Update and extension of the Labour Market Model

Final report

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Table of Contents

Figures and Tables

1. Introduction

The current project is financed under the European Programme for Employment and Social Innovation 'EaSI' 2014-2020. EaSI is a financing instrument at the EU level managed directly by the European Commission, which contributes to the implementation of the Europe 2020 strategy. It provides financial support for the Union's objectives in terms of promoting a high level of quality and sustainable employment, guaranteeing adequate and decent social protection, combatting social exclusion and poverty, as well as improving working conditions. The aim of this project is an update, extension and refinement of the existing Labour Market Model (LMM).

Striving to improve the European Commission's understanding of the transmission mechanisms of labour market policies in the context of the European Employment Strategy, the Commission has developed LMM through contracted external experts in the project 'Modelling of Labour Markets in the European Union' (see Berger et al., 2009). The model coverage was further extended in the project 'Development/Maintenance of the Labour Market Model' (Berger et al., 2012). The third external project, 'Updating of the Labour Market Model' (Berger et al., 2016), involved a comprehensive update of the underlying data and the model calibration for eight Member States, a careful documentation of all steps taken, as well as the simulation and analysis of an illustrative policy scenario.

LMM is a dynamic computable general equilibrium model with a detailed description of the labour market. The model is based on an in-depth micro-foundation for the actors involved, namely households and firms. The model is applied to assess how an economy might react to changes in labour market policies, other policy reforms, or external factors. LMM is used to provide a theoretical and empirical basis for identifying the possible direction and intensity of the effects of policies, rather than to make forecasts/projections of future developments. For instance, such policies can comprise changes in direct and indirect taxation, active and passive labour market policies, employment protection legislation (EPL), training subsidies, pension regimes, direct support to vulnerable groups (such as low-income employment), and demographic shocks (e.g., migration).

Based on an Overlapping Generations approach in the spirit of Samuelson (1958) and Diamond (1965) and refined by Gertler (1999) and Grafenhofer et al. (2007), household behaviour and all relevant labour market variables are modelled for eight different age groups. Four of these groups belong to the working-age population, three have already reached retirement age and do not participate in the labour market, while the so-called mixed age group includes people of working age who are already eligible to retire. Importantly, the model features three different skill groups (low-, medium-, and high-skilled persons), endogenous skill choice, as well as complementarity between capital formation and skills.

Decisions of households and firms are the result of an optimisation of lifetime utility and firm value, respectively. Households decide on the allocation of private consumption over the life-cycle, labour supply along several margins (participation in the labour market, the intensity of job search if unemployed, number of hours worked if employed, and retirement age) and investment in human capital (educational decisions at the beginning of a lifetime and lifelong learning decisions during active life). Firms choose the optimal amount of physical investment (according to the q-theory of Hayashi, 1982), the number of vacancies, the lay-off rate, and the amount of investment in firm-

sponsored training. The model applies a static search model, as in Boone and Bovenberg (2002), which is based on the pioneering search unemployment approach reviewed by Mortensen (1986). The specific structure of the model allows for age- and skill-specific labour markets and unemployment rates. Wages are the result of a bargaining process between firms and households. The model captures a detailed description of public revenues and expenditures, as well as relevant institutions (e.g., passive labour market policies or EPL).

Simulation results indicate the effects of policy reforms on macroeconomic and labour-market specific variables (such as GDP, investment, private consumption, unemployment, employment, and wages). Household-specific variables can either be presented on an aggregate level or on a more disaggregated level, such as age- and/or skill-dependent. Based on the model, inter- as well as intra-generational and inter-temporal effects can be analysed.

Simulation analysis with the LMM regularly feeds into the 'Employment and Social Developments in Europe' review, the Directorate General of Employment, Social Affairs and Inclusion's (DG EMPL's) annual flagship publication. In addition, the model is used to provide supporting evidence for the European Semester impact assessments, as well as for ad-hoc requests by colleagues from DG EMPL and other Directorates General.

The model derives firms' and worker's labour market and economic behaviour from some general intertemporal utility/profit maximisation problems, as described in Part II of the Berger et al. (2009) project report. Most of the resulting equations are assumed to be similar across the different Member States, while country-specific differences are implemented via different values of the same parameter.

To calibrate the model, a considerable amount of data input from various data sources is required. To the extent possible, we use harmonised data. Basically, part of the calibration procedure is based on methods that are similar across countries (e.g., age- and skill-specific labour market variables derived from disaggregated household micro data or macroeconomic indicators), while other parts of the calibration method (e.g., institutional settings) require considerable additional effort for each country.

As the model differentiates several age and skill groups, there is a need for individual and household data. Since most of the data are not available from published official statistics in sufficiently disaggregated detail, we calculate them from micro-data, including the EU Labour Force Survey (LFS), the EU Statistics on Income and Living Conditions (EU-SILC), and the Household Budget Survey (HBS). As the breakdown into several age and skill groups reduces the sample size of the datasets, we merge several years of micro-data.

Due care is taken to update institutional details in the different countries. We mainly rely on the MISSOC database, OECD publications such as *Pensions at a Glance* or *Taxing Wages*, and national sources. The aggregate structure of taxes and social contributions is taken from OECD *Revenue Statistics*. As in the previous projects, we derive the breakdown of income tax and employee and employer social security contribution rates into age and skill groups by merging the results of the TaxBEN model of the OECD with income data from the EU-SILC. Values that reflect the strictness of EPL are updated using information from the OECD's EPL Index. The system of national accounts (SNA) is used to update major macroeconomic aggregates, such as private and public consumption, as well as the capital and labour income share.

The empirical literature provides estimates for several behavioural parameters to reflect the behaviour of households and firms in the LMM. In the current project, we update the main parameters by taking into account recent empirical research results.

In addition to the severe health issues caused by the global COVID-19 pandemic, it also resulted in an economic disruption and 'put a sudden stop to the continuous improvements in EU labour markets and social situations' (European Commission, 2020). Russia's war of aggression against Ukraine entailed significant economic consequences, in particular concerning energy markets. The resulting boost of energy prices and the ongoing disruption of trade relations led to a pronounced increase of prices throughout the world, challenging growth perspectives and social cohesion. Uncertainty about the extent to which these crises affect medium-term labour market and economic prospects remains. On the other hand, the LMM is used to provide a theoretical and empirical basis for identifying the possible direction and intensity of the effects of labour market policies, rather than to make short-term forecasts/projections of future developments. This issue is taken into account for the calibration of LMM. We usually refer to data from 2015 to 2019 for the calibration of the model, partly due to the lack of availability of more recent data, partly in order to 'adjust' for these extraordinary circumstances and partly to smooth out business cycle fluctuations.

An overview of major parameters of the model and sources used to gather this information can be found in Table 1.

Table 1: Data sources for major parameters for updating LMM

Parameters	Main Data Sources
Labour market data (e.g., (un-)employment rates, LLL intensity, dismissals)	LFS, EU-SILC
Various types of income	EU-SILC
Demographic structure	Eurostat
Institutional details	MISSOC, OECD publications, national sources and experts
Public revenue structure and tax rates	OECD (Revenue Statistics and Tax and Benefit Models), EU-SILC
Employment Protection Legislation	OECD EPL Index, LFS
Behavioural parameters (e.g., labour supply elasticities, production function, human capital formation)	Empirical literature
Macroeconomic country profile	System of National Accounts
Life-cycle consumption profile	HBS

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Section 2 of this Final Report provides information on the calibration and institutional details for the update of LMM as well as the extension to all 27 Member States. A comprehensive list of variables is presented in Section 3. Section 4 provides the analysis of three illustrative policy scenarios, i.e., a change in the tax structure in the Member States, a policy reform to enhance employment of older workers and a migration scenario. The annex provides specific information for the European Commission's modelling experts on the implementation of country-specific institutional details and data issues. In addition to this Final Report, the updated LMM is sent electronically to the European Commission.

2. Calibration and Institutional Details

2.1. Macroeconomic Data

In this section, we discuss the different macro(economic) data used to calibrate the model. They are generally based on officially available harmonised data and can be updated easily.

Output

In the model, we differentiate output, gross value added (GVA), and gross domestic product (GDP). Given labour- and capital input, the production function determines the output (y). This function defines the maximum output possible given input factors. We apply several deductions, reflecting different types of costs, as stated below, to derive GVA. These costs can be primarily seen as time devoted to tasks other than the production of value added. These tasks are:

- Costs incurred for opening a vacancy (κ);
- Costs incurred for firm-sponsored training ('firmskillcost');
- Costs incurred for managerial effort to keep workers ('probcost');
- Administrative firing costs (τ^C).

GDP is derived by adding 'Taxes on Products' and deducting 'Subsidies on Products' from GVA. The definitions are shown in Table 2. Values for taxes on products are taken from the OECD revenue statistics (see Section 2.4), and subsidies on products from the national accounts.

Table 2: Definition of gross value added and gross domestic product in LMM

Variable	Description	Formula
gva	Gross value added	$y - \kappa - firmskillcost - probcost - \tau^C$
gdp	Gross domestic product	gva + taxes on products - subsidies on products

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The values for GDP, taxes on products, subsidies on products, and GVA for the year 2019 can be found in Table 3. In the model, 'gva' is normalised to 100 in the calibration in each country. For this reason, we define a parameter ('scalingfactor') to be able to derive values in billions of national currency. For example, multiplying 'gva' by 'scalingfactor' gives GVA measured in billions of national currency.

