country earnings dispersion, such as that between Belgium or Denmark and the United Kingdom, three countries which share similar median values. On the other hand, there are unexpected similarities among countries as different as France, Finland and Italy, which exhibit remarkably close values of the mean, the median, and the 20th and 80th percentiles. It should be noted that these bars show *absolute* and not *relative* differences. If percentiles were expressed as percentages of national medians, as customary in cross-national inequality comparisons, earnings differences in Eastern Europe would not look so small compared to those in the EU-15. Indeed, as shown in Table 2, Latvia and Lithuania would exhibit, together with Luxembourg, the second largest value of the quintile ratio (the ratio of the 80th percentile to the 20th percentile) after Germany. This country ranking is partly surprising. It is somewhat unusual to observe the highest values of the decile ratio (the ratio of the 90th percentile to the 10th percentile) in Germany and Sweden, and much lower values in the United Kingdom and especially Italy. This ordering is the opposite of the one that is usually found for household equivalent incomes (e.g. Wolff, 2010). It is beyond the scope of this paper to study the factors that help to explain such a difference (e.g. employment rates, other sources of income, welfare unit; see Atkinson and Brandolini 2007). Here, suffice it to say that comparing the EU-SILC with the SES results provides reassuring evidence. The correlation of

Table 2: Statistics for the distribution of gross earnings in EU countries in 2006

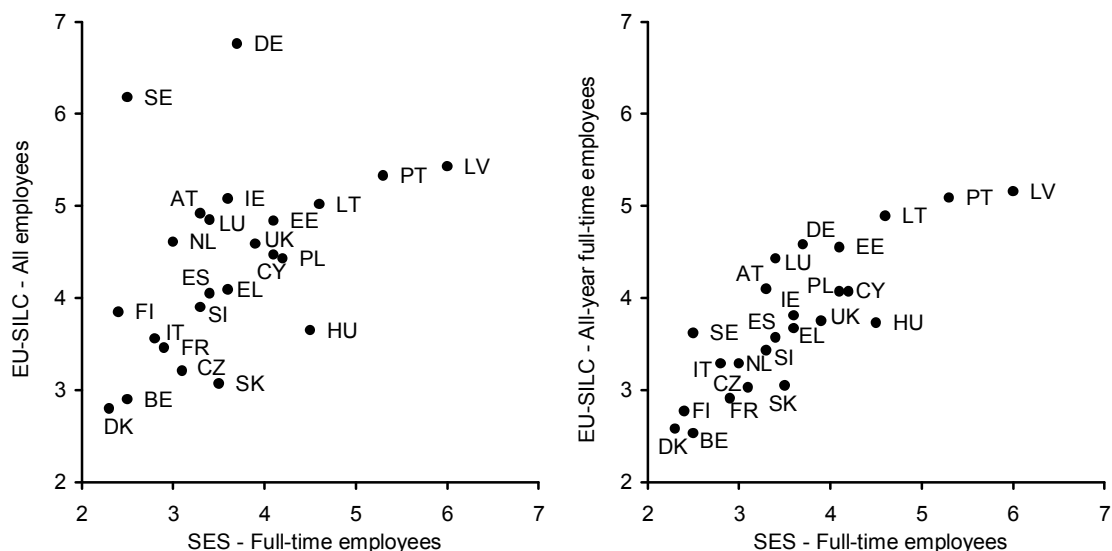
Country	Sample size	No. of employees (000)	Mean (euro)	Median (euro)	Mean (PPS-HFCE)	Median (PPS-HFCE)	Gini index	Quintile ratio	Decile ratio
<i>Monthly full-time equivalent gross earnings</i>									
BE	5,648	3,862	2,848	2,560	2,644	2,377	0.255	1.9	2.9
CZ	8,979	4,043	654	576	1,066	939	0.279	2.2	3.2
DK	6,945	2,319	3,573	3,339	2,582	2,413	0.243	1.8	2.8
DE	12,288	33,385	2,525	2,381	2,461	2,320	0.346	3.3	6.8
EE	6,493	651	613	472	895	689	0.353	2.8	4.8
IE	4,593	1,677	3,025	2,462	2,430	1,977	0.357	2.7	5.1
EL	3,725	3,059	1,657	1,331	1,862	1,496	0.337	2.5	4.1
ES	12,959	18,255	1,648	1,400	1,795	1,525	0.313	2.4	4.1
FR	10,159	23,760	2,171	1,853	2,001	1,708	0.296	2.1	3.5
IT	15,867	18,199	2,140	1,826	2,054	1,752	0.307	2.2	3.6
CY	4,146	327	1,779	1,469	2,004	1,654	0.340	2.6	4.4
LV	4,690	1,020	460	379	757	623	0.367	3.0	5.4
LT	5,254	1,483	483	388	842	676	0.359	3.0	5.0
LU	4,533	200	4,176	3,480	3,752	3,127	0.344	3.0	4.9
HU	8,155	3,782	507	408	836	673	0.329	2.5	3.7
NL	11,584	6,748	3,421	2,810	3,289	2,702	0.364	2.4	4.6
AT	6,776	3,467	2,495	2,171	2,449	2,131	0.327	2.4	4.9
PL	12,625	13,262	573	447	917	716	0.354	2.7	4.5
PT	4,087	4,024	1,183	793	1,394	934	0.414	2.9	5.3
SI	11,836	786	1,314	1,093	1,713	1,424	0.325	2.4	3.9
SK	6,174	2,247	446	403	623	562	0.260	2.0	3.1
FI	12,409	2,447	2,505	2,219	2,042	1,809	0.301	2.1	3.9
SE	8,988	4,395	2,494	2,298	2,106	1,940	0.336	2.5	6.2
UK	7,912	22,720	3,259	2,581	2,947	2,334	0.365	2.7	4.6
<i>Yearly gross earnings</i>									
BE	5,877	4,022	29,159	27,278	27,074	25,327	0.319	2.4	5.8
CZ	9,283	4,179	7,252	6,605	11,825	10,770	0.326	2.5	5.2
DK	8,497	2,899	33,549	34,246	24,246	24,750	0.361	4.3	14.5
DE	13,241	36,067	24,611	22,328	23,987	21,762	0.424	6.5	15.3
EE	6,691	666	6,692	5,369	9,767	7,836	0.392	3.2	6.3
IE	4,836	1,790	28,286	22,665	22,720	18,204	0.460	5.9	19.9
EL	3,764	3,092	18,197	14,493	20,446	16,284	0.384	3.2	6.8
ES	13,146	18,524	17,311	15,220	18,857	16,580	0.365	3.2	7.7
FR	10,925	25,497	21,851	19,682	20,139	18,140	0.364	3.0	8.1
IT	18,072	20,524	21,442	19,419	20,578	18,636	0.381	3.4	10.7
CY	4,340	341	19,248	16,121	21,675	18,154	0.403	3.5	10.5
LV	5,305	1,131	4,813	3,812	7,922	6,275	0.427	4.0	11.7
LT	5,290	1,493	5,346	4,210	9,322	7,341	0.395	3.4	6.7
LU	4,563	202	44,366	35,100	39,861	31,536	0.392	3.4	7.1
HU	8,710	4,027	5,337	4,371	8,801	7,208	0.393	3.0	8.3
NL	13,263	7,934	27,257	24,069	26,209	23,143	0.440	5.8	21.2
AT	7,012	3,589	25,235	22,376	24,765	21,959	0.392	3.7	10.4
PL	13,708	13,288	6,258	5,013	10,020	8,028	0.400	3.2	7.7
PT	4,112	4,050	13,266	9,070	15,625	10,684	0.439	3.0	7.0
SI	15,039	970	12,367	10,825	16,124	14,113	0.430	5.4	22.4
SK	6,685	2,426	4,734	4,351	6,602	6,068	0.328	2.4	6.6
FI	13,901	2,691	23,574	22,758	19,213	18,548	0.414	5.7	24.3
SE	10,211	4,975	23,525	23,526	19,860	19,861	0.396	5.1	24.6
UK	8,979	25,874	32,929	26,332	29,773	23,808	0.393	3.1	7.1

