# Labor Market and Fiscal Effects of the Demographic Transition in 27 EU countries*

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October 6, 2014

## Work in Progress!

**Abstract**

The effect of demographic change on the labor force and on fiscal revenues is topical in light of population aging and potential pension shortfalls. This paper evaluates the effect of demographic changes between 2010 and 2030 on labor force participation and tax revenue. Our three-step analysis involves the incorporation of population projections, an explicit modeling of the supply and demand side of the labor market, as well as an uprating of tax-benefits policies. This approach overcomes a shortcoming of most existing studies that focus only on labor supply when assessing the effects of policy reforms. We show how this interaction affects wages and revenues in income taxes and social security contributions. We find that ignoring these wage changes greatly understates the increase in fiscal revenues.

**JEL Classification:** J11, J21, J22, J23

**Keywords:** Demographic Change, Fiscal Effects, Labor Supply and Demand

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Labor force participation, as a determinant of long-term economic growth and a source of government revenue, has always been a key concern of policy makers in the EU. The growing burden of social security, which is partly attributable to an ageing population and, more recently, to the economic crisis, makes labor force participation even more important in the future. It is crucial for both policy makers and researchers to evaluate the degree to which expected future demographic changes may affect labor supply and labor demand. In the event of a resulting tax shortage, skill mis-match, etc., steps can be taken to implement policy changes to counteract some of the expected negative effects of demographic change.

Our analysis aims at grasping the extent of these challenges in a three-step analysis. First, we incorporate two scenarios of demographic change via a reweighting procedure into micro data sets for the EU-27 countries. In a second step, the implied wage effects are analyzed by an explicit modelling of the demand and supply side of the labor market. Finally, the consequences on fiscal budgets are investigated with a tax-benefit simulation.

Estimating the effect of policy shifts on the labor market should take account of both the supply and demand side of the market. The separate literatures on both labor supply and labor demand are quite developed (see Keane (2011) and Bargain and Peichl (2013) for an overview of the labor supply literature and Lichter et al. (2014) for an overview of the labor demand literature). However, the two are not yet systematically linked in studies due, in part, to data limitations. Most often, the effect of policy shifts on the labor market is evaluated without reference to the demand side. However, research has shown that labor demand is elastic (Hamermesh (1993)) so that omitting it from such a study will surely lead to biased estimates. In this paper, we overcome this problem by feeding labor supply and labor demand elasticities into a setting where the current population changes to reflect 2030 projections. We finally explore the impact of these shifts on fiscal budgets with EUROMOD, a European tax and transfer calculator.[1]

We rely on demographic projections up to the year 2030 for the EU-27, which are described in detail in Huisman et al. (2013). Moreover, we make use of the labor supply estimations for 17 EU countries from Bargain et al. (2014) to come up with skill, gender, and household type-specific labor supply elasticities for each EU-27 country. For the demand side, we rely on the meta-analysis approach to estimate labor demand elasticities across Europe from Lichter et al. (2014). The contribution of this paper is to combine demographic projections and behavioral responses on both sides of the labor market in order to arrive at a new equilibrium labor market participation for Europe in 2030. We show that disregarding potential wage effects from the interaction between labor demand and labor supply in this setting leads to an under-estimation of tax revenues in 2030.

Our results should be interpreted in light of some assumptions. Firstly, we assume

[1]See Sutherland and Figari (2013).

that labor supply and demand elasticities will be constant over time. While this may not necessarily be the case, it is unclear how labor market actors will adjust their behavior in this respect as a result of demographic change. Therefore, the assumption of constant elasticities is a natural one. Secondly, we abstract from any other responses to demographic change which may change the composition of the 2030 population, for example through migration responses to wage changes. Again, the assumption of constant behavior is justified on the grounds that the aim of this paper is to focus on the effects of demographic change on labor market outcomes rather than on other relevant margins of adjustment.

The remainder of the paper is structured as follows. After reviewing related literature in section 1, we present the assumptions and main trends implied by our population projections in section 2. Then, our labor market model is described and estimated effects on wages and on public revenues are presented and interpreted. A discussion of our findings is given in Section 4 before the final section concludes.

# 1 Related studies

Our findings concerning the effects on wages and fiscal revenues contributes to a broad academic debate on the impact of the demographic transition. The impact of demographic ageing and diminishing population size on long-term economic growth has been treated in a number of endogenous growth models.[2] In these models, the association between between population size and economic growth is ambiguous and subject to the modeling framework. Population ageing is regularly found to have a positive impact on growth, as households seeks to save more during their working life. This triggers investments and hence growth. However, there are models implying a negative relationship between population ageing and growth. A recent study by Börsch-Supan et al. (2014) applies a multi-country perspective. They consider a general-equilibrium model with overlapping generations and a pay-as-you-go pension system. An interesting feature of their model is the international mobility of capital. Fiscal budgets are always balanced by adjusting the pension contribution rate. Their findings implicate declining consumption and GDP per capita as a consequence of higher dependency ratios in the future. The decline in GDP per capita is however smaller than the increase in the dependency ratio, as scarce labor is substituted by capital to some extent. They show that consumption per capita can be largely maintained by a reform package that increases a) the retirement age, b) female labor force participation and decreases c) the job entry age d) the unemployment rate. The main message is that, albeit relying on a PAYG system, living standards in Europe can be maintained in spite of population aging if modest reform steps are taken.

[2]See Prettner and Prskawetz (2010) for a survey.

Concerning the effect on public revenues, there is a number of works on the sustainability of pension systems. Comprehensive projections can be found in European Commission (2012) and OECD (2013). To our knowledge, there is no study considering the impact of population ageing on the *revenue* side of the government budget. We aim at filling this gap here by a micro-founded approach. This approach is able to capture heterogeneous developments between population subgroups. Our treatment of the tax and contribution systems is able to capture far more details than any macro model. This comes at the cost of ignoring potential general-equilibrium effects. This issue will be taken up in Section 4.

# 2 Population Projections

Our population projections are differentiated along the dimensions of age, gender, household type and education separately for each country. They start from assumptions underlying the Eurostat projections EUROPOP2010, but deviate in two directions from them, which are referred to as *tough* and *friendly* scenario. The scenarios make different assumptions about international and internal migration, educational attainment, life expectancy, fertility and GDP growth. Broadly speaking, the tough scenario implies more severe challenges for European policy makers than the friendly scenario as it is based on pessimistic assumptions about fertility, educational attainment, international migration and life expectancy. The latter is assumed to cause a strong increase in the old-age dependency ratio. In contrast, the friendly scenario assumes higher net international immigration to Europe which has a positive impact on the working-age population as well as increasing the level of educational attainment.[3] An overview is provided in table 1.

We incorporate these projections into our micro data by a reweighting procedure using EU-SILC data, which serve as input for the tax-benefit calculator. Essentially, we proportionally adjust the respective sample weights for each observation to meet the target size in a respective stratification.[4] The EU-SILC data are representative for the population in each country and contain rich information about socio-demographic characteristics of households. By means of reweighting, we are able to analyze how the European labor force will change over the course of the next few decades. The reweighting procedure leads us to a population projection for the 27 EU countries in 2030. Using the implied changes in the skill and age composition, we get a projection for the future labor force and aggregate labor supply. Tables 2 and 3 present projected changes for the EU-27 labor force

[3] Comparing our population projections by skill level to those of the European Centre for the Development of Vocational Training (CEDEFOP), which provides an EU-wide population projection for 2020, shows that the two are well aligned in terms of headcounts (Cedefop (2012)).

[4] We applied the Stata package `survwgt`. For an application of sample reweighting in the context in tax-benefit microsimulation, see Cai et al. (2006).

Table 1: Underlying population scenarios

| Characteristic | Scenario tough | Scenario friendly |
|---|---|---|
| Net international migration | low | high |
| Rural-to-urban migration | high | low |
| Fertility | low | high |
| Increase in life expectancy | low | high |
| GDP growth | low | high |
| Old-age dependency ratio | high | low |
| Educational attainment | low | high |

Note: See Huisman et al. (2013) for detailed presentation of the demographic projections.

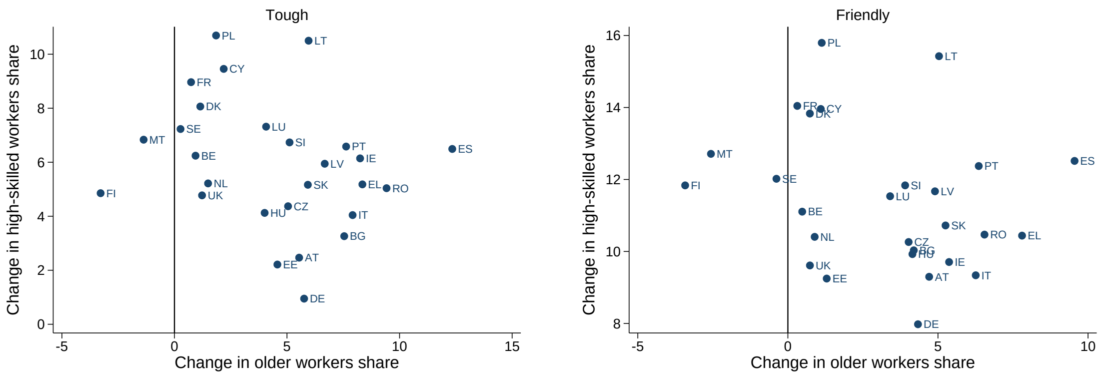
and population respectively.[5] With few exceptions, the labor force is expected to shrink across countries in both the tough and friendly scenarios. In average, the headcount of the labor force is going to shrink by 9.2% (1.0%) in the tough (friendly) scenario. The most drastic decreases are expected for Bulgaria, Romania, the Baltic countries and Germany.

