AGING WORKFORCE IN EUROPE: A SECTOR-LEVEL INVESTIGATION

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Key Messages

* The aging process in EU11 is leading to age distributions at the sector level which are significantly more skewed towards old individuals than would be expected from the experience of EU17 economies.

* As compared to EU17, in EU11 the increase in the share of older workers has been more sizable in sectors that were lagging behind in terms of labor productivity.

* Reductions in the share of young workers tend to be associated with decreases in productivity, in particular among the group of sectors with the highest output per worker levels.

* The demographic developments ahead in terms of increases in the share of older workers are expected to have negative effects in sectoral productivity and present obstacles to further convergence in output per capita across European economies.

* In the context of aging trends, further expansions of educational attainment (in terms of quantity and quality) coupled with the implementation of policies to alleviate skill mismatch in EU11 appear central to ensure further convergence in labor productivity in the continent.

Introduction

To the extent that the age-productivity linkage depends on the activities carried out in particular production processes, the sectoral structure of an economy acts as a catalyst of the effects of aging on economic outcomes at the macroeconomic level. This is amplified if the aging process is asymmetric across sectors, with the workforce in different industries getting older at different speeds. At the same time, there is reason to believe that different economic sectors will be affected differently by the aging process of their workforce. This contribution presents an analysis of the aging trends in Europe both within and across industries. In particular, it concentrates on highlighting the differences between the different regions of the European Union.

The importance of moving away from aggregated figures and considering data at the sector and firm level when assessing the economic consequences of aging has been recently stressed by, e.g., Göbel and Zwick (2012), Malmberg et al. (2008), Ilmakunnas and Ilmakunnas (2010), Lallemand and Rycx (2009) or Mahlberg et al. (2013). The evidence of the effect of workforce aging on the age-productivity profiles within sectors is mixed. Malmberg et al. (2008) show that an increase in the share of older workers in the Swedish manufacturing and mining sector, does not negatively affect plant-level productivity. Göbel and Zwick (2012), on the other hand, compare the age-productivity profiles of three broad sectors in Germany (manufacturing, metal manufacturing and services). Their analysis does not reveal any significant differences in the age-productivity profiles of these sectors, which leads them to conclude that the sectoral structure of an economy plays only a minor role in the estimation of the economic consequences of an aging labor force. Analyzing Finish data for several sub-groups of the service sector and for the industrial sector, Ilmakunnas and Ilmakunnas (2010) find differing effects of the age-structure on firm-level productivity. Lallemand and Rycx (2009) find in their analysis of Belgian firm-level data that changes in the age-structure of the work-force have differing effects for ICT and non-ICT firms. For Austria, the results of Mahlberg et al. (2013) show that both the age-productivity as well as age-wage profile have a very strong sector-specific component. In spite of the ambiguous results found in empirical studies, the importance of considering the sectoral dimension when examining the effects of aging on the economy has been widely recognized in the modern literature.

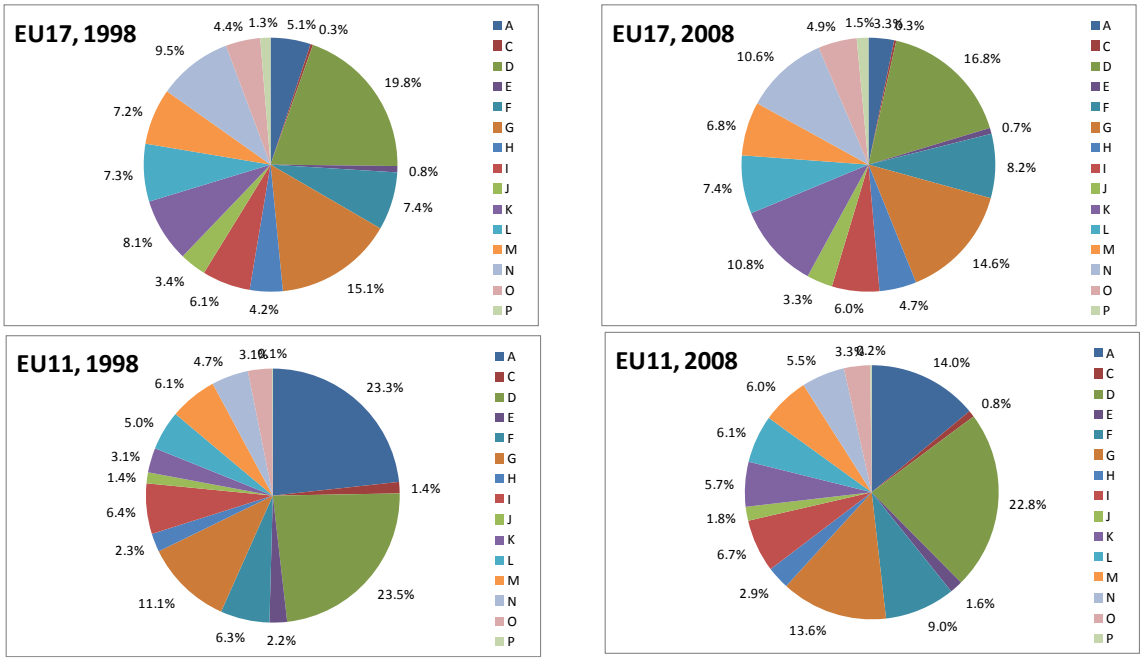
In this piece, we review the recent experience of aging in the European Union and concentrate on the differences in such developments at the sector level. We study the interaction between the demographic developments in the continent and sectoral productivity and emphasize the prospects of Europe given the expected trends in aging for the coming decades. We use EU Labor Force Survey (LFS) data to measure the age structure of the workforce at the sector level for EU27 economies in the period 1998-2008.[1] We use 15 broad sectors (categorized using the NACE 1.1 revision) and aim at identifying the differential characteristics of the aging process in the new EU member states (EU11) as compared to other economies in Europe. The 15 broad sectors defined by the NACE Rev. 1.1 categorization which are included in the analysis are presented in Table 1.

[1] Data for Malta and Croatia (the 28th EU country as of July 1st 2013) are not available.