Sources: authors' elaboration on EU-SILC users' database (Version 2007-1, March 2009).

the decile ratios for monthly full-time equivalent gross earnings in Table 2 with the corresponding SES figures reported by Casali and Alvarez Gonzalez (2010, page 4, Table 2) is positive but moderate (correlation coefficient equal to 0.42), also for the impact of two outliers, Germany and Sweden (left panel of Figure 5); when the EU-SILC sample is restricted to full-time workers employed throughout the year, in order to better match the SES

definition, the relationship becomes much stronger (correlation coefficient equal to 0.84) (right panel of Figure 5). This confirms that the spreading of temporary occupations and jobs lasting for less than the whole year has a considerable impact on measured wage inequality, as also shown by the much higher dispersion of annual earnings relative to that of monthly full-time equivalent earnings (compare the top and bottom panels in Table 2).

Figure 5: Decile ratio of gross earnings in EU countries in 2006



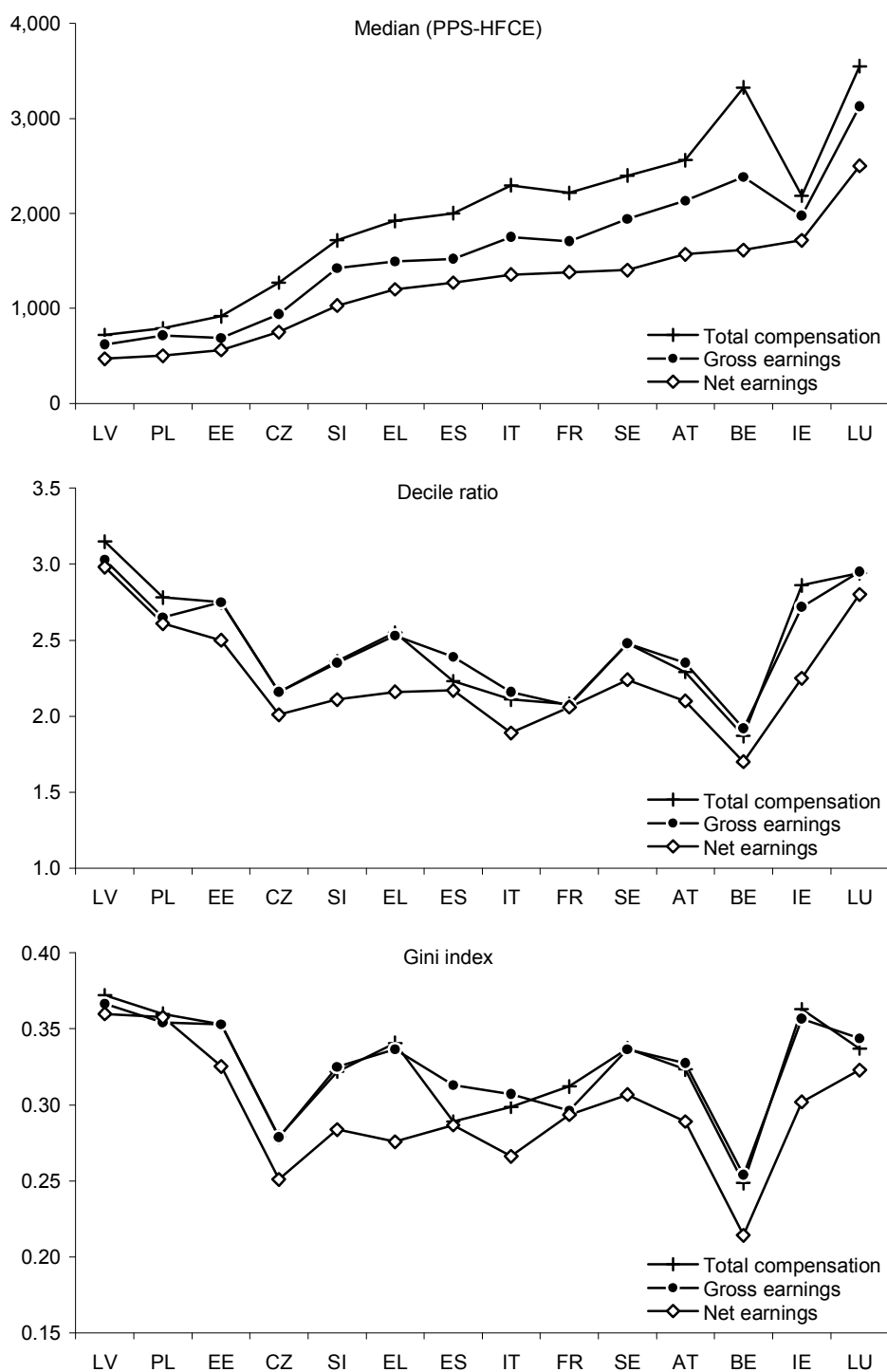
Notes: The SES figures are for the annual earnings of full-time employees in the sectors covered by the survey; the EU-SILC figures are for monthly full-time equivalent gross earnings of all employees in the left panel and of full-time workers employed throughout the year in the right panel.

