Structural and behavioral dimensions of Labor Supply in Europe in 2030*

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Abstract

The demographic transition is expected to imply major changes in the composition of the European labor force. Most analyses concentrate on changes in the head count of the labor force. In this paper, we go beyond this by accounting for potential changes in hours worked. Based on micro-date, we identify those countries where changes in the total labor force are aggravated by changes in total hours worked. Finally, we relate these findings to an assessment of the effect of demographic change on public budgets. Our results deliver a broader picture of the effects of the demographic change on labor supply in the EU.

JEL Classification: J11, J21, J22
Keywords: Labor Supply, Demograhic Trends, Reweighting

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1 Introduction

Demographic change is expected to imply major transitions on European labor markets. A declining labor force that is growing older is expected to create unforeseen challenges to policy makers. However, the demographic transition is a highly complex phenomenon that manifestates differently in every Eurpean country. In this paper, we identify the major demographic trends in the 27 EU countries and analyze which countries are likely to face the greatest challenges as a consequence of a shrinking labor force.

This paper evolved from the NEUJOBS research project, funded by the European Commission under the Seventh Framework Programme.[1] It aims at grasping the implications of a socio-ecological transition on European labor markets from a wide range of perspectives. In each working step of the project, two distinct projection scenarios are analyzed in order to give an idea on the possible bounds of the transition processes. One scenario entails rather sceptic assumptions about future developments, thus creating more policy challenges and is hence called *tough*. On the contrary, the *friendly* scenario assumes future changes to be less drastic. We shall therefore stick to this framework in this contribution. In the context of demographic projections, *tough* and *friendly* refer to assumptions on e. g. fertility, internal and external migration and economic growth. These projections were delivered by the Netherlands Interdisciplinary Demographic Institute (NIDI) (Huisman et al., 2012)).

In a first step, we apply a reweighting procedure on the data set in order to mimic the projected future working-age population. We also deliver a descriptive analysis of the major trends of the demographic change in Europe. This will also help identify trends that are common to all countries and trends which are country-specific. As in Dolls et al. (2012), we differentiate between *structural* and *behavioral* aspects of labor supply. The structural component captures the changes in size and composition in age, gender, skill-level and household type. Beyond, total labor supply is determined by the behavioral dimension, i. e. the individual decision

[1] Full Title: NEUJOBS - Creating and adapting jobs in Europe in the context of a socio-ecological transition (`www.neujobs.eu`).

on whether to work or not, and on how much to work. Taking into account the behavioral dimension is crucial for making predictions about potential threats and challenges arising from a changing composition of the working-age population. Consider the following illustrative example: If the relative share of socio-demographic groups which prefer to work part-time or which do not participate in the labor market (i. e. groups with limited possibilities to participate in the labor market, e. g. due to insufficient education, or groups which have a high preference for leisure/high distaste for work) change in a different way as 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 working-age population. In such a case, the change in total labor supply will also depend on the relative share of various socio-demographic groups, i. e. the change in labor force *composition*. In one word, we confront the change in *heads* with the change in *hours* worked. This is also of key relevance for policy-makers, as both aspects can be potentially influenced by different policies. A lower overall size of the labor force can be addressed with e. g. targeted migration policies. In contrast, fewer hours worked as a consequence of a high number of mothers can be confronted with providing better child care facilities. While the structural dimension of demographic change is captured by the NIDI projections, the behavioral dimension is analyzed by a discrete choice labor supply model.

The results presented in this paper are preliminary in two respects. First, we assume individual gross wages to be constant across the timeframe considered. This rules out equilibrium effects, such as increasing wages induced by scarcity of the production factor labor. Likewise, potential changes in returns to education are not depicted. Second, the projected changes in hours worked rest on labor supply behavior only and ignore the demand side for the moment. These topics will be adressed in the near future.

The paper is structured as follows: Section 2 briefly recapitulates the reweighting procedure and provides a descriptive analysis of the structural changes in European labor supply. Section 3 contains a short overwiew of the research on labor supply and describes the data base underlying our analysis. In section 4, the pro-

jected behavioral changes in labor supply are presented. Section 5 illustrates the key trends in more detail as part of a case study. Section 6 concludes.

2 Demographic projections

As in D10.5, we rely on NIDI's demographic projections. [2] The scenarios presume different assumptions about international and internal migration, educational attainment, life expectancy, fertility and GDP growth. Broadly speaking, the though scenario implies more severe challenges for European policy makers than the friendly scenario as it is based on pessimistic assumptions about GDP growth, educational attainment and life expectancy. The latter is assumed to be causing a strong increase in the old-age dependency ratio. In contrast, the friendly scenario assumes higher net international immigration which has a positive impact on the working-age population as well as an increasing level of educational attainment.

We incorporate the projections into our micro data by a reweighting procedure. The EU-SILC micro data is survey data which contains sample weights for every person in order to adjust for sample design and/or differential non-response. Every country data set is thus representative for that country's population, once the sample weights are used. We adjust these personal weights such that the modified sample exactly corresponds to the projected working-age population in 2030. The structural characteristics which we control for in the reweighting procedure include age, gender, skill-level and position within the household.[3] We additionally alter the weights of each country to be representative of the base year, 2010, in order to make sure that any observed development between 2010 and 2030 is due to the underlying population scenarios only and is not attributed to potential inconsistencies between the projections and the EU-SILC data.[4]

For a clearer exposition, the analysis concentrates only on differences between

[2] See Huisman et al. (2012) and Dolls et al. (2012) for further references.

[3] The household position is differentiated between singles, single parents, children living at home, couples without children, couples with children and other.

[4] These inconsistencies may arise from different reference years. The household data were collect in 2009 in most countries. A potentially more severe source of discrepancy are different skill classifications.