Table 3: GDP, taxes and subsidies on products and GVA (2019, in millions, national currency)

Country	GDP	Taxes on products*	Subsidies on products	GVA*	Currency
EU-27	14,016,533	1,638,231	84,680	12,462,983	EUR
Belgium	478,239	54,908	4,606	427,937	EUR
Bulgaria	120,395	18,784	558	102,170	BGN
Czechia	5,791,498	624,733	99,365	5,266,130	CZK
Denmark	2,310,955	330,266	16,239	1,996,928	DKK
Germany	3,473,260	360,178	7,399	3,120,481	EUR
Estonia	27,765	3,943	61	23,884	EUR
Ireland	356,705	24,279	1,191	333,617	EUR
Greece	183,250	28,882	1,486	155,855	EUR
Spain	1,245,513	124,873	7,481	1,128,121	EUR
France	2,437,635	313,364	23,511	2,147,782	EUR
Croatia	412,228	84,050	3,754	331,933	HRK
Italy	1,796,649	214,990	22,728	1,604,387	EUR
Cyprus	23,010	3,235	77	19,852	EUR
Latvia	30,647	4,281	58	26,424	EUR
Lithuania	48,860	5,640	588	43,808	EUR
Luxembourg	62,374	5,801	258	56,830	EUR
Hungary	47,530,610	7,768,832	329,055	40,090,833	HUF
Malta	14,048	1,702	72	12,419	EUR
Netherlands	813,055	98,756	1,302	715,601	EUR
Austria	397,170	47,337	793	350,625	EUR
Poland	2,293,199	294,183	1,142	2,000,158	PLN
Portugal	214,375	30,000	396	184,770	EUR
Romania	1,058,973	115,642	2,419	945,750	RON
Slovenia	48,533	6,670	39	41,902	EUR
Slovakia	94,048	11,198	440	83,291	EUR
Finland	239,858	34,201	719	206,376	EUR
Sweden	5,049,619	611,850	30,185	4,467,954	SEK

* Taxes on products deviate from national accounts and are based on OECD tax structure. Differences are small in general. GVA deviates from national accounts for the same reason.

Source: Eurostat, SourceOECD, own calculations. • Created with Datawrapper

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Required Rate of Return, Capital Stock, Investment Ratio, and Capital Share

Production involves capital input and required investment and provides compensation (capital compensation) to its owners, including the required rate of return, 'r', and compensation for depreciation of the capital stock 'δ^k'. Therefore, it is necessary to define some of these values, whereas others are determined in the calibration procedure. Data are available for capital stock and the level of investment. Capital compensation cannot be determined directly from national accounts as gross operating surplus also includes mixed income, which is the remuneration for work carried out by owners (or family members) of an unincorporated enterprise. However, there are ways to approximate the capital share.

We suggest the following calibration procedure. Information is available or can be derived for capital stock, capital share, the investment ratio, and the corporate tax rate. Using this information leaves the depreciation rate, the required rate of return, and taxes on capital available to replicate the aforementioned variables. In a steady state, the following

optimality condition must hold in LMM (for more information see Berger et al. (2009) – Final Report Part II, p. 37):

$$F_K^Y = \frac{\left(1 - t^{prof} sub^i\right)(r + \delta^K) - t^{prof} \delta^K}{(1 - t^{prof})} - t^{cap}$$

The steady state investment equation[1] pins down the depreciation rate, decreasing the degree of freedom to set parameters. The required real rate of return is set to the same value of 3 percent in about half of the member states. For the other countries we deviate from a common interest rate assumption to replicate the investment ratio. Especially, these are countries which joined the EU after 2004 with a higher than average capital share, like Czechia, Poland, Slovenia, and Slovakia. In addition, for several southern European countries, Italy, Portugal or Spain, a higher required rate of return is set. The difference follows to a large extent the interest rate differential of long-term government bonds compared to Germany, reflecting additional country-specific risk. In some cases, we also use the tax rate on capital, t^{cap}, to replicate the investment ratio of the economy.

One possible source of information about the adjusted[2] labour share ($capital\ share = 1 - adjusted\ labour\ share$) is the AMECO database. In addition, we derive a second measure for the labour share by adding compensation of employees (Source: System of National Accounts) and payroll taxes and multiply this value by a factor to reflect the labour input of self-employed persons. The factor is derived in the following way:

$$factor = \frac{\text{No. of employees} * \text{AW}_e + \text{No. of self\_employed} * \text{AW}_s}{\text{No. of employees} * \text{AW}_e},$$

where AW_e reflects average working hours of employees, and AW_s average working hours of self-employed persons.

The capital shares for both methods are presented in Table 4. For most countries, the capital share based on AMECO is higher. For most countries both methods produce similar results, for some other countries the difference is very high. Large deviations emerge in Bulgaria, Greece, and Sweden. For the calibration, we rely on calculations by ourselves for the capital share for the majority of countries. AMECO based shares are applied if they fit better to the other parameters in the calibration. A capital share within the range of the two sources is applied for Belgium and Austria. Although both methods coincide in Lithuania and Poland, a somewhat lower value is applied to replicate the investment share. For Slovenia and the Netherlands, a slightly higher share of 33.8 and 37.5 percent is applied, which delivers the right level of investment and depreciation of the capital stock.

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[1] Neglecting the exogenous growth trend 'g'.

[2] Adjusted means that the labour input of self-employed persons is treated as labour input.

Table 4: Capital share based on calculations by ourselves and AMECO database

Country	Own calculations*	AMECO	LMM	Country	Own calculations*	AMECO	LMM
EU-27	35.4	37.5	37.1	Latvia	39.3	39.8	39.3
Belgium	32.4	34.2	33.2	Lithuania	44.6	44.3	42.0
Bulgaria	43.7	35.1	35.1	Luxembourg	42.0	43.4	42.0
Czechia	42.2	44.8	42.2	Hungary	42.8	46.2	42.8
Denmark	33.1	36.3	33.1	Malta	43.2	46.3	43.2
Germany	34.2	35.8	34.3	Netherlands	32.8	35.6	37.4
Estonia	38.3	38.7	38.3	Austria	33.4	37.5	35.3
Ireland	61.2	62.4	62.4	Poland	44.7	44.8	43.0
Greece	33.5	40.4	33.5	Portugal	38.9	40.0	38.9
Spain	37.7	40.6	37.7	Romania	49.8	46.2	46.2
France	29.5	33.1	33.1	Slovenia	33.2	29.3	33.8
Croatia	35.8	35.9	35.8	Slovakia	45.2	47.7	45.2
Italy	39.3	40.0	39.3	Finland	36.0	38.9	36.0
Cyprus	40.8	42.2	40.8	Sweden	33.6	38.0	37.9

* Own calculations are based on national accounts (compensation of employees) and working hours of self-employed in relation to employees.

Source: AMECO database, Eurostat, own calculations. • Created with Datawrapper

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Table 5: Capital stock as a percentage of GVA (average 2015–2019)

Country	SNA	AMECO	LMM	Country	SNA	AMECO	LMM
EU-27	362.0	330.6	350.8	Latvia	488.6	107.9	488.6
Belgium	325.0	292.6	292.6	Lithuania	305.2	213.4	494.2
Bulgaria	445.3	296.1	383.0	Luxembourg	234.7	239.6	234.7
Czechia	406.4	324.6	324.6	Hungary	446.2	248.6	446.2
Denmark	366.7	276.7	276.7	Malta	265.7	205.6	324.7
Germany	359.5	314.8	348.0	Netherlands	325.8	298.8	298.8
Estonia	358.0	310.0	358.0	Austria	452.4	398.2	398.2
Ireland	310.8	226.0	193.3	Poland	161.9	219.9	390.0
Greece	353.1	465.4	353.1	Portugal	410.6	333.0	333.0
Spain	380.5	371.9	372.8	Romania	376.0	224.4	376.0
France	373.3	347.0	347.0	Slovenia	364.7	221.4	221.4
Croatia	537.2	275.0	275.0	Slovakia	486.5	159.1	486.5
Italy	383.4	385.0	385.0	Finland	378.1	345.9	366.8
Cyprus	347.7	295.9	347.7	Sweden	347.1	393.9	393.9

Source: AMECO database, Eurostat, own calculations. • Created with Datawrapper

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The capital share of the EU-27 in total is derived from the individual country's capital shares used in LMM and amounts to about 37 percent of GVA. The result is very similar to the capital share based on AMECO with 37.5 percent and a little bit higher than the value derived by own calculations.

The System of National Accounts and the AMECO database are possible sources for the capital stock in the modelled countries. Both provide information about the net capital stock for the total economy for a longer time horizon for all considered countries. The average ratio of capital stock to GVA for the countries can be found in Table 5. In contrast to the capital share, calculations of the stock differ to a large extent in some countries. In general, we apply the one which fits better to replicate aggregate variables in LMM. For

Malta, Lithuania, and Poland, both estimates are too low in comparison to the capital share in these countries. For this reason, we apply a higher capital stock, as in previous updates of the model. The capital stock for the EU-27 is derived from the applied LMM values for the individual Member States and aggregated across them. The resulting capital input is about 350 percent of GVA and very similar to the ones based on the National Accounts and on the AMECO database.

The investment ratio is calculated as the level of investment as percent of GDP. The information is based on national accounts. We use the average investment ratio of the period 2015 up to 2019. The average level for the modelled countries can be found in Table 6. The investment ratio is considerably lower in a lot of Southern-European member states, like Greece, Portugal, Italy or Cyprus, and exceptionally high in Ireland, which is a result of the depreciation of inward foreign direct investment assets, like intellectual property and leased aircrafts[3]. There is no necessary one-to-one-relationship between the investment ratio and level of capital stock in the economy as the depreciation rate can vary widely as a matter of different composition of capital stock (buildings, machinery, patents, etc.). The depreciation rate in the modelled countries is derived in the calibration procedure and does not need to be set.

