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The Effects of Population Structure on Employment and Productivity

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ABSTRACT/RESUME

The effects of population structure on employment and productivity

The composition of the working-age population can influence aggregate employment and average productivity because both employment rates and productivity levels vary across population groups. This paper assesses the quantitative importance of the working-age population broken down by age, gender and education in explaining differences in employment and productivity levels across countries. Differences in population structure are found to contribute importantly to variations in both labour utilisation and productivity performances. Combining these effects in a mechanical way, differences in the composition of the working-age population account for around a third of the gap in GDP per capita for Europe (EU15) *vis-à-vis* the United States, mainly due to differences in educational attainment.

JEL Classification: J21; J31; E24; J10

Keywords: Labour productivity; Aggregate employment; Quality of labour; Demographics

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Les effets de la structure de la population sur l'emploi et la productivité

La composition de la population d'âge actif peut influer sur le niveau global de l'emploi et sur la productivité moyenne car aussi bien les taux d'emploi que les niveaux de la productivité varient selon les groupes de population. Cette étude a pour objectif d'évaluer dans quelle mesure la structure de la population d'âge actif, en fonction de l'âge, du sexe et du niveau d'éducation, peut expliquer les différences de niveau d'emploi et de productivité entre pays. Les différences dans la structure de la population contribuent pour beaucoup aux écarts entre pays tant des niveaux d'utilisation de la main d'œuvre que de la productivité. En combinant ces effets mécaniques, on observe que les différences dans la composition de la population d'âge actif expliquent pour environ un tiers l'écart de PIB par habitant de l'Europe (UE15) par rapport aux États-Unis, principalement du fait des différences de niveau d'éducation.

Classification JEL: J21; J31 ; E24 ; J10

*Mots-clés***:** Productivité du travail ; Emploi agrégé ; Qualité de l'emploi ; Démographie

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THE EFFECTS OF POPULATION STRUCTURE ON EMPLOYMENT AND PRODUCTIVITY

Hervé Boulhol[1]

1. Introduction

1. The young, the old, women and the lower-educated often have a weaker attachment to the labour market than prime-age and higher-educated males; when in work, the young and lower-educated also have lower productivity. As a result, the composition of the population and the labour force can influence aggregate labour market and productivity outcomes: countries where a large share of the working-age population is young or with low educational attainment can be expected to have lower aggregate employment rates and be less productive than countries where the shares of the prime-age population and the higher-educated are high.[2]

2. Differences in employment rates across population groups are consistently observed in OECD countries. These differences stem from the influence of educational attainment, gender and age on both labour supply and demand.[3] This, to some extent, might reflect institutional factors and disincentives embedded in government policies, but their consistent pattern across OECD countries suggests that some groups may have an inherent disadvantage in being employed. Therefore, population structure could be an important determinant of aggregate employment outcome.

3. Population structure can affect average labour productivity in different ways, beyond the well-recognised role of more widespread education in boosting individuals' long-term productivity levels. Indeed, an expanding literature has stressed the importance of demographics for productivity developments (*e.g.* Lindh and Malmerg, 1999; Bloom *et al*., 2007; Feyrer, 2008; Werding, 2008). Age structure can, in principle, have a large impact on productivity as individuals' productivity may systematically differ over

1. The author would like to thank numerous OECD colleagues, in particular Sven Blöndal and also Andrea Bassanini, Romina Boarini, Sean Dougherty, Jørgen Elmeskov, Andres Fuentes, Stéphanie Jamet, Klaus Schmidt-Hebbel and Jean-Luc Schneider for their valuable comments. The author is grateful to Martine Carré, Gilbert Cette and the participants of the "Productivité" Seminar at Banque de France, as well as Martine Levasseur for technical assistance and Caroline Abettan for editorial support. The paper has also benefited from comments by members of the Working party No. 1 of the OECD Economic Policy Committee.

2. At the same time, countries with high employment rates may employ low-productivity workers more intensively, thus depressing average productivity levels. Conversely, low employment rates may be associated with low-productivity individuals not participating in the labour market, thereby raising average productivity as measured as output per hour worked. The analysis of the trade-off between employment and productivity is the subject of Boulhol and Turner (2009).

3. Changes in the age composition of the population are estimated to have increased the natural rate of unemployment (NAIRU) in the United States by 0.7 percentage point between 1960 and 1979 and reduced it by the same amount between 1979 and 1998 (Katz and Krueger, 1999). Moreover, works at the OECD and European Commission have also investigated the effect of population structure: Burniaux *et al.* (2004) and Carone (2005) conduct a shift share analysis to make projections about labour force participation, while Mourre (2009) studies the impact of demographics and education on GDP per capita.

the active period of life because of experience, depreciation of knowledge and age-related trends in physical and mental capabilities, though the net effect of these factors is open to debate.

4. This paper assesses the quantitative importance of differences in the composition of the population for cross-country variations in aggregate labour utilisation and productivity levels, and thus GDP per capita. To this end, the paper breaks down the population of each OECD country, first, into working-age population and population outside the working-age, and, second, the working-age population into 30 groups (defined by age, gender and education). It then calculates the mechanical impact on aggregate employment and average productivity if each country had the same group-specific working-age population structure as in the United States. This procedure allows a decomposition of employment and productivity gaps between countries into differences due to the composition of the population and to effective performance.

5. In short, the methodology used is the following. The effects of population shifts on the aggregate employment rate are calculated from a standard shift-share analysis, thereby extending to education on top of demographics, the so-called "Perry-weighting" procedure that is used to estimate the effect of demographic changes on employment (as *e.g.* by Katz and Krueger, 1999, and Ball and Mankiw, 2002). To compute induced changes in labour productivity, the framework of Jorgenson *et al.* (1987), which rests on a translog production function and is frequently used to measure labour quality growth between two observed dates of an economy, is extended to simulated changes in the employment structure.

6. The main findings of the analysis are as follows:

- Differences in the structure of the working-age population, especially as regards educational attainment, account for around a third of the difference in aggregate employment rates, or about 2 percentage points, between Europe (EU15) and the United States, with significant heterogeneity within Europe between low- and high-employment countries. In Korea, Japan and Norway, the population structure is more favourable to employment than in the United States.

- Aligning each country's working-age population structure with that of the United States would reduce the gap in output per hour worked *vis-à-vis* the United States, by around 4.5 percentage points on average across OECD countries and by as much as 5 percentage points for Europe (EU15). Turkey, Mexico, Portugal, Italy, the Czech Republic, the Slovak Republic and Greece would record productivity gains in excess of 10%. Again, differences in educational attainment across countries account for most of these effects.

- Combining these mechanical effects on employment and productivity, the difference in the composition of the working-age population accounts, on average across non-US countries, for 6 percentage points of the GDP per capita gap *vis-à-vis* the United States, and for 7 percentage points for Europe (EU15).

- The effect of the total population structure is somewhat lower due to an above-average dependency ratio in the United States, accounting for 4.5 and 6 percentage points of the GDP per capita gap *vis-à-vis* the United States on average for OECD and EU15 countries, respectively. This should be seen in the context of overall gaps in GDP per capita of about 40 and 25 percentage points, respectively. For central European countries, Turkey and Mexico, where gaps exceed 50 percentage points, they would narrow by around 10 percentage points.

2. Descriptive statistics

7. This section provides descriptive statistics on the structure of the population, group-specific employment rates, as well as relative wages between groups. Throughout this study, the working-age population is broken down into 30 groups: 5 age classes, 3 educational levels and by gender.[4] Data for population structure are for 2004, except for Japan (2003).

2.1. Population structure

8. Population structures differ across countries both as regards the proportion of people of working age (15-to-64) in the total population, the so-called "dependency ratio", and as regards the composition of the working-age population (Figure 1).[5] Thus, the dependency ratio ranges from 63% in Mexico and the United Kingdom to more than 70% in Korea, the Czech Republic and the Slovak Republic. As concerns the working-age population, its structure differs markedly across countries, except in the gender dimension:[6]

- Differences are important along the age structure, the prime-age population (25-to-54) representing 60 to 70% of the working-age population depending on the country; the share is comparatively low in Finland, Mexico, Japan and Sweden and relatively high in Korea, Spain and Luxembourg.

- The largest variations are along the education dimension.[7] The share of working-age persons with below upper-secondary education varies from 15% for Japan to 40% or (considerably) above for Mexico, Turkey and the southern European countries.[8] Australia, Iceland, Belgium, Ireland and France have a relatively large share of the population with below upper-secondary level attainment, whereas Sweden, Switzerland, English-speaking countries (except Australia) and most central European countries have a relatively low share.

[Figure 1. Differences in population structure across OECD countries]

2.2. Employment rates

9. The employment rates for the lower-educated, the older and female workers are notably below the average in almost all OECD countries (Figure 2); this is true also for the young, not represented in the figure). Moreover, countries like Canada, the United Kingdom and the United States that have a good

4. The results are somehow subject to the chosen population breakdown. Ideally, other dimensions, such as immigration, should also be taken into account, but this is not possible because of the lack of data.

5. The age structure of the population is influenced by life expectancy, which varies widely across countries. Using the same age limit (64) for working-age population across countries is therefore an arbitrary assumption.

6. The working-age population is almost equally split between males and females in almost all countries. Only Iceland and Mexico present an unusual gender distribution for the *working-age* population. This is due to working-age male migration, inward and outward respectively.

7 . The analysis herein relies heavily on the comparability of educational attainments across countries using the International Standard Classification of Education (ISCED).

8. This share might be significantly under-estimated for Poland and the United Kingdom, as it excludes the "ISCED 3C Short" programme that is at the limit of the lower/upper-secondary level. "ISCED 3C Short" represents 34% of the working-age population in Poland, 19% for the United Kingdom in 2005; Iceland comes third with only 7%.

overall employment record have an employment rate for the low-educated group that is below or very close to the OECD average (56%). They have, however, a small share of individuals with below upper-secondary education, as shown Figure 1.