The tough scenario keeps fertility rates constant on 2010 levels. This can however hardly explain the labor force trends, as most new-born children will not be in the labor force in 2030. The main driver seems to be the migration scenario, as net migration is assumed to be strongly negative in the countries named above.

Apart from an overall decrease, the European labor force is going to undergo two major transitions, namely a shift towards older and higher-skill workers. As table 4 demonstrates, the share of older workers is projected to rise in nearly all countries, most notably in the Southern European countries. This development is accompanied by increasing educational attainment, resulting in significant increases in the share of high-skilled workers in every country (see table 5). This holds for both demographic scenarios. In the tough (friendly) scenario, the share of high-skilled rises by only 0.9 ppt (8.0 ppt) in Germany, while other countries exhibit strong increases (e. g. 10.7 ppt and 15.8 ppt respectively in Poland). The development in both dimensions is visualized in table 1. Ageing and up-skilling are the two meta-trends that serve as explanation for most of our findings, although it becomes clear from table 1 that effects from demographics change vary substantially across countries.

[5]Throughout the paper, labor force (or, synonymously, work force) is understood as the total population between the age of 15 and 64.

Figure 1: Structural changes in the work force composition




Projected Changes between 2010 and 2030. Shares refer to total labor force. Older workers are defined as 50 years and older. High education is defined as completed tertiary education

**Structural vs. behavioral implications** So far, we concentrated on the implied change in the number of people due to demographic transitions. This is what we call the structural component of demographic change. It captures changes in the size and composition of the workforce, for example in age, gender, skill-level and household type. However, total labor supply is also affected by the behavioral dimension, meaning the individual decision on whether to work or not, and on how much to work.

Taking the behavioral dimension into account is crucial in order to make predictions about potential challenges arising from the changing composition of working-age people. If the relative share of socio-demographic groups which prefer to work part-time changes in a different way to the share of groups which prefer to work more hours, the change in total labor supply (measured in hours) will not be equivalent to the change in the size of the work force. In other words, we compare the change in *heads* with the change in *hours* worked. This distinction is of key relevance from a policy perspective, as challenges on both dimensions ask for distinct policy responses.

Applying the new sample weights on working hours in the EU-SILC data allows us to draw conclusions on the extent of the total volume of work. As the second and third column in table 6 show, the relative change in hours worked is comparable to the change in heads. In the more pessimistic scenario, total labor (in hours) shrinks by 7%, whereas it rises by about 3% in the optimistic scenario.[6] Figure 6 contrasts the changes in hours versus heads for all countries. A country above the 45 degree line marks a case where demographic change works in favor of those workers with a higher labor supply, thus weakening the effect of demographic change on the total work volume. In other words, the structural tendencies are dampened by individual behavior patterns. In countries below the 45 degree line, the change in hours exceeds the one in heads, exacerbating the demographic pressure. This is the case if, for example, labor supply is age-dependent

[6]Note that we ignore wage effects at this stage.

with older workers working fewer hours. If the share of older workers is growing, the total reduction in hours might be even larger than the reduction in headcount. Austria, Romania and Germany stand out as the most prominent examples for such a development in the tough scenario. This suggests significant pressure on public budgets for these countries due to demographic change.

# 3 Results

## 3.1 Labor Market Effects

So far, the exposition ignored behavioral reactions on the supply and demand side of the labor market. It is however unlikely that major transitions in the amount of hours worked, as implied by our projections, leave behavior of labor market participants unaffected. In most countries, the total amount of hours worked is projected to decrease ceteris paribus. In a neo-classical model of the labor market, the higher scarcity of the production factor labor is expected to induce a wage increase which, in turn, may cause workers to supply more hours of work as potential disposable income rises. We model this mechanism by linking elasticities on the supply and demand side.

**Supply Side Elasticities** Our labor supply elasticities stem from the analysis in Bargain et al. (2014). While the empirical literature on own-wage labor supply elasticities is vast, it is the first study carrying out estimations for a multitude of countries relying on a uniform methodological framework. They apply a flexible discrete choice approach where couples are assumed to maximize a joint utility function over a discrete set of working hour choices. The utility function is specified such to account for fixed costs of work, labor market restrictions within countries or even states, preference heterogeneity with respect to age, the presence and number of children as well as unobserved heterogeneity components.

Whenever possible, we relied on their results, but calculated the estimates differentiated not only by sex, but also my marital status and skill level. As the study covers only 17 EU countries, we use the mean value for the respective country group if a particular country is not covered.[7] Table 7 reports mean values by country groups for reasons of clarity. In reality, the supply elasticities are country-specific whenever possible.[8]

[7]The country groups are defined as follows. Continental: AT,BE,DE,FR,LU,NL; Nordic: DK,FI,SE; Southern: CY,EL,ES,IT,MT,PT; Eastern: BG,CZ,EE,HU,LT,LV,PL,RO,SI,SK.

[8]The total supply elasticity for subgroup $g \in [1, \dots, 12]$ in country $c$ is defined as the percentage change in total hours in relation to the percentage change in wages: $\varepsilon^S_{gc} = \frac{\partial H_{gc}}{\partial w_{gc}} \frac{w_{gc}}{H_{gc}}$. The intensive elasticity is this ratio conditional on working at least one hour. The extensive elasticity is defined as the relative change of the Employment Rate $E_{gc}$: $\varepsilon^{S,ext}_{gc} = \frac{\partial E_{gc}}{\partial w} \frac{w}{E_{gc}}$. This corresponds to the *Extensive*

Looking first at single females in table 7, we see that the labor supply elasticity of low skilled single females ranges from 0.1 in the Eastern European countries to just over 0.3 in the British Isles. In the medium skilled category, it is the Southern European countries which display the highest labor supply elasticity for single females (at around 0.3) while the same figure for the British Isles is almost unchanged compared to the low skilled category. The Nordic and Continental countries show a similarly low labor supply elasticity for this group of medium skilled single women. The labor supply elasticities of high skilled single women are much higher than those of low or medium skilled, ranging from 0.25 in Eastern Europe to 0.5 in the Southern European countries and in the UK and Ireland.

In general, married women display higher labor supply elasticities than their single counterparts (except for the high skilled category). Once again, there are discrepancies by country grouping although the labor supply elasticity of married women displays less variability by skill group than that of single women. Married Eastern European women have the lowest labor supply elasticity, regardless of skill type, at around 0.1. Married southern European women have the largest labor supply elasticities which range from 0.35 among the high skilled to 0.5 among the medium skilled. The labor supply elasticity of continental European women is fairly constant across skill groups at around 0.3 while the Nordic countries and the British Isles also have stable elasticities of around 0.2 across skill groups.

Among single men, the highest labor supply elasticities are to be found among the high and low skilled with the group of medium skilled single men displaying reasonably stable labor supply elasticities across countries of between 0.1 (in the Continental countries) and 0.2 (in the Nordic countries). Among the low-skilled single men, the British Isles have the largest labor supply elasticity of around 0.45. The smallest, of 0.15, are to be found in the Continental and Eastern European countries. Meanwhile the Nordic and Southern European low skilled single men have labor supply elasticities of around 0.25. Similar cross-country grouping patterns are found for the high-skilled with the highest elasticities found in the British Isles (0.65), followed by the Nordic (0.35) and Southern European (0.3) countries.

Finally, we observe very low labor supply elasticities for married men, regardless of their skill level. These range from 0.06 to 0.14 with the largest values observed for high skilled men, followed by low skilled and then medium skilled men. The Nordic countries display the largest elasticities across country groups for married men, regardless of the skill group.

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*margin (particip.)* in the result tables of Bargain et al. (2014).

**Demand Side Elasticities** For the reaction on the demand side of the labor market, we use skill-specific demand elasticities from the meta-analysis in Lichter et al. (2014), shown at the bottom of table 7. The study carried out meta-regression relying on a rich dataset covering 105 studies from 30 years. This allows us to obtain mean estimates for a given country, controlling for characteristics of the study, such as the time period or the estimation methods. The demand elasticity we apply is effectively a conditional mean value of the existing empirical evidence. Due to lack of available empirical evidence, the demand elasticities can only be differentiated on the level of skill and country grouping. This can be justified on grounds of convergence processes among countries in the same geographic region. We further differentiate the demand for low-skilled workers and for others. The meta-study reveals a generally negative elasticity, particularly for Eastern Europe. Beyond, the demand side is in general estimated to be more elastic than the supply side.