Table 6: Investment ratio (average 2015–2019, as a percentage of GDP)

Country	Investment ratio (% GDP)	Country	Investment ratio (% GDP)
EU-27	21.7	Latvia	22.7
Belgium	24.5	Lithuania	19.5
Bulgaria	20.4	Luxembourg	18.2
Czechia	27.0	Hungary	24.7
Denmark	21.8	Malta	22.2
Germany	20.9	Netherlands	21.3
Estonia	26.2	Austria	24.8
Ireland	36.3	Poland	20.1
Greece	12.5	Portugal	17.1
Spain	19.7	Romania	23.7
France	23.4	Slovenia	19.9
Croatia	21.7	Slovakia	23.3
Italy	17.9	Finland	23.7
Cyprus	18.3	Sweden	25.2

Source: Eurostat, own calculations. • Created with Datawrapper

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Subsidies on Production

Subsidies do not only arise as subsidies on products but also in production. Annual national accounts contain data about this type of subsidy, labelled as d.39. In the model, subsidies on production are implemented as transfers to firms. From an economic point of view, the higher the subsidies on production, the less capital in production needs to earn

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[3] See Ireland's national statistics office, https://www.cso.ie/en/releasesandpublications/in/nie/in-mgnicp/. According to the statistics office, GDP in Ireland is distorted for two reasons, (i) a high level of investment due to depreciation of foreign direct investment assets and (ii) a high trade balance caused by a high negative factor income from the rest of the world. The statistics office shows that both aspects distort GDP to a large extent in Ireland. The corrections lead to a decrease of the investment ratio by 19.5 percent of GDP.

to yield the required rate of return on capital that is determined on the capital markets. The share of subsidies on production relative to Gross Value Added ranges from 0.4 percent in Cyprus to 3.6 percent in Bulgaria (see Table 7).

Table 7: Subsidies on production (average 2015–2019, as a percentage of GVA)

Country	Subsidies on production (% GVA)	Country	Subsidies on production (% GVA)
EU-27	1.4	Latvia	2.7
Belgium	3.3	Lithuania	0.6
Bulgaria	3.6	Luxembourg	0.9
Czechia	1.2	Hungary	2.3
Denmark	1.5	Malta	1.1
Germany	0.9	Netherlands	1.4
Estonia	1.1	Austria	1.7
Ireland	0.9	Poland	1.5
Greece	1.8	Portugal	1.3
Spain	0.9	Romania	1.1
France	2.3	Slovenia	1.5
Croatia	1.5	Slovakia	1.3
Italy	0.6	Finland	1.4
Cyprus	0.4	Sweden	1.3

Source: Eurostat, own calculations. • Created with Datawrapper

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External Balance of Goods and Services

Produced goods and services can either be consumed (private or public consumption), invested or exported to other countries. Consumption and investment consist of domestically produced and imported goods. The difference between exported and imported goods results in the external balance of goods and services. Data for the external balance, which is used for the calibration of the model, is available in the System of National Accounts provided by Eurostat. The average external balance of the years 2015 to 2019 as a percentage of GVA is provided in Table 8.

In some countries, the external balance is higher than the steady state assumption in a calibration would suggest. The reasons for this differ across countries. In Ireland, the high level of external balance is mainly driven by factor income of direct investment to the rest of the world. Correcting for this issue leads to a trade balance lower by 20 percentage points. In Luxembourg, the trade balance is adjusted for two reasons. The first corrects the trade balance for the export of investment income of persons living in other countries, which in turn leads to a very high negative primary income in the current account balance. The second adjustment deals with the high share of cross-border workers in Luxembourg, working in Luxembourg but living in another country. According to the current account balance, compensation of employees who are cross-border workers amounts to about one-third of total employment compensation. As cross-border workers consume a high fraction of income outside of Luxembourg, this leads to a high trade balance. In the model, we assume that cross-border workers live in Luxembourg and therefore also consume there, leading to a smaller trade balance. The second adjustment leads to a higher level of private consumption than the System of National Accounts reports. The resulting trade balance in the model is reduced to 0.5 percent of GVA.

Table 8: External balance (average 2015–2019, as a percentage of GVA)

Country	External Balance (% GVA)	Country	External Balance (% GVA)
EU-27	4.6	Latvia	−0.8
Belgium	0.9	Lithuania	2.0
Bulgaria	3.7	Luxembourg	17.4
Czechia	7.3	Hungary	7.0
Denmark	7.9	Malta	8.6
Germany	7.5	Netherlands	11.0
Estonia	4.3	Austria	3.9
Ireland	21.2	Poland	4.1
Greece	−1.8	Portugal	0.9
Spain	3.6	Romania	−2.7
France	−1.0	Slovenia	9.9
Croatia	0.2	Slovakia	2.4
Italy	3.3	Finland	−0.7
Cyprus	1.2	Sweden	3.6

Source: Eurostat, own calculations. • Created with Datawrapper

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For the Netherlands, the reduction of the trade balance amounts to 4.1 percent of GVA. The reason is a high share of unexplained components in the trade balance[4] (maybe a result of the Rotterdam-Antwerp effect). The trade balance of Malta is assumed to be lower by 1.7 percent of GVA as a result of an important financial sector (decreasing by the balance of investment income of the current account; the same way as for Luxembourg). And for Slovenia, a longer period is taken into account, reducing the trade balance by 1.5 percent of GVA.

Similar results for corrected trade balances can be found in Torslov et al. (2022) and Di Nino and Ekstam (2020). In the model, the corrected trade balance is used for calibration. To derive "correct" values for GVA and GDP these correction terms are added. For simulation scenarios it is assumed that these terms are kept constant and assumed to be independent of national economic activity.

Government Debt

Private savings can either be held in domestic firm assets, government debt, or foreign assets. Foreigners in turn can hold assets from the modelled countries. These can be firm assets or government debt. The external balance of financial assets is defined by the external balance of goods and services. The model does not distinguish which of the assets in the home country are held by domestic households and which are held by foreigners. The value of government debt in the period 2015 to 2019 as a percentage of GVA can be found in Table 9.

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[4] See IMF (2021), p. 37.

Table 9: Gross government debt (2015–2019, as a percentage of GVA)

Country	Government debt (% GVA)	Country	Government debt (% GVA)
EU-27	91.7	Latvia	44.0
Belgium	114.0	Lithuania	42.5
Bulgaria	28.7	Luxembourg	23.1
Czechia	38.0	Hungary	84.8
Denmark	41.9	Malta	55.3
Germany	72.5	Netherlands	64.3
Estonia	10.7	Austria	88.7
Ireland	72.9	Poland	57.3
Greece	211.7	Portugal	145.4
Spain	112.0	Romania	40.6
France	110.3	Slovenia	86.6
Croatia	95.0	Slovakia	57.0
Italy	150.6	Finland	71.4
Cyprus	114.6	Sweden	45.4

Source: Eurostat, own calculations. • Created with Datawrapper

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2.2. Educational Attainment and Demography

LMM includes a detailed breakdown of the population with respect to age and educational attainment, which enables analysis of both age- and skill-dependent impacts of policy reforms. The model differentiates three groups of educational attainment. The group of low-skilled individuals includes individuals with pre-primary, primary, and lower-secondary education (ISCED 0-2), individuals with completed tertiary education (ISCED 5+) are high-skilled, and medium-skilled individuals have an upper-secondary (and post-secondary non-tertiary) level of education (ISCED 3-4). The distribution of the working age population (aged between 25 and 64 years) according to the highest level of educational attainment is based on Eurostat data and is shown in Table 10. In 2020, the share of low-skilled individuals ranges from less than 10 percent in several countries (Czechia, Latvia, Lithuania, Poland, Slovenia, Slovakia, and Finland) to 37 percent in Spain and Italy, 41 percent in Malta and 45 percent in Portugal. On the other hand, the share of high-skilled individuals ranges from around 20 percent in Romania and Italy to nearly 50 percent in Ireland.

Table 10: Distribution of educational groups (25–64 year olds), 2020

	low ISCED 0-2	medium ISCED 3-4	high ISCED 5+
EU-27	21.0%	46.3%	32.8%
Belgium	20.2%	37.3%	42.4%
Bulgaria	16.9%	53.9%	29.2%
Czechia	5.9%	69.2%	24.9%
Denmark	18.5%	40.9%	40.6%
Germany	14.3%	54.5%	31.2%
Estonia	10.7%	49.2%	40.1%
Ireland	14.5%	35.5%	49.9%
Greece	21.2%	46.1%	32.7%
Spain	37.1%	23.2%	39.7%
France	18.5%	41.8%	39.7%
Croatia	13.4%	61.4%	25.2%
Italy	37.1%	42.7%	20.1%
Cyprus	16.8%	38.3%	44.9%
Latvia	8.3%	53.8%	37.8%
Lithuania	4.6%	51.3%	44.1%
Luxembourg	21.5%	31.4%	47.1%
Hungary	14.4%	58.4%	27.2%
Malta	40.7%	28.7%	30.6%
Netherlands	19.0%	38.4%	42.7%
Austria	14.3%	51.5%	34.2%
Poland	6.8%	60.4%	32.9%
Portugal	44.6%	27.2%	28.2%
Romania	19.6%	61.7%	18.7%
Slovenia	9.7%	54.4%	35.9%
Slovakia	7.3%	65.9%	26.8%
Finland	8.9%	43.6%	47.5%
Sweden	13.5%	41.8%	44.6%

Source: Eurostat. • Created with Datawrapper

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LMM is calibrated to a balanced growth path that assumes a stationary demographic structure which implies that the demographic structure in the model deviates from the actual demographic structure. We use current (2019) mortality rates for each one-year-cohort from Eurostat and derive average mortality rates for the different age groups in the model. Table 11 illustrates the actual demographic structure and the initial LMM demographic structure. We underestimate the group of medium-aged individuals (40 to 64 years old) in each of the countries and overestimate the group of older individuals in most of the countries (apart from five Eastern Member States). However, we adjust the flat pension '$p00$' in order to derive actual pension expenditures in the countries (see Section 2.9).