Table1: NACE Sectors, Rev. 1.1.

NACE Sector	Description
A	Agriculture, hunting and forestry
C	Mining and quarrying
D	Manufacturing
E	Electricity, gas and water supply
F	Construction
G	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods
H	Hotels and restaurants
I	Transport, storage and communication
J	Financial intermediation
K	Real estate, renting and business activities
L	Public administration and defence; compulsory social security
M	Education
N	Health and social work
O	Other community, social and personal service activities
P	Activities of households

Figure 1: Employment in EU17 and EU11, composition by sector (1998 and 2008)

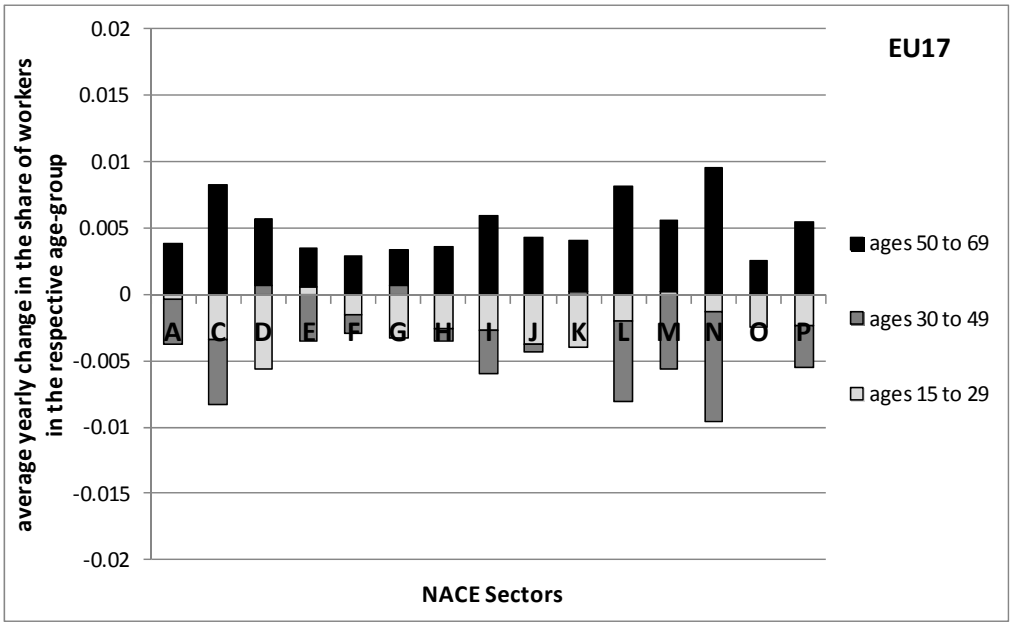


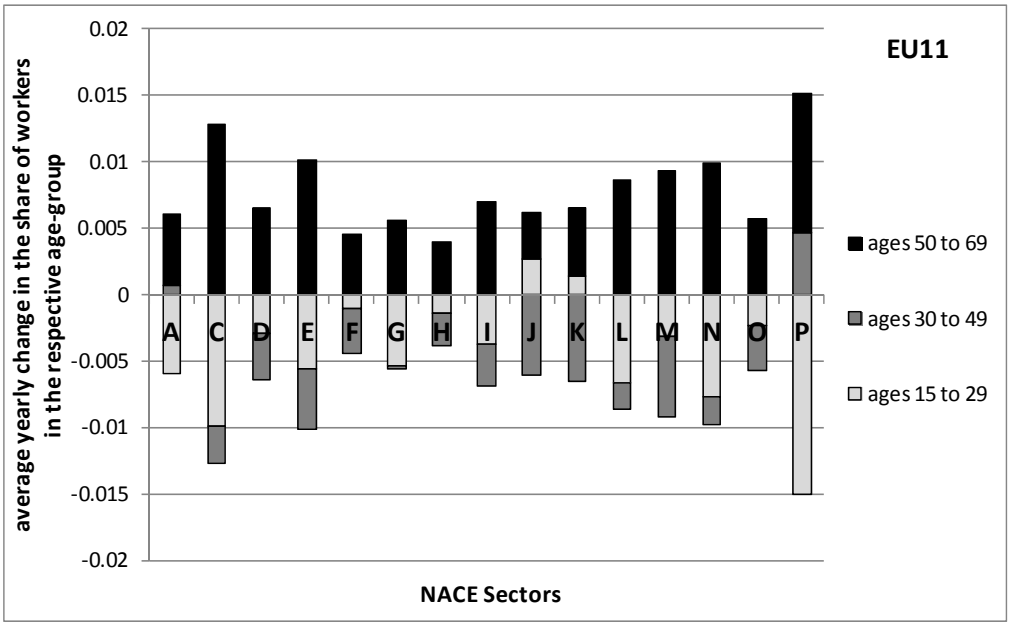
Demographic developments in Europe and the productivity of sectors

There are notable structural changes in the sectoral composition of the economy with respect to employment which has occurred since 1998. The focus on the sector level appears particularly relevant when comparing the composition of employment by sector in EU17 and EU11. Figure 1

presents the proportion of employed persons by NACE sector and regional grouping in 1998 and 2008. In EU11 as well as the EU17 region, the main sector of employment in 2008 was NACE sector D (manufacturing). In the EU11 region, manufacturing comprised almost a fourth of all employment, which is only a slight reduction compared to 1998. The largest change in absolute percentage points occurred in NACE sector A (agriculture, hunting and forestry), that accounted for 23.3 % of all employment in 1998 but only represents 14.0 % in 2008. In the EU17 region, shifts in the sectoral employment structure occurred as well but at a much smaller scale: the manufacturing sector, for instance, decreased its share in total employment from 19.8 % to 16.8% and NACE sector K (real estate, renting and business activities) increased it from 8.1 % to 10.8 %.

