Development of a Quality Adjusted Labour Productivity Index in the European Union – Example of the Employment Embodied in European Exports

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A. Introduction

Eurostat in collaboration with the Joint Researcher Centre - IPTS of the European Commission has developed a standardized methodology for a Quality Adjusted Labour Index (QALI) in the European Union and a time series from 2002 to 2014 for each Member State of the European Union and the European aggregates: euro area and European Union.

QALI is a key input to multi-factor productivity and growth accounting analysis. It provides a more complete picture of the labour input to the production process taking into account the heterogeneity of the workforce.

The elaboration of Quality–Adjusted Labour Input indicators combines macro-data from National Accounts to which any data on employment is benchmarked and micro-data from the EU statistics of the Labour Force Survey (LFS) , the Structural Earnings Survey (SES) as well as the EU-Statistics on Income and Living Conditions (EU-SILC). The QALI indicator by taking account of the composition of the workforce regarding its age and skill provides a broader perspective in assessing productivity performance.

Consolidated supply, use and input-output tables for the European Union and euro are published annually by Eurostat since 2011. Embodied employment (in hours worked measure) in European exports account in 2014 for 47.7 billion of hours worked representing 12.9% of the European Union total employment.

Connected to the decomposition of the volume by type of workers (by age and by skill), the results will give interesting insights on what kind of employment is supported by European exports in terms of age, qualifications, and in which industrial activities.

Alongside the QALI estimations, Eurostat and the JRC-IPTS are producing a set of capital indicators for EU Member States for productivity analysis purposes.

B. Methodology of the QALI

The developed QALI are annual data from 2002 to 2014. Both indicators and underlying time series will be published.

a) A Törnqvist index

The Quality Adjusted Labour productivity Indicators are drawn as a Törnqvist index weighted geometric average of growth rates of hours worked, where the weights are labour income shares across the different groups (Törnqvist, 1936).

$$QALI_{i\ T}^{t} = 1 + \Delta ln(L_t) \times 100 = 1 + ln\left(\frac{L_t}{L_{t-1}}\right) \times 100$$

$$= \sum_i \left[\left(\frac{w_{i,t} + w_{i,t-1}}{2}\right) ln\left(\frac{h_{i,t}}{h_{i,t-1}}\right)\right] \times 100$$

b) Workers groups

To perform the quality adjustment, hours worked and earnings are differentiated into types of workers. The two qualities considered in the compilation of QALIs are the skill levels and the age of the workforce.

Skills are considered from the proxy of the highest education level attained by the worker. Higher degrees of education are associated with higher earnings/payments. The classification used is the International Standard Classification of Education (ISCED 1997) of UNESCO.

Age is used as a proxy for work experience. The assumption here is that older workers are more productive due to their enhanced experience and thus receive a higher salary. However, we do not take into account periods of unemployment or inactivity.

Table 1. Summary of qualities of labour

Age	*Skill*
15-29	High (ISCED97= 0-2)
30-49	Medium (ISCED97= 3-4)
50+	Low (ISCED97= 5-6)

Initial considerations of gender and status (self-employed, employee) had to be dropped for excessive non-publishable information due to the representativeness of the different categories.

The Industry breakdown into NACE Rev.2 A*10 and A*21 (for selected MS and European Aggregates) activities is the last labour characteristic envisaged.

C. Data sources

To calculate QALIs two types of data sources are used: macro data of the National Accounts hours worked and compensation of employees on one hand and on the other hand micro data from the Labour Force Survey (LFS) and the Structure of Earnings Survey (SES). The EU-Statistics on Income and Living Conditions (EU-SILC) was also used to obtain earnings estimates for the Agricultural industry. Surveys data's contribution is basically to split up the totals coming from NA into the different skill levels and age groups assuming the surveys structures.

Due to reliability limits and confidentiality issues for the survey-based sources the target of QALI values is limited to as shown in table 2.

Table 2. Targeted QALI results

	Skill/Age					
	MS	EU/EA	MS	EU/EA	MS	EU/EA
TOT	Yes	Yes	Yes	Yes	Yes	Yes
A10		Yes	Yes	Yes	Yes	Yes
A21		Yes	6 MS	Yes	12 MS	Yes

Notes: 6MS: FR, DE, (NL), ES, IT, UK; 12MS: 6 MS + AT, BE, CZ, PL, (SI), SE

Annual National Accounts data are available for most countries when it comes to hours worked (for which separate measures are transmitted for employees and self-employed). Compensation of employees are however available only for the total of both groups. When hours worked or compensation of employees are missing the QALI indicators are not computed.

An extensive flagging of the data has been performed. This allows for tracking the reason behind a missing result; lack of NA data; lack of data, confidentiality or very low reliability of any specific of the different surveys sample (identification each case). This would allow for analysing where the main limitation for extending the coverage of the project relies.

After some analysis of the data a methodological choice has been made not to impute the survey data. One of the reasons is the NACE conversion (LFS has been surveyed against NACE Rev 1.1 for 2002 and 2006 and against NACE Rev 2 in 2010) but mismatch of definitions across the different surveys or changes overtime of definitions are others. Those limit the details of underlying time series (see table 3). Furthermore as mentioned earlier National Accounts data is not exhaustively available mainly due to derogations under the current 2010 transmission program which would be lifted in the common years and improve the availability of time series. Therefore the current number of QALIs compiled should improve over time.