Table 11: Demographic distribution (as a percentage of individuals aged 15 and older), 2019

		15-39	40-64	65+
EU-27	Model	38.1	35.6	26.3
	Data	35.0	41.1	23.9
Belgium	Model	37.6	35.7	26.7
	Data	37.2	40.1	22.8
Bulgaria	Model	42.1	36.3	21.6
	Data	33.6	41.5	24.9
Czechia	Model	39.4	35.6	25.0
	Data	35.1	41.6	23.3
Denmark	Model	38.1	35.8	26.1
	Data	37.3	39.3	23.4
Germany	Model	38.1	36.1	25.8
	Data	34.1	41.0	24.9
Estonia	Model	39.6	35.7	24.7
	Data	36.7	39.6	23.6
Ireland	Model	37.2	35.8	27.0
	Data	42.0	40.3	17.7
Greece	Model	37.8	35.6	26.6
	Data	33.1	41.2	25.7
Spain	Model	36.5	35.3	28.1
	Data	33.5	43.8	22.8
France	Model	36.9	34.5	28.6
	Data	36.4	39.2	24.4
Croatia	Model	39.9	36.5	23.6
	Data	35.2	40.7	24.0
Italy	Model	36.7	35.4	27.9
	Data	30.8	42.9	26.4
Cyprus	Model	37.4	35.8	26.8
	Data	44.5	36.3	19.2
Latvia	Model	41.6	36.4	22.1
	Data	35.1	40.8	24.1
Lithuania	Model	41.0	36.4	22.5
	Data	35.1	41.6	23.3
Luxembourg	Model	37.2	36.2	26.5
	Data	41.4	41.5	17.1
Hungary	Model	41.4	36.2	22.4
	Data	35.6	41.8	22.6
Malta	Model	36.9	35.1	28.0
	Data	42.0	36.3	21.6
Netherlands	Model	37.5	35.9	26.6
	Data	36.9	40.3	22.8
Austria	Model	37.6	36.3	26.0
	Data	36.6	41.4	22.0
Poland	Model	40.1	35.7	24.2
	Data	39.2	40.0	20.9
Portugal	Model	37.7	35.4	26.8
	Data	32.7	42.0	25.3
Romania	Model	41.7	36.0	22.3
	Data	36.0	42.0	22.0
Slovenia	Model	38.0	35.6	26.4
	Data	34.0	42.6	23.4
Slovakia	Model	40.2	36.3	23.5
	Data	39.4	41.5	19.0
Finland	Model	37.5	34.9	27.6
	Data	36.2	37.8	26.0
Sweden	Model	37.0	35.2	27.9
	Data	38.4	37.4	24.2

Source: Eurostat, own calculations. • Created with Datawrapper

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2.3. Consumption Profile

In LMM, individuals optimally decide how much to consume now or save for later periods, determined by the optimal marginal propensity to consume ('*mpc*') out of expected total lifetime wealth (consisting of financial wealth and the present value of future labour market and pension income and transfers). As described in the LMM documentation, the '*mpc*' is age-dependent and determined by different variables such as preference parameters (e.g., the subjective discount factor and the intertemporal elasticity of substitution), the interest rate, policy parameters such as consumption tax rates, and mortality rates. Thus, combined with future earnings and transfers, the '*mpc*' determines the intertemporal distribution of consumption expenditures of households.

This means that the model's consumption profile (i.e., expenditures per age group relative to a reference group) would potentially deviate from the profile actually observed in the data. This is one reason why LMM incorporates inter-vivo transfers between households. We calibrate these transfers such that the consumption profile observed in the data corresponds to optimal household behaviour in the model.[5] Data on private consumption expenditures per adult equivalent, according to the age of the household's reference person, are derived from Eurostat's Household Budget Survey (HBS) 2015 micro-dataset.[6] As this dataset contains few observations for very young and very old household reference persons, we estimate a quadratic consumption age profile.

As can be seen in Table 12, this results in the expected hump-shaped profile for each of the countries (except Bulgaria). Some countries, such as Belgium, Germany, and Spain, exhibit a fairly steep consumption profile (i.e., consumption expenditures of individuals aged 40 to 69 years are high compared to younger and older individuals). In other countries (Ireland, Poland, Slovenia, and Slovakia; i.e., notably Eastern European countries), the consumption profile is much flatter and/or private consumption of younger age groups is high compared to older age groups.

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[5] Given calibrated values for income and transfers and the consumption profile, the profile of financial assets is endogenously determined as a result of the intertemporal budget constraint of individuals.

[6] The micro-dataset does not include data for Austria. Therefore, we refer to data from Statistik Austria.

Table 12: Consumption profile

	15-19	20-24	25-39	40-54	55-69	70-79	80-84	85+
EU-27	0.85	1.00	1.16	1.30	1.32	1.24	1.15	1.07
Belgium	0.72	1.00	1.31	1.59	1.64	1.52	1.36	1.21
Bulgaria	1.06	1.00	0.92	0.80	0.70	0.63	0.59	0.58
Czechia	0.89	1.00	1.10	1.16	1.10	0.96	0.83	0.72
Denmark	0.76	1.00	1.26	1.48	1.49	1.33	1.17	1.01
Germany	0.81	1.00	1.21	1.42	1.48	1.42	1.34	1.25
Estonia	0.94	1.00	1.04	1.01	0.87	0.67	0.51	0.47
Ireland	0.92	1.00	1.08	1.15	1.15	1.10	1.05	0.99
Greece	0.97	1.00	1.02	1.00	0.92	0.82	0.74	0.67
Spain	0.79	1.00	1.23	1.43	1.45	1.34	1.21	1.08
France	0.82	1.00	1.19	1.37	1.40	1.32	1.21	1.12
Croatia	0.93	1.00	1.06	1.10	1.05	0.95	0.87	0.79
Italy	0.82	1.00	1.20	1.39	1.42	1.34	1.24	1.14
Cyprus	0.78	1.00	1.22	1.38	1.33	1.12	0.93	0.75
Latvia	0.97	1.00	1.01	0.98	0.86	0.72	0.61	0.55
Lithuania	0.97	1.00	1.02	1.01	0.94	0.84	0.76	0.69
Luxembourg	0.71	1.00	1.32	1.60	1.64	1.49	1.31	1.15
Hungary	0.89	1.00	1.12	1.25	1.28	1.25	1.20	1.15
Malta	0.92	1.00	1.07	1.08	0.97	0.79	0.65	0.58
Netherlands	0.84	1.00	1.18	1.35	1.38	1.32	1.24	1.16
Austria	0.86	1.00	1.15	1.26	1.25	1.15	1.05	0.95
Poland	0.95	1.00	1.05	1.09	1.07	1.01	0.96	0.91
Portugal	0.86	1.00	1.15	1.27	1.26	1.15	1.04	0.94
Romania	0.94	1.00	1.05	1.08	1.03	0.94	0.86	0.80
Slovenia	0.95	1.00	1.04	1.05	0.99	0.90	0.82	0.75
Slovakia	0.91	1.00	1.09	1.14	1.08	0.95	0.84	0.74
Finland	0.79	1.00	1.21	1.38	1.34	1.16	0.99	0.82
Sweden	0.84	1.00	1.16	1.28	1.24	1.08	0.94	0.80

Private Consumption profile per age group relative to 20-24-year-old households in LMM calibration.

Source: Eurostat Household Budget Survey 2015, own calculations. • Created with Datawrapper

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2.4. Public Revenues from Taxes and Social Security Contributions

Public revenues from taxes and social security contributions in the different countries are derived using detailed data from OECD's database on *Revenue Statistics* (see e.g., OECD, 2021). We group the detailed items into five categories according to their economic function: Personal Income, Capital Gains, Corporate Income, Social Security Contributions, and Consumption.

Results are presented in Figure 1. Note that the presented data may deviate from officially published OECD revenue data because some items (such as occupational pension schemes) are included in LMM but are sometimes not included in the *Revenue Statistics*. Background information on these adjustments that may be relevant for the European Commission's modelling experts is provided in the annex (see Section 5.3).

The amount of public revenues varies widely between the different countries. The share of 'total revenues as in the LMM' (including revenues from taxation and social security

contributions and the additional items mentioned above) ranges from 25 percent of Gross Value Added (GVA) in Ireland to 60 percent in Denmark. Among the three largest items (i.e., Income, Social Security, and Consumption), revenues vary significantly for Income and Social Security, whereas there is less variation of revenues from consumption taxes.

Figure 1: Public revenues as in LMM, as share of GVA, average 2015–2019

Numbers shown here may deviate strongly from OECD Revenue Statistics numbers as some items (e.g. occupational pension schemes) are included in LMM, but not in the Revenue Statistics.