[Figure 2. Group-specific employment rates *vs* aggregate employment rate, 2007]

10. The link between population structure and the total employment rate appears clearly in the educational dimension. The share of the working age population not having an upper-secondary education is significantly and negatively correlated with the total employment rate across countries (Figure 3). Based on this very simple relation, a 10 percentage point lower share in the population having at most a lower-secondary education qualification would on average be associated with an increase in the total employment rate of 2 percentage points. This would imply that education affects GDP per capita beyond its effect on aggregate labour productivity.

[Figure 3. The share of population with below upper-secondary education is negatively correlated with the total employment rate]

2.3. Productivity

11. Throughout the study, relative wages, either observed or estimated based on Mincer-type regressions, are used as proxy for relative *marginal* productivity. In the long run, the contribution of labour to output should be closely related to the cost of labour. That is, marginal labour productivity should be closely related to wages. Indeed, if relative wages between two groups of workers differ too much from the relative marginal productivity of the two groups, firms will adjust their employment structure to restore the balance. In practice, relative wages can differ significantly from relative "intrinsic" productive capacities, as a result of *e.g.* firms' strategies to retain workers, rent-sharing or discrimination. This, however, does not imply that relative wages are inconsistent with – even though they are necessarily an imperfect proxy for - relative marginal productivities (more on this in section 4 after the presentation of the theoretical framework).

12. Table 1 reports data on relative wages across age and education groups for a selected number of countries based on the baseline wage measure, which is defined as total wages divided by hours worked for each group (see Annex 1 for data details, especially about the different wage measures including those derived from micro-data using a Mincer-type approach). Based on this imperfect proxy for relative productivity, young workers with below upper-secondary education appear to be only about half as productive as the average worker (at the margin), whereas the most productive groups (individuals older than 45 with tertiary education) are about 50% more productive.

[Table 1. Productivity levels by age groups and education levels]

13. Based on fixed effects analysis controlling for age, education, gender and country (Table 2), wages for the 25-34 age group, for example, is 24% lower than for those aged between 45 and 54, and females are paid on average 17% lower than males of the same age and education level. All other things equal, wages for those with below upper-secondary and with tertiary education are, respectively, 20% lower and 27% higher than those with upper-secondary attainment; Annex 2 provides details of these regressions by country. The education premia are larger with the alternative wage measure based on the

Mincerian approach, as wages for workers with below-upper secondary and tertiary education are 32% lower and 41% higher, respectively, than wages for workers with upper-secondary education.[9]

[Table 2. Wage equation, all countries, 2004]

3. Methodology

14. Aggregate labour input typically enters the production function in two components: the total number of hours worked and the aggregate quality of labour. Changes in the composition of employment determine changes in the quality of labour, which in turn contribute to labour productivity growth. This section describes the method used to estimate the impact of population structure on aggregate employment and of changes in labour composition on labour productivity.

15. The method is an extension to both demographics and education of the Perry-weighting procedure (Perry, 1970) which assesses the impact of demographic changes on aggregate employment, holding group-specific employment rates constant.[10] The method is also an extension of Jorgenson *et al.* (1987), which is frequently used to compute the labour quality growth between two dates of a real economy, to simulated changes in the employment structure of an economy.

3.1. Mechanical effect of population structure on labour utilisation

16. The main experiment considered consists of analysing the consequences of aligning the structure of the working-age population in each OECD country with that of the United States, while keeping both group-specific employment rates and average working times at their current levels. The total employment rate gap of country *k vis-à-vis* the United States can be broken down into a component due to differences in working-age population structure and another component reflecting the employment performance within groups as follows, denoting $ER_{i,k}$ and $s_{i,k}^{pop}$ the employment rate and the share of group i in country k working-age population, respectively:

$$ER\ gap_k \equiv ER_k - ER_{USA} = \sum_i \left(s_{i,k}^{pop} - s_{i,USA}^{pop}\right) ER_{i,k} + \sum_i s_{i,USA}^{pop} \left(ER_{i,k} - ER_{i,USA}\right) \quad (1)$$
$$= \quad Structure \quad + \quad Performance$$

17. The former ("structural") component measures the difference between a country's total employment rate and the one that would obtain if this country had the US population structure while keeping its own group-specific employment rates. Conversely, the latter ("effective performance") component measures group-specific employment-rate differences *vis-à-vis* the United States, weighted by the share of each group in the total US working-age population:

$$Structural\ component_k = ER_k - ER_k^{adj} \quad with \quad ER_k^{adj} = \sum_i s_{i,USA}^{pop}\ ER_{i,k} \quad (2)$$

9. To be precise, these numbers, based on regressions reported in Table 2 where the dependent variable is the logarithm of wages, are actually log-points, such that, for example, the -32 and +41 log-points imply that wages are in fact 27% lower and 50% higher, respectively.

10. As highlighted by Ball and Mankiw (2002), this assumption has been questioned due to possible indirect effects, but with unresolved inferences. For example, Shimer (1999) argues that a younger labour force raises unemployment among the young, whereas Shimer (2001) argues that it reduces unemployment for both young and older workers.

18. The structural component measures (the opposite of) the change in aggregate employment rate in this experiment, and reflects differences in population structure as much as differences in employment rates across groups. Indeed, if, within a given country, all 30 groups included in the analysis had the same employment rate, population structure would not matter and the "between-group" component would be nil:

$$\Delta ER_k = \text{- } Structural\ component_k = \sum_i \left(s_{i,USA}^{pop} - s_{i,k}^{pop}\right) ER_{i,k} = \sum_i \left(s_{i,USA}^{pop} - s_{i,k}^{pop}\right)\left(ER_{i,k} - ER_k\right) \qquad (3)$$

In addition, because the employment-rate distribution across groups is influenced by country-specific policies, the computed effects of a shift in population structure towards that of the United States can differ even for countries having the same population structure.

19. To measure the induced change in hours worked, the relative differences in average working-time between groups should also be taken into account, as changes in the structure of the working-age population affect total average working-hours through a composition effect. Denoting $h_{i,k}$ the average hours worked by group i in country k *relative* to the overall average hours worked in that country, the relative change in hours worked implied by the shift in population structure is:

$$\frac{\Delta H_k}{H_k} = \sum_i \left(s_{i,USA}^{pop} - s_{i,k}^{pop}\right) \frac{ER_{i,k}}{ER_k} h_{i,k} \qquad (4)$$

The implied change in employment for each group is weighted by the relative working-time of that group in order to obtain the induced change in hours worked.

3.2. Induced impact on labour productivity

20. This sub-section provides a direct computation of the effect of labour composition on productivity levels. The chosen method borrows from the framework developed by Jorgenson *et al*. (1987) to assess the contribution of labour quality to labour productivity growth. It is regularly applied, for example by the US Bureau of Labor Statistics (BLS, 1993) and in central banks or academic research programmes (*e.g.* Bell *et al*., 2005; Schwerdt and Turunen, 2007). Although this framework has been designed to analyse actual changes through time, in this exercise it is extended to simulated states of an economy, as explained below.

21. The objective is to calculate the changes in labour productivity induced by changes in the composition of labour, from the current situation of an economy to a simulated scenario, *e.g.* one in which the structure of the working-age population structure is the same as in a reference country, while group-specific employment rates and average working-time remain at their current country-specific levels. The production function $Y = F(K, A\ N)$ is supposed to have constant returns to scale, where K is the stock of capital and A the level of labour-augmenting technological progress. The labour aggregate N is a translog function of labour inputs defined by the hours worked H_i, $i = 1,...,n$, of n groups of workers.[11] Assuming that wages are given when choosing employment, output growth between two states of an economy, t and $t+1$, and then hourly labour productivity (HP) growth are given by:

$$\Delta Log\ Y = (1-s)\ \Delta Log\ K + s\ \Delta Log\ N + s\ \Delta Log\ A \qquad (5)$$

11. The transcendental logarithmic (translog) function was introduced by Christensen *et al*. (1971). Whereas the Cobb-Douglas function is a log-linear function of the various inputs, the translog function is log-quadratic.

$$\Delta Log\ HP \equiv \Delta Log\ \frac{Y}{H} = \Delta Log\ A + (1-s)\ \Delta Log\ \frac{K}{AN} + \Delta\ Log\ \frac{N}{H} \qquad (6)$$

where s is labour share in value added, $H = \sum H_i$ is total hours worked. Labour quality, Q, is implicitly defined by the ratio of aggregate labour and total hours worked, *i.e.* $N \equiv Q\,H$; differences in aggregate labour inputs between two economies having the same total of hours worked reflect differences in labour quality. It is assumed that, taking a medium-term perspective, capital adjusts to aggregate effective labour, AN, which implies that productivity growth is the sum of labour-augmenting technological progress and labour quality growth:

$$\Delta\ Log\ HP = \Delta\ Log\ A + \Delta\ Log\ Q \qquad (7)$$

22. Even though population structure might influence aggregate technology through its impact on technological adoption decisions (Beaudry and Collard, 2003), the focus in this paper is placed on direct composition effects at given technological levels. This means that induced changes in technology are assumed away and, therefore, according to (7), changes in labour productivity are given by changes in labour quality.