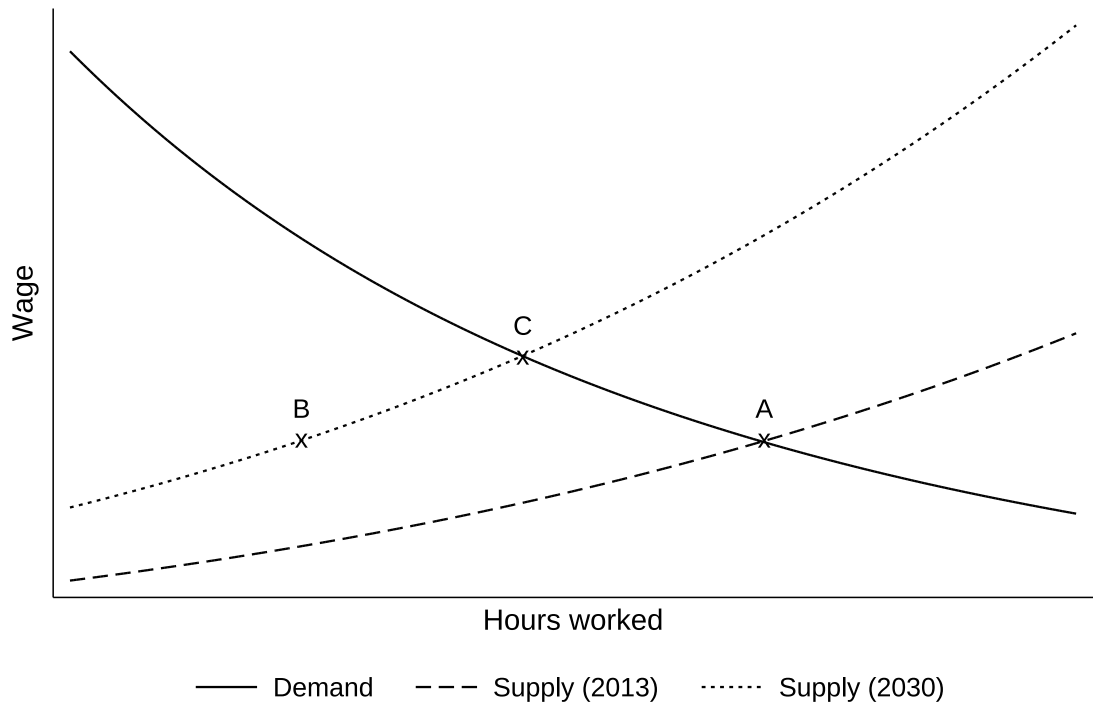
**Linking Labor Supply and Demand** Two ways of linking labor supply and demand within a microsimulation framework have been suggested by Creedy and Duncan (2005) and Peichl and Siegloch (2012). The approach we follow here builds on the latter, but extends their approach to the case of aggregate labor supply shifts.[9]

Our implementation of the supply-demand link defines twelve distinct labor markets, differentiated by marital status, gender and three skill levels. This ensures a flexible adjustment process as it incorporates the main sources of heterogeneous labor market behavior.

Figure 2 shows the basic idea of our supply-demand-link. Starting with the equilibrium point $A$ in 2010, a decrease in the labor force due to demographic trends (as is observed in most EU countries between 2010 and 2030), shifts the aggregate supply curve to the left. Holding wages constant moves the equilibrium from point $A$ to point $B$. However, we know that labor demand will respond to a shift in labor supply and, therefore, $B$ will not be the new labor market equilibrium. Assuming time-constant preferences on both market sides (equivalent to constant elasticities), both demand and supply curves are fully characterized. The analytical solution of the intersection $C$ of both curves yields the new equilibrium wage for this sub-market. It should be emphasized that this static approach ignores the time-dimension and, hence, does not allow any conclusions on the timing of the convergence process to the new equilibrium. Applying the relative change in (gross) wages and re-running the tax-benefit calculator yields the fiscal effects after labor

[9] Peichl and Siegloch (2012) assume a setting in which every single worker adjusts her labor supply in response to changes in individual net income, for example due to lower taxes. These individual labor supply adjustments result in changes to wages in order to balance labor supply and demand. This, in turn, induces a labor supply reaction and triggers an iteration process that ends in the new labor market equilibrium. In contrast to this procedure, the reweighting, described above, takes place on the aggregate level. It is therefore necessary to implement the demand adjustment on an aggregate level as well.

Figure 2: Supply and demand adjustment



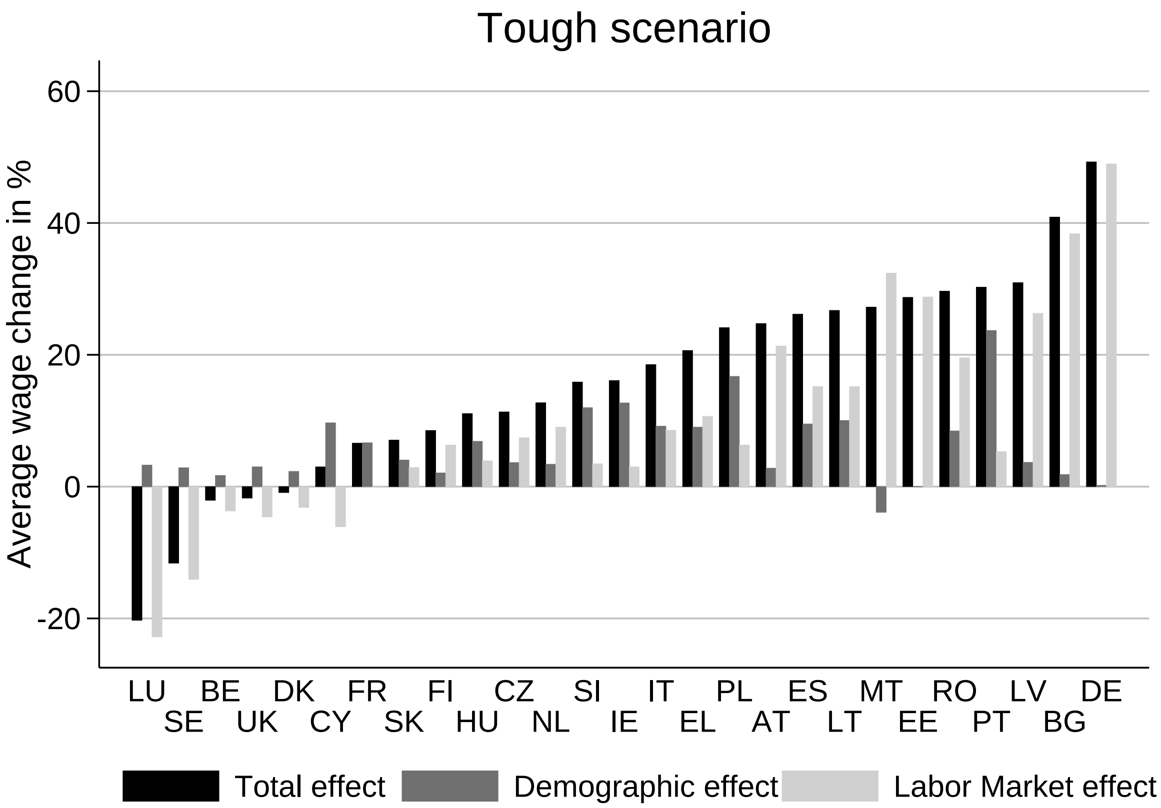

market reactions.

As we have information both on the intensive and the extensive margin of labor supply, our analysis accounts for the fact that wage increases (decreases) yield both a higher (lower) participation rate and a higher (lower) level of hours worked, allowing us to calculate both the the share of working individuals and the number of hours worked at the new equilibrium.

## 3.2 Wage Effects

In the first instance, we examine how demographic change can be expected to affect wages (through the shift from point A to point C in table 2). As most countries experience a decrease in the hours worked between 2010 and 2030 (table 6), most of the country labor supply shifts will be to the left, as depicted in table 2, resulting in wage increases. For a small minority of countries (Belgium, Cyprus, Denmark, Luxembourg, Sweden and the UK), we will observe a rightward shift in the labor supply curve which should result in wage decreases.

Figure 3: Average wage changes due to demographic change and the labor market response

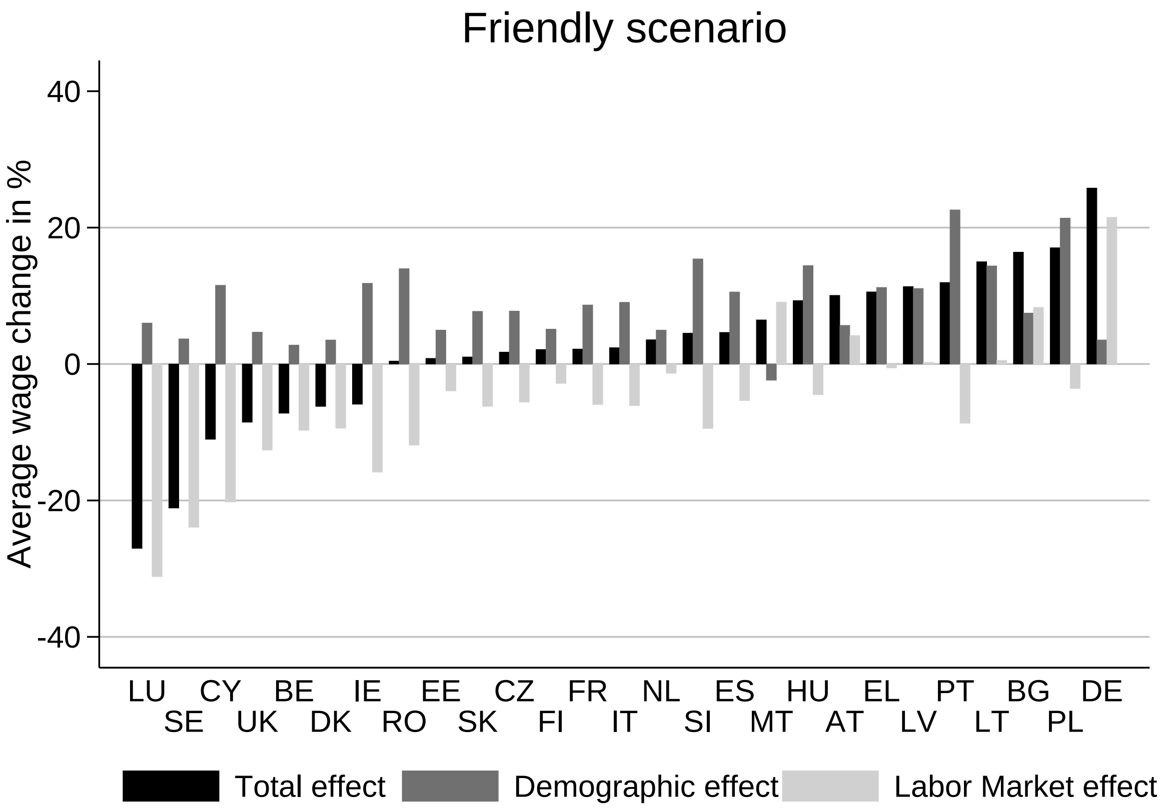



Note: Own calculations.