Sources: authors' elaboration on EU-SILC users' database (Version 2007-1, March 2009) and SES data drawn from Casali and Alvarez Gonzalez (2010, page 4, Table 2).

Before examining the EU-wide distribution, it is useful to assess the importance of the earnings definition. The three panels of Figure 6 report the median, the decile ratio and the Gini index for the distributions of net earnings, gross earnings and total compensations in the 14 countries where all three variables are available. (Lithuania and Portugal are not included for the reasons discussed above.) All three variables are expressed on a monthly basis after adjusting for part-time and are deflated by the PPP index for HFCE; the sample is restricted to observations that have a positive value for all definitions. Countries are ranked in ascending order of median net earnings. The absolute gap between net and gross earnings tends to widen as countries become richer, with the exception of Ireland. Latvia and Poland together with Ireland and Luxembourg show narrow differences between gross earnings and total compensations, whereas Belgium stands out for the largest difference. In all countries but France, Latvia, Poland and Spain, dispersion decreases substantially considering net rather than gross earnings, as a consequence of the progressive structure of labour income taxation. Conversely, there is little difference, on average, between the dispersion of the labour cost and that of gross earnings. This follows from the fact that the difference is generally small and in either direction, as employers' social security contributions tend to be roughly proportional and sometimes mildly regressive (especially in Spain, apparently).<sup>22</sup>

<sup>22</sup> For the same reason, estimates of the average returns to education are barely affected by the choice between gross earnings or total compensation, whereas more substantial changes are observed if net instead of gross earnings are used. Labour income taxation affects country ranking: for instance, France moves from the 12th

Figure 6: Distribution of real monthly full-time equivalent earnings in selected EU countries by different definitions of earnings in 2006 (PPS-HFCE)



Sources: authors' elaboration on EU-SILC users' database (Version 2007-1, March 2009).

Taking the 14 countries as a whole, median net earnings are 69 per cent of median gross earnings, and 62 per cent of median labour cost. The Gini index falls slightly from 0.354 for total compensations to 0.350 for gross earnings, and more significantly to 0.330 for net earnings. A similar picture is provided by the mean logarithmic deviation which has the

to the 9th position looking at the returns to tertiary education for male full-time workers if net instead of gross earnings are used.

advantage of being decomposable into a between- and a within-country component. The fall in dispersion from gross to net earnings is entirely due to a decline in the within-country component: the progressivity of income taxes and employees' social contributions reduces the degree of inequality in each country without affecting their relative rankings. The fall in dispersion from total compensations to gross earnings is instead driven by the between-country component, following from the high cross-country variability of employers' social security contributions levied at approximately proportional rates. This evidence confirms that the earnings definition may affect the comparison of national distributions and, hence, the construction of area-wide statistics. Gross earnings are the only measure available for all countries in the EU-SILC users' database, but are possibly the least suited, as they do not account for the different structure of income taxes across countries and depend on the composition of social contributions.<sup>23</sup>

## 6. The EU-wide distribution of gross earnings

Statistics for the distribution of monthly (full-time equivalent) and annual earnings for both the euro area and the EU-25 taken as a whole are reported in Table 3. Since the conversion factor affects mean country earnings and thus distributive measures for groups of countries, Table 3 contains statistics based on market exchange rates as well as the two PPP indices for GDP and HFCE. Using unadjusted figures parallels the standard practice in national reports of ignoring territorial differences in price levels, a sensible exercise particularly in the analysis of the wage distribution in the monetary union.<sup>24</sup>

In the euro area, the average employee earns 2,263 euro per month, gross of taxes and social contributions and after adjusting for part-time, while the median employee earns 15 per cent less, or 1,918 euro per month. These values fall by 5 and 7 per cent to 2,153 and 1,786 euro per month, respectively, when the whole EU-25 is considered. Inequality is always higher when earnings are measured in euros at market rates than in PPS with either index; it is always lower if earnings are converted using the PPP index for GDP (but differences are generally small, especially in the euro area). The much greater dispersion observed for annual than monthly earnings indicate that labour supply does not offset lower wage rates. Lastly, inequality is larger when measured for the EU-25 than for the euro area, which is not surprising given that the latter does not include the poorer Eastern European countries that joined the Union in 2004.

The distribution of earnings in the euro area and in the EU-25 can be traced back to the distribution of the observable characteristics of the underlying populations. By denoting by

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<sup>23</sup> Thus, nations with similar levels of labour cost will show different average gross earnings depending on the share of contributions paid by the employee. In some countries, like France, contributions paid by employers are the largest component of the total tax-wedge, but in other countries they account for a smaller fraction and the difference between gross earnings and labour cost is narrow. Similar considerations would apply to in-kind payments, which are not considered here.