23. With a translog functional form, changes in aggregate labour are measured exactly by changes in Tornqvist indexes of labour inputs (Diewert, 1976):

$$\Delta Log\ N = \sum_i \frac{a_i(t) + a_i(t+1)}{2}\ \Delta Log\ H_i \qquad (8)$$

where a_i is the share of group i in total wages. Consequently, changes in labour quality become:

$$\Delta Log\ Q = \Delta Log\ N - \Delta Log\ H = \sum_i \frac{a_i(t) + a_i(t+1)}{2}\ \Delta Log\ \frac{H_i}{H} \qquad (9)$$

This means that the change in labour quality is equal to the sum of the changes in relative inputs H_i / H weighted by the average of i's share in total wages over the two states of the economy. When computing the impact on productivity of aligning the population structure of a country with that of the United States based on equation (9), $a_i(t)$ is the share of group *i* in total wages for that country and $a_i(t+1)$ is that share for the United States:[12]

$$Population\ \ structure\ effect = \Delta Log\ Q_k = \sum_i \frac{a_{i,k} + a_{i,USA}}{2}\ \Delta Log\ \frac{H_{i,k}}{H_k} \qquad (10)$$

The implied changes in hours worked are given by equation (4), and therefore:

$$Population\ \ structure\ effect = \Delta Log\ Q_k = \sum_i \frac{a_{i,k} + a_{i,USA}}{2}\ Log\ \frac{s^{pop}_{i,USA}}{s^{pop}_{i,k}} - Log \sum_i s^{pop}_{i,USA}\ \frac{ER_{i,k}}{ER_k}\ h_{i,k} \qquad (11)$$

12. Because the considered population shifts are sometimes huge, the underlying assumptions behind such estimates are on the edge of what the methodology can support: approximating the production function by a quadratic function of inputs might not be enough. The whole exercise is simply meant to provide orders of magnitude and highlight the main mechanisms at work.

24. The term above is therefore the mechanical effect of population structure on hourly productivity. Another way to interpret equation (7) is the following. Assuming that the capital stock adjusts to effective labour $A\,N$, which takes into account both the technological level and labour quality (long-term or steady-state assumption), the difference in hourly productivity between two countries is the sum of the differences in technological levels and in the quality of employment. In turn, the difference in employment quality is the sum of the population structure effect as given by (11) and of the employment-rate structure effect, which is obtained by applying differences in group-specific employment rates between the two countries at given population structure – identical population and employment-rate structures imply identical employment structure. This employment-rate structure effect is the main focus of Boulhol and Turner (2009) who study the contribution of labour composition to the trade-off between employment and productivity:

$$Log\frac{HP_k}{HP_l} = Log\frac{A_k}{A_l} + \underbrace{Population\ structure\ effect + Employment\text{-}rate\ structure\ effect}_{Employment\ structure\ effect} \qquad (12)$$

4. Results

25. This section computes the effect on countries' labour utilisation (sub-section 4.1), labour productivity (4.2) and GDP per capita (4.3) of aligning their population structure to that of the United States based on the methodology described in the preceding section. Whereas only the structure of the working-age population matters for labour utilisation and productivity within this framework, and therefore for GDP per *working-age person*, differences in the dependency ratio between countries has also a direct impact on GDP per *capita*.

4.1. Labour utilisation

26. This sub-section computes the changes in aggregate labour utilisation obtained if each country had the same population structure as the United States while keeping its group-specific employment rates at their current level. Labour utilisation is defined as total hours worked divided by the working-age population. Even though group-specific average working hours are assumed to remain at their current level, changes in labour composition alter the aggregate average working-time. Therefore, the effect on labour composition includes the induced change in total average hours worked on top of employment changes. The employment-rate gap *vis-à-vis* the United States is first broken down based on the shift-share analysis (equation 1) in order to compute the part of the gap due to the structure of the population.

27. For EU15 countries on average, about a third of the difference in aggregate employment rates *vis-à-vis* the United States comes from the structural component (Table 3).[13] This means that if these countries had the US working-age population structure while maintaining their own group-specific employment rates, a third of the total employment gap *vis-à-vis* the United States would disappear. The structural component is particularly large in Mexico, southern and central European countries, France and Ireland. The implication is that, given their population structures, these countries would have to perform better in terms of group-specific employment rates than the United States to reach a similar aggregate employment

13. As pointed out in sub-section 3.1, this breakdown is likely to be influenced by the stance of policies because group-specific employment rates in different countries are partly a result of country-specific policies. However, if the structural component is computed using the US employment rates rather than the country ones, population structure accounts for half of the employment gap between Europe and the United States (see Boulhol and Turner, 2009).

rate. By contrast, the population structure in Korea, Japan, Norway and the United Kingdom seems more favourable to employment than that of the United States.

[Table 3. Change in labour utilisation when aligning the working-age population structure with that of the United States]

28. Changes in labour composition do not strongly affect the aggregated average of hours worked such that the changes in labour utilisation obtained when taking into account relative average hours worked by groups are similar to the changes in employment. Column 5 of Table 3 replicates, but in per cent, the structural component as reported in the third column. In column 6, changes in total hours worked are computed using group-specific relative average hours worked $h_{i,k}$ according to equation (4). As data on relative average hours worked is not available in many countries, the last column reports the implied changed in total hours worked based on the US relative average hours worked $h_{i,USA}$. Comparing the last two columns reveals that using $h_{i,USA}$ instead of $h_{i,k}$ makes little difference, which justifies the use of $h_{i,USA}$ when the corresponding data are not available in a given country. All in all, for both EU15 and OECD countries on average, differences in working-age population structure *vis-à-vis* the United States are estimated to reduce labour utilisation by 3.3 and 2.2 per cent, respectively.

4.2. Productivity

29. The impact of population structure on labour productivity is first computed applying equation (11) based on the observed wage shares by group (the baseline wage measure), $a_{i,k}$, and results are reported in the first column of Table 4. Because data are missing for many countries, productivity changes obtained when applying US relative wages for all countries are shown in the second column.[14] Comparing the two columns indicates that, except for Portugal, the choice between countries' relative wages and US relative wages has limited consequences. This is because the main determinants of the productivity effect are the differences in population structure *vis-à-vis* the United States and the broad pattern of relative wages across age and education levels, whereas differences in relative wages across countries are of secondary importance.[15] Hence, the US relative wages are used to compute the wage shares in the baseline.[16]

[Table 4. Effect of population structure on labour productivity]

30. Aligning working-age population shares for all groups in OECD countries on those in the United States would increase average productivity levels in almost all countries. Based on this mechanical effect, differences in the composition of the working-age population compared with the United States penalise Europe (EU15) in terms of output per hour worked by 6%, while the effect for central European countries is about 10% and for Turkey and Mexico more than 20% in lost productivity (Figure 4). It needs to be stressed that the structure of the working-age population in these calculations is not just something policy has to contend with: an important driver of the results is past education policies (see below).

14. This means that in that case the wage shares $a_{i,k}$ in country *k* are computed using countries' worked hours and US relative wages.

15. When gender differences are ignored and the population is broken down in 15 groups (instead of 30), the estimated productivity effect is very similar to that reported in Table 4, and Figure 4.

16. The reason why the choice of the wage measure matters for Portugal lies in the huge education premia inferred from observed Portuguese wage shares (see Annex 2).

[Figure 4. Mechanical effect of population structure differences *vis-à-vis* the United States on average hourly productivity, 2004]

31. Figure 5 recapitulates the above results, bringing together the effects on labour utilisation and hourly productivity. Clearly, population structure effects tend to move labour utilisation and productivity in the same direction. As shown below differences in education structure contribute for the most part to these effects, but given that education achievements are generally associated with productivity performance, one interesting result is that the effect of the working-age population structure on labour utilisation is on average 70% as large as that on productivity. When changes are essentially driven by skill upgrading, employment and productivity outcomes are *positively* correlated, which contrasts with the idea of a trade-off between employment and productivity in the literature surveyed in OECD (2007).[17]

[Figure 5. Mechanical effect of population structure differences *vis-à-vis* the United States]

32. A comment is warranted about the exact meaning of using relative wages as a proxy for relative productivity levels. The assumption of the model is that wages are pre-determined to employment decisions. It follows that the model can be consistent with the fact that relative wages do not reflect relative "intrinsic" abilities. Indeed, if the wage structure is "internalised" by employers, relative wages would equate *marginal* relative productivity, even though both differ from relative abilities. Nevertheless, as gender discrimination might raise the most serious concern regarding the approach, results have also been replicated ignoring gender differences, which led to very similar results. What matters essentially is that the wage structure broadly reflects the productivity differences across both educational attainments and age, and that results are robust across various wage measures.

33. How sensitive is the effect of population structure on aggregate productivity to the choice of the baseline wage measures above versus Mincer-type ones? The wage premia for education that are estimated for the reference country, the United States, based on the Mincerain approach are much larger than that obtained from directly dividing wages by hours worked for each group. This means that the other characteristics used as controls in Mincer-type equations, such as marital status or public sector employment, exhibit a strong group pattern. Using the observed wage shares $a_{i,USA}$ is one way to implicitly take into account these characteristics.

34. Nevertheless, as a robustness check, it is possible to use the wage structure derived from the estimated effects in the Mincerain approach of only age and education (and with or without the estimated one for gender). This tends to amplify the estimated effects on productivity of aligning the population structure to that of the United States for two reasons. First, because the shifts in population are associated with an increase in educational attainment for most countries, using a greater wage premium for education boosts the inferred productivity changes. Second, because the other characteristics, which are correlated with education and age and which tend to limit the actual wage differences across education levels, are ignored.

17. Because group-specific employment rates differ across countries, the employment structure (by education, age and gender) influences differences in average productivity across countries beyond the sole effect of population structure: the employment structure combines the structure of the working-age population and that of the employment rates (equation 12). In most countries, measured productivity is artificially boosted due to an employment-rate structure that is relatively more detrimental to low-productivity groups than in the United States: the effect on overall productivity is about 3% on average for the OECD and 1.5% for Europe (EU15), much lower in absolute terms that the population structure effect shown above (see Boulhol and Turner, 2009).

35. Figure 6 reports the sensitivity of the effect of population structure differences *vis-à-vis* the United States on hourly productivity across the various wage measures, starting from the baseline estimate, as shown in Figure 5. On average across countries, the contribution of these productivity effects to the productivity gap *vis-à-vis* the United States increases from 4.5 percentage points in the baseline wage measure to 6 percentage points on average for Mincerian-type measures. The most important differences between measures are obtained for the countries for which the effects of the population structure are strong to start with, such as Italy, Turkey, Austria and Luxembourg.