Figure 2: Average yearly change in the share of workers by age group at the NACE sector level, 1998-2008, EU17 and EU11



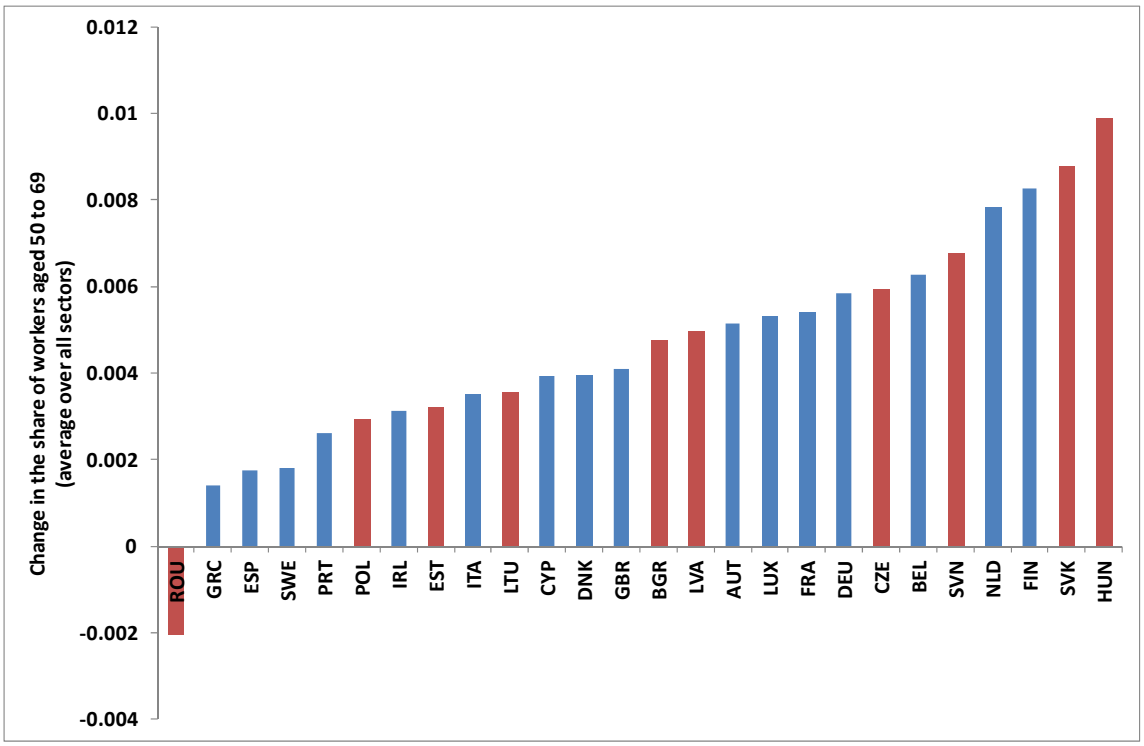


There is a regional dimension in the aging process at the sectoral level in Europe. The level and speed of the aging process in the last decade has differed strongly across sectors and EU regions. Figure 2 depicts the average yearly change in the share of workers by age group at the NACE sector level for the period 1998-2008 in EU17 and EU11. The average yearly increase of the share of older workers (ages 50 to 69) over all sectors has been higher in EU11 (0.7 percentage points per year, as opposed to 0.5 percentage points on average in EU17), as expected by the overall demographic dynamics in this region as compared to the rest of the EU.

However, strong differences in the relative developments by sector are visible in Europe (Figure 1). Financial intermediation (NACE J) is the only sector where the share of older workers grew more on average in EU17 than in EU11, while workforce aging (as defined by the evolution of the share of workers aged 50 to 69) in NACE sectors E, G and O (Electricity, gas and water supply; wholesale and other social services, respectively) took place in EU11 at more than twice the speed of aging in EU17. The decrease in the share of employment of middle-aged and young workers that complemented the observed increases in the employment shares of older workers between 1998 and 2008 concentrated in the EU11 region more on the younger age-group than in the EU17 region.

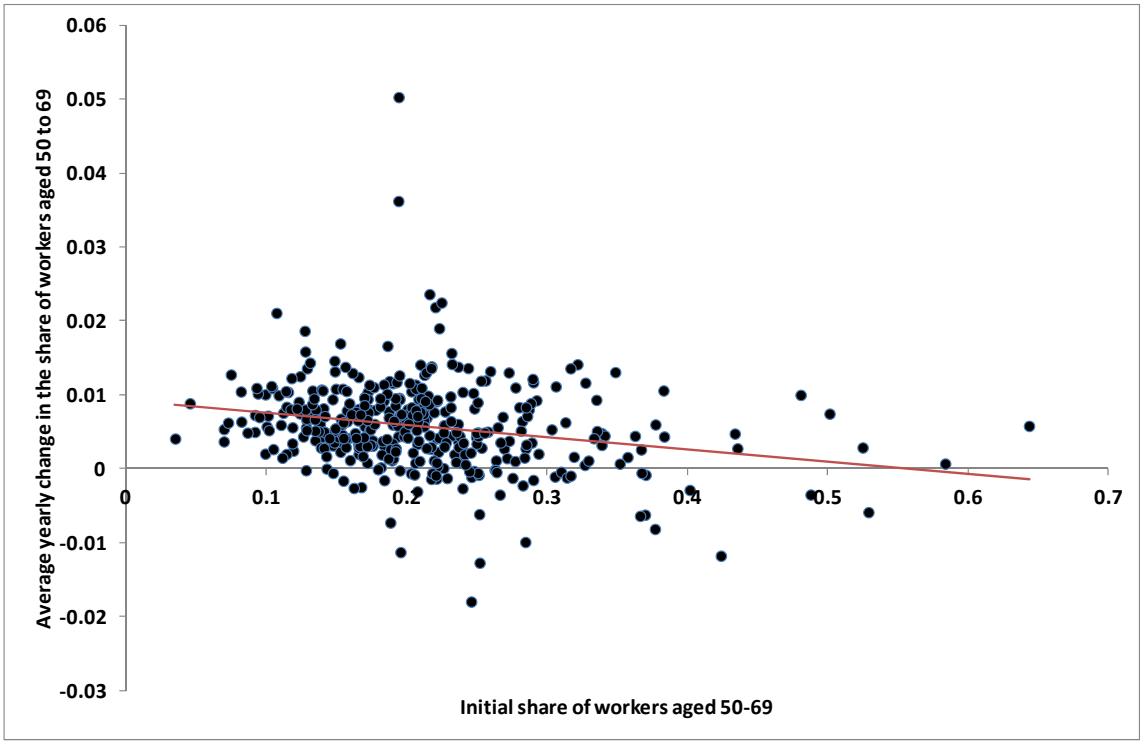
This descriptive evidence suggests that the aging process is taking place at a speedier path in EU11 than in the rest of the EU and that such a demographic development is affecting sectors asymmetrically. To the extent that age-productivity profiles may differ across sectors, such changes in age structure may lead to differences in the economic growth potential of the EU11 region vis-à-vis the rest of the EU and thus affect the potential for further income convergence in the continent. The overall developments across countries in terms of average changes in the share of older workers by sector also took place in a heterogeneous fashion in the EU, as Figure 4 summarizes.