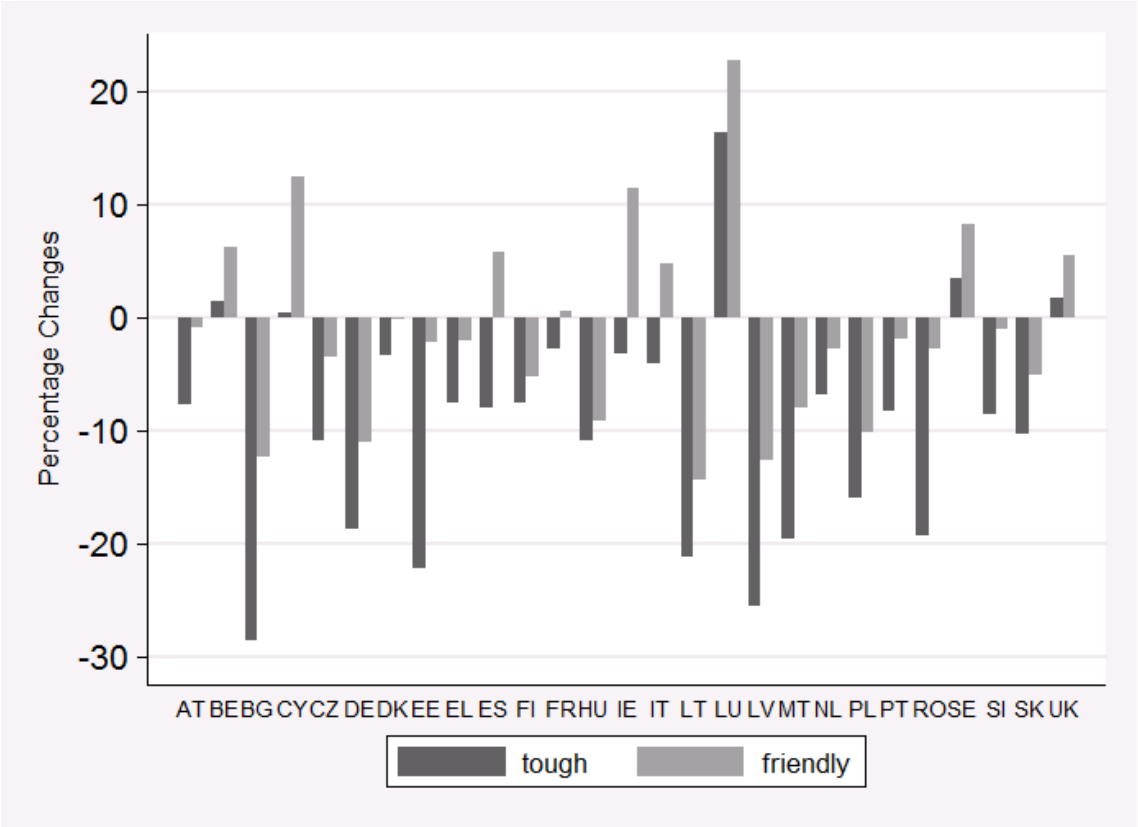
2010 and 2030 and ignores intermediate developments. In the remainder of this paper, the labor force is defined as the total population between the age 15 and 64, irrespective of retirement or education status.

Figure 1 depicts the projected changes in the total headcount of the labor force (see also Table 2 in the Appendix). [5] On average, the labor force shrinks by 9.2% (1.0%) in the tough (friendly) scenario across all countries. The projections imply divergent trends across countries. The decrease in labor supply is strongest in Bulgaria, Germany, the Baltic States and Romania. In these countries, labour supply in headcounts is projected to shrink by 18 to 28 percent in the tough scenario. By contrast, the labor force in Belgium, Cyprus, Luxembourg, Sweden and the UK is projected to grow in both scenarios.

In addition to structural changes to the European labor force, the socio-demographic characteristics of the labor force are projected to change in the next two decades. Table 3 illustrates changes in the age composition between 2010 to 2030. The general picture that emerges is rather uniform. In general, the European labor force is becoming older. The share of workers above the age of 50 is projected to increase in all countries, with the exception of Finland and Malta (and Sweden in the friendly scenario, see also Figure 2). The rise in the share of elderly workers is strongest in southern European countries such as Spain, Italy and Greece with increases of up to 12 percentage points (Spain in the tough scenario). Furthermore, the projections imply heterogeneous developments concerning the group of young workers in the age range from 15 to 29 years. Although this group is, on average, decreasing in size, mirroring the old age development, some countries such as Belgium, Denmark and Italy display an increasing share of this group in the labor force, even for the tough scenario (Table 3). Reasons for this are the different underlying

[5] The analysis in this paper entails some discrepancies with the numbers presented for Germany in Dolls et al. (2012). This is due to two reasons. First, the scenarios underlying the population projections by NIDI underwent substantial changes to incorporate findings from the NEUJOBS project. Second, we apply a slightly different labor force definition, as in Dolls et al. (2012), persons in the education system were not accounted for. This might however lead to misleading conclusions, as people in the education system are not necessarily inactive on the labor market.