The shift in wages is composed of two distinct parts. The first is the change in average wages in the population which is simply caused by a compositional change in the labor force between 2010 and 2030, namely ageing and up-skilling. The demand side is ignored here. The second component is the change caused by the labor market reaction (the shift from point A to point C in table 2) to this demographic change. tables 3 and 4 illustrate the relative magnitude of each of these effects. In each scenario, we find that the effect of demographics on average wages is positive, reflecting the EU-wide up-skilling and population aging that is projected for 2030. For countries such as Greece, Malta, Poland, Portugal, and Romania, which are expected to experience substantial up-skilling of the labor force until 2030, we predict large average wage changes due to demographics, particularly in the tough scenario.

In the tough scenario, we mostly find positive wage effects effect from labor market adjustments, indicating that the change in labor supply implied by demographic change will result in higher wages. In the friendly scenario, we find both positive and negative effects of labor market adjustment on wages, depending on the country examined. We will discuss these in more detail below.

Figure 4: Average wage changes due to demographic change and the labor market response




Note: Own calculations.

In the tough scenario, the largest labor market induced average wage increases are found in Bulgaria, Germany, Estonia and Latvia, countries which are expected to experience the largest decrease in headcounts (table 2). A small number of countries, notably Luxembourg and Sweden, are expected to experience wage decreases by 2030. These decreases are driven by the labor market effect and are due to the fact that these countries are projected to undergo a rising labor force both in heads and hours worked.

In the friendly scenario, the overall wage changes are rather moderate and tend to be driven by a positive demographic effect, partly or wholly counteracted by a negative labor market effect. These negative labor market effects can arise from two sources. With few exceptions, each country that experiences a negative labor market effect on wages, does so in response to an increase in hours worked. Some exceptions (e.g. Greece) arise due to the fact that there are twelve distinct labor markets in each country. An overall decrease in headcounts can therefore still lead to an average wage decrease if, within that overall decrease in headcounts, there exist both increases and decreases for certain skill/family types. If the increase in headcounts for a particular labor market leads to a larger average wage decrease (through different demand and supply elasticities) than the increase in the average wage for the other labor markets, the overall average wage change will be negative. The largest labor market induced average wage decreases are found in Cyprus, Luxembourg and Sweden, countries which are expected to experience the largest increase in headcounts in the friendly scenario (table 2).

## 3.3 Fiscal Effects

In order to assess the effects on tax revenues as a consequence from labor market developments, we apply EUROMOD, a European tax-benefit calculator Sutherland and Figari (2013). EUROMOD is linked to data from the European Union Statistics on Income and Living Conditions (EU-SILC, Eurostat (2013)). This is an integrated and harmonized household survey conducted by Eurostat for the EU-27 countries. While suffering some drawbacks common to all survey data, such as under-reporting of capital income and under-coverage of certain population subgroups, there are clear advantages of using EU-SILC instead of nationnaly conducted surveys. By applying the same definitions in every country, high comparability is guaranteed in EU-SILC. EUROMOD uses the EU-SILC data and feeds them into country-specific tax-benefit calculators. These replicate the national tax and benefit regulations and calculate individual payments for all relevant taxes, contributions and benefits. The tax-benefit calculator are designed and maintained by national experts, guaranteeing timeliness and accuracy.

We next provide an analysis of the fiscal effects implied by the structural and behavioral adjustments outlined above. We contrast EUROMOD results, before and after reweighting and wage adjustments. In what follows, taxes encompass all personal taxes, including those not explicitly simulated in EUROMOD. The main components are taxes on personal income, capital income and property. Social security contributions are calculated for employees, employers and self-employed together, including old-age, health, long-term care, unemployment and accident insurance, if existent in the country.[10] Table 9 in the Appendix lists the change in tax revenues, while table 10 illustrates the change in revenues from social security contributions (SSC). All Euro figures are expressed in 2010 prices. As we observe virtually no difference in total hours worked between the fixed and adjusted wage scenarios, and only small changes to the employment rate, most of the expected changes to tax and SSC revenues after wage adjustment can be attributed to wage changes resulting from the labor market adjustment to the changing size of the labor force.

[10]These correspond to the EUROMOD variables `ils_tax`, `ils_sicee`, `ils_sicer` and `ils_sicse`. We report aggregate simulated tax and social security contribution revenues. These are comparable to the simulated revenues reported in the relevant EUROMOD country reports. Small differences come from the fact that we reweight the 2008 datasets to represent the 2010 population before running our baseline simulations. The reported revenues mostly exhibit under-coverage of tax revenues when compared to officially reported numbers (as is usually the case with EUROMOD simulated tax revenues). These differences can arise from insufficient modeling of complex tax rules in EUROMOD. If these errors are not systematic however, the projected revenue *changes* will be consistent.

As shown in section 3.2, we predict in average increasing real wages in the EU-27 countries. When assessing the effect on tax revenues and social security contributions, one needs to take into account potential uprating of tax-benefit policy parameters. Ignoring this could imply substantial bracket creep or fiscal drag. Therefore, all policy parameters are indexed with a factor $\alpha$, denoting the change in average market income between 2010 and 2030.

In the friendly scenario, we find that introducing wage adjustment to the 2030 population projection increases the projections for income tax receipts by 24.5% after wage adjustment, compared to 22.0% before wage adjustment. This is because of two counteracting effects. Firstly, hours worked and employment rates are expected to increase in the friendly scenario due to demographic change (before wage adjustment). This leads to a decrease in average wages in many of the EU-27 in this scenario (see figure 4). This wage decrease leads to an additional small increase in employment rates (an increase of 2.7 ppt after wage adjustment compared to an increase of 1 ppt before wage adjustment) while overall hours worked remain constant. This employment change widens the tax base, leading to more tax revenue. The wage decreases which lead to this employment change partly counteract this effect but, overall, tax revenues rise.

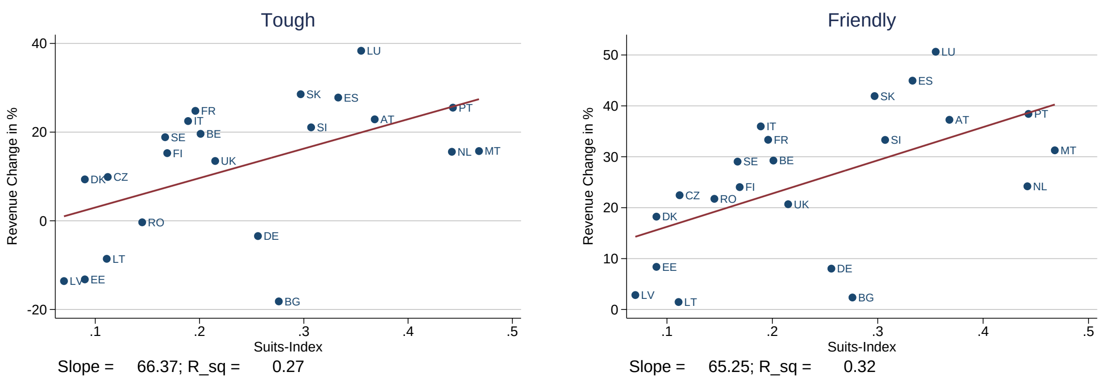
In the tough scenario, we find that introducing wage adjustments to the 2030 population projection increases tax revenue in the EU-27 by 12.9% compared to the increase of 7.0% observed without wage adjustment. This is in large part attributable to the wage increases observed in the tough scenario due to the smaller projected labor force. From figure 3, we see that wages are expected to increase in most of the EU-27 countries.

The projected change in Social Security Contributions (SSC) between 2010 and 2030 is depicted in table 10. We see that, in both the tough and friendly scenarios, SSC receipts are expected to increase from their 2010 levels, after wage adjustment. This contrasts to the fixed wage projections which see a decrease in SSC revenue in the tough scenario but a similar increase in the friendly scenario. The wage changes implied by demographic change have two roles in increasing SSC projections. Firstly, as wage increases are projected for most countries (at least in the tough scenario), this increases SSC receipts. Secondly, the increase in hours worked and employment rates which follows wage increases will also increase SSC revenue. Contributions are usually paid as a flat rate on labor earnings. After an assessment threshold, these contributions are fixed, implying a marginal contribution rate of zero for employees above the cap. For this reason, we see smaller increases in SSC contributions than in income tax contributions. Countries which have projected wage decreases also experience SSC increases due to the fact that the wage increases are initially brought about by an increase in labor supply, which is not wholly reversed by wage responses.