Source: OECD Database, own calculations • Created with Datawrapper

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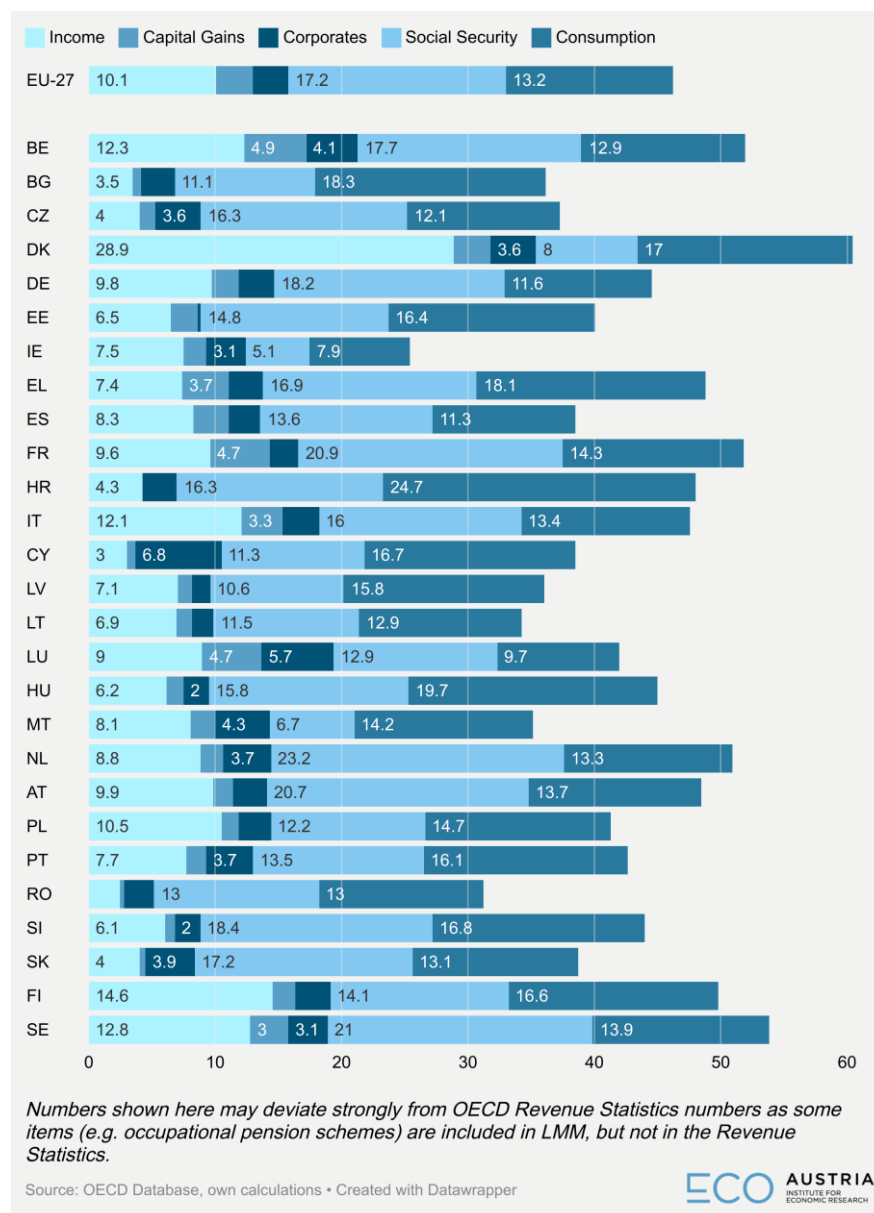
The 'LMM Revenues' in the five different categories are used to calibrate LMM's tax rates. Some tax rates (taxes on consumption and capital gains taxes) are calculated directly by relating these revenues to the respective assessment base (i.e., consumption or capital gains). For instance, the effective consumption tax rate is equal to revenues from taxes on consumption divided by the assessment base for consumption tax, consisting of total private consumption and a share of public consumption (intermediate consumption and consumption of fixed capital). Income tax rates and social security contribution rates of employers, employees and retirees according to education and age are derived via the method described in Section 9.2.3 of Part II of 'Modelling of Labour Markets in the

European Union' (Berger et al. 2009). To put it simply, we derive age- and skill-specific tax and social security contribution rates using the OECD's TaxBEN model[7] and the EU-SILC. For LMM's calibration, these rates are adjusted for all groups so that we replicate public revenues as in Figure 1 (only minor adjustments are necessary for most of the countries). For corporate taxation, we use effective corporate tax rates of the ZEW (2020); see Section 2.5. In a second step, we calibrate the necessary deductions of the tax base so that LMM revenues correspond to revenues based on OECD data.

2.5. Effective Corporate Tax Rates

The calibration of corporate tax rates is based on results of a ZEW (2020) research report for DG TAXUD of the European Commission. Among other indicators, the report computes effective marginal corporate tax rates (EMTRs) for a mean of different asset types and sources of finance for the Member States based on the method of Devereux and Griffith (2003). The EMTRs for the LMM countries are presented in Table 13.

Table 13: Effective marginal corporate tax rates (EMTR), 2020

	EMTR, 2020		EMTR, 2020
EU-27	21.0	Latvia	7.9
Belgium	19.2	Lithuania	6.5
Bulgaria	6.2	Luxembourg	14.3
Czechia	10.6	Hungary	12.3
Denmark	14.6	Malta*	26.9
Germany	23.3	Netherlands	16.6
Estonia	2.5	Austria	18.8
Ireland	12.3	Poland	7.9
Greece	20.6	Portugal*	21.4
Spain	32.5	Romania	11.5
France	29.0	Slovenia	13.1
Croatia	6.1	Slovakia	13.0
Italy	16.5	Finland	18.7
Cyprus	6.9	Sweden	14.5

Effective marginal corporate tax rate, Mean for different asset types and sources of finance.
*Given that EMTR 2020 is negative for MT and PT according to ZEW (2020), but corporate income tax revenues are robustly positive, we refer to the EMTR 2016 (for MT) and EATR 2020 (for PT)

Source: ZEW (2020), own calculations for EU-27 • Created with Datawrapper

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There is a wide range of effective rates between countries. According to the ZEW report, the highest EMTR can be found in Spain (32.5 percent) and France (29 percent). Given that the EMTR is negative for Malta and Portugal according to the ZEW, but corporate income tax revenues are robustly positive in these two countries, we refer to the EMTR 2016 (for MT) and the EATR 2020 (for PT). For the EU-27-model, we calibrate an EMTR

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[7] This means that we perform own calculations based on the OECD tax-benefit model, http://oe.cd/TaxBEN.

of 21 percent based on a weighted average of the 27 Member States (the weights are based on assessment bases for corporate taxation according to EU-LMM).

2.6. Income Taxation and Social Security Contributions

LMM's detailed breakdown of households according to age and skill groups enables implementation of, for example, progressive income tax systems, maximum thresholds for social security contributions or earned income tax credits. The drawback is the considerable calibration effort. As described by Berger et al. (2009), the calibration relies on a sophisticated (and rather time-consuming) application of the OECD's TaxBEN model (using institutional details based on the year 2019) in combination with EU-SILC micro-data.

This section gives a very brief overview of the institutional background of personal income taxes and social security contributions in the different countries. The information is mainly drawn from editions of *Taxing Wages* (OECD), *Benefits and Wages* (OECD), the MISSOC database and, if necessary, national sources. The annex provides specific information that might be relevant for the European Commission's modelling experts.

Belgium

Spouses are taxed separately in Belgium. However, a notional amount of income can be transferred between spouses if one of them earns less than 30 percent of the combined income.[8] Individuals can deduct social security contributions and some work-related expenses for income taxation and there is an amount of exempt income that varies with regards to family situation. The model also takes into account the local government tax. Employees and employers contribute to several social insurance items (e.g., unemployment, health insurance, health care, pensions). A reduction of employer and employee social security contributions, a special social security contribution, as well as tax credits for low-income workers are also taken into account in the model. Pension benefits are subject to income taxation and to social security contributions amounting to 3.55 percent (above a certain threshold) and are also subject to a 'solidarity' contribution if they exceed a certain threshold.

Bulgaria

Income taxes are paid on an individual basis in Bulgaria and income tax is not differentiated according to marital status. Parents can, however, make a deduction from their taxable income according to the number of children. Social security contributions are deductible from taxable income. A flat income tax rate without a tax-free range is applied. Social security contributions for pensions-, general disease-, motherhood-, unemployment-, and health-insurance are levied from employees and employers with a maximum monthly insurance income of BGN 3,000 in 2019. According to MISSOC, old age and disability pension benefits are not subject to income taxation and social security contributions.

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[8] This system is called the non-earning spouse allowance or 'quotient conjugal'.

Czechia

Spouses are taxed separately in Czechia, but some tax credits are dependent on household characteristics. Non-standard tax reliefs include, for instance, supplementary pension scheme contributions, private life insurance premiums and charitable donations allowances. It is important to note that taxable income is comprised of gross earnings *augmented by employers'* social security contributions (in most other Member States, taxable income is comprised of gross earnings minus employees' social security contributions). In 2008, a progressive system of taxation was replaced by a single tax rate of 15 percent. However, tax credits for each taxpayer, for a spouse (depending on their income) and for children lead to modest progressivity in the system. Employees and employers both contribute to health and social insurance based on gross earnings. However, the overall contribution rate is much higher for employers (34 percent in 2019) than for employees (11 percent). Pension benefits are exempted from social security contributions and only high pensions which annually exceed a multiple of 36 of the minimum monthly wage are subject to income taxation.

Denmark

The income of an individual taxpayer is split into three categories: personal income (consisting of, e.g., employment income, business income, pensions, unemployment benefits), capital income (e.g., interest payments and capital gains), and taxable income (personal plus capital income minus deductions). Spouses are taxed separately in Denmark, but some unutilised personal allowances can be transferred between them. Work-related expenses (e.g., transportation or unemployment premiums) can be fully deducted from wage or salary earnings. Taxable income is subject to a central government income tax as well as state and local income taxes. Standard tax reliefs include, for instance, expenses in order to earn income, an extra employment allowance for single parents, as well as different tax credits depending on the amount of earned income. In addition, individuals pay an 8 percent Labour Market Contribution which, following *Taxing Wages* and *Revenue Statistics*, are included in the income tax rate in LMM.

Concerning social security contributions, employees make earnings-independent contributions to an unemployment insurance and an early retirement scheme. Furthermore, employees and employers contribute to the Labour Market Supplementary Pension Scheme ATP. Pension benefits are subject to income taxation and there are no special reliefs. Old-age pensioners do not pay social security contributions, but disability pensions are subject to the ATP.

Germany

Spouses are generally assessed jointly for income taxation in Germany, but they also have the option of being assessed separately. Income tax liability is calculated by applying the splitting method: the income tax is calculated on basis of one-half of the joint taxable income, the resulting amount is doubled to obtain the joint tax liability. Essentially, even if two partners have a different income, they share the same income tax rate determined by

their joint income. Tax reliefs include reliefs for children, for lone parents, for work-related expenses and for special expenses. Social security contributions and other expenses for financial security (e.g., life insurance) are deductible up to specific limits. The tax schedule is formula based in Germany. A solidarity surcharge of 5.5 percent of income tax liability is additionally levied. Employers and employees contribute to sickness, pension, unemployment, care and work injury insurance.