<sup>24</sup> It is, however, potentially inconsistent to correct only for cost-of-living differences across nations, while ignoring those across geographical areas within the same nation. This would be justifiable if the latter were less important than the former, but little is known due to the lack of reliable territorial price indices. Accounting for within-country territorial differences is likely to affect results considerably. Moretti (2008) recently estimated that half of the observed increase in the returns to college in the United States between 1980 and 2000 disappears when the college premium is measured in real terms, by deflating nominal wages by a price index that allows for differences in the cost of housing across metropolitan areas. In more general terms, the question is whether we should use group-specific price indices to transform nominal wages into real wages. A discussion of these issues is beyond the scope of this paper.



$y_{jc}$  the (natural logarithm of) earnings of person  $j$  in country  $c$ , the overall variance can be decomposed as follows:

$$Var(y_{jc}) = \frac{1}{N} \sum_c \sum_j (y_{jc} - y_{EU})^2 = \sum_c \sigma_c n_c + \sum_c n_c (y_c - y_{EU})^2,$$

where  $n_c$  is the share of EU population in country  $c$ ,  $\sigma_c$  is the variance in country  $c$ , and  $y_c$  and  $y_{EU}$  are the average earnings of country  $c$  and the EU as a whole, respectively<sup>25</sup>. The first term on the right-hand side is the within-country component of the total variance while the second term is the between-country component. These components can be linked to the observable ( $X$ ) and unobservable ( $u$ ) individual characteristics by assuming that (log) earnings are a linear function of them, or  $y_{jc} = X_{jc} b_c + u_{jc}$ .

Table 3: Statistics for the EU-wide distribution of gross earnings in 2006

Gross earnings definition	Sample size	No. of employees (000)	Mean	Median	Gini index	Quintile ratio	Decile ratio
Euro area							
<i>Monthly full-time equivalent</i>							
PPS-HFCE	104,628	119,083	2,199	1,857	0.343	2.7	5.0
PPS-GDP	104,628	119,083	2,200	1,860	0.342	2.7	4.9
Euro at market rates	104,628	119,083	2,263	1,918	0.349	2.8	5.3
<i>Yearly</i>							
PPS-HFCE	112,712	127,982	21,745	18,722	0.405	4.2	11.7
PPS-GDP	112,712	127,982	21,760	18,736	0.404	4.1	11.7
Euro at market rates	112,712	127,982	22,368	19,246	0.409	4.3	11.8
EU-25							
<i>Monthly full-time equivalent</i>							
PPS-HFCE	196,825	176,118	2,099	1,732	0.381	3.3	6.5
PPS-GDP	196,825	176,118	2,099	1,734	0.377	3.2	6.3
Euro at market rates	196,825	176,118	2,153	1,786	0.410	4.1	9.2
<i>Yearly</i>							
PPS-HFCE	215,450	190,252	21,071	17,443	0.428	4.6	11.7
PPS-GDP	215,450	190,252	21,072	17,510	0.425	4.5	11.5
Euro at market rates	215,450	190,252	21,613	17,684	0.453	5.9	14.4

Sources: authors' elaboration on EU-SILC users' database (Version 2007-1, March 2009).

Country differences may stem from differences in the characteristics of workers (such as education) and differences in the way these characteristics are valued in the labour market (returns). To disentangle these two factors we make use of the Oaxaca-Blinder decomposition (Oaxaca, 1973; Blinder, 1973), which allows us to decompose the term  $(y_c - y_{EU})$  into a part explained by population differences between country  $c$  and the whole EU and a part due to differences in returns to specific individual attributes:

$$(y_c - y_{EU}) = X_c b_c - X_{EU} b_{EU} = (X_c - X_{EU}) b_{EU} + X_c (b_{EU} - b_c).$$

Since this decomposition applies to the difference in means, while we are interested in the effects of these two components on the between-country variance, we compute  $CBV = \sum_c n_c [(X_c - X_{EU}) b_{EU}]^2$ .  $CBV$  can be interpreted as the counterfactual between-

<sup>25</sup> For analytical convenience and comparability with the literature in labour economics, we focus here on the variance of logarithms, though it is not a proper inequality measure due to its violation of the Pigou-Dalton transfer principle (Foster and Ok, 1999).

country variance that would arise if all countries displayed the same EU-wide returns to given observable attributes (i.e. the same wage schedule). As our calculations below include a set of dummy variables for the interaction of sex, education, age and birth in the survey country, the above quantity can also be seen as the pure effect of country composition on between-country differences.<sup>26</sup> Within-country variance  $\sigma_c$  reflects both the heterogeneity of the underlying population,  $Var(X_{jc})$ , and the returns to unobservable characteristics. We compute the explained within-country variance as  $Var(X_{jc}b_c)$ , where  $b_c$  is the OLS estimate of the vector of parameters of the country wage equation. The residual is the unexplained component.

Table 4: Variance decomposition of the logarithm of monthly full-time equivalent earnings in 2006 (absolute values and percentage shares in italics)

Gross earnings of account	unit	Total	Between-countries		Within-countries		
			Actual	Counter- factual	Total	Explained	Unexplained
		[1]=[2]+[4]	[2]	[3]	[4]=[5]+[6]	[5]	[6]
Euro area							
PPS-HFCE		0.498	0.029	0.004	0.469	0.116	0.353
		<i>100.0</i>	<i>5.9</i>	<i>0.8</i>	<i>94.1</i>	<i>23.3</i>	<i>70.9</i>
Euro at market rates		0.517	0.049	0.005	0.469	0.116	0.353
		<i>100.0</i>	<i>9.4</i>	<i>0.9</i>	<i>90.6</i>	<i>22.4</i>	<i>68.2</i>
EU-25							
PPS-HFCE		0.611	0.147	0.002	0.463	0.107	0.357
		<i>100.0</i>	<i>24.1</i>	<i>0.3</i>	<i>75.9</i>	<i>17.5</i>	<i>58.4</i>
Euro at market rates		0.789	0.326	0.002	0.463	0.107	0.357
		<i>100.0</i>	<i>41.3</i>	<i>0.3</i>	<i>58.7</i>	<i>13.5</i>	<i>45.2</i>

Notes: The total variance in column [1] is equal to the sum of the between-countries component in column [2] and the within-countries component in column [4]; the latter component is decomposed into the part explained by observable characteristics in column [5] and the residual unexplained part in column [6]. The counterfactual between-countries variance in column [3] is obtained by imposing the same EU-wide returns to given observable attributes in all countries.