Table 3. Percentage of data gaps

	Underlying data				Number of QALIs		
	2008-2013				2008-2013		
LFS	**Skill+Age**	**Skill**	**Age**	**LFS**	**Skill+Age**	**Skill**	**Age**
Total	0%	0%	0%	Total	0%	0%	0%
A10	0%	4.8%	2.3%	A10	0%	12.8%	5.3%
A21	0%	5.6%	4.3%	A21	0%	10.5%	6.7%
SES	**Skill+Age**	**Skill**	**Age**	**SES**	**Skill+Age**	**Skill**	**Age**
Total	0%	0%	0%	Total	0%	0%	0%
A10	0%	1.2%	1.1%	A10	0%	1.5%	1.1%
A21	0%	2.9%	2.1%	A21	0%	4.2%	2.1%
SILC_A	**Skill+Age**	**Skill**	**Age**	**SILC_A**	**Skill+Age**	**Skill**	**Age**
Total	0%	0%	0%	Total	0%	0%	0%
A10	0%	18.9%	11.1%	A10	0%	56.7%	33.3%
A21	0%	6.7%	12.2%	A21	0%	20.0%	36.7%

A10: 28 MS, EU28, EA19 SILC_A = Agriculture
A21: 14 MS

D. Consolidated European Input-Output tables

Since 2011 Eurostat disseminated European Supply, Use and Input-Output tables for the European Union and Euro area by consolidating the national transmitted or estimated tables.

The European input-output tables are derived from the European supply and use tables using a transformation related to the industry technology assumption to give product-by-product tables (see Box 4.1 and Model B, Eurostat 2008 Manual of Supply, Use and Input-Output Tables, p.349).

The latest European consolidated tables are disseminated under the ESA2010 (SNA 2008) methodology for the year 2010 to 2013.

European (EU and euro area) consolidated tables are now projected back to 2005 using the euro method from the 2010 reference date and project forward to 2014.

As a standard input-output technique, the European Input-Output Tables were used for the calculation of the results of applying the Leontief quantity model to employment.

Firstly, a domestic input coefficient matrix (A) was calculated for each homogenous branch of activity showing the direct input requirements for the production of one unit of output. Subsequently, the Leontief inverse matrix (the inverse of I — A, being I, the identity matrix) was computed to obtain the so called matrix of output multipliers. Next, the Leontief inverse matrix was post-multiplied by a column vector of exports to calculate the total output embodied in those exports. Finally, output coefficients of employment pre-multiplied the above embodied output values to obtain the employment embodied in exports.

Here the employment could be further disaggregated against the different type of workers. As an output data on high-skilled employment embodied in exports for EU28 (for example) is compiled.

E. Results

A full dataset of QALI indicators and underlying time series has been produced and will be disseminated by Eurostat in 2017 under research working papers.

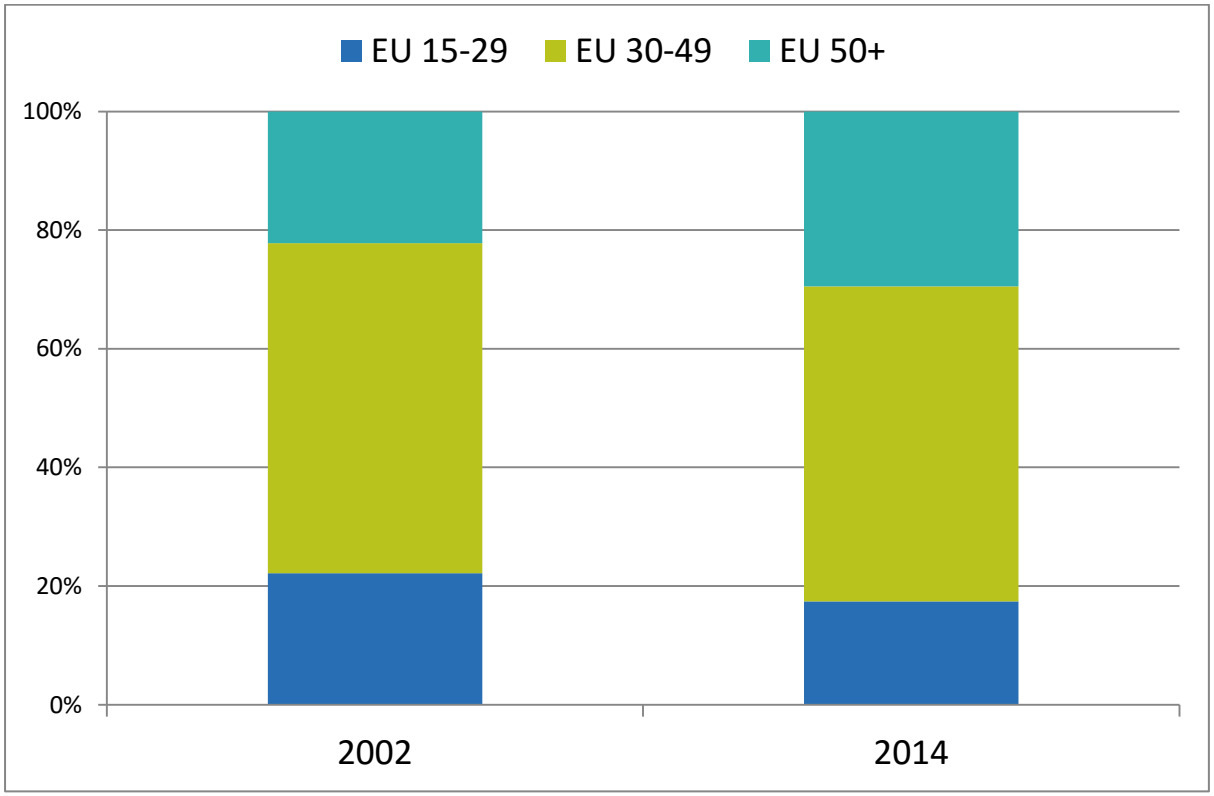
The consolidated European tables for years 2005 to 2014 has been disseminated in May 2016. An update will occur after summer 2016 taking into account the latest national data available.