The gradual transition of the income tax system to deferred taxation of pension benefits implies several changes. First, a gradually increasing share of employee contributions can be deducted from their income tax base. Second, the share of pension benefits taxed gradually increases over time for each new retiree cohort (starting from 50 percent of the benefits in the year 2005 to 80 percent in 2020 and to 100 percent in 2040). Retirees pay social security contributions for sickness and care.

Estonia

In Estonia, the income tax unit has been the individual since 2017, but some tax reliefs (e.g., the general and the child allowance) depend on household characteristics such as the spouse's income. Employee social security contributions (including contributions to the second pension pillar) are deductible for income taxation. Social security contributions consist of pension, health and unemployment insurance. While compulsory employee contributions amount to only 1.6 percent, employer contributions amount to 33.8 percent of gross earnings. For employer contributions, there is a minimum monthly assessment base of EUR 500 per month. No social security contributions are applied to pension income in Estonia. While public old-age pension benefits are subject to general income taxation rules, disability pensions (according to MISSOC) are not subject to income taxation.

Ireland

Income tax is levied on the combined income of spouses in Ireland. However, spouses can opt for a separate assessment. It should be noted, though, that a combined assessment does not imply a splitting system as in Germany, for example. However, the amount of standard tax credits for couples, for example, is twice the amount as for a single person and the tax schedule differs depending on family situation. Social security contributions are not deductible for income taxation. Non-standard tax reliefs include, for instance, work-related expenses and medical insurance. In addition to income tax, the 'Universal Social Charge' (USC) is based on gross income.[9]

Employees' social security contributions (to pension and social insurance) amount to 4 percent. Employers' contributions are 10.95 percent (for pension and social insurance, occupational injuries and a redundancy contribution), with a reduced rate for earnings below a threshold. Pension benefits are taxable and subject to the USC, but there are no social security contributions.

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[9] Following the TaxBEN model and *Revenue Statistics*, we model the USC as an income tax.

Greece

Individuals are taxed separately in Greece. Spouses file a joint return but each spouse is liable for the tax to be paid on their share of the joint income. The amount of a tax credit is determined by the number of dependent children in the household. Apart from this tax credit, standard tax reliefs include, in particular, employee social security contributions. In addition to the standard progressive income tax, there is a special solidarity contribution, which is also progressive. Social security contributions to the Unified Social Security Fund (EFKA), the Supplementary Insurance Branch (ETEAEP) and 'other funds' are levied from employees and employers up to a ceiling of EUR 6,500 per month from February 2019. Pension payments are subject to general personal income taxation rules and subject to health care and solidarity contributions.

Spain

Individuals are taxed separately in Spain, but families also have the option of being taxed as married couples or as heads of households. Taxpayers can claim several standard reliefs like a basic relief, an employment-related allowance, and tax credits depending on household characteristics, as well as several non-standard reliefs (like investment in own housing). Social security contributions are fully deductible for income taxation. In addition to the central government income tax, there are also substantial regional surcharges. We follow the OECD TaxBEN model for the calibration of LMM and apply the tax schedule of the Madrid region. Employers' social security contribution rates (29.9 percent) are substantially higher than those of employees (6.35 percent). Pension benefits are subject to income taxation but there are some reductions for people aged 65 years and older. Social security contributions for pension benefits do not arise.

France

In France, the tax base is aggregate family income, but children over 18 are included only if their parents claim them as dependents.[10] The 'family quotient' system takes into account the household situation by dividing net taxable income into a certain amount of shares.[11] The total tax levied is equal to the income tax with respect to one share times the number of shares. In the French income tax system, there are standard reliefs such as work-related expenses. The universal social contribution ('contribution sociale généralisée – CSG') and the contribution to the reimbursement of social debt ('contribution au remboursement de la dette social – CRDS') are assigned to the personal income tax system (and are not treated as social security contributions) in the OECD publications *Taxing Wages* and *Revenue Statistics* and in LMM. There are several different types of employee and employer social security contributions that have different ceilings and thresholds and there are also some reductions for employer-paid social security contributions. In addition, there is an in-work benefit to promote the return to full-time work for low-paid workers. Pension and invalidity benefits are subject to income taxation (with a

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[10] Since 2004, the law allows for joint taxation of partners in a French civil union ('PACS').

[11] For example, one share for singles, two shares for couples, and an additional half a share for each dependent child.

special allowance), to CSG and CRDS. In addition, occupational pensions are subject to a small social security contribution for illness.

Croatia

Income taxes are paid individually in Croatia. Apart from a general allowance, there are family allowances if a taxpayer provides support to an immediate family member, and for dependent children. Furthermore, employee social security contributions are tax deductible. In addition to the central government income tax, towns and municipalities can prescribe a surtax to taxpayers. Employees pay social security contributions to (first and second pillar) pension insurance, while health insurance contributions are levied from employers – other types of contributions were abolished from 2019. According to MISSOC, pension and disability benefits are subject to income taxation (the tax allowance is the same as the general allowance for employed individuals). Pensions exceeding the average monthly national net wage in the preceding year are subject to a health insurance contribution of 3 percent.

Italy

Spouses are taxed separately in Italy, but certain reliefs depend on household characteristics. Social security contributions due by law can be deducted from taxable income. There are several tax credits, for example, a basic employee tax credit, the PAYE tax credit, as well as tax credits for family dependents (spouse and child tax credit). There are also several non-standard tax allowances and credits, for example, for charitable donations or certain expenses. In addition to the central government income tax, there are regional and local surcharges. In accordance with the OECD TaxBEN model, we apply the tax rate paid in the capital Rome in our model. In 2019, employee contributions amounted to 9.49 percent up to EUR 47,143 and 10.49 percent up to EUR 102,543, whereas employer contributions amounted to 31.58 percent. Pension benefits are subject to taxation and there are no special reliefs for these benefits. They are subject to social security contributions for the National Institution for Italian Pensioners amounting to EUR 0.01 per month.

Cyprus

The income tax system in Cyprus refers to individual persons. The main tax relief is the deduction of social security contributions from gross income and there is a progressive income tax schedule with a zero income tax bracket (of up to EUR 19,500 in 2019). Social security contributions are comprised of the Social Insurance Fund (which featured a gross income ceiling of EUR 54,648 in 2019) and the Redundancy Fund. In addition, the Social Cohesion Fund and the Industrial Training Fund are funded by payroll taxes. Contributions to the medical and provident funds are voluntary and not implemented in the OECD TaxBEN model and in the LMM. According to MISSOC, pension and disability benefits are subject to income taxation with no special reliefs, but there are no social security contributions on these benefits.

Latvia

Each individual is taxed separately in Latvia, but some tax reliefs (in particular, an allowance for dependents) differ according to household characteristics. Standard tax reliefs include, for instance, a general allowance and, most importantly, employee social security contributions. From 2018, progressive income taxation has been implemented in Latvia. Social security contributions cover state pension, unemployment, disability, maternity and sickness, parental and health insurance, and accidents at work. From 2016, a solidarity tax was introduced that is paid for income exceeding the maximum assessment base for social security contributions. Pension payments granted or recalculated since 1996 are subject to income taxation with general taxation rules while benefits already granted before are exempt from taxation. Pension benefits are not subject to social security contributions.

Lithuania

The tax unit in Lithuania is the individual. Compared to other Member States, household characteristics are less reflected in income taxation rules, but mostly in family benefits. There is a general allowance that amounts to EUR 3,600 for individuals whose annual income does not exceed twelve-times the minimum wage, which is gradually phased out for higher income. Other tax reliefs exist, for instance, for disadvantaged individuals and for second pillar pension and voluntary social security contributions. However, according to *Taxing Wages*, mandatory employee contributions are not deductible for income taxation. Social security contributions consist of pension-, health-, sickness-, maternity-, unemployment-, and accidents-at-work insurance. In 2019, a labour taxation reform was introduced that shifted most employer contributions to employees and income taxation, accompanied by a compulsory gross salary increase of 28.9 percent. In addition, there are payroll taxes to the Guarantee fund and the Long-term employment benefit fund. Each of these two contributions corresponded to 0.16 percent of the gross wage in 2019. As we include Lithuania's funded pension scheme in the LMM, we add the contribution of 3 percent to employee social security contributions. Public pension benefits are not subject to income taxation and social security contributions.

Luxembourg

Spouses and partners' income is taxed jointly in Luxembourg. This means that individual tax liability is calculated on the basis of one-half of the joint taxable income; the resulting amount is doubled to obtain the joint tax liability. Standard tax reliefs include, for instance, deductions for work-related expenses and for commuting expenses. Social security contributions paid to compulsory health insurance and pension schemes are deductible, but contributions to the dependency insurance are not deductible. In addition to these reliefs, there is a tax credit for wage-earners and pensioners, a single-parent tax credit and a new tax credit for social minimum wage earners which was introduced in 2019. Furthermore, the tax schedule is applied to an adjusted taxable income for some taxpayers (widow(er)s, taxpayers with a dependent child and persons over 64 years). Income tax is subject to an additional 'solidarity surtax' to finance the employment fund. Social security contributions are levied for pension and disability, health, dependency,

health in the workplace, and accident insurance. In addition, employers make payments to the Employers' Mutual Insurance Scheme. Pension and disability benefits are subject to income taxation and pensioners benefit from similar tax reliefs as employees (although some amounts are different). Social security contributions on pension benefits include health care and long-term care insurance.