## 3.4 The role of tax progression

In this section, we provide an intuition for the revenue effects reported above. In particular, we focus on the degree of progression of a given tax system. This is measured by the tax progression index as proposed by Suits (1977).[11] Its virtue lies in the fact that it is normalized to the [-1;1] interval, extreme tax progression being indicated by value of 1. The degree of progression depends on the existence and amount of tax exemptions, the slope of the tax schedule and the top marginal tax rate.

Figure 5: Tax Revenues and progression




Source for values of Suits-Index: Peichl et al. (2013). Changes in tax revenues from table 9 (changes after wage changes). Slope and $R^2$ are obtained from bivariate OLS.

Figure 5 demonstrates, despite some outliers in the countries with strongest labor force decreases, that a good deal of variation in revenue changes can be explained by the degree of progression. While it is unrealistic that tax schedules remain unchanged until 2030, a progressive income tax system may be a measure to stabilize the detrimental effect of demographic change on public budgets.

# 4 Discussion

Interpreting our findings concerning the effects on wages and fiscal revenues is not straightforward and should be seen in light of our (partly) strong modeling assumptions. First, it should be noted that the demographic projections define a sensible range for the European

[11] Let denote the relative concentration of tax payments with $R_T(q)$, $q$ being the cumulated share in pre-government income. This is equivalent to the Gini, the difference being that the concentration of tax payments (and not income) is of interest. For progressive tax systems, a higher share of taxes is paid by richer households. In such a case, $R_T(q)$ is upward sloping. The Suits Index $\pi_{Suits}$ is defined by $\pi_{Suits} = 2\int_0^1 [q - R_T(q)]\, dq$.

population in 2030. Here, we present two extreme cases represented by the two scenarios: tough and friendly. Any outcome between these two is likely to be realized in the future.

The assumption of constant behavioral parameters of labor supply and labor demand also deserves discussion. While there is evidence of a declining elasticity of labor supply of women over the last few decades (Blau and Kahn; 2007), it is not clear whether this development will continue in the future. More important for the wage changes we project is, however, the demand side of the labor market. There is some evidence that the demand for labor has become more elastic over time (see Lichter et al. (2014)) but, once again, it is unclear if this pattern can be expected to continue. If we assume a higher reactivity of wages to extreme demographic transitions in the future, this would increase projected tax revenues. Assuming some trajectory for these behavioral parameters rather than keeping them constant would however lack empirical foundation and seems rather arbitrary.

Our treatment of the wage-setting process is somewhat simplistic and neglects important aspects that might play a greater role for future relative wages than non-constant elasticities. A prominent example is declining returns to skills as a consequence of increasing educational attainment. If the increasing prevalence of highly skilled workers means that high skills pay off less in the future, the wage changes projected in this analysis are overestimated. If wages are expected to rise in the future, this needs to be accompanied by a corresponding productivity increase. Two recent studies investigating the long-term productivity trends in industrialized countries are Bergeaud et al. (2014) and Crafts and O'Rourke (2013). In general, their findings indicate that industrialized countries have been confronted with steadily declining factor productivity throughout the last decades. Bergeaud et al. (2014) report an annual growth in labor productivity per hour by only 1% to 2% since 2000, marking a historic low. Productivity shocks are found to be caused by policies or technological innovations, such as the ICT revolution in the 1990s. Assuming a value of 1% for the annual productivity growth of labor over the period under consideration, we end up with a total increase in labor productivity of 22% from 2010 to 2030. This is line with most, while not all wage changes induced by our model. Moreover, an annual productivity growth in this magnitude is a standard assumption in comparable studies.[12] This back-of-the envelope calculation suggests that our wage changes are not too unrealistic, although some projected developments (e. g. Bulgaria and Germany in the tough scenario) should be treated with care.

Beyond, our model is not able to capture general equilibrium effects through the commodity market. A shrinking population is likely to demand less commodities (see also Börsch-Supan et al. (2014)) . Ceteris paribus, this should entail lower labor demand and therefore more moderate wage growth. While the labor force is projected to shrink

[12] See European Commission (2012, p. 75) and Börsch-Supan et al. (2014) who both assume a growth rate of 1.5%.

by 9.2% in the tough scenario, the *total population* decreases by only 2.7%, while rising by 7.9% in the friendly scenario (table 3). Total domestic demand might therefore stay about constant, one can however certainly expect a significant change in the structure of demand for goods, leading to differentiated response on the labor demand side.

Despite these caveats, our results shed light on the fiscal consequences of demographic transitions. While the development of social security contributions is proportional to the volume of labor, this might not be the case for personal income taxes as discussed above.

# 5 Conclusion

In this paper, we have carried out an analysis on the effect of demographic changes between 2010 and 2030 on labor markets and public budgets. Using EU-SILC micro data and EUROMOD, the tax and transfer calculator for the EU-27, we have shown how projected population changes and the interaction of labor supply and labor demand may affect labor market outcomes in 2030. Our main results are as follows. Focusing on the pure demographic effect, in other words not taking into account any adjustments on the labor supply or labor demand side, we find that the labor force will shrink by -1% (-9%) in the friendly (tough) scenario. This significant structural change in the labor market causes wages to adjust which will affect labor demand and supply leading to a new labor market equilibrium. We find that the decline in total hours worked is of a similar magnitude to the reduction in headcounts on the EU-level, but results differ considerably by countries.

Interestingly, our results show that employment rates will slightly increase which can be explained by the fact that higher wages will induce more people to enter the labor market. Finally, we have shown that, given rising wages in the majority of European Union countries and despite the reduction in total hours worked, income tax revenues and social insurance contributions may significantly increase in the next two decades.

Our results have to be interpreted in light of the various limitations of our analysis. Firstly, our analysis is based on the assumption of constant labor supply and demand elasticities over time. While structural changes such as huge demographic shifts may prompt labor market actors to change their behavior, it is unclear from today's perspective how supply and demand elasticities will be affected by these changes. Therefore, the assumption of constant elasticities is the natural choice in the context of our paper which provides labor market projections rather than forecasts. Our projections illustrate the challenges lying ahead of policy-makers if labor market and tax-benefit policies do not change apart from indexing policy parameters to changes in earnings levels. Secondly, we have abstracted from behavioral responses to changing labor market conditions such as migration responses which may change our results. As with supply and demand elasticities, the assumption of constant behavior is justified on the grounds that the aim of this paper is to focus on the effects of demographic change on labor market outcomes rather than on other relevant margins of adjustment. Thirdly, the positive effects on fiscal revenues have to be contrasted with potentially increasing benefit payments, particularly for old-age pensions. An accurate simulation of these claims is however beyond the scope of our static model. Nonetheless, our results suggests that the pressure on public budgets might be overstated, as improvements in labor productivity (reflected by wage increases) might contribute to more balanced public budgets in the future.

We intend to extend our findings with an investigation on the expenditure side of the government budget. In a subsequent step, we can assess the impact of certain policies coping with demographic change (by increasing the retirement age, for example) on fiscal balances.

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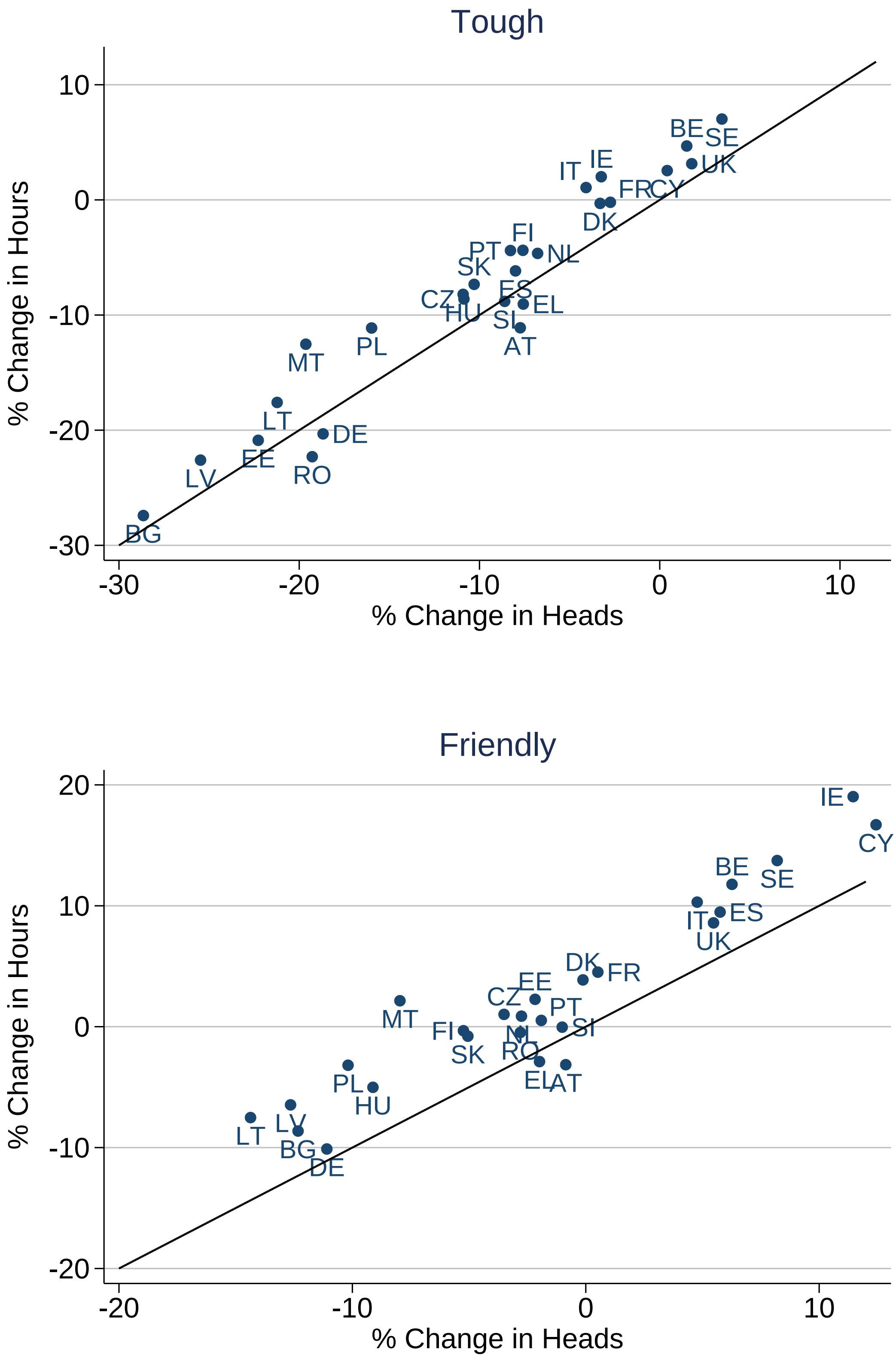
# Appendix