Here are some illustrations of data compiled for analytical purposes.

a) Composition of employment in the European Union

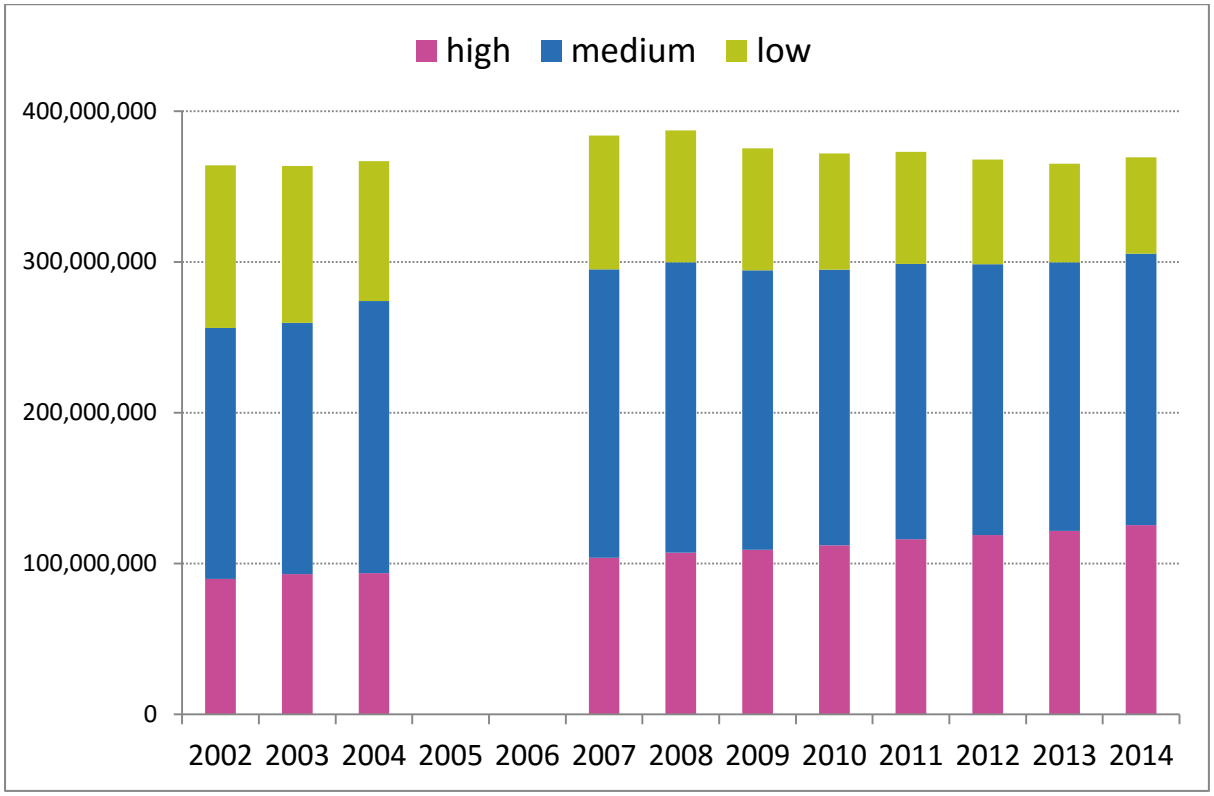
The employment pattern of the European Union is for more than half composed of workers between 30 and 49 years old. This share is slightly bigger in 2014 compared to 2002. The employment in the two other categories is much lower: workers of more than 50 years old represent 30% in 2014. Their share into the workforce is larger in 2014 compared to 2002 to the detriment of the younger workers who represent in 2014 only 17% of the workforce.

Figure 1: Composition of the employment by age group in the European Union



Looking at the skill group half of the workforce has medium skill level with 49%. This share has been extremely stable over the last decade. The high skilled group has increased in relative terms from one fourth to one third of the workforce while the low skilled group represents in 2014 17% in the workforce.

Figure 2: Composition of the employment by skill level in the European Union



Overtime the impact of the crisis is quite visible looking at the skill level group: number of hours worked by the medium skill workers decreases since 2008 (on average by -1.1% every year from 2008 to 2014). However the decrease is even deeper for the low skill workforce: on average -3.5% annually from 2002 to 2008 and -5.1% from 2008 to 2014. Only the number of hours given by the high skilled group increases overtime with an annual average of 2.8%.

From 2002 to 2008 the labour compensation was characterised by upward trend for all groups driven by a remuneration of medium skill group and the middle age group. In 2009 the labour compensation observes a decrease. The level of 2008 is back in 2014.