Figure 4: Average yearly change in the share of workers aged 50 to 69 over all NACE sectors, 1998-2008



On average, the changes in the age structure of workforce by sector in the EU have led to an equalization of the share of older workers across industries and countries. Figure 5 shows a scatter plot linking the initial share of workers aged 50 to 69 against the average yearly change in the period 1998-2008 by country/sector.

Figure 5: Average yearly change in the share of workers aged 50 to 69 versus initial share, by country/sector; 1998-2008.



However, the question whether the behavior of EU11 economies significantly differs from that in other countries of the EU has to be addressed by means of regression analysis. Therefore, we specify convergence equations by regressing the average change in the share of older workers on the share in the initial period. This specification is then expanded by a dummy variable taking value one if the sector/country observation belongs to EU11. This regression is used to assess whether the overall aging process in sectors of EU11 has been significantly different than that in EU17 once that we take into account that the initial age distribution of workers differed across regions. In the third specification we include in addition sector dummies which account for the fact that there could be sector-specific differences in terms of the demand of workers by age group.

Table 2: Age structure convergence equations

	(1)	(2)	(3)
Initial share of workers aged 50-69	-0.0166***	-0.0153***	-0.0275***
	[0.00333]	[0.00333]	[0.00448]
EU11 dummy		0.00178***	0.00156***
		[0.000634]	[0.000597]
Intercept	0.00925***	0.00829***	0.0139***

	[0.000712]	[0.000747]	[0.00193]
Sector dummies	No	No	Yes
Observations	386	386	386
R-squared	0.053	0.074	0.244

Dependent variable is the change in the share of workers between 1998 and 2008. Robust standard errors in brackets. *** stands for significance at the 1% level

Note: Column (1) presents the standard convergence equation for the whole EU27 sample, which does not account for potential differences across European regions. Column (2) presents the estimates of the model including a dummy variable for observations in EU11; convergence is assumed to take place towards a single EU region-specific share. Column (3) presents the results of the estimation of the specification with sectoral dummies.

There are three key finding based on the empirical results of the convergence analysis (Table 2):

(i) First, on average, sectors with a lower starting share of workers aged 50-69 tended to increase this share by significantly more than those with higher starting values, thus leading to an equalization of the share of older workers throughout sectors of EU27 (see Figure 5, the results in column (1) of Table 2).

(ii) Second, the estimated positive parameter for the EU11 dummy implies that on average aging has led to sectors with significantly older workforces in EU11 than in EU17, after taking into account the fact that their starting point in terms of age structure was different. The difference between EU17 and EU11 in terms of the unconditional expectation of the share of old workers in a representative sector is 11.6 percentage points for this specification.[2] This implies that given the dynamics of the age structure of employees at the sector level observed hitherto in Europe, sectors in EU11 appear to converge towards age distributions which are on average older that their counterparts in EU17.

(iii) Third, the aging process in the EU11 countries is leading to sectors with significantly higher shares of older workers than in the rest of the EU. Since this result could be driven by the differences in the sectoral composition of EU11 economies as compared to that in EU17 (and thus the differences would stem from differing age structures across sectors and not across regions), we expand the regression model with sectoral dummy variables.[3] The results in column (3) suggest that the speed of age structure convergence, embodied in the absolute value of the parameter estimate for the initial share of workers aged 50-69, is higher in this model. In spite of the fact that such sector-specific differences are controlled for in this specification, the EU11 dummy variable is still significant and positive. The implied long-run equilibrium of the share of older individuals employed in EU11 sectors is 5.7 percentage points higher than in EU17 according to the estimates of this specification.

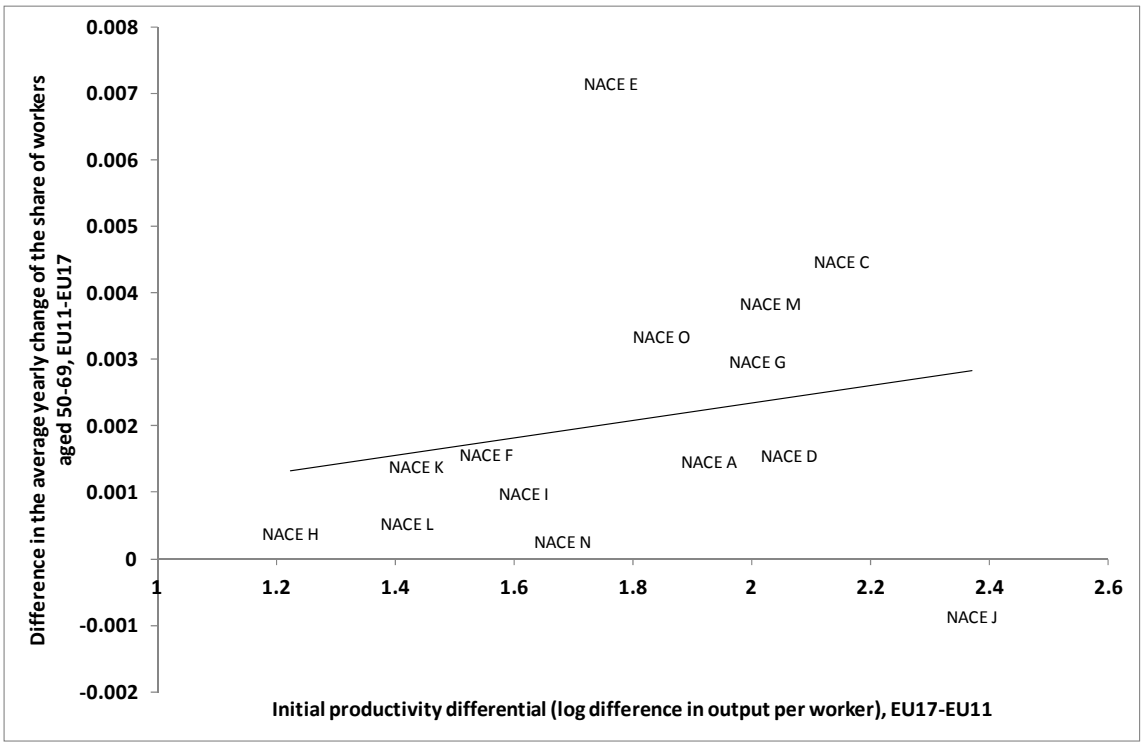
How are these differences in the speed of aging across sectors and EU regions related to productivity differentials?