Table 2: Projected Total Labor Force

| | Million Workers | | | % Change | |
|---|---|---|---|---|---|
| *Country* | Base | tough | friendly | tough | friendly |
| AT | 5.7 | 5.2 | 5.6 | -7.7 | -0.9 |
| BE | 7.1 | 7.3 | 7.6 | 1.5 | 6.3 |
| BG | 5.2 | 3.7 | 4.6 | -28.6 | -12.3 |
| CY | 0.6 | 0.6 | 0.6 | 0.4 | 12.4 |
| CZ | 7.4 | 6.6 | 7.2 | -10.9 | -3.5 |
| DE | 53.9 | 43.8 | 47.9 | -18.7 | -11.1 |
| DK | 3.6 | 3.5 | 3.6 | -3.3 | -0.1 |
| EE | 0.9 | 0.7 | 0.9 | -22.3 | -2.2 |
| EL | 7.5 | 7.0 | 7.4 | -7.6 | -2.0 |
| ES | 31.4 | 28.9 | 33.2 | -8.0 | 5.8 |
| FI | 3.6 | 3.3 | 3.4 | -7.6 | -5.2 |
| FR | 40.7 | 39.6 | 40.9 | -2.7 | 0.5 |
| HU | 6.9 | 6.1 | 6.2 | -10.9 | -9.1 |
| IE | 3.0 | 2.9 | 3.4 | -3.2 | 11.5 |
| IT | 39.7 | 38.0 | 41.5 | -4.1 | 4.8 |
| LT | 2.3 | 1.8 | 2.0 | -21.2 | -14.4 |
| LU | 0.3 | 0.4 | 0.4 | 16.3 | 22.7 |
| LV | 1.5 | 1.2 | 1.4 | -25.5 | -12.6 |
| MT | 0.3 | 0.2 | 0.3 | -19.6 | -8.0 |
| NL | 11.1 | 10.4 | 10.8 | -6.8 | -2.8 |
| PL | 27.2 | 22.9 | 24.5 | -16.0 | -10.2 |
| PT | 7.1 | 6.5 | 7.0 | -8.3 | -1.9 |
| RO | 15.0 | 12.1 | 14.6 | -19.3 | -2.8 |
| SE | 6.1 | 6.3 | 6.6 | 3.4 | 8.2 |
| SI | 1.4 | 1.3 | 1.4 | -8.6 | -1.0 |
| SK | 3.9 | 3.5 | 3.7 | -10.3 | -5.1 |
| UK | 41.0 | 41.7 | 43.2 | 1.8 | 5.5 |
| Unweighted Avg. | | | | -9.2 | -1.0 |
| Population Weighted Avg. | | | | -8.7 | -1.4 |

Figure 6: Heads change vs. Hours change




Own calculations without after reweighting, but without age adjustments. In countries below the 45 degree line, the demographic change works, in average, in favor of those workers with fewer hours. LU is an outlier and not displayed for clarity reasons.

Table 3: Projected Total Population

| | Million People | | | % Change | |
|---|---|---|---|---|---|
| *Country* | Base | tough | friendly | tough | friendly |
| AT | 8.4 | 8.3 | 9.1 | -1.2 | 8.7 |
| BE | 10.8 | 11.7 | 12.5 | 8.1 | 15.1 |
| BG | 7.6 | 5.8 | 7.2 | -22.9 | -4.5 |
| CY | 0.8 | 0.9 | 1.0 | 10.4 | 23.9 |
| CZ | 10.5 | 10.1 | 11.2 | -3.8 | 6.5 |
| DE | 81.8 | 72.3 | 80.8 | -11.6 | -1.2 |
| DK | 4.5 | 4.7 | 4.9 | 3.2 | 8.7 |
| EE | 1.3 | 1.1 | 1.4 | -15.4 | 5.9 |
| EL | 11.3 | 10.9 | 11.8 | -4.0 | 4.4 |
| ES | 46.0 | 44.8 | 52.0 | -2.6 | 13.0 |
| FI | 4.5 | 4.6 | 4.8 | 2.3 | 7.4 |
| FR | 62.8 | 66.2 | 69.5 | 5.4 | 10.6 |
| HU | 10.0 | 9.2 | 9.7 | -8.3 | -2.7 |
| IE | 4.5 | 4.7 | 5.3 | 4.2 | 18.0 |
| IT | 60.3 | 60.6 | 67.6 | 0.5 | 12.1 |
| LT | 3.3 | 2.8 | 3.1 | -15.2 | -5.9 |
| LU | 0.5 | 0.6 | 0.7 | 21.4 | 30.4 |
| LV | 2.2 | 1.8 | 2.1 | -21.4 | -5.1 |
| MT | 0.4 | 0.4 | 0.4 | -9.5 | 4.6 |
| NL | 16.6 | 17.0 | 18.1 | 2.6 | 9.0 |
| PL | 38.2 | 34.8 | 38.3 | -8.8 | 0.3 |
| PT | 10.6 | 10.0 | 11.1 | -5.8 | 4.0 |
| RO | 21.5 | 18.0 | 21.9 | -16.0 | 2.0 |
| SE | 9.3 | 10.3 | 11.0 | 10.6 | 17.5 |
| SI | 2.0 | 2.1 | 2.3 | 0.6 | 10.8 |
| SK | 5.4 | 5.3 | 5.7 | -3.2 | 5.2 |
| UK | 62.0 | 67.5 | 70.8 | 8.8 | 14.2 |
| Unweighted Avg. | | | | -2.6 | 7.9 |
| Population Weighted Avg. | | | | -2.3 | 7.4 |

Table 4: Age Group Shares

| *Country* | Shares | | | Change in % Points | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Base | | | tough | | | friendly | | |
| | 15-29 | 30-49 | 50-64 | 15-29 | 30-49 | 50-64 | 15-29 | 30-49 | 50-64 |
| AT | 28.0% | 45.1% | 27.0% | -1.2 | -4.3 | 5.5 | -1.0 | -3.7 | 4.7 |
| BE | 28.0% | 42.8% | 29.1% | 0.8 | -1.7 | 0.9 | 0.9 | -1.4 | 0.5 |
| BG | 28.0% | 41.8% | 30.2% | -3.8 | -3.7 | 7.5 | -2.9 | -1.3 | 4.2 |
| CY | 33.5% | 40.7% | 25.8% | -5.7 | 3.5 | 2.2 | -6.3 | 5.2 | 1.1 |
| CZ | 28.0% | 42.6% | 29.4% | -2.0 | -3.0 | 5.0 | -1.8 | -2.2 | 4.0 |
| DE | 26.3% | 44.4% | 29.4% | -1.7 | -4.0 | 5.8 | -1.1 | -3.2 | 4.3 |
| DK | 27.1% | 42.9% | 29.9% | 1.7 | -2.8 | 1.1 | 1.9 | -2.7 | 0.7 |
| EE | 32.0% | 40.3% | 27.7% | -5.1 | 0.5 | 4.6 | -4.1 | 2.8 | 1.3 |
| EL | 26.1% | 45.6% | 28.3% | -1.4 | -6.9 | 8.3 | -1.6 | -6.2 | 7.8 |
| ES | 26.3% | 48.2% | 25.5% | -0.1 | -12.2 | 12.3 | 0.2 | -9.8 | 9.6 |
| FI | 28.2% | 39.0% | 32.7% | 0.4 | 2.9 | -3.3 | 0.4 | 3.0 | -3.4 |
| FR | 28.8% | 41.6% | 29.6% | 0.6 | -1.3 | 0.7 | 1.1 | -1.4 | 0.3 |
| HU | 28.4% | 41.9% | 29.7% | -4.1 | 0.1 | 4.0 | -4.0 | -0.1 | 4.1 |
| IE | 31.7% | 44.5% | 23.8% | 0.7 | -8.9 | 8.2 | 2.2 | -7.5 | 5.4 |
| IT | 24.2% | 47.0% | 28.8% | 0.8 | -8.7 | 7.9 | 1.3 | -7.5 | 6.3 |
| LT | 32.5% | 41.8% | 25.6% | -7.7 | 1.7 | 6.0 | -7.3 | 2.3 | 5.0 |
| LU | 27.5% | 46.6% | 26.0% | -0.8 | -3.3 | 4.1 | -0.6 | -2.8 | 3.4 |
| LV | 32.2% | 40.9% | 26.9% | -8.8 | 2.1 | 6.7 | -8.1 | 3.2 | 4.9 |
| MT | 28.4% | 39.9% | 31.7% | -4.5 | 5.9 | -1.4 | -4.3 | 6.9 | -2.6 |
| NL | 27.1% | 43.0% | 29.9% | 1.4 | -2.9 | 1.5 | 1.6 | -2.5 | 0.9 |
| PL | 32.2% | 38.7% | 29.1% | -8.0 | 6.1 | 1.8 | -7.5 | 6.4 | 1.1 |
| PT | 27.1% | 45.2% | 27.7% | -1.9 | -5.7 | 7.6 | -0.8 | -5.6 | 6.4 |
| RO | 30.7% | 42.5% | 26.7% | -6.5 | -2.9 | 9.4 | -6.6 | 0.1 | 6.6 |
| SE | 29.8% | 41.0% | 29.2% | -1.0 | 0.7 | 0.3 | -0.6 | 1.0 | -0.4 |
| SI | 27.2% | 43.5% | 29.3% | -2.5 | -2.6 | 5.1 | -2.1 | -1.9 | 3.9 |
| SK | 31.5% | 41.5% | 27.0% | -7.9 | 2.0 | 5.9 | -7.7 | 2.4 | 5.3 |
| UK | 30.2% | 42.3% | 27.5% | -0.1 | -1.1 | 1.2 | 0.1 | -0.8 | 0.7 |
| Unweighted Avg. | | | | -2.5 | -1.9 | 4.4 | -2.2 | -1.0 | 3.2 |
| Population Weighted Avg. | | | | -1.5 | -3.4 | 4.9 | -1.1 | -2.6 | 3.7 |