Figure 3: Labour compensation in the EU

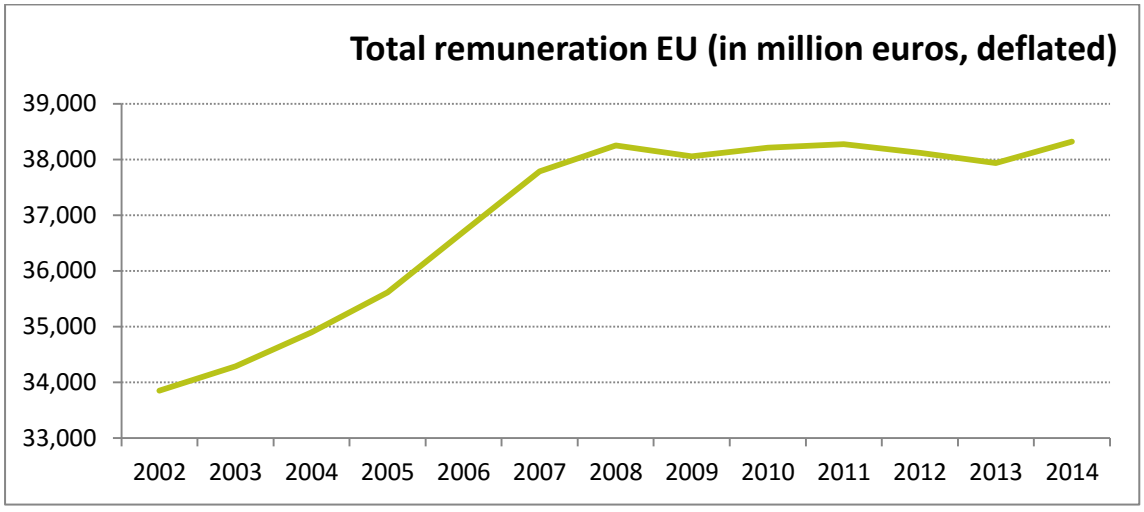
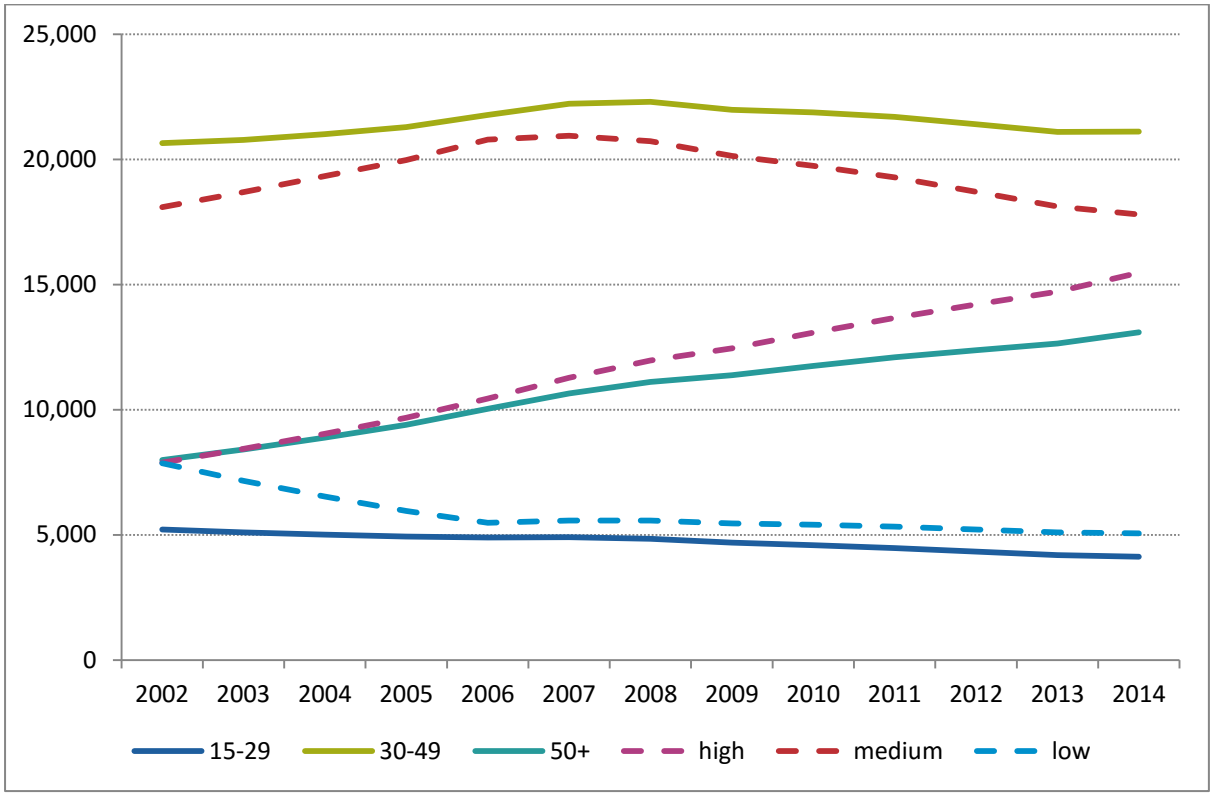


Figure 4: Labour compensation (D1) pattern in million € (PPS deflated, base year 2010)



Average annual growth of remuneration for EU				
Skill level	**High**	**medium**	**low**	**total**
2002-2008	**7.2%**	**2.3%**	**-5.6%**	**2.1%**
2008-2014	**4.4%**	**-2.5%**	**-1.6%**	**0.0%**
Age group	**15-29**	**30-49**	**50+**	
2002-2008	**-1.2%**	**1.3%**	**5.7%**	**2.1%**
2008-2014	**-2.7%**	**-0.9%**	**2.8%**	**0.0%**

The increase of the remuneration up to 2008 was due mainly by the high growh of high workers' remuneration. On the age side, the workers with the most experience (the oldest) drove the increase up to 2008. After the crisis, the slowdown was coming mainly from the medium skilled workers and the youngest ones.

b) The QALI for the European Union

The figure 5 compares an index of unadjusted hours worked for the European Union economy with the QALI considering three types of weighting patterns for the remuneration: the age group, the skill groups or the combination of age and skill. One must note that considering both age and skill at the same time provides more information compared to the skill or age taken alone. Breaking down the workers into groups of skill and age level is therefore meaningful for labour input analysis.