Sources: authors' elaboration on EU-SILC users' database (Version 2007-1, March 2009).

Table 4 shows the results of this decomposition for the distribution among employees aged 20-64 of the logarithm of monthly full-time equivalent gross earnings, both in euro and PPS-HFCE, in the euro area and the EU-25. The earnings equation includes a dummy for birth in survey country (PB210=LOC), two dummies for education (High School, if PE040=3; College, if PE040=4,5), with "at most ISCED3" (PE040=1,2,3) as the residual category, and nine age classes (20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64). Column [1] of Table 4 reports the total variance, which is the sum of the between-countries component, in column [2], and the within-countries component, in column [4]; the latter is in turn decomposed into the part explained by observable characteristics, in column [5], and the residual unexplained part, in column [6]. Differences across countries in average monthly earnings explain a small part, less than a tenth, of total dispersion in the euro area, but are much more important in the EU-25 (24 per cent with PPS-HFCE, 41 per cent with euro). Conversely, the within-country component accounts for more than 90 per cent of total variance in the euro area, but for only 59 (euro) or 76 (PPS-HFCE) per cent in the EU-25: in

<sup>26</sup> We do not include occupation among the characteristics of interest. Williams (2010) explores the relationship between occupation and education and develops measures of occupational skill intensity to study the skill composition of employment.

both areas, however, no more than a quarter of the within-country component is attributable to observable characteristics, the rest being unexplained by the empirical model. Lastly, the counterfactual between-country variance, reported in column [3], is virtually nil in all cases, suggesting that the between-country component is essentially due to heterogeneous returns to individual attributes rather than to a different demographic composition of employees.<sup>27</sup>

## 7. A first look into the determinants of the EU-wide distribution of gross earnings

The previous decomposition is silent about the extent to which the variance of (log) earnings hinges on the distribution of each characteristic. For example, would the variance increase or decrease, should the educational composition of the workforce change, holding all else constant? In order to address this question, we apply here the regression-based method recently developed by Firpo, Fortin and Lemieux (2009), which allows us to isolate the effect of each characteristic on the variance more straightforwardly than the alternative procedures devised by Machado and Mata (2005) and Melly (2006).

Firpo, Fortin and Lemieux's method replaces the dependent variable of interest (in our case, log earnings) with the recentered influence function (*RIF*) for the distributional statistic of interest (in our case, the variance). The influence function (*IF*), a widely used and easy-to-compute concept in robust statistics, measures the robustness of a given functional  $g$  of a specific distribution  $F$ ,  $g(F)$ , to outlier data and is defined by:

$$IF(y; g, F) = \lim_{e \rightarrow 0} [g(F_e) - g(F)] / e,$$

where  $F_e(y) = (1-e)F + e\delta_y$ ,  $0 \leq e \leq 1$ , and  $\delta_y$  is a distribution that only puts mass at  $y$ . For the variance,  $g(F) = \int (s - \mu)^2 dF(s)$  and

$$\begin{aligned} IF(y; g, F) &= \lim_{e \rightarrow 0} [\int (s - \mu)^2 dF_e(s) - \int (s - \mu)^2 dF(s)] / e = \\ &= \lim_{e \rightarrow 0} [(1-e) \int (s - \mu)^2 dF(s) + e(y - \mu)^2 - \int (s - \mu)^2 dF(s)] / e \\ &= \lim_{e \rightarrow 0} [e(y - \mu)^2 - e \int (s - \mu)^2 dF(s)] / e = (y - \mu)^2 - \sigma^2. \end{aligned}$$

The recentered influence function is simply obtained by adding the statistic of interest to *IF*,  $RIF(y; g, F) = g(F) + IF(y; g, F)$ , and is obviously defined for each available observation. It can be shown that  $\int IF(y; g, F) dF(y) = 0$ , which implies  $\int RIF(y; g, F) dF(y) = g(F)$ . The main contribution of Firpo, Fortin and Lemieux (2009) is to show that the effect on the statistic of interest of a small location shift in the distribution of a specific covariate, all else constant, can be obtained by estimation by standard methods of the relevant *RIF*.

This method can be applied to any statistic for which a *RIF* can be computed: here, we consider the variance and the main percentiles. We focus, as before, on gross monthly earnings in PPS-HFCE of employees aged 20 to 64, but we restrict the attention to full-time employees in order to obtain more robust estimates. As a term of comparison, we report results also for Germany, the largest EU economy, in addition to those for the euro area and the EU-25 taken as a whole. The results in Table 5 and Figure 7 show the effects on the distribution of (log) earnings of a small change in the composition of the workforce by sex, birth in the survey country, education and age.<sup>28</sup> (To facilitate comparisons of the effects of different covariates, the same scale is used for the vertical axis in each panel of Figure 7.) Unlike those obtained from standard conditional quantile regressions, these effects represent the change in the unconditional distribution associated with a change in the characteristic of interest. Thus, the fact that the effect of high school in Germany is larger at the 10th than at the 90th percentile

<sup>27</sup> The same conclusion is reached by Behr and Pötter (2010) for EU-15 countries using ECHP data.

<sup>28</sup> The same model estimated with country dummies yields similar results.

implies that its overall effect is to reduce inequality, as measured by the difference between these two percentiles. In a standard conditional quantile regression this conclusion would apply only to employees sharing the same values of the other covariates; in the case of the unconditional quantile regressions underlying the results of Table 5, the conclusion is more general as the estimation accounts also for the effect of high school achievement across groups.