Figure 1: Change in Total Labor Force



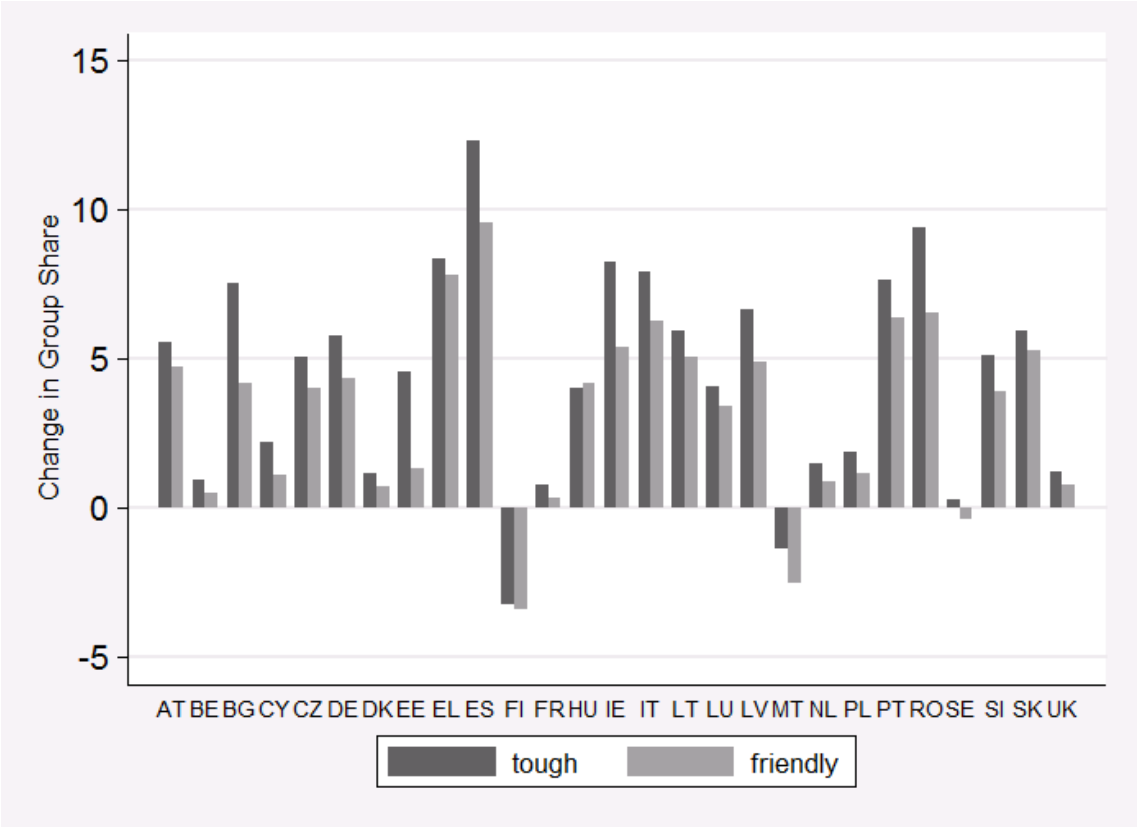
For source data, see Table 2.

migration scenarios and fertility developments across countries in the past 20 years. [6]

A similar decomposition of the skill structure of the labor force is presented in Table 4. We distinguish between those who are high-skilled, medium-skilled and low-skilled. We define medium-skilled individuals as those who have completed at least an upper secondary education (ISCED 3 and 4). High-skilled individuals are defined as those with a completed tertiary education or higher (at least ISCED 5). Strikingly, the population projections imply increasing educational attainment throughout the EU. This can be seen by the increasing share of high-skilled workers in all countries, even in the tough scenario. The lowest increases are found in Germany and Austria. One possible reason for this is be the institutionalized vocational training system

[6] Assumptions about future fertility are unlikely to exert substantial influence on the development of the share of young workers in the labor force as changes in fertility are not reflected in the labor force before 20 years has passed, which is beyond the time scope of our projections.

Figure 2: Changes in the share of elderly workers in the labor force



Note: Elderly workers are defined as those aged 50 years and above.

in these countries. In some cases, these eduaction tracks are comparable with a technical college degree in other countries. The tough scenario implies an increase of only 0.9 percentage points of high-skilled for Germany. The strongest boosts, on the other hand, are observed in Poland and France. Even in the tough scenario, the share of high-skilled in these countries is projected to increase by 10.7 and 9 percentage points, respectively. These increases are substantially stronger in the friendly scenario.

Summing up, one can conclude that, on average, the total population available for the labor market is projected to shrink across the majority of EU countries between 2010 and 2030. Moreover, the labor force will become older on average and contain a higher share of high-skilled workers. Importantly, the projections show that European countries will be affected heterogeneously by demographic trends.

3 Behavioral Labor Supply Model and data base

So far, our analysis has focused on the structural component of demographic change, i.e. changes in population subgroups in absolute and relative terms. From a labor supply perspective, it is of particular interest to draw conclusions on how these structural demographic changes translate into the total quantity of work that is supplied in an economy. As in Dolls et al. (2012), we interpret the difference between the change in the headcount and hours worked as the *behavioral* dimension of demographic change.[7]

Individual and household labor supply, i.e. the decision on whether to work and, if so, how much, is one of the most extensively studied fields in labor economics.[8] Today's research focuses on aspects such as the consequences of changes in the tax and welfare system on labor supply, for example, changing work requirements of transfers. Researchers have identified a wide range of determinants affecting individual behavior on the labor market. Among these, age, gender, marital status and

[7]It is important to note that we hold gross wages and the institutional setting constant in each country.

[8]For an overview about recent advances in the literature, see Blundell and MaCurdy (1999) and Keane (2011).

number of children are found to be of major importance in explaining labor market behavior. Typically, the distribution of weekly working hours is concentrated around non-participation and full-time work. In our sample, about 46% of all individuals of the European Labor Force are found in the full-time category. Part-time and over-time work are exceptions, accounting together for only one fifth of the sample. Substantial differences in the hours distribution can be traditionally observed between men and women. Especially in countries with classic gender roles, men are predominantly found in the full-time and over-time category, while women are rather concentrated in the non-working and part-time category. This translates into lower behavioral responses of men to changes in the wage rate, implying a wage elasticity of labor supply close to zero. On the other hand, married women are found to have rather high responses to wage changes, although this pattern has been subject to change in recent decades as women's wage elasticity of labor supply is found to have declined. (Blau and Kahn, 2007). Beyond this, the institutional setting of an economy plays a crucial role for an individual's labor supply. For example, increasing the availability of child care facilities is typically expected to increase female labor market participation.

The behavioral labor supply model used to forecast changes in future labor supply follows standard economic theory by assuming that households seek to maximize their utility. Utility is assumed to depend on leisure and consumption. Both arguments enter a joint utility function. In this context, "joint" utility implies the joint decision of couples with equal treatment of wives' and husbands earnings. The standard framework to deal with this kind of problem is the discrete choice approach first proposed by van Soest (1995) and widely adapted and used thereafter. Assuming a discrete choice of labor supply entails several advantages compared to treating labor supply as a continuous choice. Institutional constraints and empirical evidence reveal that the actual distribution of hours worked is concentrated on a few mass points. In addition, in using a discrete choice labor supply model, one circumvents the cumbersome procedure of specifying the non-linear and highly complex budget constraint inherent to all modern tax and benefit systems. Instead, it is sufficient to evaluate the budget constraint at a few points of interest. Finally, the discrete

choice approach allows an easy treatment of the joint decision-making within a couple. A technical description can be found in Dolls et al. (2012) and Peichl et al. (2010) and is therefore not presented here in detail. In this paper, we build on Bargain et al. (2012) for the data processing and the labor supply estimation. This implies a deviation from the methodology in Dolls et al. (2012) one aspect by assuming a smaller choice set of only four alternatives instead of seven in order to reduce the computational burden.[9] In the remainder of the paper, the choice set is composed of non-participation, part-time work, full-time work and overtime work. As a consequence, the choice set for a couple entails 16 choices. Though nested in a neo-classical tradition, our framework is able to capture non-pecuniary aspects of labor, such as a negative utility arising from receiving welfare benefits (welfare stigma).