[Figure 6. Mechanical effect of population structure differences vis-à-vis the United States on hourly productivity across various wage measures, 2004]

4.3. GDP per capita

36. Although, given the approach followed in this paper, the structure of the *working-age* population only matters for employment and productivity, and therefore for GDP divided by the working-age population, the dependency ratio also affects GDP per capita. This sub-section combines the effect of the working-age population structure and of the dependency ratio to calculate the contribution of overall population structure to on the GDP per capita gap *vis-à-vis* the United States.

37. Figure 7 presents first the results of Figure 5 in terms of the contributions of working-age population structure to labour utilisation (Panel A) and hourly productivity (Panel B) gaps *vis-à-vis* the United States, where the country *k* gap for variable X is defined here as $(X_k - X_{USA}) / X_{USA}$. On average for both OECD and EU15 countries, population structure accounts for 3 percentage points of the labour utilisation gap (Panel A). This is to be compared with outstanding gaps of 8.3 and 13.8 percentage points, respectively. [18] The contribution of population structure to the productivity gap *vis-à-vis* the United States is 4.5 and 5 percentage points on average for OECD and EU15 countries, respectively, against current gaps of 35 and 16 percentage points (Panel B).

[Figure 7. Differences in structure-adjusted labour utilisation and labour productivity, 2004]

38. Combining these, the structure of the working-age population accounts for 6 percentage points of the GDP per capita gap *vis-à-vis* the United States for OECD countries on average, and for 7 percentage points for Europe (Figure 8). But the effect of the total population structure is somewhat lower due to an above-average dependency ratio in the United States, accounting for 4.5 and 6 percentage points of the gap on average for OECD and EU15 countries, respectively. These effects compare with overall GDP per capita gaps of 40 and 25 percentage points, respectively.

[Figure 8. Structure-adjusted GDP per capita differences, 2004]

39. The effect of the population structure is dominated by differences in the education composition of the working-age population. In fact, the impact of replicating the United States education structure for each country-specific gender-age group suggests that education explains about 85% of the total population structure effect (Figure 7). Although education is primarily thought of affecting productivity, the effect of

18. One reason is that working-time differences across countries explain a large part of differences in labour utilisation, and that the analysis has been carried out holding group-specific average working-time constant in each country.

differences in population structure on labour utilisation is on average almost as large as that on productivity. As the education achievements are strongly influenced by education policies over previous decades, the large population-structure effects reported in this paper are suggestive of the potential for education reforms to improve future employment and productivity performance.

40. Even though the computed effects of population structure are large in many cases, they only alter modestly the qualitative assessment of countries' performance in terms of labour utilisation and productivity. The main differences from taking into account the effect of population structure are the following:

- Labour utilisation: the "underlying" performance of Mexico, Hungary, Italy, Poland, France and the Slovak Republic is significantly better than unadjusted measures indicate, whereas the converse is true for Korea, Japan and Norway.

- Labour productivity: adjusting for working-age population structure leads to a higher output per hour worked, especially for Italy, Austria, France and Ireland, and also for Turkey, Portugal and Greece.

- GDP per capita: adjusted measures are higher than unadjusted ones in Italy, Mexico, France, Iceland, Greece and Portugal, and lower in Canada, Japan and Switzerland.

5. Conclusion

41. This paper calculates, for each OECD country, the mechanical effect of a hypothetical shift of the population structure to that of the United States on labour utilisation, labour productivity and GDP per capita. It is mechanical because group-specific employment rates and countries' aggregate technological levels are assumed to remain at their current levels in each country. This implies that the complex implications of such population shifts for group-specific labour utilisation performance and for technology adoptions are ignored. To the extent that such changes in the composition of the working-age population would be associated in many countries with skill upgrading, they would likely be conducive to the adoption of more efficient technologies. This would imply that those shifts in population structure have also indirect effects that amplify the direct ones that are computed herein.

42. Based on these mechanical calculations, the difference in the composition of the working-age population accounts for, on average for OECD and EU15 countries, 16% and 28%, respectively, of the GDP per capita gap *vis-à-vis* the United States. Three-fifths of these contributions of the working-age population are associated with labour productivity performance, and two-fifths with employment performance. The effects of the total population structure are somewhat lower due to an above-average dependency ratio in the United States.

43. Differences in education attainments explain about 85% of the overall effect of differences in the composition of population. Therefore, the secular increase in labour quality due to young higher educated cohorts replacing relatively lower-educated cohorts would imply both greater productivity *and* employment performance over time. Given the converging trends in total educational attainment across countries, the effects due to differences in population structure across countries are likely to diminish over time. This underscores the scope of education policies to boost employment and productivity performance.

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Table 1. **Productivity levels by age groups and education levels**

(Proxied by wages; average wage for workers aged 45-54 with upper-secondary education = 100)

	Wage measure: total wages / total hours worked[1]				
Age groups	15-24	25-34	35-44	45-54	55-64
	Primary and lower-secondary education				
France	42	55	64	69	71
Germany	36	84	94	90	86
Italy	52	65	72	73	72
Spain	49	57	63	69	70
Sweden	51	85	93	92	92
United Kingdom	76	87	89	85	82
United States	45	69	78	82	83
	Upper-secondary education				
France	30	58	82	100	119
Germany	63	90	98	100	97
Italy	56	72	88	100	107
Spain	53	62	80	100	98
Sweden	70	88	95	100	109
United Kingdom	71	88	99	100	91
United States	51	79	95	100	102
	Tertiary education				
France	43	75	110	117	155
Germany	64	107	129	133	136
Italy	77	94	112	155	164
Spain	55	80	109	142	155
Sweden	61	101	130	125	147
United Kingdom	75	105	124	118	112
United States	72	116	151	149	159

1. See Annex 1 for data sources.

Table 2. **Wage equation, all countries, 2004**[1]

	Country wages[2]	Mincer 1[2]	Mincer 2[2]
Male	0	0	0
Female	-0.166***	-0.136***	-0.136***
Educational attainment			
Primary and low-secondary	-0.202***	-0.316***	-0.350***
Upper-secondary	0	0	0
Tertiary	0.266***	0.405***	0.405***
Age-group			
15 to 24	-0.550***	-0.556***	-0.556***
25 to 34	-0.241***	-0.280***	-0.280***
35 to 44	-0.069***	-0.091***	-0.091***
45 to 54	0	0	0
55 to 64	0.029	-0.006	-0.006
Number of observations	540	600	600

Note: *** denotes significance at 99% confidence level based on robust standard errors.

1. Wage equations regress for each wage measure the log of hourly wages of each gender x age x education group on country, gender, education and age fixed effects.

2. See Annex 1 for data sources.

Table 3. **Change in labour utilisation when aligning the working-age population structure with that of the United States**

Country	Aggregate employment rate[1]	Employment rate gap vs the United States *(Percentage points)*			Effect of population structure on labour utilisation[3] *(Percentage)*		
		Total	Population structure component	Effective performance component	Effect on employment[4]	Effect on hours worked based on countries' relative average hours worked[5]	Effect on hours worked based on US relative average hours worked[6]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Turkey	46.1	-25.1	-1.3	-23.8	-2.9	.	-5.3
Poland	51.9	-19.4	-5.2	-14.2	-10.0	.	-9.8
Hungary	56.8	-14.5	-5.6	-8.8	-9.9	.	-9.5
Slovak Republic	57.0	-14.2	-3.3	-10.9	-5.8	.	-6.4
Italy	57.4	-13.8	-6.5	-7.3	-11.2	-9.0	-10.7
Greece	59.6	-11.6	-2.0	-9.6	-3.3	-1.0	-3.7
Mexico	59.9	-11.4	-8.1	-3.3	-13.5	.	-14.8
Belgium	60.4	-10.8	-2.9	-7.9	-4.7	-5.7	-4.7
Spain	62.0	-9.2	-3.2	-6.0	-5.2	-5.2	-5.3
France	62.4	-8.9	-3.3	-5.6	-5.3	-6.9	-5.8
Luxembourg	62.5	-8.8	1.4	-10.1	2.2	0.8	2.2
Korea	63.6	-7.6	4.1	-11.8	6.5	.	6.4
Czech Republic	64.2	-7.0	-2.3	-4.7	-3.5	.	-3.9
Germany	65.0	-6.2	-0.8	-5.4	-1.2	-2.0	-0.6
Ireland	65.5	-5.7	-3.3	-2.4	-5.0	-5.0	-5.8
Finland	67.2	-4.0	-1.3	-2.7	-1.9	-2.4	-1.9
Austria	67.8	-3.5	-2.1	-1.3	-3.1	-3.1	-3.0
Portugal	67.8	-3.4	-3.1	-0.3	-4.6	-4.9	-6.2
Japan[2]	68.4	-2.9	2.3	-5.2	3.4	.	3.4
Australia	70.3	-0.9	-2.6	1.7	-3.7	.	-4.1
United States	71.2	0.0	0.0	0.0	0.0	0.0	0.0
Netherlands	71.2	0.0	-2.5	2.5	-3.5	-3.0	-2.9
Canada	72.5	1.3	0.7	0.6	1.0	.	1.4
United Kingdom	72.7	1.4	1.8	-0.3	2.5	2.8	2.6
Sweden	73.5	2.2	0.0	2.2	0.0	0.3	0.6
New Zealand	73.5	2.3	-0.9	3.2	-1.3	.	-2.1
Norway	75.6	4.4	2.1	2.3	2.8	.	3.2
Denmark	76.0	4.8	-1.1	5.9	-1.4	.	-0.8
Switzerland	77.4	6.2	-0.4	6.5	-0.5	.	0.1
Iceland	82.9	11.7	-0.6	12.2	*-0.7*	.	-1.2
European Union (EU15)	*64.8*	*-6.4*	*-2.2*	*-4.2*	*-3.4*		*-3.3*
OECD	*65.1*	*-6.1*	*-1.3*	*-4.8*	*-2.1*		*-2.2*

1. Employed persons as a percentage of the working-age population (15-to-64-year-olds).
2. 2003.
3. Labour utilisation is defined as the total hours worked divided by the working-age population.The effect on labour utilisation includes the impact on aggregate employment plus the compositional effect on aggregate average working hours, holding group-specific average working hours constant.
4. This column is entirely comsistent with the "structure" component reported in the column (3). As an example, for Turkey , -1.3 / 0.461 = -2.9.
5. Based on equation (4).
6. Based on equation (4) using $\hat{h}_{usa,k}$ for all countries.