[2] This figure is calculated as the ratio of the estimated parameter for the EU11 dummy and the absolute value of the parameter estimate of the initial share variable.

[3] As opposed to column (2), where the convergence is assumed to take place towards a single EU region-specific share, the specification in column (3) allows for sector-specific equilibria in terms of age distribution.

As compared to EU17, the changes in the distribution of workers by age caused by the ongoing demographic trends in EU11 were more marked in those sectors that were initially (relatively) less productive. Figure 6 shows a scatter plot linking initial productivity differentials between EU17 and EU11 (in the reference year for the measure of the change in the share of older workers) against the differential in the change of the share of workers. If aging dynamics took place homogeneously across sectors, no particular correlation would be expected between these two variables. Instead, the evidence suggests that lower productivity sectors in EU11 were the ones more affected by aging than higher productivity ones. This result is further reinforced if NACE sector J (Financial intermediation), where the measurement of productivity is notoriously difficult, is excluded from the sample.

Figure 6: Difference in the average yearly change of the share of workers aged 50 to 69 between EU11 and EU17 versus initial productivity differential, by sector; 1998-2008.



How did aging in Europe interact with productivity growth at the sector level?

While on average productivity tended to converge across sectors and countries in Europe, there is no significant evidence that aging at the sectoral level has been associated with any changes in productivity. Table 3 reports the estimates of alternative convergence equations for productivity at the sector level in the EU. We start by regressing the growth rate of productivity on the initial level of productivity for the sector/country observations available. The regression results, in column (1) of Table 3, indicate that on average productivity in Europe tended to converge across sectors and countries in the period 1998-2008. In column (2) we expand the specification to include the change in the share of older workers, as well as its interaction with initial productivity, as extra regressors. The parameter estimates of this regression model suggest that there is no significant evidence that increases of the share of older workers has been accompanied by any changes in productivity after controlling for the initial level of output per worker. This result still holds if exogenous, sector-specific

productivity equilibria are included in the specification by means of sector dummies (column (3)). This specification, however, does not take into account that investment in physical capital has also differed across sectors and countries in the period considered. In a further analysis, we control for investment in a modeling setting with a more theoretical background in the next section.

Table 3: Sector productivity convergence equations

	(1)	(2)	(3)
Initial (log) productivity	-0.00864**	-0.0125***	-0.0163***
	[0.00353]	[0.00453]	[0.00453]
Change in share of older workers		-3.119	-1.305
		[2.433]	[2.649]
Change in share of older workers × Initial (log) productivity		0.843	0.399
		[0.598]	[0.595]
Intercept	0.0583***	0.0731***	0.0337
	[0.0136]	[0.0199]	[0.0256]
Sector dummies	No	No	Yes
Observations	70	70	70
R-squared	0.089	0.11	0.519

Dependent variable is the growth rate of labor productivity between 1998 and 2008. Robust standard errors in brackets. *** stands for significance at the 1% level

Age structure and labor productivity in Europe: How are they linked?

In order to refine the estimates of the association between age structure and productivity at the sector level in Europe, we need to control for the differences in physical capital accumulation in addition to accounting for fixed sector-specific unobservable factors. We do this by setting up a specification based on a production function with heterogeneous labor input in the spirit of Crépon et al. (2002)[4]. Assume that the production technology of sector *i* is given by a Cobb-Douglas production function relating total output in the sector (Y_i) to the corresponding factors of production,

$$Y_i = A_i K_i^{\alpha} \tilde{L}_i^{1-\alpha} \qquad (1)$$

where A_i is total factor productivity, K_i refers to the capital stock and the total labour input (L_i)of the sector is given by the aggregation of workers by some characteristic *k*, $\tilde{L}_i = \sum_j \delta_{ij} L_{ij}$, with mixing parameters δ_{ij} which capture the individual productivity of each group of workers. Starting

[4] See also Mahlberg et al. (2013) for a recent application of this framework to matched employer-employee dataset.

with this production function with heterogeneous labor input, simple algebra (see Crepón, 2002) allows us to reach a specification for (log) output per worker which is given by

$$\ln y_i = \ln A_i + \alpha \ln k_i + (1-\alpha) \sum_j \mu_j l_{ij}. \quad (2)$$

In this specification, y_i is income per worker, k_i denotes physical capital per worker and l_{ij} is the share of workers with characteristic *j* over the number of workers in the corresponding sector. The relative productivity difference between an employee of type *j* and the reference group is given by μ_j, assumed equal across sectors.

Equation (2) provides a natural specification to assess quantitatively the relationship between productivity and age structure in a panel setting and suggests regressing output per worker at the sectoral level on physical capital per worker, the share of workers by age group (and eventually other categories beyond age) and a series of country, sector and time fixed effects that account for total factor productivity differences across sectors and over time.