The basic estimation process works as follows. For the base scenario, we estimate the parameters of the utility function based on observed work behavior, given socio-demographic characteristics of the household. Leisure is simply derived from subtracting hours worked from an assumed maximum working time of 80 hours per week. In order to obtain the disposable income, and hence the consumption opportunities for each household, we require for each country under investigation.

1. a micro-dataset containing information on labor market behavior, household composition and market income

2. a detailed replication of the tax and transfer system

This information is accessible via the European Union tax-benefit microsimulation model EUROMOD (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 bearing some drawbacks common to all survey data (e. g. under-reporting of capital income, under-coverage of certain population subgroups), there are clear advantages of using EU-SILC instead of nationally conducted surves. By applying the same definitions in every

[9]The size of the choice set has been found to be of minor importance for the sensitivity of results, provided the choice set is not implausibly small (Euwals and van Soest, 1999).

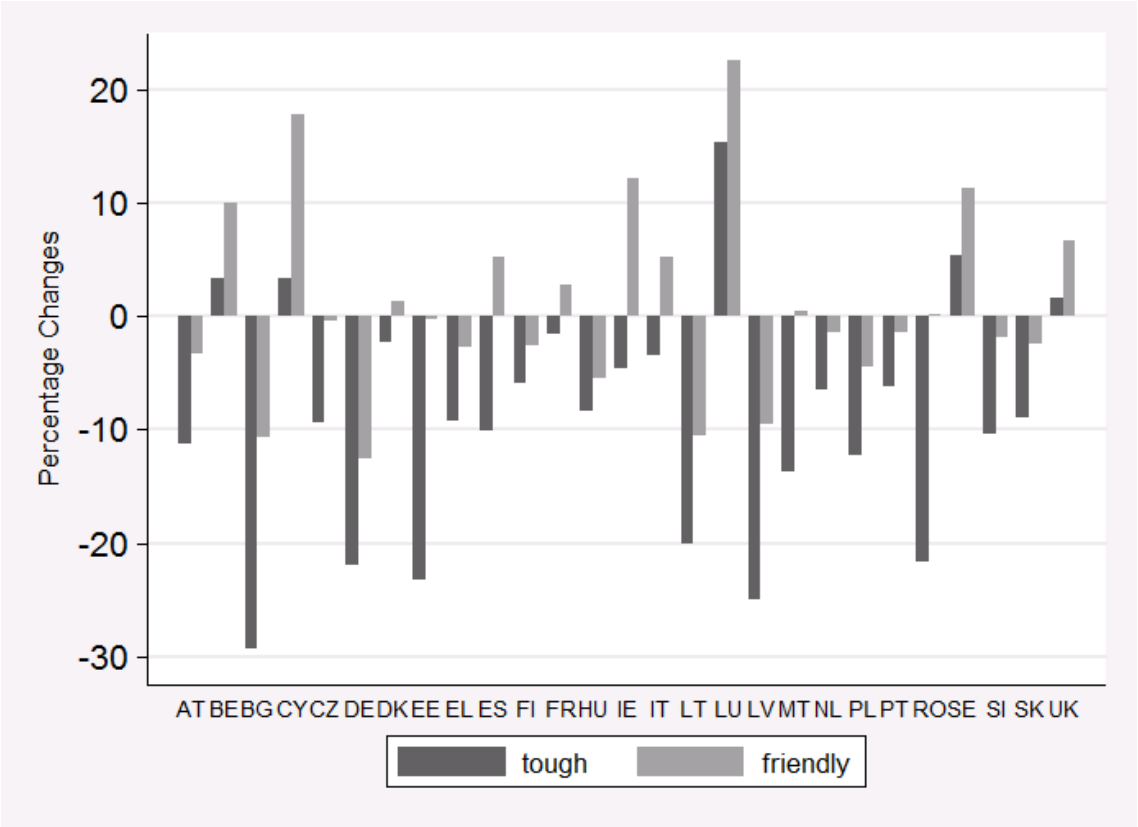
country, high comparability is guaranteed. EUROMOD uses the EU-SILC data and feeds them into country-specific tax-benefit calculators. These replicate the national tax and benefit regulations and calculate individual payments for all relevant taxes, contributions and benefits. The tax-benefit calculators are designed and maintained by national experts, guaranteeing timeliness and accuracy. The resulting disposable income, *after* taxes and tranfers, serves then as input for the labor supply estimation.

There are a range of benefits (especially unemployment benefits) that are paid only for a limited period of time. If a recipient is needy after this time period, he is eligible for another, usually lower, transfer which typically takes the form of a minimum income. Since we apply a long-term perspective of 20 years, we artificially set all temporary benefits to zero. Ignoring this step would imply that if a household receives temporary unemployment benefit in the sample year, he is predicted to receive the same benefit in 2030. This would cause potentially misleading conclusions with respect to labor supply behavior and fiscal budgets. Instead, we set these households to long-term unemployment benefit / social assistance for both periods.

4 Labor Supply in 2030

Based on the estimated preference parameters, we are able to obtain choice probabilities for each working hour category. Multiplying each choice probability with the sample weight and its attributed amount of hours and then summing over the whole population yields the total number of worked hours for a given country.*ES: We could justify somewhere why we use LS at all. For the exercise here, observed choice could've been used, too. However, we will make us of it when matching supply and demand. Beyond it might be appropriate to view one household as the representative of a certain sub-population, whose choices are not concentrated on one category. I will estimation tables later on...* By altering the weights for future populations, we can assess the change in the total amount of hours worked, as depicted in Figure 3 (see also Table 5 in the Appendix).