Hungary

The tax unit in Hungary is the individual person. The main standard relief for income taxation is a family tax allowance, which is dependent on the number of children and may be claimed by one spouse or be split between spouses. From 2014, the family tax allowance was extended with the consequence that families whose income is not sufficient to claim the maximum amount can deduct the remaining amount from social security contributions. Social security contributions are levied for pension, sickness and unemployment insurance and are not deductible for income taxation. From 2012, employer contributions were merged into a new social contribution tax. In addition, employers pay a training levy. Pension and disability payments are not subject to personal income tax and not subject to social security contributions.

Malta

Each person is considered individually for income taxation in Malta. However, persons who are married and live together or parents can opt for a 'married rate' assessment if this is more beneficial for them.[12] According to the TaxBEN model, social security contributions are not deductible for income taxation. Social security contributions are levied on employees and on employers. For individuals born after 1962, they were levied up to a ceiling of EUR 465.27 per week in 2019. In 2015, a (non-taxable) means-tested in-work benefit was introduced, whose amount depends on household composition and income. Pension and disability benefits are subject to income taxation with no special reliefs, but there are no social security contributions on pension benefits.

Netherlands

There are three categories of taxable income in the Netherlands. Similar to *Taxing Wages*, we focus on the category 'taxable income from work and owner-occupied housing'. Spouses are taxed separately in the Netherlands, but some tax credits and exemptions depend on the family situation. Several different tax credits of the Dutch system, such as the general tax credit, a work credit, and the income-dependent combination credit, are taken into account in the calibration of LMM. In addition, there are several non-standard tax reliefs (such as for some travelling and medical expenses or contributions to private pension schemes). In contrast to most other Member States, employee social security contributions are not deductible for income tax purposes. Contributions to occupational pension schemes as well as employee contributions to health insurance (paid to private insurance companies) and employer contributions for medical care are treated as NTCP ('non-tax-compulsory-payments') in *Taxing Wages* and are included in the calibration of LMM. Pension benefits are subject to income taxation

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[12] The calibration of the LMM follows the OECD TaxBEN model here, which chooses the better option.

and social security contributions, but they are not subject to contributions for the old age pension system.

Austria

Each person is taxed separately in Austria, but some of the tax reliefs and tax credits (e.g., sole earner's or sole parent's tax credits) depend on household characteristics. Standard tax reliefs include, for instance, work-related expenses and, most importantly, employee social security contributions. There is a preferential taxation of the Christmas and leave bonus. Several tax credits, such as the family tax credit, a commuting tax credit, a sole earner and a single parent tax credit exist. Social security contributions, for example for pension, health, and unemployment insurance are levied upon employees and employers up to a ceiling of EUR 5,220 per month (14 times because of holiday and Christmas pay) in 2019. In addition, payroll taxes include contributions to the Family Burden Equalisation Fund (at a rate of 3.9 percent in 2019) and the Community Tax (3 percent). Pension payments are subject to the same personal income tax schedule (even though the tax credit for retired persons is slightly different), social security contributions on pension benefits only include health insurance.

Poland

Married couples can opt to be taxed on their joint income in Poland. In that case, the splitting method system applies, i.e., the tax bill for a couple is twice the income tax due on half of the joint income. Furthermore, single parents with dependent children are also entitled to use the splitting system. There is a basic tax credit as well as reliefs for children. Social security contributions of employees include contributions to old age, disability and sickness/maternity insurance, and the National Health Fund. Social security contributions other than health insurance contributions are deductible from taxable income. The contribution of 9 percent of earnings to the National Health Fund is taken into account via a tax credit of 7.75 percent. Employers pay contributions to social insurance (pension and disability payments and an industrial accident fund), to the Labour Fund, the Solidarity Support Fund for Disabled Persons, and the Guaranteed Employee Benefit Fund. Old-age pension and early retirement benefits are subject to income taxation and there are no special reliefs available for those benefits. Old-age and early retirement recipients pay health care insurance.

Portugal

Income is taxed individually in Portugal, but families can opt for joint taxation, in which case an income-splitting system is applied. There was a standard deduction of EUR 4,104 in 2019. If compulsory social security contributions exceed that limit, the deduction equals the amount of these contributions. Other reliefs include, for instance, tax credits for dependent children, for persons with disabilities, and for households' general expenses. Social security contributions (for health, old age, maternity, family and unemployment) are levied upon employees and employers with no income ceiling. According to MISSOC, pension and disability benefits are subject to the same amount of the standard relief as employee's income and not subject to social security contributions.

Romania

Each person is taxed individually in Romania. However, the new income deduction that came into force in 2018 is based on monthly income and the number of persons in care. In addition, employee social security contributions are deductible for income taxation. In 2018, a major part of employer contributions was transferred to employees, compensated by higher gross nominal earnings. Thus, employees contribute to the health (10 percent) and social security (25 percent) scheme up to a ceiling of five-times average gross earnings, while employers contribute 2.25 percent to the general budget. Besides that, there is a risk and accident fund (contributions depend on the risk class) and there are some exceptions for certain sectors. Both features are not implemented in the TaxBEN calculation but implicitly reflected in the LMM calibration – as the LMM calibration is based on aggregate revenues. According to information from DG EMPL, income tax and health insurance contributions are levied on pension income exceeding certain income levels.

Slovenia

Income is taxed on an individual basis in Slovenia, but some tax reliefs (in particular family allowances) depend on household characteristics. Standard tax reliefs are a general (basic) allowance as well as an additional allowance for low-income earners. Employee's compulsory contributions for the social security system are deductible for income tax purposes. In addition, there are several non-standard tax reliefs such as reliefs for reimbursement of expenses associated with work. The income tax schedule for 2019 has five tax brackets and there are no regional or local income taxes. The compulsory social security insurance system consists of four schemes: pension and disability insurance, health insurance, unemployment insurance, and parental leave insurance. In 2019, employee and employer social security contribution rates amount to 22.1 percent and 16.1 percent, respectively.[13]

According to MISSOC, (old-age and disability) pensions are subject to social security contributions (for health services and refund of commuting expenses in case of sickness) of 5.96 percent. Pension benefits are entitled to a tax credit amounting to 13.5 percent of the pension/compensation received from the compulsory pension. According to information provided by the Slovenian research institute IMAD, severance pay on redundancy is exempt from income taxation up to a certain amount.

Slovakia

Individuals are taxed separately in Slovakia, but there are some reliefs that depend on the family situation. Apart from that, a basic relief and employee social security contributions are deductible for income taxation. As from 2013, the previous flat tax rate of 19 percent was replaced by a new tax schedule that includes a second bracket above 177-times the MLS – Minimum Living Standard (which corresponds to EUR 36,257 in 2019). Compulsory social security contributions are paid by employees and employers. The

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[13] In addition, Slovenia implements a minimum assessment base for social security contributions. For gross earnings below the minimum income threshold, social security contributions are calculated on the basis of the minimum social security contribution base and not actual gross wage earnings.

introduction of a health insurance contribution allowance in 2015 basically implies that employee contributions are reduced for low-income earners. In 2005, a privately managed, fully funded pension pillar has been introduced. A given proportion of employer contributions (4.75 percent in 2019, increasing to 6 percent from 2024) is paid to these funds instead of the public social insurance agency for those covered. Pension benefits are not taxable and not subject to social security contributions.

Finland

Spouses are taxed separately in Finland. Income taxation is comprised of a central government and a local income tax. The main reliefs for the central government tax are work-related expenses, an earned income tax credit and several non-standard reliefs (such as membership fees or travelling expenses). Local income taxes account for a major share of income tax revenues in Finland, and we follow the OECD by assuming an average local tax rate of 19.88 percent. The tax base for local income taxes is the same as for the central government tax, but an earned income tax allowance can be considered for local income taxation. Social security contributions are paid by employers and employees. For employees, they are comprised of pension insurance, unemployment insurance and a health insurance contribution. In addition, employers contribute to an accident and group life insurance. Pension benefits are subject to income taxation (whereby the income tax allowances for retirees differ to some extent from those of the working-age population) and health insurance contributions.

Sweden

Spouses are taxed separately in Sweden. There is a basic allowance that varies with income and there are several non-standard reliefs. Employees are granted a tax credit equal to 100 percent of compulsory employee social security contributions. In addition, there is an Earned Income Tax Credit (EITC) worth up to SEK 30,400. These tax credits are wastable in the sense that they do not reduce an individual's tax payment below zero. Apart from the central government income tax, which is progressive and levied from taxable income of approximately SEK 500,000, Sweden has local government income taxes (with the same tax base and an average rate of 32.19 percent in 2019 according to the OECD). Employees and employers pay social security contributions. In addition, there are quasi-mandatory occupational pension schemes that cover more than 90 percent of employees. Pension benefits are taxable with general taxation rules, but no social security contributions are levied.

2.7. Employment Protection Legislation (EPL)

A literature review of both theoretical and empirical EPL research is presented in Part I of Berger et al. (2009), Part II contains a more detailed description of the calibration. In LMM, the elasticity of the layoff rate with respect to (w.r.t.) EPL is based on OECD (2004) estimates. Applying a cross-country GLS estimation, this study finds that the flow into unemployment decreases by 0.165 percentage points if the OECD EPL index increases by 1 point.

We implement the relative strictness of EPL in the Member States in LMM by calculating a *Modified EPL Index*. Starting from version 3 of the EPL Index for 2019 and weighing the sub-indices for regular and temporary workers with their actual share in the labour market (taken from Eurostat) produces the modified EPL index, provided in Table 14. For Croatia, the calibration is based on the most recent OECD EPL Index for 2015. For Bulgaria, Cyprus, Malta and Romania, there exists no OECD EPL Index. However, the World Bank's EWI (Employing Workers Index) provides information for several items that are closely related to items of the EPL Index and we approximate EPL for these countries by using EWI information. Finally, we use the index value of the 27 Member States and the number of employees as weights to calculate an EU-27 value.