QALI shows after 2008 a sharp decrease until recently where in 2014 is observed an uptrend for QALI.

QALI increases more when considering the skill grouping than the observed increase in hours accounting for a larger increase of the highly skilled and highly remunerated type of labour. Combining skill and age the growth is even stronger.

Figure 5: whole economy QALI (2010=1)

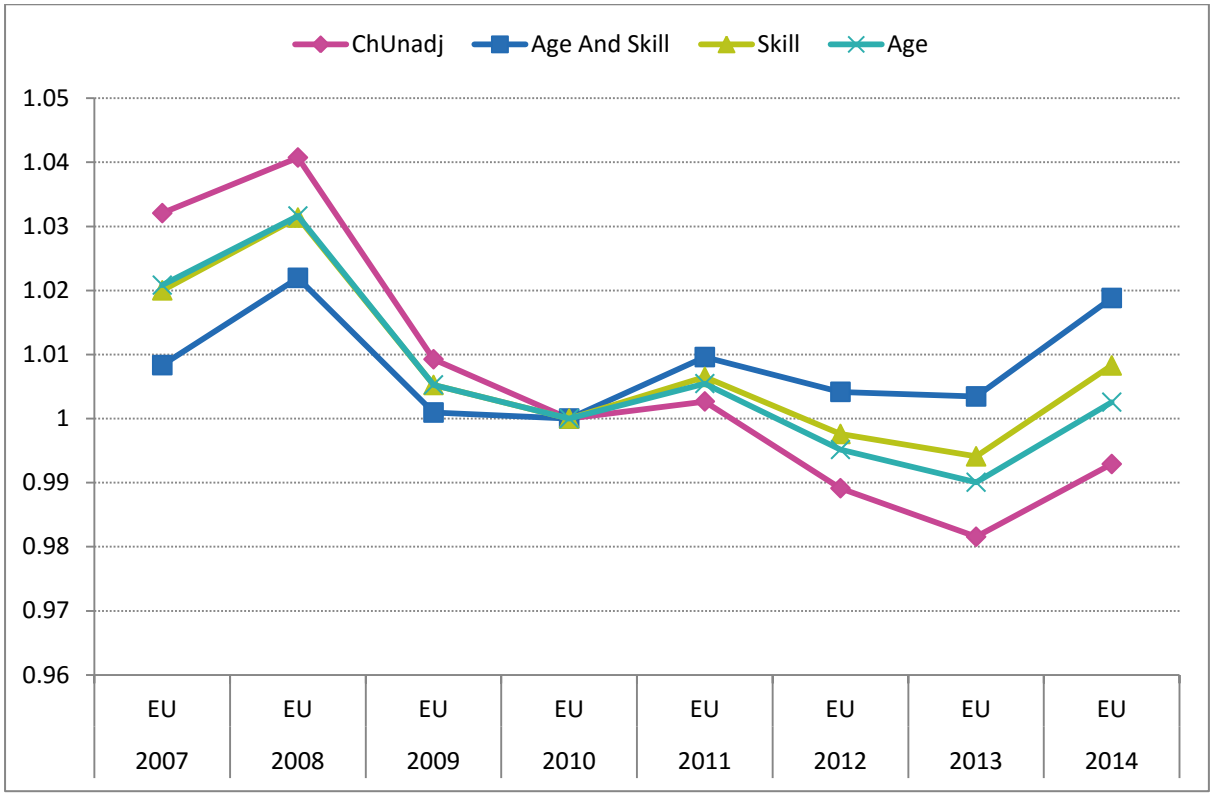
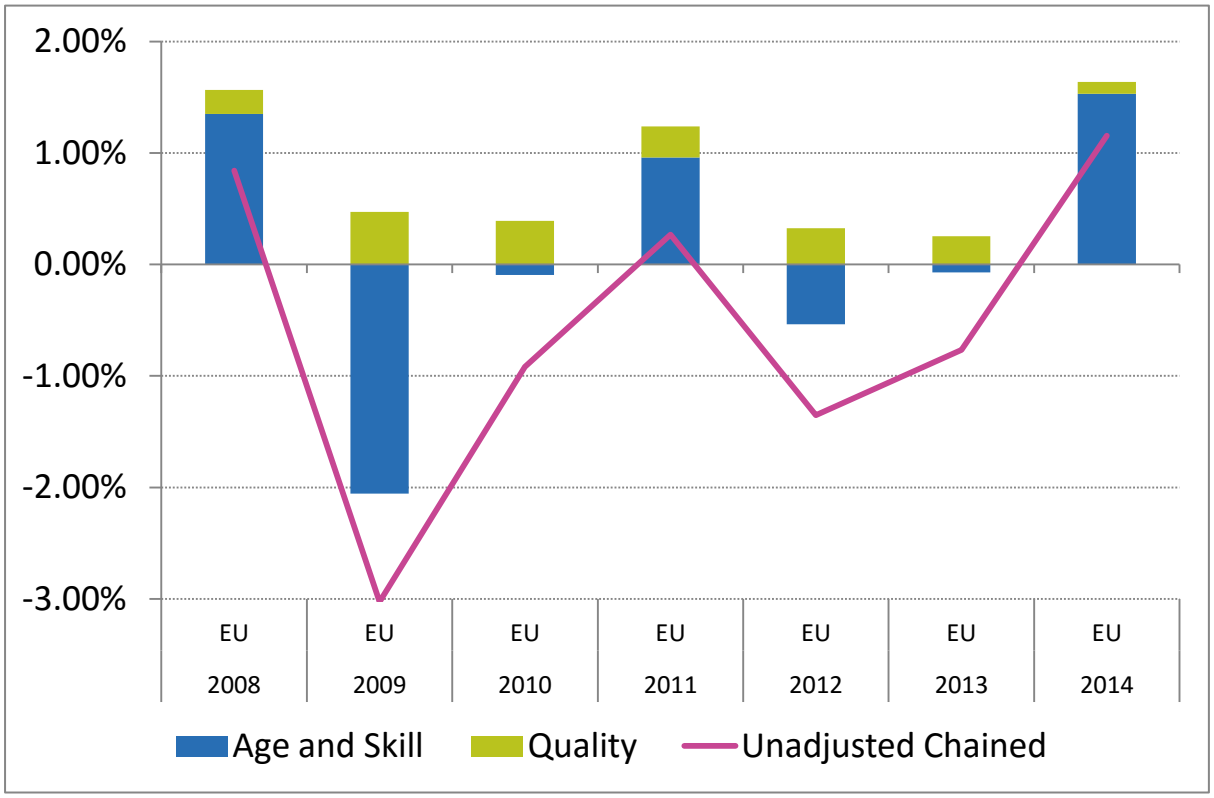