We start by estimating equation (2) using yearly sectoral data that span the period 1998-2008. We consider in a first stage workers by age group (young age group: 19 to 49 ages old, old age group: 50 years old and above) and educational attainment level (low = at most lower secondary education; medium = upper secondary or post-secondary non-tertiary education; high = tertiary education) to define groups with potentially heterogeneous productivity. The results of the panel regression model, which includes fixed sector, country and year effects are presented in column 1 of Table 4. The reference group is the share of old age group workers with low or medium educational attainment level. The recent experience in Europe unveils a robust association between age structure changes and output per worker at the sectoral level, with age distributions skewed towards younger workers being related to higher labor productivity. On average across all sectors, differences in age structure provide a more valuable signal to differentiate productivity levels within sectors than differences in educational attainment.

Given the potential heterogeneity in the relationship between sectoral age structure and productivity for high versus low productivity sectors, we also approach the estimation of equation (2) using quantile regressions. Quantile regression methods allow us to account for the differences in the parameters of equation (2) across quantiles of the distribution of labor productivity across European sectors. We provide the estimates corresponding to the 25th and 75th percentile of the distribution in column 2 and 3 of Table 2, respectively. The results for the 25th percentile emphasize that in relatively low productivity sectors increases in the share of older workers with low and medium education tend to be related with decreases in labor productivity. On the other hand, as we move towards the higher productivity section of the distribution of output per worker it is exclusively the share of highly educated young workers that appears related to increases in labor productivity. Dividing the sample into EU17 and EU11 economies (see columns 4 and 5 in Table 4) reveals that the overall relationship found for the whole sample is robust across the two subsamples, although the parameters associated to the young age groups (independently of their educational attainment level) are quantitatively more sizeable for EU11 economies.

Table 4: Sector productivity and age/education structure

	(1)	(2)	(3)	(4)	(5)
	Full	Quant.	Quant.	EU17	EU11

	sample	reg, 25th perc.	reg, 75th perc.	subsample	subsample
Log capital-labor ratio	0.270***	0.292***	0.305***	0.320***	0.249***
	[0.0239]	[0.0312]	[0.0281]	[0.034]	[0.033]
Young, high educ. share	1.166***	1.327***	1.013***	1.021***	2.196***
	[0.182]	[0.237]	[0.298]	[0.350]	[0.291]
Old, high educ. share	0.676	1.582**	0.128	0.119	0.453
	[0.460]	[0.650]	[0.575]	[0.696]	[0.516]
Young, mid/low educ. share	1.155***	1.272***	0.501	0.979***	1.654***
	[0.234]	[0.305]	[0.318]	[0.342]	[0.310]
Constant	0.792***	0.834**	1.663***	2.933***	0.693***
	[0.286]	[0.358]	[0.453]	[0.298]	[0.380]
Observations	1,016	1,016	1,016	453	563
R-squared	0.939			0.881	0.891

Dependent variable is the yearly growth rate of labor productivity. The sample covers the period 1998 - 2008. Robust standard errors in brackets. *** stands for significance at the 1% level. All specifications include country, sector and year fixed effects.

The reduction in the share of young workers that is expected to take place as the ageing process in the continent advances is thus expected to come hand in hand with reductions in productivity, in particular at the high-productivity end of the sectoral spectrum. Although we cannot necessarily interpret the results of the regression analysis in a purely causal way going from age structure to productivity, the estimates do reveal very clear patterns of association between productivity and age structure across sectors in Europe. The estimates indicate that, assuming no changes in labor force participation and/or productivity, aging of the workforce may become an important obstacle to productivity growth in highly productive sectors. Some studies in the literature find a particular importance of the share of young workers in determining productivity gains in ICT firms (see Lallemand and Rycx, 2009, for example), a result that may help explain partly the results at the sectoral level.

On the future of Europe's labor force and productivity

In order to understand the challenges posed by ageing and measure their potential effects on sector productivity, we construct projections of the labor force by age and education for the 26 countries of our analysis. These projections were performed in two steps. First, we calculate labor force participation rates by age, sex and highest level of educational attainment for 2010, and use these starting values for the calculation of two participation scenarios until 2050. Second, we combine the participation rates of these two scenarios with existing population projections (see Box 1).

Box 1: Labor Force Projections 2010-2050 – A Methodological Note

Participation rates were estimated by 5-year age-groups (15-19 to 65-69) and highest level of educational attainment separately for men and women. Given the differences in participation between men and women, this distinction is necessary in order to get reliable projections.

We design two different scenarios for labor force participation dynamics over the coming decades. In

one of the two participation scenarios, we keep participation rates constant at the 2010 level, which means that any projected changes in the size and composition of the labor force are driven by changes in the population structure. In the second scenario, we use a benchmark approach in that we let participation in all countries converge to the participation profile that is currently observed in Sweden. Participation is highest in Sweden among our group of economies for men as well as women for the great majority of combinations of age-groups and education. This scenario means in almost all countries significant increases in economic activity for women of all ages and men ages 50+.

The population projections we used are provided by the Wittgenstein Centre for Demography and Global Human Capital[5]. Besides the usual dimensions age and sex, these data break down the population additionally by highest level of educational attainment. We use two of their education scenarios, one where education progressions (in terms of attainment and enrolment rates) are kept constant at the current level (constant enrolment rate scenario, CER), and one where future assumptions of educational attainment are based on the past global trend of education progressions observed historically at the global level (global education trend scenario, GET, KC and Lutz 2014). Combining the two participation scenarios with the two education scenarios results in four labor force scenarios.[6]

EU17 and EU11 do not differ today when it comes to the overall age-structure of their labor forces, albeit with deferring compositions under the two scenarios. About three fourths of the labor force is between ages 20 to 49, and one fourth is above age 50 (Table 5). In each of the labor force scenarios overall aging of the labor force is the rule, much more so in the case of the scenario where Swedish participation levels are assumed than under the assumption of constant participation. This is due to the fact that the benchmark scenario implies significantly higher participation of persons 50 and older than is currently the case in most European countries. Comparing the two education scenarios clearly reveals the higher shares of young as well as old workers with tertiary education in the GET scenario, compared to the assumption of constant enrollment rates.