Table 4. **Effect of population structure on labour productivity**[1]

(Percentage)

	Country wages[2]	US wages[3]
Portugal	-24.4	-14.4
Italy	-13.7	-14.1
Greece	-10.7	-11.6
Austria	-8.3	-8.3
Ireland	-8.5	-8.0
Spain	-8.4	-7.1
France	-7.4	-7.0
Luxembourg	-7.4	-6.4
United Kingdom	-2.8	-4.1
Belgium	-2.2	-2.7
Netherlands	-0.2	-2.2
Finland	0.0	-0.7
Germany	-0.2	-0.1
United States	0.0	0.0
Sweden	0.2	0.1

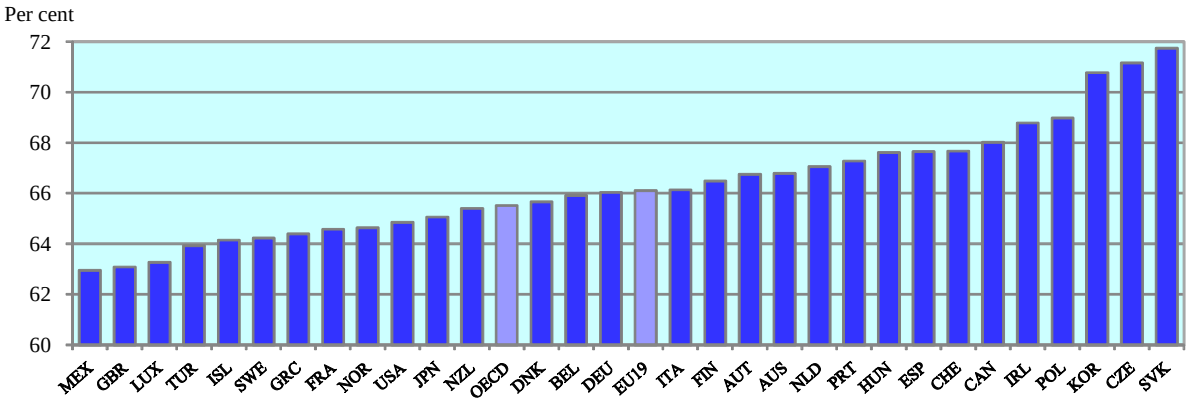
1. In France, for example, average hourly productivity is mechanically reduced by 7.4% and 7.0%, depending on the wage measure, compared with the situation where France had the same population structure as the United States while keeping its group-specific employment rates.

2. Group-specific wage shares are those observed in each country (measure 1, see Annex 1).

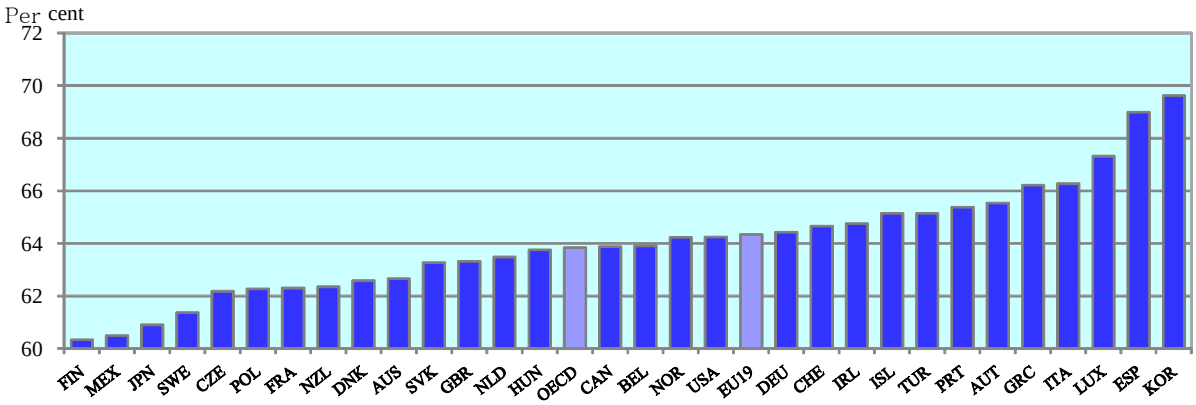
3. US relative wages are used to compute group-specific wage shares in each country (measure 1, see Annex 1).

Figure 1. **Differences in population structure across OECD countries**[1]

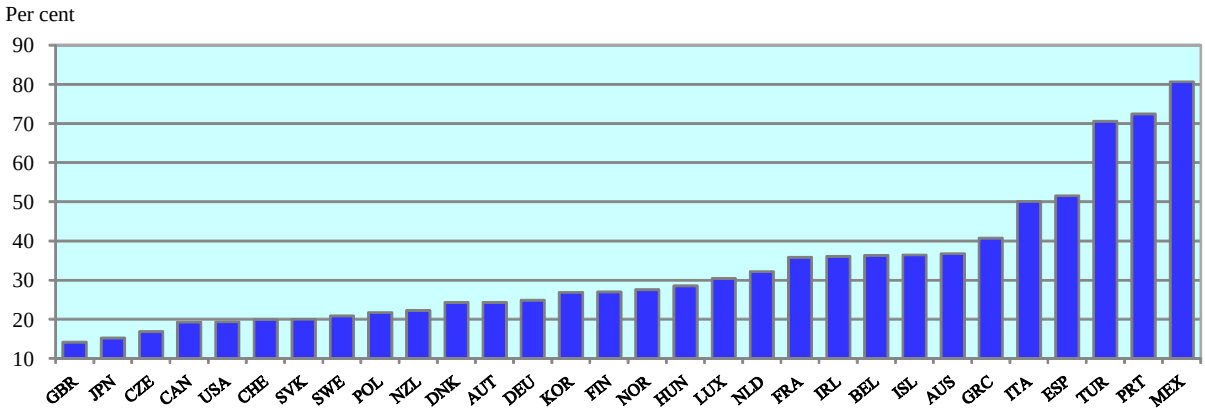
A. Share of working-age population in total population, 2007



B. Share of prime-age persons in the working-age population, 2007



C. Share of persons with below upper-secondary education in the working-age population, 2005 [2]



1. The working-age population refers to the population aged 15 to 64, the prime-age population refers to the population aged 25 to 54.

2. For Poland and the United Kingdom, this share might be significantly under-estimated as it excludes the "ISCED 3C Short" programme that is at the limit of the lower/upper-secondary level. "ISCED 3C Short" represents 34% of the working-age population in Poland, 19% for the United Kingdom in 2005; Iceland comes third with only 7%.

Figure.2. **Group-specific employment rates *vs* aggregate employment rate, 2007**