Figure 6 shows that overtime labour quality[1] is contributing positively to the QALI growth even in the years where the number of hours worked declined thus implying that employed workforce is moving towards higher remunerated QALI categories. During the recession period low-skilled workers may have suffered proportionally more than higher skilled workers.

[1] Labour quality is defined here as the difference between the unadjusted index and the quality adjusted labour index. It is a measure of labour composition.

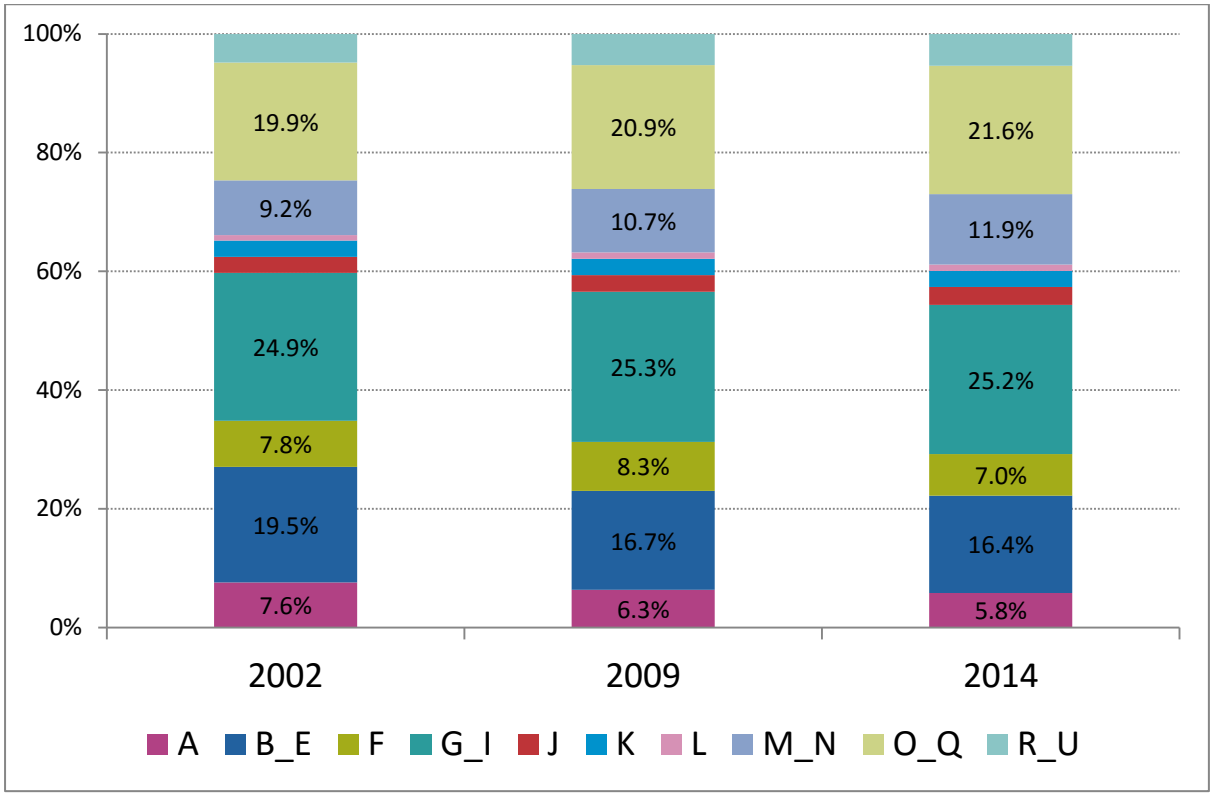
Figure 6: annual growth of labour input from 2008 onwards – Percentage points



c) Labour input per industries in the European Union

The composition of the labour input (here hours worked) has changed over the last decade in the European Union. While agriculture and industry was accounting for 27% in 2002 this share has decreased to 22,2% in 2014. The construction industry shows a decrease of the share of labour input in the total economy. When it comes to trade and services, the share of labour input increased from 2002 to 2014: not much for trade (from 24,9% in 2002 to 25,2% in 2014), services 15,6% to 18,7% (see Figure 7).