Table 5: Composition of the total labor force, EU17 and EU11, by age-group (young and old), education level (low, medium, high) and labor force participation scenario, 2010 and 2050

EU17	2010	2050			
		constant_CER	constant_GET	benchmark_CER	benchmark_GET
L_young	5%	4%	1%	4%	1%
M_young	45%	41%	31%	39%	29%
H_young	22%	23%	36%	20%	33%
L_old	5%	2%	1%	2%	1%
M_old	15%	18%	16%	21%	18%
H_old	7%	12%	16%	14%	18%
share 20-49	73%	68%	68%	63%	63%
share 50+	27%	32%	32%	37%	37%

[5] The population projections are available at Wittgenstein Centre (2014).

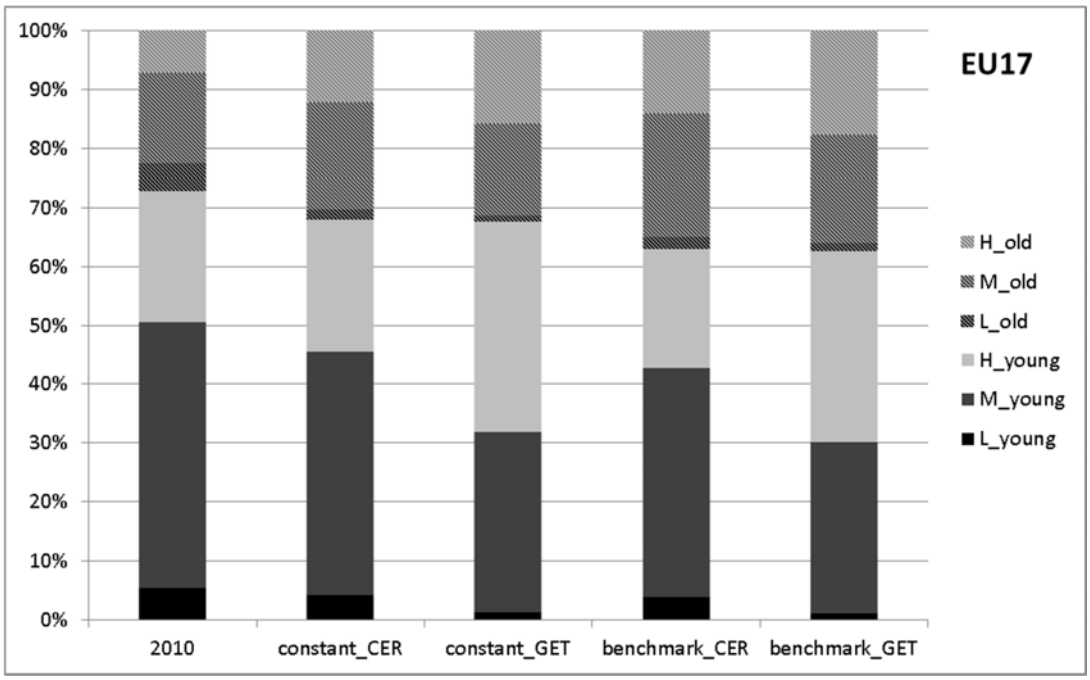
[6] The population projections include in the highest education group everyone with ISCED 4,5 and 6, which means there is a slight mismatch between the definition of the highest education level in the labor force data (ISCED 5-6) and the population data (ISCED 4-6). In most countries, the share of the adult population ages 15-69 that falls in ISCED4 is negligible, but in some (Austria, Estonia, Germany, Greece, Ireland, Latvia, Lithuania, Sweden) it is 5 % or more. This means there is a slight overestimation of workers with higher education, since we apply participation rates based on ISCED5-6 to the population of ISCED 4 as well. Overall, the effect is quantitatively small.

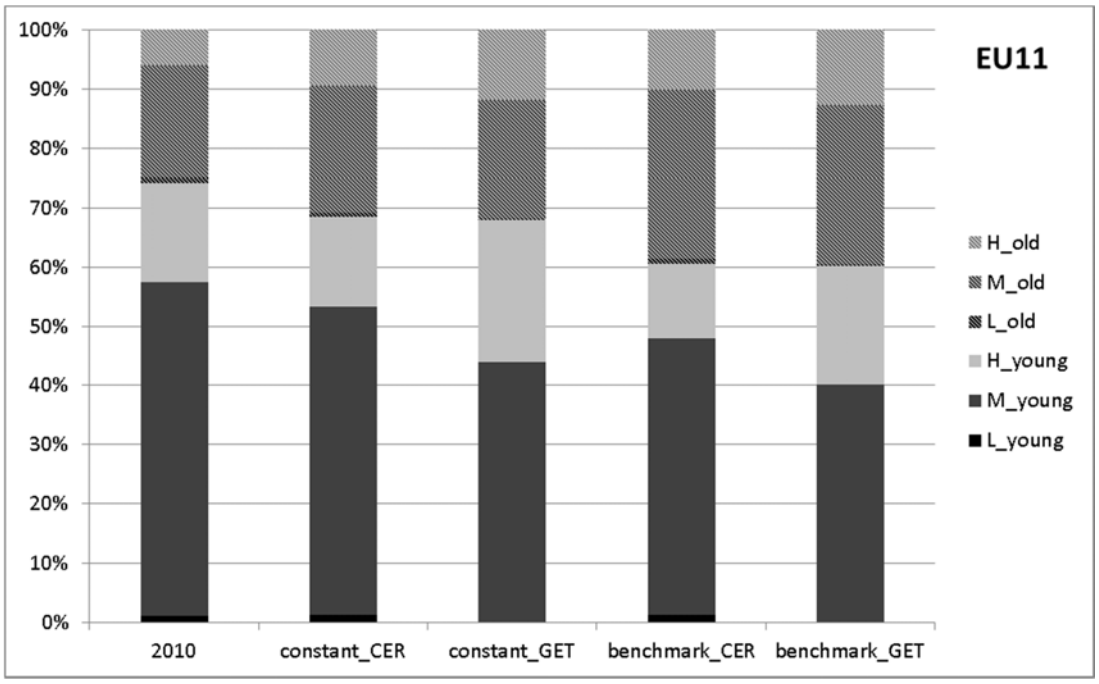
EU11	2010	2050			
		constant_CER	constant_GET	benchmark_CER	benchmark_GET
L_young	1%	1%	0%	1%	0%
M_young	57%	52%	44%	47%	40%
H_young	17%	15%	24%	13%	20%
L_old	1%	1%	0%	1%	0%
M_old	19%	21%	20%	28%	27%
H_old	6%	9%	12%	10%	13%
share 20-49	74%	68%	68%	61%	60%
share 50+	26%	32%	32%	39%	40%

Source: EU LFS, own calculations.