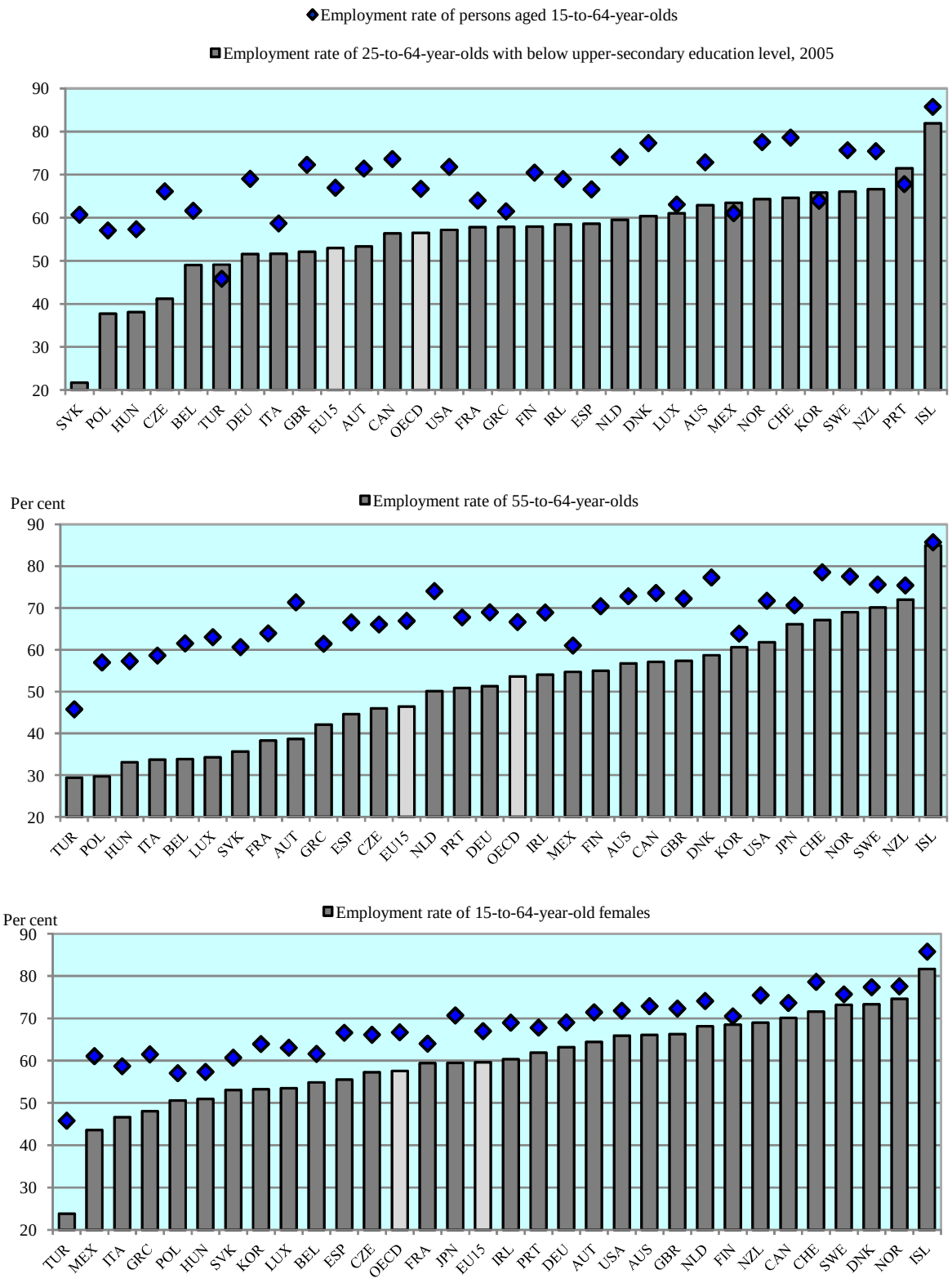
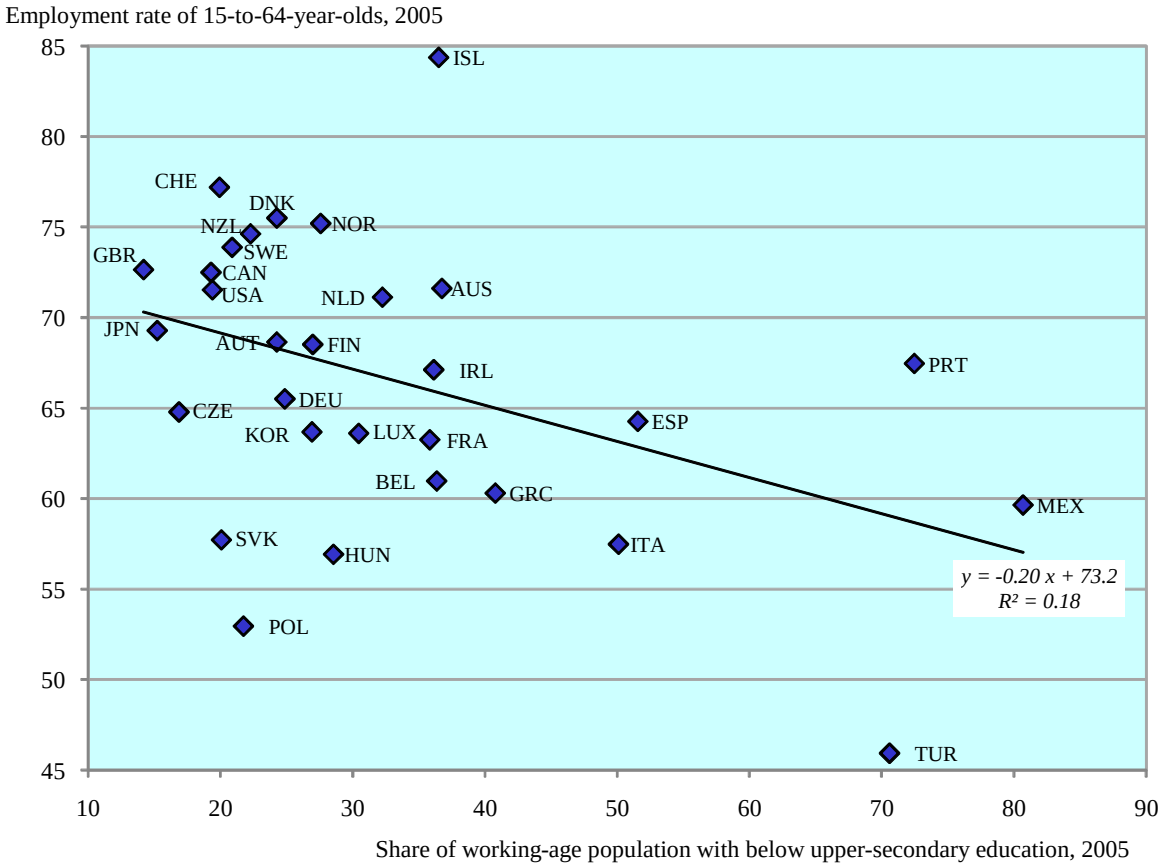
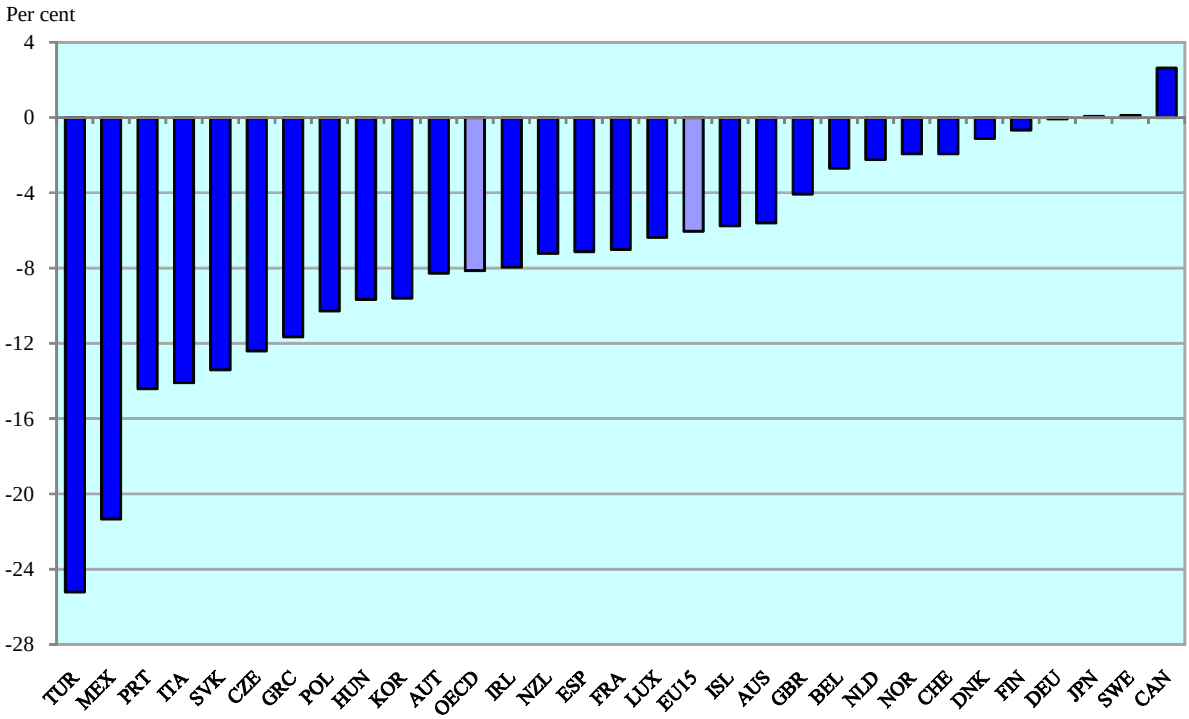


Figure 3. **The share of population with below upper-secondary education is negatively correlated with the total employment rate**



1. The regression coefficient is -0.20 with a standard error of 0.08 (P-value 0.02). When the countries recording a GDP per capita lower than half of the US level (Hungary, Mexico, Poland, the Slovak Republic and Turkey) are excluded, the coefficient is -0.17 (s.e. 0.09, P-value 0.07). When Portugal and Iceland are further excluded, the coefficient is -0.34 (s.e. 0.09, P-value < 0.01).

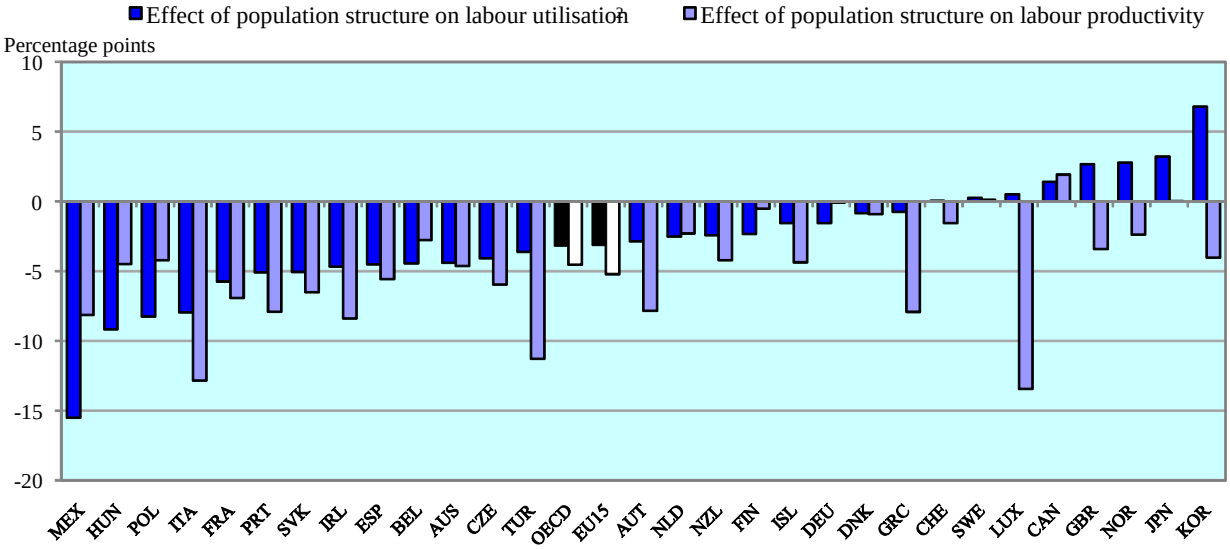
Figure 4. **Mechanical effect of population structure differences *vis-à-vis* the United States on average hourly productivity, 2004** [1]



1. In France, for example, average hourly productivity is mechanically reduced by 7.0% compared with the situation where France had the same population structure as the United States while keeping its group-specific employment rates. Data for EU15 and OECD (minus the United States) are weighted averages.