Figure 7: Structure of the labour input per industry



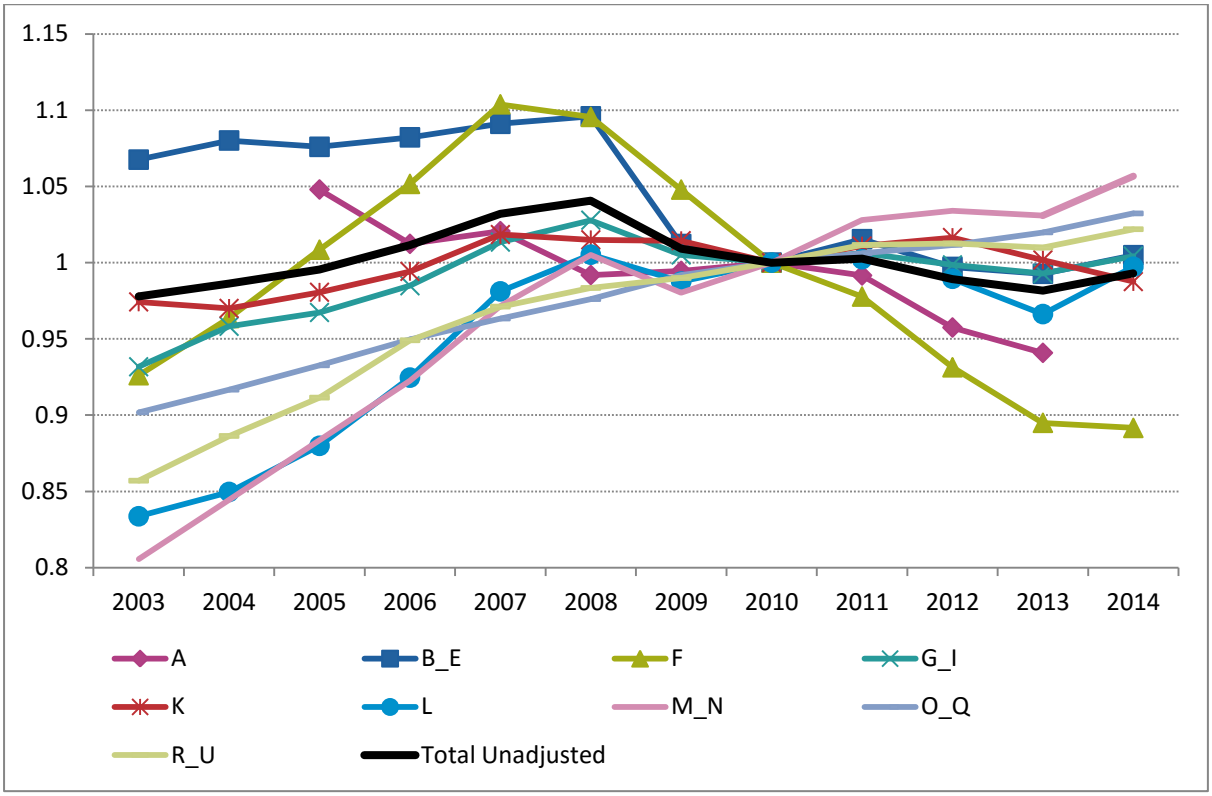
d) The QALI at industry level

Figure 8 displays the Quality Adjusted Labour Index per industry. The construction industry (F) had a period before the 2008 crisis of high growth in the quality adjusted labour input but was the industry to present as well a very sharp decrease in the index after 2008.

The only industry[2] to keep its upper trend was the business services industry (supporting businesses) such as accounting, legal services, security etc.

[2] Industries are given by their classification codes in NACE Rev 2.