Table 5: Determinants of the distribution of the logarithm of real monthly gross earnings among full-time employees aged 20 to 64 in Germany, the euro area and the EU-25 in 2006

Characteristic	Variance	Bottom decile	2nd decile	3rd decile	4th decile	5th decile	6th decile	7th decile	8th decile	Top decile
Germany										
Female	0.016 (0.023)	-0.237** (0.056)	-0.270** (0.033)	-0.213** (0.024)	-0.175** (0.018)	-0.152** (0.014)	-0.166** (0.013)	-0.170** (0.013)	-0.183** (0.014)	-0.254** (0.018)
Birth in country	0.107** (0.036)	-0.201 (0.129)	0.085 (0.077)	0.083 (0.055)	0.089* (0.040)	0.058 (0.032)	0.001 (0.029)	0.007 (0.030)	0.016 (0.034)	-0.008 (0.049)
Aged 20-34	0.416** (0.025)	-1.372** (0.069)	-0.722** (0.038)	-0.528** (0.028)	-0.397** (0.021)	-0.310** (0.016)	-0.252** (0.014)	-0.222** (0.014)	-0.194** (0.016)	-0.197** (0.020)
Aged 50-64	0.027 (0.027)	0.062 (0.035)	-0.039 (0.031)	-0.013 (0.025)	0.026 (0.020)	0.028 (0.017)	0.031* (0.015)	0.060** (0.016)	0.084** (0.019)	0.121** (0.028)
High school	-0.665** (0.037)	1.368** (0.135)	0.664** (0.068)	0.404** (0.047)	0.282** (0.033)	0.207** (0.024)	0.145** (0.021)	0.094** (0.019)	0.077** (0.019)	0.052* (0.023)
College	-0.605** (0.038)	1.688** (0.136)	0.971** (0.067)	0.725** (0.047)	0.595** (0.033)	0.519** (0.024)	0.472** (0.021)	0.466** (0.021)	0.469** (0.022)	0.529** (0.031)
Euro area										
Female	-0.023* (0.011)	-0.328** (0.016)	-0.253** (0.009)	-0.219** (0.007)	-0.229** (0.007)	-0.235** (0.007)	-0.243** (0.007)	-0.259** (0.007)	-0.253** (0.007)	-0.292** (0.009)
Birth in country	-0.061** (0.019)	0.071* (0.034)	0.116** (0.019)	0.119** (0.015)	0.119** (0.014)	0.107** (0.015)	0.092** (0.014)	0.055** (0.015)	0.025 (0.015)	0.009 (0.021)
Aged 20-34	0.029* (0.012)	-0.479** (0.019)	-0.352** (0.010)	-0.318** (0.008)	-0.328** (0.008)	-0.345** (0.008)	-0.339** (0.008)	-0.329** (0.008)	-0.283** (0.007)	-0.297** (0.010)
Aged 50-64	0.068** (0.015)	0.079** (0.014)	0.079** (0.009)	0.068** (0.008)	0.090** (0.008)	0.105** (0.008)	0.132** (0.009)	0.145** (0.009)	0.144** (0.010)	0.161** (0.015)
High school	-0.140** (0.014)	0.565** (0.022)	0.393** (0.012)	0.343** (0.009)	0.349** (0.008)	0.356** (0.008)	0.327** (0.008)	0.286** (0.008)	0.210** (0.007)	0.174** (0.009)
College	-0.006 (0.014)	0.783** (0.022)	0.585** (0.011)	0.548** (0.009)	0.596** (0.008)	0.647** (0.008)	0.657** (0.008)	0.667** (0.008)	0.612** (0.009)	0.671** (0.013)
EU-25										
Female	-0.007 (0.009)	-0.375** (0.012)	-0.379** (0.010)	-0.315** (0.008)	-0.275** (0.006)	-0.285** (0.006)	-0.278** (0.006)	-0.286** (0.006)	-0.268** (0.006)	-0.298** (0.008)
Birth in country	0.000 (0.015)	-0.182** (0.022)	-0.177** (0.021)	-0.062** (0.017)	0.003 (0.014)	0.007 (0.014)	0.023 (0.014)	0.007 (0.014)	-0.028 (0.015)	-0.054* (0.021)
Aged 20-34	-0.007 (0.009)	-0.345** (0.013)	-0.400** (0.012)	-0.344** (0.009)	-0.319** (0.007)	-0.329** (0.007)	-0.329** (0.007)	-0.322** (0.007)	-0.283** (0.007)	-0.286** (0.009)
Aged 50-64	0.069** (0.011)	0.000 (0.011)	0.016 (0.010)	0.042** (0.008)	0.049** (0.007)	0.064** (0.007)	0.076** (0.008)	0.093** (0.008)	0.080** (0.008)	0.085** (0.012)
High school	0.066** (0.011)	-0.010 (0.017)	0.077** (0.015)	0.161** (0.011)	0.228** (0.009)	0.269** (0.008)	0.269** (0.008)	0.265** (0.007)	0.215** (0.006)	0.189** (0.008)
College	0.137** (0.012)	0.436** (0.016)	0.546** (0.015)	0.526** (0.011)	0.556** (0.009)	0.627** (0.008)	0.651** (0.008)	0.687** (0.008)	0.638** (0.008)	0.681** (0.011)