Figure 3: Change in Total Hours Worked



For source data, see Table 5

For the interpretation of Figure 3 it is important to note that households are not exposed to a different economic environment in 2030, therefore they are not induced to adjust their labor supply behavior in the strict sense. What we refer to here as the behavioral dimension is the consequences of a change in the demographic structure on aggregate labor supply measured in hours. We demonstrated an increasing share of older workers in the European labor force. This is reflected by higher sample weights in our data, implying that the individual behavior of older workers is attributed more weight for the overall population. A decreasing amount of hours therefore implies that those people that work less on average take a larger share in the future labor force.

Our projections indicate that the total amount of hours worked is expected to shrink in the tough scenario by 8.7% on average. The friendly scenario, however, implies an aggregate increase of 1%. Significant reductions in total hours worked are projected for Bulgaria, Germany, the Baltic States and Romania, mirroring the development in total heads. On the other hand, the friendly scenario projects an

increase, or at least a stagnation in hours worked in about half of the EU countries. This indicates divergent changes in the labor force when accounting for the behavioral dimension. In some countries, demographic change reduces the relative size of the population group working full time. In other countries, a reduction in part-time work is projected. These divergent patterns are discussed in more detail in a case study for Germany and France in section 5.

Considering the extensive margin of labor supply, Table 6 demonstrates the implicated development for the Employment Rates, i. e. the share of people working at least part-time. These changes are rather modest in average. For the friendly scenario, European employment rates are projected to increase by about one percentage point in average. However, the employment rates of Germany, Austria and Slovenia are expect to decrease by at least one percentage point in both scenarios.

In order to differentiate between the two dimensions of demographic change (structural and behavioral), we investigate whether the projected relative change in total hours is larger or smaller than the change in heads. For this, the so-called *excess difference* ED is calculated. It is defined as the difference between the percentage change in hours minus the percentage change in heads.

$$ED = \Delta\%\text{Hours} - \Delta\%\text{Heads}$$

This difference is displayed in table 1 for each country and scenario.

An ED of less than zero indicates that the structural tendencies are reinforced by individual behavior patterns. If, for example, labour supply is age-dependent with older workers working fewer hours and the share of older workers is growing, the total reduction in hours is even larger than the reduction in the headcount. Such a case is indicated with dark grey shading of the respective cell in Table 1. On the contrary, it might be that the reduction in hours is less severe than in heads because, for example, there are fewer part-time workers, thereby weakening the adverse effect on total labor supply. These cases are indicated with a light grey shading.[10]

[10] The effects may also run in the opposite direction. In Belgium, for example, an increasing labor force is accompanied by an even stronger increase in total hours.

Table 1: Excess difference

Country	tough	friendly
AT	-3.4	-2.5
BE	1.8	3.7
BG	-0.7	1.6
CY	2.9	5.4
CZ	1.4	3.0
DE	-3.3	-1.5
DK	1.0	1.5
EE	-1.0	2.0
EL	-1.7	-0.7
ES	-2.1	-0.5
FI	1.8	2.7
FR	1.2	2.3
HU	2.5	3.6
IE	-1.3	0.7
IT	0.7	0.4
LT	1.1	3.8
LU	-0.9	-0.2
LV	0.5	3.2
MT	5.9	8.4
NL	0.3	1.4
PL	3.7	5.8
PT	2.1	0.5
RO	-2.4	3.0
SE	1.9	3.1
SI	-1.7	-0.9
SK	1.3	2.6
UK	-0.1	1.2

Intuitively, the dark-shaded cases represent a significant challenge from a policy point of view. It basically implies that the drop in total labor supply is even stronger than the drop in headcounts. The demographic change is thus aggravated by the pattern of age-specific labour supply. For example, the adverse effect of demographic change on public budgets, e. g. via increasing old-age pension obligations, might be underestimated if only the structural development is accounted for. For these cases, the demographic change exerts additional pressure on policy-makers. Based on the figures presented so far, it is, however, hard to gauge the extent of pressure on public budgets.

To make this point clear, we provide an analysis of the fiscal effects implied by the structural and behavioral adjustments outlined above. These are derived

from EUROMOD calculations. Table 8 lists the change in income tax revenues, while Table 9 illustrates the change in revenues from social security contributions (SSC).[11]

The results presented in the Appendix reveal that the trend in public revenues partly follows the development in total hours worked. In the tough scenario, income tax revenues are expected to shrink in those countries with a decreasing overall labor supply. The most drastic revenue cuts are projected for Bulgaria, Estonia, Germany and Latvia. In these countries, income tax revenues decrease by about one quarter. The average decrease (6.0%) is however lower than the decrease in hours (8.7%).[12] In the friendly scenario, in contrast, tax revenues are expected to rise in most countries, the notable exception being Germany. This may sound counterintuitive, as total hours worked remain constant on average (Table 5). Because we keep real wages fixed, labor earnings and hence the income tax base should not be affected dramatically as well. Therefore, one could expect minor changes in tax revenues, too. Table 8 however reveals an average increase in income tax revenues of 7.0% for the friendly scenario. This can be explained by the fact that income tax schedules are predominantly progressive in the EU. Although individual labor earnings remain unchanged, total labor earnings and thus the income tax base may increase because those with higher earnings take a larger share of the future population. This is plausible given that we project an increasing share of old-age workers, who typically earn more in average than younger workers. In a progressive tax system, this mechanism leads to higher total tax revenues. In most countries, this "progression effect" works against the change in total hours worked. The Portuguese example illustrates this. While the change in hours is negative, but moderate (-6.2% and -1.4% respectively), projected tax revenues are projected to increase by 4.1% and

[11] Income taxes are equivalent to the EUROMOD variable `tin_s`. In some countries (e. g. Austria and Luxembourg), this includes a tax credit, leading to potentially negative individual tax payments. SSC revenues are calculated for employees only, including old-age, health, long-term care, unemployment and accident insurance, if existent in the country. This corresponds to the EUROMOD variable `ils_sicee`.