Figure 8: QALI by industry



e) Embodied employment in exports for the EU28

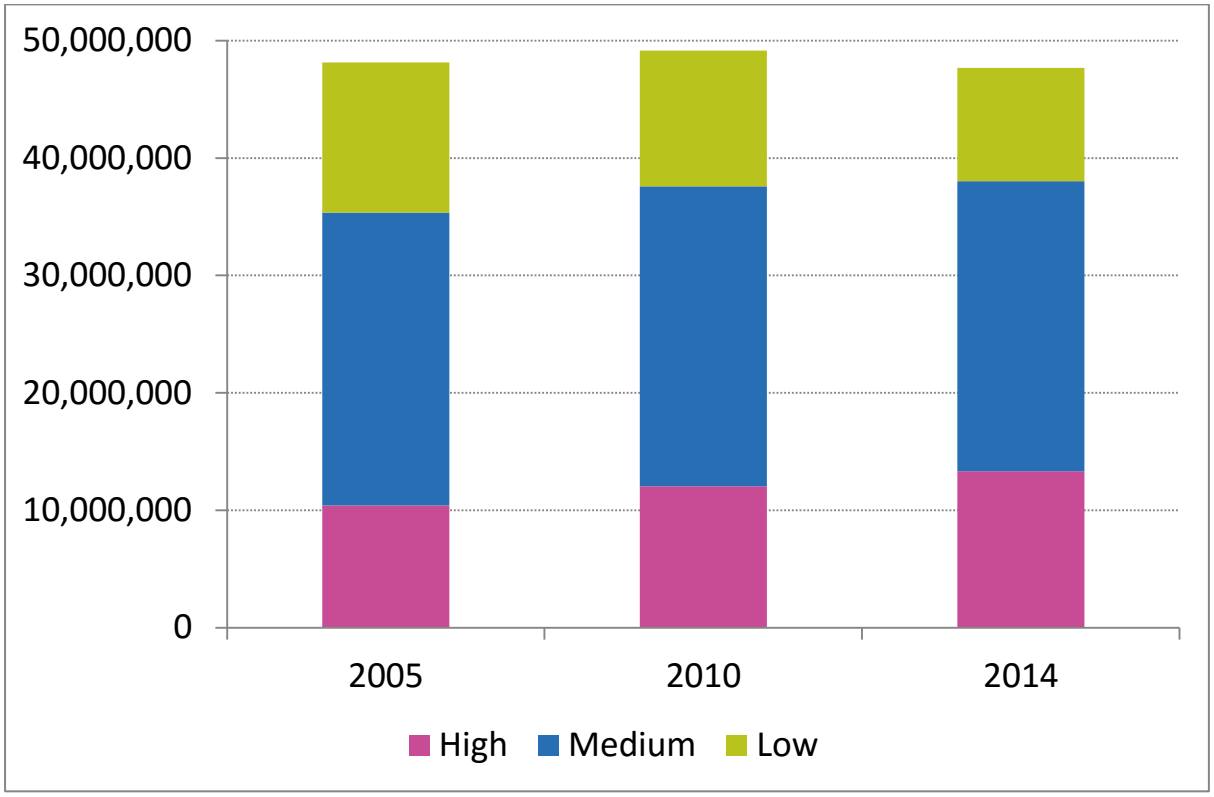
The underlying data of QALI indices give us the composition of the employment (in hours worked here) according to some qualities. Here the skill groups are considered. The same could be illustrated with the age groups.

Combined with the consolidated European Input-Output tables and using the Leontief modelling the employment embodied in exports is derived.

Figure 9 indicates that the employment embodied in exports for the European Union (here expressed in hours worked) is around 47 billion hours worked which represent 13% of the total employment in EU28.

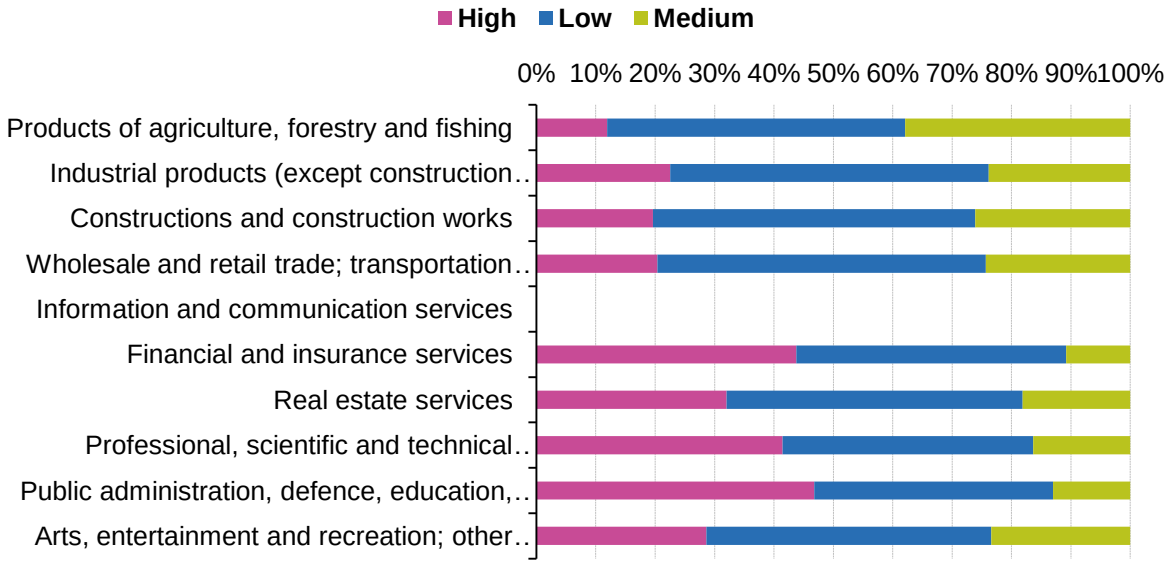
The level of hours worked linked to exports activities found its level back in 2014 compared to 2005. Employment embodied in exports is for one half due to medium skill workers and this is quite stable over time.

Figure 8: Embodied employment in exports for the EU28 (in thousands of hours worked) and its composition by skill level workers



The employment embodied in exports at EU28 level varies from one industry to another (see Figure 10): while the industries of primary and secondary sectors concentrate more low skill employment in their exports, the services industries and public administration when exporting are more oriented towards high skill employment.

Figure 10: Embodied employment in exports for EU28, year 2014 by industry



f) Conclusion

The new datasets available to Eurostat on breakdown of the labour input data by skill, age and industry as well as QALI indicators provide valuable information for analysis and for productivity measurement.

Similar analysis quickly done here for exports could be made for imports substitution and therefore provide information on the type of jobs that EU imports substitute.

The analysis could be repeated for each EU Member States and provides information on the single market relationship and balance in terms of types of jobs.

Eurostat in collaboration with the JRC has started a project to build up a European Inter-Country Suply, Use, Input-Output Tables with some extensions for labour accounts taking into consideration the work done up and presented in this document.