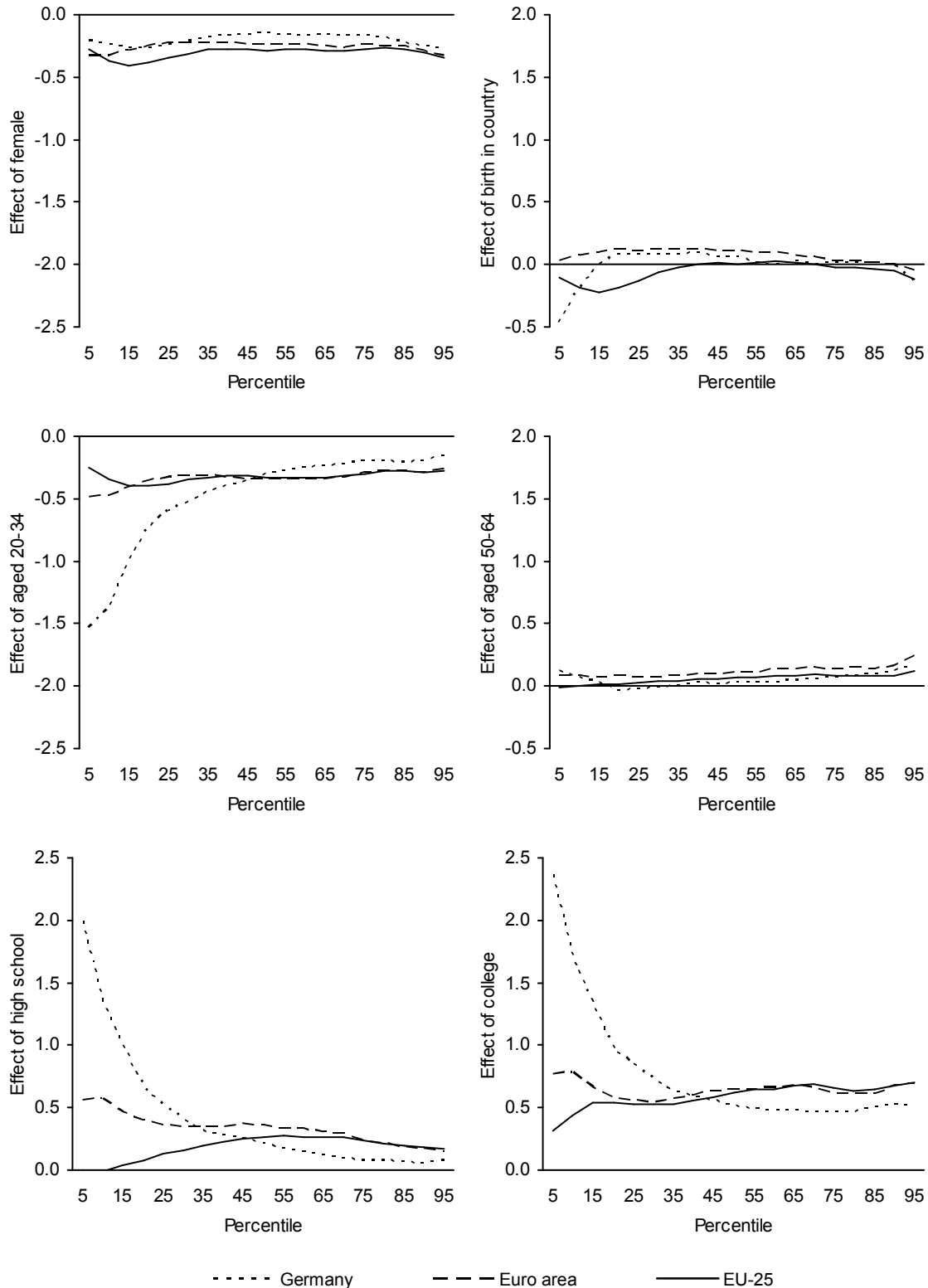
Notes: Standard errors in parentheses; significance \*\*  $p < 0.01$ , \*  $p < 0.05$ . There are 8,436 observations for Germany, 80,574 for the euro area, and 161,617 for the EU-25.

Sources: authors' elaboration on EU-SILC users' database (Version 2007-1, March 2009).

In all three areas, an increase in the share of female full-time employees would lead to a statistically significant reduction of all percentiles, which confirms the existence of a gender wage gap. The change would be however similarly spread across the entire distribution, and the effect on the overall inequality would be negligible (mildly significant only in the euro

area). The objective of raising female labour participation in the EU need not bring about a more unequal wage dispersion.

Figure 7: Determinants of the distribution of the logarithm of real monthly gross earnings among full-time employees aged 20 to 64 in Germany, the euro area and the EU-25 in 2006



Notes: effects are shown for all 19 vingtiles. There are 8,436 observations for Germany, 80,574 for the euro area, and 161,617 for the EU-25.

Sources: authors' elaboration on EU-SILC users' database (Version 2007-1, March 2009).

On the contrary, results for the effect of being born in the survey country are mixed. An increase in the proportion of native born employees would increase the overall variance in Germany, would reduce it in the euro area, and would have no effect in the EU-25. The German result is driven by a strong, and difficult to explain, deterioration at the bottom of the distribution (see top-right panel in Figure 7), which dominates an otherwise flat profile. In the euro area, a larger share of native employees would instead thicken the middle of the distribution: the effects are small but statistically significant. In the EU-25, there are little action in the middle and a worsening of the bottom and very top percentiles, which offset each other. These results are not easy to interpret, but suggest that an increase of cross-country mobility might increase wage inequality in the euro area, and possibly in the EU-25, as mobile workers polarise at the bottom and the top of the earnings distribution.

To assess the effects of population ageing, we partition employees in three groups: the young, or those aged 20 to 34, those aged 35 to 49, and the old, aged 50 to 64. The age effects are rather consistent across the three areas: an increase in the proportion of employees younger than 35 would reduce all percentiles, while a rise in the share of the older employees would tend to increase all percentiles (somewhat less in Germany). The earnings gap of the young appears to be strong in Germany, and the steep percentile profile shown in Figure 7 implies that the overall variance would significantly go up should their proportion increase. The effect is far smaller in the euro area and the EU-25, where it would rather be a greater presence of older employees to widen the distribution. All in all, these results indicate that, by itself, ageing is likely to make the European earnings distribution more unequal.

The greatest effects are associated with education, but in very different ways. In Germany, a rise in the share of more educated people increases all percentiles, but far more intensively at the bottom: there is a clear egalitarian impact, as measured by the variance or the difference between the 90th and the 10th percentiles. Effects are stronger for college than for high school. The opposite results are found for the EU-25: raising the average educational level has a greater positive influence at the top than at the bottom of the earnings distribution and increases the overall variance. The evidence for euro area falls between these two extremes. As for ageing, improving the educational level of the employees might lead to higher earnings inequality for the EU as a whole. On the other hand, the contrasting results found for Germany and the EU-25 point at the operation of different mechanisms of wage determination.