[12] We also report aggregate simulated revenues. They mostly exhibit under-coverage of tax revenues when compared to officially reported numbers. We simulate personal income taxes from workers only, ignoring pensioners' tax payments. Further differences may arise from insufficient modelling of the tax rules in EUROMOD. If these errors are not systematic however, the projected revenue *changes* seem to be a consistent number.

16.2% respectively, overcompensating the hours effect. This suggests that a progressive tax system may be one institution capable of smoothening the adverse effects of demographic change.

A slightly different picture however emerges for the projected changes in revenues from social security contributions (SSC, Table 9). For SSC, the expected changes in revenue are on average more adverse than for the income tax. If one weights the differences by country population, SSC revenues even decline slightly in the friendly scenario. This is due to the fact that 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. Infact, the changes in SSC revenues are mostly comparable to the changes in total hours.

Hence, SSC cannot have a stabilizing role for public budgets as the personal income tax scheme can. It should be noted, however, that contribution-based welfare systems are not of equal importance for the welfare system across EU countrie. As an example, the financing of the Danish public health and pension system is based on tax payments only, which makes SSC revenues a relatively minor source of revenue. Nonetheless, a cut in SSC might be particularly problematic in light of an increasing dependency ratio and higher pension payments.

5 Case Study: Germany vs. France

The socio-ecological transition entails various policy challenges for European labor markets. In what follows, we sketch two of these developments in more detail for the example of the two core economies in the EU: Germany and France.

We observe some differences in the distribution of hours worked in 2010. While non-participants and part-time workers in Germany account for 47% of the labor force, we observe only 41% in these categories in France. Consequently, the share of full-time workers in France (50%) exceeds the German share (42%). This difference can be explained by a higher labor market participation of women. While the age structure of the labor force is quite comparable in the two countries, there are strik-

ing differences in the skill structure. On the one hand, there are more low-skilled workers in France (32% vs. 21%). On the other hand, the share of high-skilled workers is slightly higher in France, too (26% vs. 22%). One should, however, keep in mind the different training systems in both countries. Germany has an institutionalized vocational education system providing a relatively high qualification. Some master craftsmen, although they do not have a college degree, should arguably be classified as high-skilled. We, however, follow common practice and classify them as medium-skilled, as in Peichl and Siegloch (2013). Considering the projected structural changes, we have discussed the dramatic shrinking of the German labor force by 2030. At the same time, the French labor force is projected to remain about constant. This can be explained by a larger child cohort in France today, as fertility rates are traditionally higher in France (about 2.0 vs. 1.4 in Germany). In 2030, the projected age structure in France is largely comparable with the 2010 structure. Compared to that, the elderly share in Germany increases by about 5 percentage points in both scenarios. An opposing picture emerges from the changes in the skill structure. While it is projected to be rather stable in Germany, France will, according to the projections, extend its high-skill share, at the cost of its low-skilled share. To summarise, a projected increasing educational attainment of the French labor force is accompanied by a stable age structure, while the German labor force grows older while maintaining a constant educational attainment.

Figure 4: Change in Hours Distributions, tough scenario

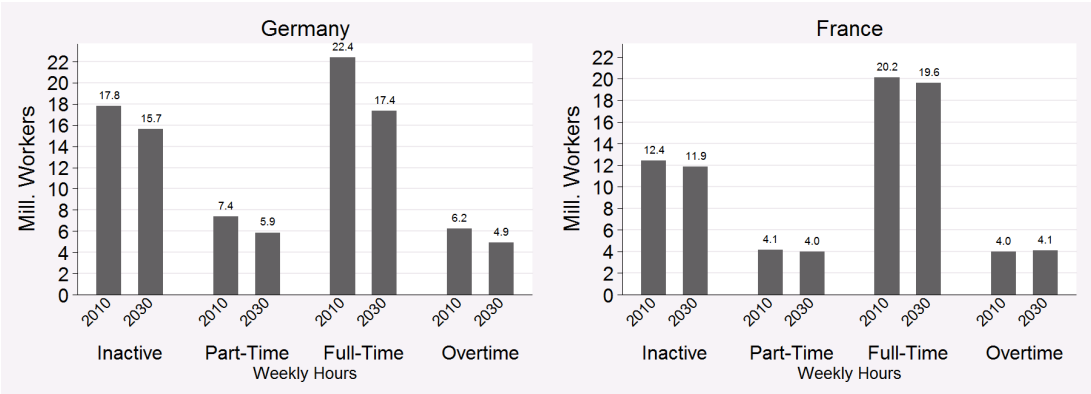


Figure 4 is a decomposition of the total labor force by year and hours category. These are obtained by multiplying individual choice probabilities with the respective sampleweights, delivering the amount of people in every choice category. For the

tough scenario, we project a sharp fall in the number of workers throughout all hours categories in Germany. This is, in principle, not surprising, considering the decrease in total labor force. The drop in total workers is however disproportionate in the full-time category. Decomposing this trend helps to identify the key factors behind this development. Medium-aged workers (30 to 49 years) account for more than half of the workers in the full-time category in 2010 in Germany. The decline of this group leads to 3 million less workers in the full-time category in this age group alone. This is an illustrative example for the behavioral dimension of changes in labour supply. Demographic change reduces the share of those groups that exhibit, on average, a higher number of working hours.

The French hours distribution is projected to maintain its baseline structure for the most part. As opposed to Germany, the age structure will be hardly affacted by demographic change, which eliminates this channel for reducing the amount of full-time workers. As outlined above, the population projections for France imply increasing educational attainment and, therefore, a rising share of high-skilled workers. This change, however, is not reflected in the total hours distribution, as the preferences on how much to work do not seem to differ substantially between different levels of education.

Comparing Germany and France, therefore, suggests that the change in the age composition of the labor force is a major driving force for changes in hours worked. Differences in the future skill structure are negligible. If the shift towards elderly workers is particuarly strong, one would expect adverse behavioral effects on labor supply, thus aggravating the trends from the structural demographic change.