Figure 5. **Mechanical effect of population structure differences *vis-à-vis* the United States on labour utilsation and hourly productivity, 2004**

Contribution to the gap *vis-à-vis* the United States (USA = 100) [1]

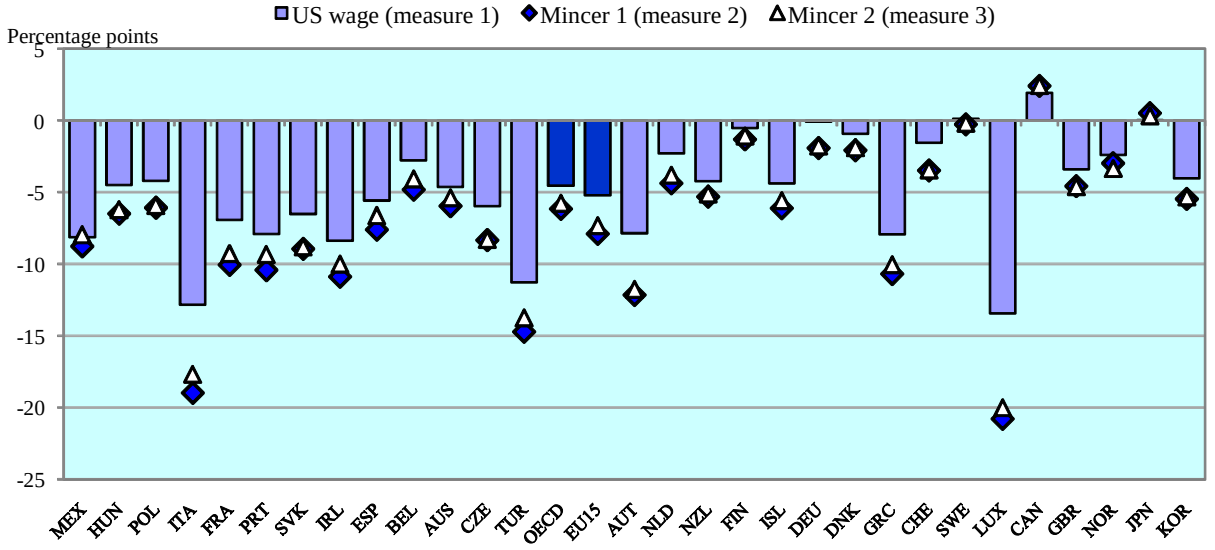


1. Data for EU15 and OECD (minus the United States) are weighted averages.

2. Labour utilisation is defined as the total hours worked divided by the working-age population.The effect on labour utilisation the index impact on aggregate employment plus the compositional effect on aggregate average working hours, holding group-specific average hours constant.

Figure 6. **Mechanical effect of population structure differences *vis-à-vis* the United States on hourly productivity across various wage measures, 2004** [1]

Contribution to the gap *vis-à-vis* the United States (USA = 100) [2]

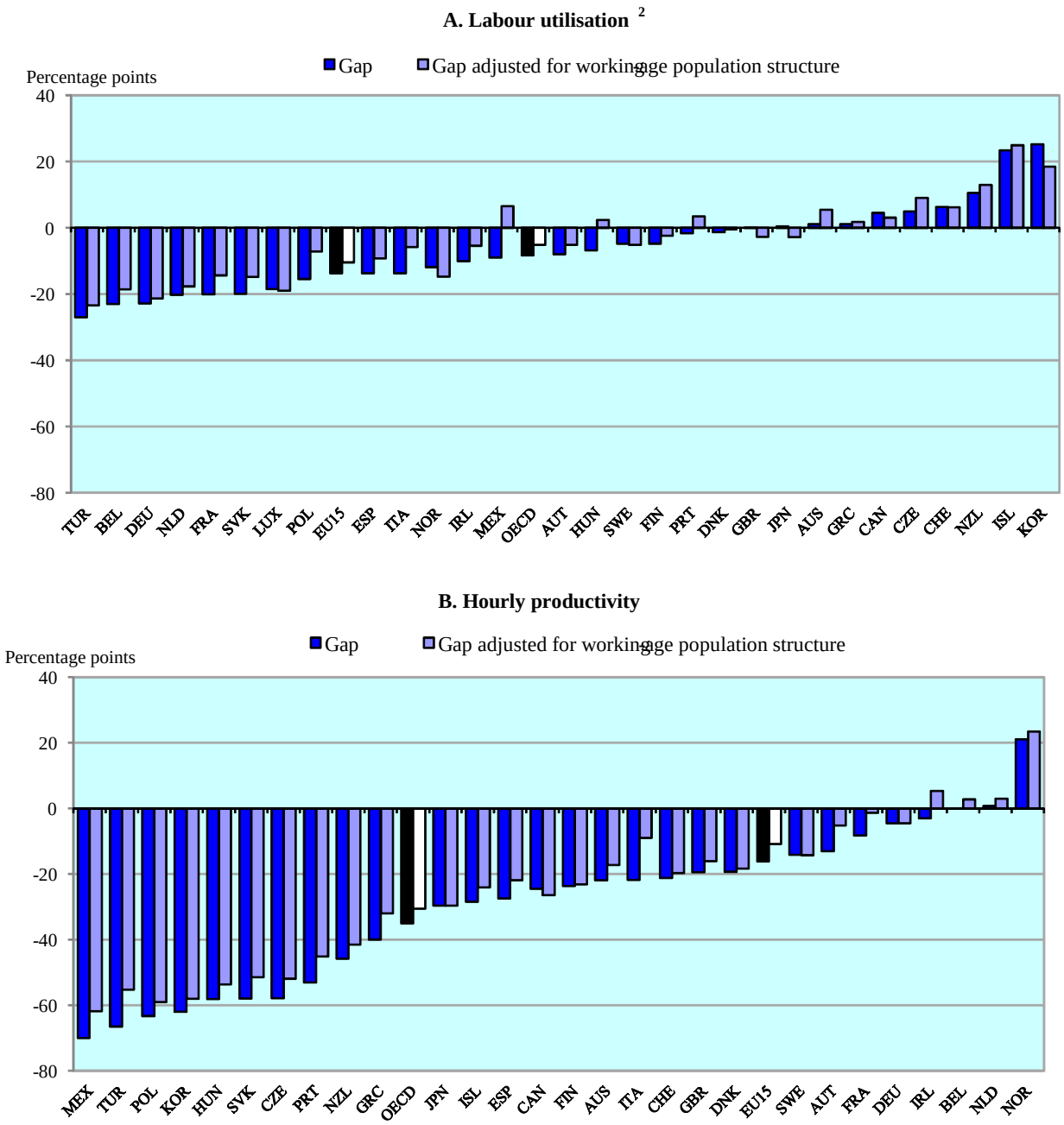


1. See Annex 1 for the definition of wage measures. The baseline measure, the average wage by group in the United States, obtained by dividing total wages by total hours worked for each group is the one used in Figure 5 of the main text.

2. Data for EU15 and OECD (minus the United States) are weighted averages.

Figure 7. **Differences in structure-adjusted labour utilisation and labour productivity, 2004**

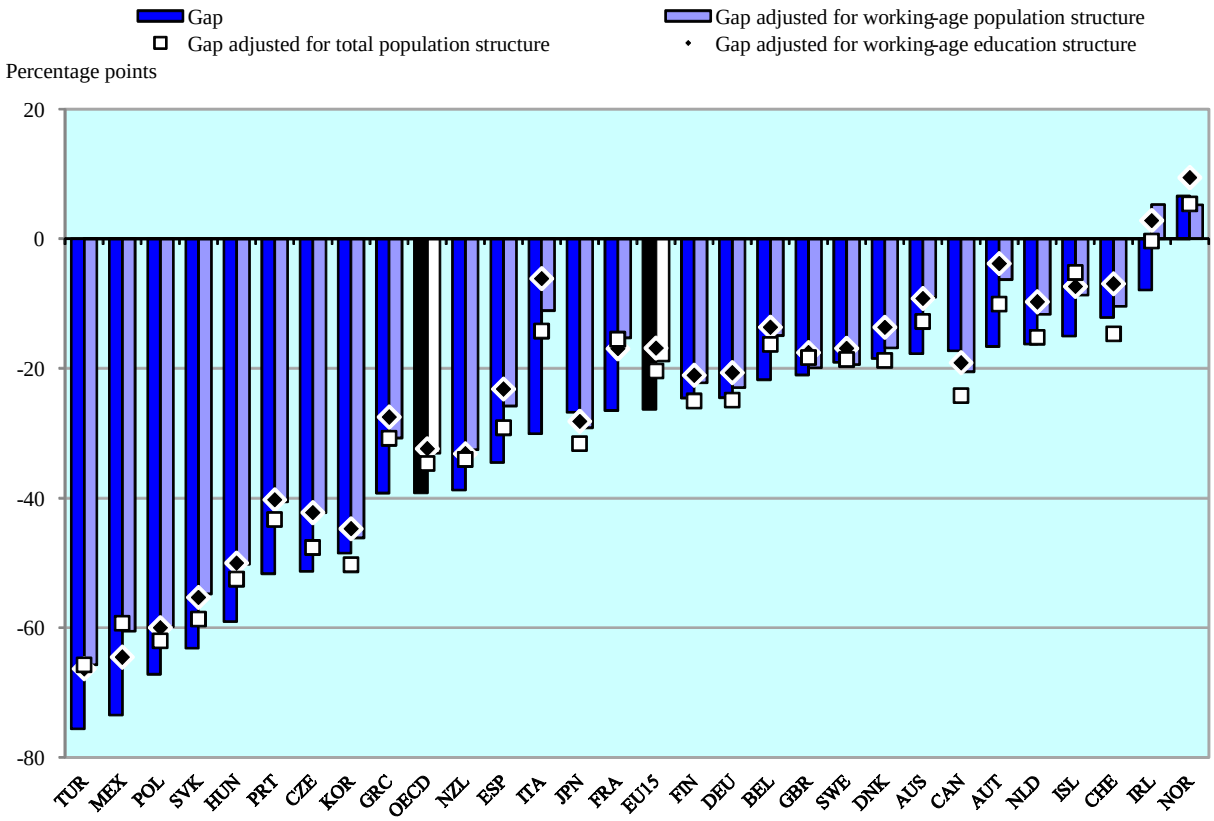
Contribution to the gap *vis-à-vis* the United States (USA = 100) [1]



1. Data for EU15 and OECD (minus the United States) are weighted averages.
2. Labour utilisation is defined as the total hours worked divided by the working-age population. Adjusted labour utilisation takes into account the effect of the working-age population structure on employment plus the composition effect on aggregate average working hours, holding group-specific average working hours constant.