## **8. Conclusions**

In the EU-SILC users' database, net earnings are missing in some countries and not fully comparable in the others, because of differences in the items subtracted from the gross value. Comparisons of the labour cost are limited because employers' social insurance contributions are unavailable in two major countries and puzzlingly characterised by many nil values in several other countries. Gross earnings represent the only indicator available for all countries. Although the study of the wage distribution for the EU as a whole is not possible for all three definitions, the available information makes the EU-SILC users' database a valuable source for comparative analysis of the structure of the labour cost and of the tax wedge.

Three developments seem worth pursuing. First, data comparability needs to be further improved by using more homogeneous definitions on the items deducted from gross earnings to obtain net earnings. The definition of French net earnings appears to be particularly out of line. Second, as a conspicuous number of variables are calculated from other variables (e.g. net from gross earnings, or vice versa), it would be important to provide details about the estimation procedures, for instance by specifying whether the imputation was carried out by a

tax-benefit simulation model or some statistical matching technique. This would also be important to assess the fraction of wages and salaries that may be hidden to tax and social security authorities. Third, to facilitate a proper use of the data, the available basic description of the variables could be integrated with additional summary documentation on institutional features that would help the user to realise which data may be more problematic.

Our results for the distribution of full-time equivalent monthly gross earnings show the expected ranking of countries by the median value, with Eastern European nations at the bottom and Luxembourg at the top. Earnings differences are sizeable, both across and within countries. Taking the euro area and the EU-25 as a whole, inequality is higher when earnings are measured in euro at market rates rather than using a PPP index, and using the PPP index for HFCE than that for GDP. Inequality is higher when measured for the EU-25 than for the euro area, which is not surprising given that the former includes the poorer Eastern European countries that joined the Union in 2004. Indeed, the decomposition exercise shows that the higher inequality observed in the EU-25 is largely attributable to the between-country component. This in turn is essentially due to the returns to individual attributes rather than to a different composition of the employees with respect to these attributes. This suggests that monitoring the evolution of these returns may provide useful insights on the process of integration of labour markets in the EU.

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Table A1: Alternative definitions of employee cash or near cash income in EU-SILC, Survey Year 2007 (per cent)

Country	Net employee cash or near cash income (PY010N)							Gross employee cash or near cash income (PY010G)				Employer's social insurance contributions (PY030G) (1)			Total number of employees with positive labour income in 2006
Variable for which data are collected	Net of tax on income at source and social contributions	Net of tax on social contributions		Gross		Unknown		Net of tax on income at source and social contributions	Net of tax on social contributions	Gross	Unknown	Positive value	Nil value	Missing	
Definition in database	Net of tax on income at source and social contributions	Net of tax on income at source and social contributions	Net of tax on social contributions	Net of tax on income at source and social contributions	Net of tax on social contributions	Net of tax on income at source and social contributions	Net of tax on social contributions								
BE	99.9	-	-	0.1	-	-	-	10.0	-	90.0	-	94.8	1.4	3.8	5,877
CZ	26.0	-	-	74.0	-	-	-	26.0	-	74.0	-	98.7	1.3	-	9,283
DK	-	-	-	-	-	-	-	-	-	100.0	-	93.6	6.4	-	8,497
DE	-	-	-	-	-	-	-	-	-	100.0	-	-	-	100.0	13,241
EE	88.9	-	-	8.9	-	2.2	-	88.9	-	8.9	2.2	96.3	3.7	-	6,691
IE	50.9	-	-	49.1	-	-	-	-	-	100.0	-	87.3	12.7	-	4,836
EL	100.0	-	-	-	-	-	-	100.0	-	-	-	95.6	4.4	-	3,764
ES	100.0	-	-	-	-	-	-	45.7	-	54.3	-	84.7	15.3	-	13,146
FR	-	-	100.0	-	-	-	-	-	100.0	-	-	75.0	25.0	-	10,925
IT	100.0	-	-	-	-	-	-	100.0	-	-	-	93.6	6.4	-	18,072
CY	2.1	-	-	-	-	-	-	-	-	100.0	-	89.4	10.6	-	4,340
LV	100.0	-	-	-	-	-	-	-	-	100.0	-	91.7	8.3	-	5,305
LT	85.4	-	-	11.6	-	3.0	-	85.4	-	11.6	3.0	-	100.0	-	5,290
LU	100.0	-	-	-	-	-	-	-	-	100.0	-	100.0	-	-	4,563
HU	-	-	-	-	-	-	-	-	-	100.0	-	100.0	-	-	8,710
NL	-	-	-	-	-	-	-	-	-	100.0	-	99.7	0.3	-	13,267
AT	100.0	-	-	-	-	-	-	-	-	100.0	-	100.0	-	-	7,012
PL	100.0	-	-	-	-	-	-	100.0	-	-	-	56.5	43.5	-	13,708
PT	72.8	-	15.7	7.9	3.2	0.1	0.2	72.8	15.7	11.1	0.4	100.0	-	-	4,112
SI	100.0	-	-	-	-	-	-	-	-	100.0	-	78.8	21.2	-	15,039
SK	-	-	-	-	-	-	-	-	-	100.0	-	95.6	4.4	-	6,685
FI	-	-	-	-	-	-	-	-	-	100.0	-	98.5	1.5	-	13,901
SE	-	100.0	-	-	-	-	-	-	100.0	-	-	97.0	3.0	-	10,211
UK	-	-	-	-	-	-	-	-	-	100.0	-	16.4	1.7	82.0	8,979

Notes: Figures represent the shares of total observations with the features described in the column headings. For instance, in Belgium 99.9 per cent of net earnings were collected net of tax on income at source and social contributions and only 0.1 per cent was collected gross of these items. (1) Only individuals with positive gross earnings.  
Sources: authors' elaboration on EU-SILC users' database (Version 2007-1, March 2009).