6 Conclusions

The contribution of this paper was an analysis of structural and behavioral changes in European labor supply for the year 2030. Building on Bargain et al. (2012), Dolls et al. (2012) and Peichl and Siegloch (2013), we incorporated demographic projections and provided micro-based descriptive evidence for the major demographic trends in Europe. Our main findings can be summarized as follows. The labor force,

defined as the population between 15 and 64, is projected to shrink in most EU countries. At the same time, it will change its composition towards better-educated and older workers. Considering the development in total hours worked (i. e. the behavioral dimension), our projections imply divergent developments. While the behavioral changes (in hours) aggravate the structural changes (in heads) in some countries, they are weakened in other countries. Notable challenges are expected to arise in Austria, Germany and Spain. These developments are likely to translate into cuts in public revenues, though a progressive system of personal income taxes seem to be able to compensate for the adverse effects of shrinking labor supply to some extent.

Although there are some meta-trends present in nearly all countries, such as increasing educational attainment, our analysis demonstrates the complexity and non-uniformity of the socio-ecological transition across the 27 EU countries.

There are some drawbacks to our analysis. Real wages were assumed to be constant across the projection period. Moreover, we considered only the supply side of the labor market, ignoring potential demand effects. In the subsequent work-steps, we will address these shortcomings by confronting our findings with reactions on the demand side of the labor market. Based on this, we are able to draw conclusions on the development of skill-specific wages, leading to a more complete picture of labor market trends in Europe.

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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
Weighted Avg.				-8.7	-1.4

Table 3: 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

Table 4: 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

Table 5: Hours worked

Country	Mill. Hours	% Change	
	Base	tough	friendly
AT	153.3	-11.2	-3.4
BE	185.0	3.3	10.0
BG	171.6	-29.3	-10.7
CY	16.9	3.3	17.8
CZ	226.2	-9.4	-0.5
DE	1436.0	-22.0	-12.6
DK	112.0	-2.3	1.3
EE	29.1	-23.2	-0.2
EL	210.0	-9.2	-2.7
ES	891.0	-10.1	5.2
FI	107.6	-5.8	-2.5
FR	1131.5	-1.5	2.8
HU	186.1	-8.4	-5.5
IE	81.4	-4.6	12.1
IT	1091.4	-3.4	5.2
LT	67.9	-20.1	-10.6
LU	9.4	15.4	22.5
LV	49.3	-25.0	-9.5
MT	6.8	-13.7	0.4
NL	282.4	-6.5	-1.4
PL	752.7	-12.2	-4.4
PT	204.6	-6.2	-1.4
RO	372.4	-21.7	0.2
SE	176.3	5.3	11.3
SI	39.1	-10.3	-1.9
SK	117.8	-9.0	-2.4
UK	1020.1	1.6	6.7
Unweighted Avg.		-8.7	1.0
Weighted Avg.		-8.8	-0.2

Table 6: Employment Rates

	Employment Rate, in %			Change in Percentage Points	
Country	Base	tough	friendly	tough	friendly
AT	67.3	64.8	65.5	-2.6	-1.8
BE	64.9	66.0	67.0	1.1	2.1
BG	75.5	74.6	76.7	-0.9	1.2
CY	71.7	73.2	74.6	1.5	2.8
CZ	70.2	71.2	72.3	1.0	2.0
DE	67.7	65.0	66.4	-2.7	-1.3
DK	80.2	81.0	81.5	0.8	1.3
EE	77.9	76.8	79.2	-1.1	1.3
EL	65.0	63.8	64.6	-1.1	-0.3
ES	69.6	68.0	69.3	-1.6	-0.4
FI	76.9	78.2	79.0	1.4	2.1
FR	69.5	70.1	70.7	0.6	1.2
HU	65.7	67.2	67.9	1.5	2.2
IE	70.2	69.4	70.8	-0.8	0.6
IT	66.3	66.5	66.3	0.2	0.0
LT	71.9	72.8	74.9	1.0	3.1
LU	68.0	67.2	67.5	-0.8	-0.5
LV	76.7	77.1	79.0	0.4	2.2
MT	57.2	61.6	62.6	4.4	5.4
NL	72.0	72.2	72.9	0.2	1.0
PL	65.3	68.1	69.4	2.8	4.1
PT	68.9	69.8	68.8	0.9	-0.1
RO	58.8	57.1	60.7	-1.7	1.9
SE	78.7	80.0	80.9	1.3	2.2
SI	67.0	65.4	66.1	-1.5	-0.9
SK	70.1	71.4	72.5	1.2	2.3
UK	64.8	64.7	65.4	-0.1	0.6
Unweighted Avg.				0.2	1.3
Weighted Avg.				-0.3	0.7