Figure 8. **Structure-adjusted GDP per capita differences, 2004**

Gap *vis-à-vis* the United States (USA = 100)[1]



1. For Belgium as an example, the GDP-per-capita gap is 21.7 percentage points, falling to 14.9 when adjusting for the working-age population structure. Education contributes 13.6 of these 14.9 percentage points. The gap adjusted for total population is 16.3 percentage points.

ANNEX 1: DATA SOURCES

Labour productivity and total hours worked: OECD Productivity Database

Employment and population by gender, age and education: Labour Force Surveys according to ISCED Classification.

Hours worked by group: OECD Secretariat's estimates based on European Labour Force Surveys (see Table F of the Statistical Annex in the Employment Outlook) and Census Population Survey for the United States.

RELATIVE WAGE MEASURES

Measure 1: "country wages": total wages / total hours worked.

Source: European Community Household Panel for Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, the United Kingdom up to 2001, and Census Population Survey up to 2003 for the United States.

Measure 2: "Mincer 1"

It is derived from estimations of Mincer equations controlling for the effects of education, age and gender. Source: Strauss and de la Maisonneuve (2007), Table 3.

Measure 3: "Mincer 2"

Because the prime objective of Strauss and de la Maisonneuve (2007) was to estimate the wage premium due to tertiary education, controls might be inadequate to infer the effects of age and of below upper secondary education. Therefore, the age and below upper-secondary education coefficients were constrained to be equal, for each country, to their estimated average across countries. This gives a coefficient of 0.335 on age and -0.0487 on age-squared, and of -0.35 for below upper-secondary (versus upper-secondary but below tertiary, see Annex 2).

ANNEX 2: TABLES

Table A2.1. **Wage equation, measure 1 (country wage), 2004**[1]

	AUT	BEL	DEU	DNK	ESP	FIN	FRA
Male	0	0	0	0	0	0	0
Female	-0.19	-0.10	-0.21	-0.06	-0.21	-0.15	-0.12
Educational attainment							
Primary and low-secondary	-0.30	-0.13	-0.17	-0.15	-0.25	-0.06	-0.18
Upper-secondary	0	0	0	0	0	0	0
Tertiary	0.20	0.18	0.20	0.13	0.29	0.22	0.26
Age-group							
15 to 24	-0.53	-0.36	-0.67	-0.44	-0.61	-0.27	-0.88
25 to 34	-0.21	-0.20	-0.14	-0.08	-0.38	-0.13	-0.40
35 to 44	-0.08	-0.10	-0.03	-0.01	-0.17	-0.05	-0.12
45 to 54	0	0	0	0	0	0	0
55 to 64	-0.05	0.05	-0.02	-0.01	0.01	0.04	0.17

	GBR	GRC	IRL	ITA	JPN	LUX	NLD
Male	0	0	0	0	0	0	0
Female	-0.14	-0.23	-0.17	-0.10	-0.25	-0.18	-0.11
Educational attainment							
Primary and low-secondary	-0.08	-0.22	-0.21	-0.24	-0.24	-0.30	-0.06
Upper-secondary	0	0	0	0	0	0	0
Tertiary	0.17	0.39	0.39	0.32	0.23	0.33	0.05
Age-group							
15 to 24	-0.30	-0.55	-0.47	-0.52	-0.66	-0.76	-0.63
25 to 34	-0.07	-0.37	-0.22	-0.30	-0.38	-0.34	-0.21
35 to 44	0.03	-0.08	-0.04	-0.15	-0.13	-0.10	-0.05
45 to 54	0	0	0	0	0	0	0
55 to 64	-0.08	0.06	0.06	0.04	-0.05	0.05	0.09

	NZL	PRT	SWE	USA	Total
Male	0	0	0	0	0
Female	-0.17	-0.14	-0.17	-0.26	-0.17
Educational attainment					
Primary and low-secondary	-0.24	-0.46	-0.13	-0.19	-0.20
Upper-secondary	0	0	0	0	0
Tertiary	0.29	0.55	0.16	0.40	0.27
Age-group					
15 to 24	-0.44	-0.67	-0.54	-0.63	-0.55
25 to 34	-0.13	-0.43	-0.15	-0.22	-0.24
35 to 44	0	-0.14	-0.01	-0.03	-0.07
45 to 54	0	0	0	0	0
55 to 64	-0.04	0.10	0.06	0.03	0.03

1. Wage equations regress for each wage measure the log of hourly wages on gender, age and education fixed effects. See Annex 1 for data sources.

Table A2.2. **Wage equation, measure 2 (Mincer 1), 2004** [1]

	AUS	AUT	BEL	CAN	CHE	DEU	DNK
Male	0	0	0	0	0	0	0
Female	-0.05	-0.16	-0.06	-0.25	-0.14	-0.14	-0.08
Educational attainment							
Primary and low-secondary	-0.18	-0.52	-0.23	-0.30	-0.62	-0.23	-0.26
Upper-secondary	0	0	0	0	0	0	0
Tertiary	0.35	0.43	0.33	0.40	0.38	0.38	0.39
Age-group							
15 to 24	-0.57	-0.57	-0.57	-0.57	-0.57	-0.57	-0.57
25 to 34	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28
35 to 44	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09
45 to 54	0	0	0	0	0	0	0
55 to 64	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

	ESP	FIN	FRA	GBR	GRC	HUN	IRL
Male	0	0	0	0	0	0	0
Female	-0.28	-0.12	-0.07	-0.12	-0.17	-0.10	-0.14
Educational attainment							
Primary and low-secondary	-0.28	-0.24	-0.13	-0.35	-0.24	-0.26	-0.27
Upper-secondary	0	0	0	0	0	0	0
Tertiary	0.23	0.42	0.46	0.50	0.30	0.48	0.43
Age-group							
15 to 24	-0.57	-0.57	-0.57	-0.57	-0.57	-0.57	-0.57
25 to 34	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28
35 to 44	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09
45 to 54	0	0	0	0	0	0	0
55 to 64	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

	ITA	LUX	NLD	PRT	SWE	USA	Total
Male	0	0	0	0	0	0	0
Female	-0.11	-0.08	-0.13	-0.28	-0.05	-0.19	-0.14
Educational attainment							
Primary and low-secondary	-0.27	-0.42	-0.26	-0.44	-0.18	-0.65	-0.32
Upper-secondary	0	0	0	0	0	0	0
Tertiary	0.41	0.42	0.35	0.51	0.26	0.65	0.41
Age-group							
15 to 24	-0.57	-0.57	-0.57	-0.57	-0.57	-0.57	-0.56
25 to 34	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28
35 to 44	0	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09
45 to 54	0	0	0	0	0.0	0	0
55 to 64	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

1. Wage equations regress for each wage measure the log of hourly wages on gender, age and education fixed effects. See Annex 1 for data sources.

Table A2.3. **Wage equation, measure 3 (Mincer 2), 2004** [1]

	AUS	AUT	BEL	CAN	CHE	DEU	DNK
Male	0	0	0	0	0	0	0
Female	-0.05	-0.16	-0.06	-0.25	-0.14	-0.14	-0.08
Educational attainment							
Primary and low-secondary	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35
Upper-secondary	0	0	0	0	0	0	0
Tertiary	0.35	0.43	0.33	0.40	0.38	0.38	0.39
Age-group							
15 to 24	-0.57	-0.57	-0.57	-0.57	-0.57	-0.57	-0.57
25 to 34	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28
35 to 44	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09
45 to 54	0	0	0	0	0	0	0
55 to 64	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

	ESP	FIN	FRA	GBR	GRC	HUN	IRL
Male	0	0	0	0	0	0	0
Female	-0.28	-0.12	-0.07	-0.12	-0.17	-0.10	-0.14
Educational attainment							
Primary and low-secondary	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35
Upper-secondary	0	0	0	0	0	0	0
Tertiary	0.23	0.42	0.46	0.50	0.30	0.48	0.43
Age-group							
15 to 24	-0.57	-0.57	-0.57	-0.57	-0.57	-0.57	-0.57
25 to 34	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28
35 to 44	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09
45 to 54	0	0	0	0	0	0	0
55 to 64	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

	ITA	LUX	NLD	PRT	SWE	USA	Total
Male	0	0	0	0	0	0	0
Female	-0.11	-0.08	-0.13	-0.28	-0.05	-0.19	-0.14
Educational attainment							
Primary and low-secondary	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35
Upper-secondary	0	0	0	0	0	0	0
Tertiary	0.41	0.42	0.35	0.51	0.26	0.65	0.41
Age-group							
15 to 24	-0.57	-0.57	-0.57	-0.57	-0.57	-0.57	-0.56
25 to 34	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28
35 to 44	0	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09
45 to 54	0	0	0	0	0.0	0	0
55 to 64	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

1. Wage equations regress for each wage measure the log of hourly wages on gender, age and education fixed effects.
See Annex 1 for data sources.

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