Table 5: Skill Shares

| Country | Shares | | | Change in % Points | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Base | | | tough | | | friendly | | |
| | low | med | high | low | med | high | low | med | high |
| AT | 22.8% | 60.9% | 16.3% | -4.4 | 1.9 | 2.5 | -7.1 | -2.2 | 9.3 |
| BE | 32.6% | 36.7% | 30.7% | -8.6 | 2.4 | 6.2 | -10.5 | -0.6 | 11.1 |
| BG | 25.4% | 55.2% | 19.5% | -1.4 | -1.9 | 3.3 | -7.5 | -2.5 | 10.0 |
| CY | 28.7% | 39.5% | 31.8% | -8.0 | -1.5 | 9.5 | -12.1 | -1.8 | 14.0 |
| CZ | 14.6% | 71.0% | 14.4% | -1.6 | -2.8 | 4.4 | -4.6 | -5.7 | 10.3 |
| DE | 21.0% | 56.6% | 22.5% | -0.4 | -0.5 | 0.9 | -4.2 | -3.8 | 8.0 |
| DK | 30.9% | 40.6% | 28.5% | -7.4 | -0.6 | 8.1 | -9.3 | -4.5 | 13.8 |
| EE | 18.3% | 52.0% | 29.7% | 1.7 | -3.9 | 2.2 | -4.5 | -4.7 | 9.2 |
| EL | 38.5% | 40.5% | 21.0% | -9.3 | 4.1 | 5.2 | -11.1 | 0.6 | 10.4 |
| ES | 48.4% | 23.9% | 27.7% | -8.7 | 2.2 | 6.5 | -12.0 | -0.5 | 12.5 |
| FI | 23.4% | 45.6% | 31.1% | -5.8 | 1.0 | 4.9 | -7.9 | -4.0 | 11.8 |
| FR | 31.8% | 41.9% | 26.3% | -8.5 | -0.4 | 9.0 | -10.2 | -3.9 | 14.0 |
| HU | 24.3% | 58.5% | 17.2% | -4.7 | 0.6 | 4.1 | -6.9 | -3.0 | 9.9 |
| IE | 29.5% | 37.6% | 32.9% | -7.1 | 0.9 | 6.1 | -7.8 | -2.0 | 9.7 |
| IT | 46.2% | 40.8% | 13.0% | -11.5 | 7.5 | 4.0 | -9.7 | 0.3 | 9.3 |
| LT | 16.5% | 56.4% | 27.1% | 0.2 | -10.7 | 10.5 | -5.4 | -10.0 | 15.4 |
| LU | 29.1% | 40.6% | 30.3% | -4.7 | -2.6 | 7.3 | -6.6 | -4.9 | 11.5 |
| LV | 19.5% | 58.0% | 22.5% | 1.0 | -6.9 | 5.9 | -7.5 | -4.1 | 11.7 |
| MT | 71.5% | 16.9% | 11.6% | -11.7 | 4.9 | 6.8 | -14.4 | 1.7 | 12.7 |
| NL | 31.4% | 40.4% | 28.3% | -6.6 | 1.4 | 5.2 | -9.1 | -1.3 | 10.4 |
| PL | 17.9% | 62.4% | 19.7% | -4.4 | -6.3 | 10.7 | -6.9 | -8.9 | 15.8 |
| PT | 67.3% | 18.9% | 13.8% | -14.6 | 8.0 | 6.6 | -11.3 | -1.1 | 12.4 |
| RO | 30.3% | 57.9% | 11.8% | -3.1 | -1.9 | 5.0 | -11.0 | 0.5 | 10.5 |
| SE | 25.7% | 46.2% | 28.2% | -5.2 | -2.0 | 7.2 | -8.7 | -3.3 | 12.0 |
| SI | 20.8% | 58.9% | 20.2% | -5.7 | -1.0 | 6.7 | -5.0 | -6.8 | 11.8 |
| SK | 16.0% | 68.9% | 15.0% | -3.3 | -1.9 | 5.2 | -5.8 | -4.9 | 10.7 |
| UK | 26.9% | 43.0% | 30.0% | -5.2 | 0.4 | 4.8 | -6.7 | -2.9 | 9.6 |
| Unweighted Avg. | | | | -5.5 | -0.4 | 5.9 | -8.3 | -3.1 | 11.4 |
| Population Weighted Avg. | | | | -5.9 | 0.5 | 5.4 | -8.2 | -2.8 | 11.0 |

Table 6: Hours worked

| | Million Hours | % Change, after Demography | | % Change, Dem & Wage | |
|---|---|---|---|---|---|
| | Base | tough | friendly | tough | friendly |
| AT | 148.0 | -11.1% | -3.1% | -9.5% | -2.9% |
| BE | 177.9 | 4.7% | 11.8% | 1.5% | 7.4% |
| BG | 179.0 | -27.4% | -8.6% | -29.9% | -12.3% |
| CY | 17.0 | 2.6% | 16.8% | 0.4% | 12.3% |
| CZ | 221.4 | -8.6% | 1.0% | -9.9% | -1.0% |
| DE | 1442.5 | -20.3% | -10.1% | -17.8% | -10.0% |
| DK | 109.4 | -0.3% | 3.9% | -2.5% | 1.3% |
| EE | 29.8 | -20.9% | 2.2% | -22.8% | -1.9% |
| EL | 218.1 | -9.1% | -2.9% | -9.4% | -4.1% |
| ES | 910.5 | -6.2% | 9.5% | -7.3% | 5.1% |
| FI | 110.2 | -4.4% | -0.3% | -7.5% | -3.6% |
| FR | 1080.2 | -0.2% | 4.5% | -3.5% | 1.0% |
| HU | 188.5 | -8.2% | -5.0% | -13.5% | -10.2% |
| IE | 82.1 | 2.0% | 19.0% | -0.9% | 12.4% |
| IT | 1169.6 | 1.1% | 10.3% | -4.8% | 2.7% |
| LT | 69.6 | -17.6% | -7.5% | -19.4% | -9.9% |
| LU | 9.6 | 17.3% | 24.7% | 13.5% | 20.0% |
| LV | 51.6 | -22.6% | -6.5% | -24.4% | -10.1% |
| MT | 6.7 | -12.6% | 2.1% | -14.9% | -2.4% |
| NL | 270.6 | -4.6% | 0.9% | -5.6% | -0.8% |
| PL | 745.3 | -11.1% | -3.2% | -12.2% | -4.6% |
| PT | 206.5 | -4.4% | 0.5% | -6.5% | -2.1% |
| RO | 376.3 | -22.3% | -0.5% | -21.7% | -1.9% |
| SE | 177.9 | 7.0% | 13.7% | 2.4% | 8.2% |
| SI | 40.3 | -8.8% | 0.0% | -11.9% | -3.9% |
| SK | 119.5 | -7.3% | -0.8% | -8.6% | -2.5% |
| UK | 1033.9 | 3.1% | 8.6% | 1.8% | 6.6% |
| Mean | | -7.0% | 3.0% | -9.1% | -0.3% |

Table 7: Supply and Demand Elasticities

| | Skill Level | | |
|---|---|---|---|
| | High | Medium | Low |
| **(Total) Labor supply elasticities** | | | |
| *Single Male* | | | |
| Continental | 0.15 | 0.11 | 0.23 |
| Nordic | 0.27 | 0.21 | 0.34 |
| UK/IRL | 0.46 | 0.14 | 0.65 |
| Southern | 0.27 | 0.18 | 0.27 |
| Eastern | 0.15 | 0.17 | 0.24 |
| *Single Female* | | | |
| Continental | 0.23 | 0.14 | 0.38 |
| Nordic | 0.19 | 0.11 | 0.36 |
| UK/IRL | 0.32 | 0.20 | 0.51 |
| Southern | 0.26 | 0.29 | 0.48 |
| Eastern | 0.09 | 0.10 | 0.48 |
| *Married Male* | | | |
| Continental | 0.09 | 0.08 | 0.10 |
| Nordic | 0.11 | 0.09 | 0.14 |
| UK/IRL | 0.09 | 0.06 | 0.11 |
| Southern | 0.06 | 0.08 | 0.07 |
| Eastern | 0.08 | 0.08 | 0.08 |
| *Married Female* | | | |
| Continental | 0.28 | 0.30 | 0.27 |
| Nordic | 0.18 | 0.17 | 0.22 |
| UK/IRL | 0.20 | 0.23 | 0.19 |
| Southern | 0.40 | 0.49 | 0.36 |
| Eastern | 0.11 | 0.12 | 0.11 |
| **Labor demand elasticities** | | | |
| Continental | -0.42 | | -0.59 |
| Nordic | -0.34 | | -0.64 |
| UK/IRL | -0.53 | | -0.55 |
| Southern | | -0.48 | |
| Eastern | -0.89 | | -0.82 |

Note: Supply elasticities based on estimations from Bargain et al. (2014). Demand elasticities from Lichter et al. (2014). Due to insufficient empirical estimates, we could not differentiate between skills levels for demand elasticities.