Table 7: Labor Force by Working Hours

Country	Mill. Workers				% Change							
	Base				tough				friendly			
	0	20	40	60	0	20	40	60	0	20	40	60
AT	1.8	0.5	2.7	0.6	-0.5	-10.3	-11.8	-9.5	4.5	-2.7	-4.1	-1.2
BE	2.5	0.8	3.1	0.8	-1.7	3.7	2.7	4.8	0.0	8.4	9.4	12.1
BG	1.3	0.3	2.7	1.0	-26.1	-28.3	-30.3	-27.6	-16.7	-16.0	-10.4	-10.8
CY	0.2	0.0	0.3	0.1	-4.9	-8.4	2.8	6.5	1.2	2.9	17.4	21.3
CZ	2.2	0.3	3.8	1.1	-13.8	-12.1	-9.8	-8.4	-10.0	-3.6	-1.2	1.5
DE	17.4	7.4	22.8	6.3	-11.9	-20.6	-22.5	-21.4	-7.5	-13.7	-13.0	-11.1
DK	0.7	0.5	2.2	0.2	-7.3	-2.6	-2.2	-2.9	-6.6	3.0	1.2	1.1
EE	0.2	0.0	0.6	0.1	-18.4	-23.2	-23.8	-21.0	-7.8	-4.4	-0.9	3.4
EL	2.6	0.6	3.0	1.3	-4.6	-6.6	-10.0	-8.4	-1.1	2.1	-3.4	-2.4
ES	9.5	2.9	15.2	3.8	-3.1	-12.3	-9.5	-11.2	7.0	2.2	6.4	2.7
FI	0.8	0.4	2.0	0.3	-13.0	-7.1	-5.8	-5.5	-13.9	-4.8	-2.0	-3.6
FR	12.4	4.0	20.3	4.0	-4.6	-3.3	-2.6	2.7	-3.5	-0.0	1.7	7.3
HU	2.4	0.3	3.7	0.5	-14.9	-13.2	-9.2	-3.7	-14.9	-13.0	-6.7	1.5
IE	0.9	0.4	1.5	0.2	-0.5	0.9	-6.8	1.5	9.2	15.9	11.2	13.7
IT	13.4	3.6	17.2	5.6	-4.8	-3.5	-4.9	-0.3	4.6	5.4	3.6	8.2
LT	0.6	0.1	1.3	0.2	-23.9	-19.0	-20.5	-18.5	-23.7	-11.9	-10.8	-9.1
LU	0.1	0.0	0.2	0.0	19.3	13.6	14.1	19.6	24.6	20.4	20.4	29.3
LV	0.4	0.1	0.8	0.2	-26.6	-27.3	-24.9	-24.7	-21.0	-19.6	-9.2	-8.1
MT	0.1	0.0	0.1	0.0	-27.9	-8.7	-13.8	-14.3	-19.5	2.9	0.9	-1.6
NL	3.1	2.4	5.1	0.5	-7.5	-6.4	-6.5	-6.8	-6.1	-2.2	-1.0	-2.6
PL	9.5	2.0	11.7	4.1	-22.8	-13.9	-12.2	-12.0	-20.8	-7.8	-3.8	-5.0
PT	2.2	0.4	3.6	0.9	-10.8	-15.0	-8.0	0.4	-1.5	-8.3	-2.7	3.4
RO	6.2	0.4	7.1	1.3	-16.0	-24.6	-21.1	-23.4	-7.2	-19.2	2.3	-5.5
SE	1.3	1.1	3.3	0.4	-3.0	4.1	5.7	4.0	-3.2	10.2	11.9	9.3
SI	0.5	0.1	0.8	0.1	-4.4	-14.1	-11.1	-6.2	1.6	-8.2	-2.4	1.4
SK	1.2	0.1	2.2	0.5	-14.0	-7.6	-8.2	-11.4	-12.4	-1.3	-0.6	-7.9
UK	14.4	5.2	18.3	3.0	2.2	1.3	1.4	2.6	3.7	4.6	6.9	7.0

Table 8: Change in Income Tax revenues

	Billion Euros			% Change	
Country	Base	tough	friendly	tough	friendly
AT	21.7	19.1	21.2	-12.0	-2.3
BE	30.7	31.6	34.0	3.1	10.7
BG	0.7	0.6	0.7	-25.4	-4.8
CY	0.6	0.6	0.7	7.0	29.0
CZ	3.6	3.3	3.8	-7.5	5.8
DE	178.5	133.6	155.0	-25.1	-13.2
DK	6.8	6.8	7.0	0.1	3.2
EE	0.6	0.5	0.6	-22.8	0.8
EL	5.5	5.8	6.6	5.0	20.0
ES	39.3	36.8	43.6	-6.3	10.7
FI	13.7	13.0	13.7	-5.3	0.3
FR	36.6	36.4	38.0	-0.4	3.9
HU	4.1	3.8	4.2	-8.6	2.3
IE	11.2	10.7	12.4	-4.5	10.3
IT	74.5	71.4	80.8	-4.2	8.4
LT	1.5	1.3	1.4	-17.0	-5.8
LU	1.0	1.2	1.3	14.6	25.4
LV	1.3	1.0	1.2	-25.8	-5.6
MT	0.3	0.3	0.3	-10.6	8.0
NL	38.2	36.0	39.2	-5.7	2.6
PL	4.9	4.5	5.0	-9.4	1.9
PT	6.3	7.1	7.8	13.2	23.6
RO	2.2	1.9	2.5	-12.9	17.7
SE	35.4	38.3	40.6	8.1	14.5
SI	2.1	2.0	2.3	-3.2	10.1
SK	1.1	1.0	1.1	-8.8	0.4
UK	111.7	115.8	123.1	3.7	10.3
Unweighted Avg.				-6.0	7.0
Weighted Avg.				-7.1	4.4

Table 9: Change in Social Insurance Contributions

	Billion Euros			% Change	
Country	Base	tough	friendly	tough	friendly
AT	14.0	12.3	13.7	-12.1	-2.1
BE	13.8	14.2	15.1	2.3	9.4
BG	0.5	0.4	0.5	-26.7	-5.2
CY	0.2	0.2	0.3	2.7	19.7
CZ	3.6	3.4	3.7	-7.4	3.4
DE	121.3	91.3	103.8	-24.8	-14.4
DK	6.3	6.2	6.4	-1.9	1.8
EE	0.1	0.0	0.1	-23.7	0.4
EL	5.3	5.3	5.9	0.9	12.3
ES	14.3	12.7	15.2	-11.0	6.1
FI	2.8	2.7	2.8	-5.9	-0.8
FR	68.1	67.0	70.0	-1.5	2.9
HU	3.2	2.8	3.1	-10.3	-2.5
IE	2.8	2.6	3.1	-6.4	10.7
IT	30.8	29.3	32.6	-4.9	6.1
LT	0.2	0.2	0.2	-17.4	-6.8
LU	0.8	0.9	1.0	14.3	21.5
LV	0.6	0.4	0.5	-25.8	-5.8
MT	0.1	0.1	0.1	-16.9	-0.8
NL	33.1	31.1	33.4	-5.9	0.9
PL	9.9	8.4	9.3	-14.9	-6.1
PT	4.8	4.8	5.2	0.6	9.8
RO	2.2	1.8	2.5	-15.2	13.9
SE	5.8	6.2	6.6	7.9	14.0
SI	2.9	2.7	3.1	-6.0	6.7
SK	1.7	1.5	1.7	-10.2	-2.5
UK	54.6	56.5	59.9	3.4	9.7
Unweighted Avg.				-8.0	3.8
Weighted Avg.				-8.8	1.6

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`.