Note: young=ages 20-49, old=ages 50+; low education= at most lower secondary education, ISCED0-2; medium education= upper secondary or post-secondary non-tertiary education, ISCED 3-4; high education=tertiary education, ISCED 5-6. constant=constant labor force scenario. benchmark=benchmark labor force scenario. CER=constant enrolment rate education scenario. GET= global education trend education scenario.

Figure 7: Composition of the total labor force, EU17 and EU11, by age-group (young and old), education level (low, medium, high) and labor force participation scenario, 2010 and 2050



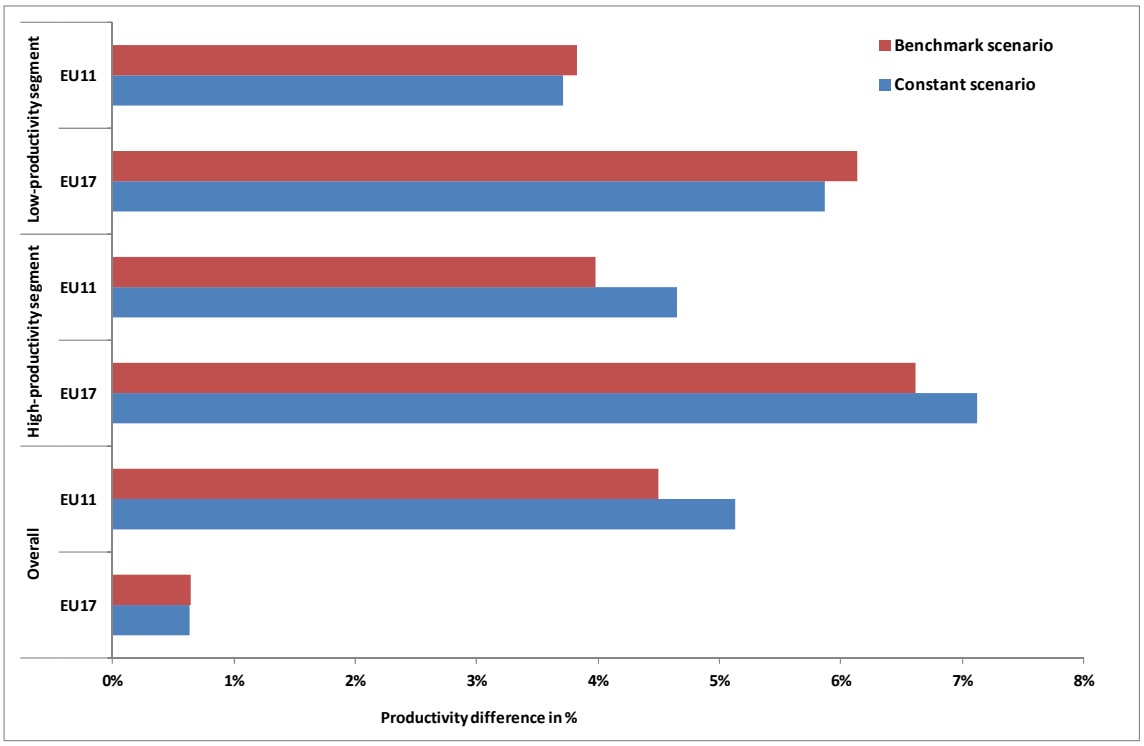


Source: EU LFS, own calculations

Note: young=ages 20-49, old=ages 50+; low education= at most lower secondary education, ISCED0-2; medium education= upper secondary or post-secondary non-tertiary education, ISCED 3-4; high education=tertiary education, ISCED 5-6. constant=constant labor force scenario. benchmark=benchmark labor force scenario. CER=constant enrolment rate education scenario. GET= global education trend education scenario.

In order to assess explicitly the potential effects of the change in age/education structures implied by each one of the labor force projections, we combine the elasticities obtained in our regression analysis of sectoral productivity with the resulting age-education shares by scenario. By computing the difference in productivity changes between the CER and GET scenarios, we concentrate on the role that further education expansion may play as a counteracting factor for the negative effects of aging on sectoral productivity. Figure 8 shows the differences in productivity implied by the scenarios entertained for EU11 and EU17 using the parameter estimates for the overall sample, as well as for the high-productivity and low-productivity segments (from the quantile regression estimates).

Figure 8: Average productivity differences implied by labor force projections: difference between GET and CER scenarios, 2010-2050



The estimates reported in Figure 8 point towards very limited overall effects of counteracting the productivity decline through changing age structure by education expansion in EU17. Sectors in EU17 on the extremes of the distribution of value added per worker, however, do have room for productivity improvement through investment in skills. For these, the labor productivity projections implied by exploiting the correlation between age-education structures and sectoral value added per worker are between 6% and 7% higher in the GET scenarios as compared to the CER scenarios, independently of the assumptions on labor force participation. Countries in EU11, on the other hand, do appear to have room to fight aging through improving overall productivity by investing in a more skilled workforce over the coming decades. The differences between the low and high productivity segments in the case of EU11 do not differ strongly from the average projected changes for the whole set of sectors. In this context, further expansions of educational attainment (in terms of quantity and quality) coupled with the implementation of policies to alleviate skill mismatch in EU11 appear central to ensure further convergence in labor productivity in the continent.

Since the projection exercise is based exclusively in labor force scenarios and takes as such a supply perspective, further research is needed to ensure that labor demand dynamics allow for employment changes which are in line with the projected composition of labor supply by age and education level. As such, the quantification of these effects can be thought of as potential supply-driven productivity trends.

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