Table 8: Employment Rates

| | Employment Rate, in % | Change in ppt, after reweighting | | Change in ppt, after wage adj. | |
|---|---|---|---|---|---|
| *Country* | Base | tough | friendly | tough | friendly |
| AT | 64.1 | -2.6 | -1.9 | -1.8 | -1.3 |
| BE | 62.7 | 0.8 | 1.6 | 2.2 | 3.4 |
| BG | 72.0 | -0.9 | 1.3 | 0.9 | 2.6 |
| CY | 68.2 | 1.0 | 2.2 | 3.9 | 5.3 |
| CZ | 61.8 | 0.7 | 1.9 | 4.0 | 5.8 |
| DE | 62.8 | -2.5 | -1.2 | 1.7 | 2.6 |
| DK | 77.0 | 0.7 | 1.1 | 1.3 | 1.7 |
| EE | 75.1 | -1.5 | 0.6 | 0.4 | 1.7 |
| EL | 59.1 | -1.2 | -0.5 | 2.4 | 2.9 |
| ES | 65.2 | -1.4 | -0.1 | 2.3 | 3.3 |
| FI | 73.2 | 1.2 | 1.9 | 2.9 | 4.1 |
| FR | 66.6 | 0.3 | 0.8 | 2.1 | 2.7 |
| HU | 62.8 | 1.2 | 1.7 | 2.2 | 2.9 |
| IE | 67.0 | -1.0 | 0.5 | 0.9 | 1.6 |
| IT | 63.1 | 0.2 | 0.0 | 2.9 | 1.8 |
| LT | 70.0 | 0.7 | 2.7 | 0.5 | 3.2 |
| LU | 64.2 | -1.2 | -1.2 | 0.4 | 0.6 |
| LV | 73.1 | 0.2 | 1.8 | 2.8 | 4.1 |
| MT | 56.8 | 3.8 | 4.7 | 5.5 | 6.7 |
| NL | 68.4 | 0.3 | 1.0 | 0.7 | 1.3 |
| PL | 57.9 | 2.6 | 3.8 | 4.8 | 6.0 |
| PT | 66.5 | 0.8 | 0.1 | 2.6 | 1.5 |
| RO | 55.6 | -1.7 | 2.1 | -0.2 | 3.5 |
| SE | 78.9 | 1.2 | 2.0 | -0.3 | 0.6 |
| SI | 63.5 | -1.7 | -1.1 | 0.4 | 1.1 |
| SK | 67.6 | 0.8 | 1.7 | 1.5 | 2.7 |
| UK | 66.8 | -0.3 | 0.6 | 0.0 | 1.1 |
| Unweighted Avg. | | 0.0 | 1.0 | 1.7 | 2.7 |
| Population Weighted Avg. | | -0.3 | 0.6 | 1.9 | 2.7 |

Table 9: Change in Income Tax revenues

| | Billion Euros | % Change, after Demography | | % Change, Dem & Wage | |
|---|---|---|---|---|---|
| *Country* | Base | tough | friendly | tough | friendly |
| AT | 22.12 | 22.9% | 37.3% | 41.3% | 35.7% |
| BE | 37.27 | 19.6% | 29.2% | 8.3% | 8.3% |
| BG | 1.25 | -18.4% | 2.4% | -8.0% | 4.0% |
| CY | 1 | 36.0% | 53.0% | 23.0% | 39.0% |
| CZ | 4.52 | 9.7% | 22.3% | 10.4% | 12.6% |
| DE | 223.68 | -3.4% | 8.0% | 53.4% | 21.9% |
| DK | 46.48 | 9.3% | 18.2% | 8.3% | 17.2% |
| EE | 1.02 | -12.7% | 8.8% | 4.9% | 6.9% |
| EL | 11.99 | 15.3% | 28.6% | 34.0% | 31.7% |
| ES | 65.81 | 27.8% | 45.0% | 46.7% | 36.7% |
| FI | 30.11 | 15.2% | 24.0% | 20.6% | 29.4% |
| FR | 133.29 | 24.8% | 33.3% | 25.0% | 34.9% |
| HU | 3.76 | 4.5% | 14.1% | -0.5% | 1.6% |
| IE | 11.54 | 27.0% | 39.6% | 51.8% | 23.1% |
| IT | 219.45 | 22.5% | 36.0% | 35.3% | 33.9% |
| LT | 1.51 | -8.6% | 1.3% | 7.3% | 11.9% |
| LU | 2.17 | 38.2% | 50.2% | -1.4% | 1.4% |
| LV | 2.17 | -13.8% | 2.8% | 1.4% | 7.8% |
| MT | 0.2 | 15.0% | 30.0% | 30.0% | 20.0% |
| NL | 59.41 | 15.6% | 24.2% | 25.4% | 23.8% |
| PL | 28.41 | 10.3% | 23.4% | 12.0% | 23.5% |
| PT | 10.26 | 25.5% | 38.4% | 47.8% | 34.5% |
| RO | 6.2 | -0.3% | 21.8% | 10.5% | 10.5% |
| SE | 48.62 | 18.8% | 29.0% | 4.9% | 13.5% |
| SI | 2.27 | 21.1% | 33.5% | 25.1% | 7.9% |
| SK | 1.18 | 28.0% | 41.5% | 6.8% | 11.0% |
| UK | 243.3 | 13.5% | 20.7% | 13.6% | 16.0% |
| Mean | | 13.5% | 26.5% | 19.9% | 19.2% |

Table 10: Change in Social Insurance Contributions

| | Billion Euros | % Change, after Demography | | % Change, Dem & Wage | |
|---|---|---|---|---|---|
| *Country* | Base | tough | friendly | tough | friendly |
| AT | 42.92 | 2.6% | 13.7% | 8.9% | 7.4% |
| BE | 47.24 | 10.4% | 18.5% | 3.5% | 3.6% |
| BG | 3.56 | -19.9% | 0.3% | -11.0% | 1.1% |
| CY | 1.51 | 10.6% | 25.2% | 2.6% | 4.6% |
| CZ | 20.62 | 0.7% | 12.0% | 1.5% | 7.2% |
| DE | 358.7 | -11.1% | -1.2% | 3.6% | 3.2% |
| DK | 11.48 | 5.1% | 12.4% | 2.8% | 7.2% |
| EE | 2.31 | -15.2% | 6.5% | -0.9% | 5.6% |
| EL | 23.84 | -3.6% | 4.7% | 6.0% | 5.5% |
| ES | 140.09 | 0.2% | 16.4% | 12.7% | 14.8% |
| FI | 25.98 | 1.2% | 7.5% | 5.7% | 10.1% |
| FR | 358.52 | 7.6% | 13.8% | 8.0% | 13.3% |
| HU | 9.24 | -2.9% | 4.5% | -4.3% | -0.3% |
| IE | 14.2 | 8.7% | 22.9% | 25.6% | 8.9% |
| IT | 239.17 | 1.0% | 12.3% | 12.6% | 10.5% |
| LT | 4.37 | -11.0% | -1.1% | 2.5% | 7.3% |
| LU | 3.13 | 24.0% | 33.9% | 3.8% | 7.7% |
| LV | 3.12 | -16.7% | -0.6% | -2.2% | 4.5% |
| MT | 0.4 | -2.5% | 10.0% | -7.5% | 2.5% |
| NL | 99.12 | 4.4% | 11.6% | 6.7% | 8.7% |
| PL | 41.58 | -2.9% | 8.7% | 0.3% | 9.8% |
| PT | 21.49 | 0.4% | 10.1% | 21.5% | 14.9% |
| RO | 9.58 | -8.2% | 12.3% | 1.4% | 0.8% |
| SE | 55.14 | 13.1% | 21.6% | -1.1% | -0.5% |
| SI | 6.17 | 6.0% | 17.0% | 9.7% | 6.5% |
| SK | 8.87 | 4.4% | 14.3% | -4.6% | 0.9% |
| UK | 151.21 | 5.7% | 12.6% | 7.2% | 5.9% |
| Mean | | 0.5% | 11.8% | 4.3% | 6.4% |

Contributions from employees only, including old-age, health, long-term care, unemployment and accident insurance, if existent in the country. This corresponds to the EUROMOD income list `ils_sicee`.