Among the countries modelled, the Netherlands, Latvia, Belgium, and France feature the strictest EPL (with index values of around 3), whereas the lowest values are derived for Denmark and Ireland (values below 2).

Table 14: Modified EPL index; share of severance pay costs among total firing costs (2019)

	Modified EPL Index	Share of Severance Pay		Modified EPL Index	Share of Severance Pay
EU-27*	2.60	27.8%	Latvia	3.05	22.3%
Belgium	2.94	41.7%	Lithuania	2.24	44.6%
Bulgaria**	2.44	27.5%	Luxembourg	2.77	25.9%
Czechia	2.82	17.9%	Hungary	2.07	20.6%
Denmark	1.86	23.7%	Malta**	2.00	21.8%
Germany	2.67	27.6%	Netherlands	3.09	30.1%
Estonia	2.10	26.0%	Austria	2.37	22.8%
Ireland	1.88	24.8%	Poland	2.38	22.8%
Greece	2.54	24.9%	Portugal	2.62	26.6%
Spain	2.47	29.9%	Romania**	2.02	25.4%
France	2.88	34.2%	Slovenia	2.36	22.4%
Croatia***	2.42	16.9%	Slovakia	2.69	20.7%
Italy	2.76	27.4%	Finland	2.01	31.9%
Cyprus**	2.30	17.4%	Sweden	2.46	22.6%

*EU-27: weighted (weight: no. of employees) average of 27 Member States; **based on World Bank EWI, ***Croatia based on OECD EPL Index 2015

Source: OECD EPL Index, World Bank EWI, own calculations • Created with Datawrapper

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LMM differentiates severance payments and administrative firing costs. We calculate the share of severance payments of total firing costs by classifying the different items of the EPL index according to whether they can be associated to severance payments or administrative costs.

As we have more detailed information on firing costs in Germany based on Grund (2003) and Goerke and Pannenberg (2005), the calibration of firing costs in all countries is implemented by comparing the modified EPL index with the (historic) value for Germany. Using these estimates and the average tenure for each age and skill group from the LFS,

we derive average severance payments for each group. Administrative costs are a multiple of severance payments and can be derived from the share in Table 14. In our view, this calibration approach results in a useful approximation of firing costs in LMM.

2.8. Unemployment Benefits

The unemployment system is an important part of the public social system, which provides income in case of unemployment, but also influences the behaviour of economic agents. According to economic theory, higher unemployment benefits imply positive incentives to participate in the labour market, but negative incentives to search for a job, if a person is unemployed. Furthermore, unemployment benefits influence the wage bargaining process between workers and firms as wages in general will rise as a consequence of higher reservation wages if the replacement rate in the unemployment system increases. Unemployment regulations differ widely among countries. In this section, we discuss the systems country by country. The information is mainly drawn from the MISSOC database and the OECD *Benefits and Wages* publication. We focus on the regulations of January 2019. For the calibration of the model, we rely on EU-SILC data as it is not possible to translate institutional regulations into the model one by one. Institutional regulations by themselves do not provide information on whether a person is eligible for unemployment payments, or about the replacement rate, as the rate often depends on the length of the unemployment spell or other aspects.

Furthermore, this section provides information on how the variables which reflect the unemployment system in the model are calibrated. These variables are 'xi1', 'brepl' and 'b00'. 'xi1' reflects the share of unemployed persons receiving benefits depending on labour income before unemployment ('earnings-related benefits'). Other individuals either receive benefits independent of previous labour income, like social assistance in most of the countries, or no public unemployment benefits. 'brepl' reflects the gross replacement rate in the public or private mandatory unemployment insurance and/or assistance system. If unemployment insurance as well as unemployment assistance benefits both depend on prior labour income then 'brepl' reflects both of them and the generosity depends on the shares of persons eligible for unemployment insurance and unemployment assistance (if eligibility differs between these two types, which is usually the case). In general, 'brepl' and 'xi1' are based on EU-SILC data. However, if unemployment insurance is dependent on labour income but unemployment assistance is not, then additional information is necessary to derive them. This is the case in nine of the EU member states, namely Belgium, Germany, Estonia, Spain, France, Lithuania, Portugal, Finland, and Sweden. In several countries, unemployment insurance benefits are flat, that is, independent of previous labour income. In this case 'xi1' is set to zero and unemployment insurance benefits are included in 'b00'. The reason for the division of these types of benefits is the different impact on the incentives of unemployed persons. If replacement income depends on previous labour income, higher wages will induce a higher replacement income, which is not the case for a fixed flat replacement income. For this reason, unemployment benefits are divided into the income-dependent unemployment insurance and the income-independent unemployment assistance in the model.

'b00' also includes social assistance benefits in the model, but these are not discussed in this section and therefore also not included in the values for 'b00' in the following tables. For this reason, the values may differ from the ones which can be found in 'DataInputXX.xls' files. However, sources of 'b00' are shown in the 'DataInputXX.xls' files.

In order to derive the rate of eligibility and the replacement rate, we refer to the variable unemployment benefits PY090G in the EU-SILC, where G stands for gross income. This variable contains the annual income of a person received from several sources, like full and partial unemployment benefits, early retirement benefits, vocational training allowances, mobility or resettlement benefits, severance payments and others, but excludes family allowances. This income category is broader than required, but no better sources are available. As the income variable represents income received across the whole year, we divide it by the number of months spent in unemployment represented by the variable PL080 to calculate monthly income. To get rid of very low and very high benefits (which might, for example, result from high severance payments), we set very low benefits equal to zero and high benefits to an upper bound. The upper bound is set by institutional specifications (upper bound of benefits).[14] Eligibility for unemployment compensation is defined as the number of persons with months spent in unemployment and receiving positive unemployment benefits in relation to the aggregate number of persons with months spent in unemployment.

The relation of average monthly unemployment benefit payments to average monthly income for the different age and skill groups gives the gross replacement rate for the unemployment period. To derive monthly employee cash or near cash income we divide the income variable PY010G by the number of months spent in full- or part-time work (PL073, PL074).

In the following, the unemployment systems in the considered countries are discussed. The rate of eligibility for unemployment payments (total of unemployment insurance and unemployment assistance) as well as the gross replacement rate (weighted average of unemployment insurance benefits and assistance benefits as a percentage of average gross labour income of the respective age and skill group) will be presented in each country's section. The latter are compared to important parameters of the system to check for plausibility.

Belgium

Unemployment insurance in Belgium is compulsory and pays earnings-related benefits (lump-sum benefits for young persons), dependent on family status. The qualifying period depends on the age of the insured persons and is between 312 working days within the last 21 months and 624 working days within the previous 42 months. No waiting period must be considered. The duration of eligibility for unemployment benefits is unlimited if an unemployed person provides enough search effort for a new job. Accumulation with work-income is possible to a certain extent if the activity is subordinate. Other income from work reduces benefits proportionally to the number of days worked.

The unemployment system in Belgium distinguishes three periods. The first period covers the first year of unemployment. The second period lasts two months extended by an additional two months for each year of previous employment. The maximum duration in the second period is 36 months. In the third period, unemployed individuals receive a flat unemployment benefit.

In the first period the replacement rate equals 65 percent of last income in the first three months and 60 percent afterwards. Upper and lower ceilings for unemployment benefits are defined. The lower ceiling for cohabitants with dependants amounts to average daily earnings of EUR 48.89

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[14] The lower bound is set to EUR 30 or EUR 100 per month. Lower values are generally used for Member States with lower average wages.

(2019), the upper ceiling to EUR 66.78 (2019). For single persons and cohabitants without dependants, the lower ceiling amounts to EUR 40.48 and EUR 29.46 (2019 both), respectively. The upper ceiling decreases stepwise. In the second period, the replacement rate still amounts to 60 percent for cohabitants with dependants but decreases to 55 percent for single persons (40 percent for cohabitants without dependants). The upper and lower ceilings decrease further stepwise. The flat benefit in the third period amounts to EUR 48.89 (2019) for cohabitants with dependants, EUR 40.48 for single persons, and EUR 21.17 for cohabitants without dependants.

For young individuals, lump-sum daily benefits are defined, for older workers there exist age supplements. Unemployment benefits are subject to taxation. Social security contributions are 6.5 percent for monthly unemployment benefits above EUR 1,449.73 (2019, EUR 1,746.22 for persons with dependants).

The third period benefit requires separation of unemployment benefits into income-dependent benefits ('xi1', 'brepl') and flat benefits ('b00'). We distinguish these two types by the duration of unemployment. Persons searching for a job for more than two years are assigned to the third period, other unemployed persons to the first two periods.

The share of persons receiving unemployment insurance benefits, as a percentage of all unemployed persons, is reflected in the policy parameter 'xi1'. The policy parameter 'brepl', which stands for benefit replacement, captures the gross replacement rate in the unemployment insurance. The variable 'b00' reflects the income of persons receiving unemployment assistance. These inputs are necessary for countries with an income-independent unemployment replacement income. For other countries, only values for 'xi1' and 'brepl' are needed as unemployment insurance as well as unemployment assistance are income dependent.

In Table 15, one can find eligibility for income-dependent unemployment benefits ('xi1') and the corresponding replacement rate ('brepl') in Belgium. The replacement rate is lower than the aforementioned 50 to 60 percent, which may be the consequence of the upper ceiling. According to data from the Office National de l'Emploi, the share of persons receiving flat benefits is higher than 35 percent. As this share is rather high, 'b00', the flat rate unemployment benefits are also very important in Belgium, as shown in Table 15.

Table 15: Unemployment benefit eligibility and gross replacement rate in Belgium

	xi1				brepl				b00 (as percent of gross labour income)		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	0.8%	-	-	15-19	88.5%	-	-	15-19	0.2%	-	-
20-24	37.7%	37.0%	-	20-24	34.4%	24.3%	-	20-24	18.8%	12.3%	-
25-39	54.1%	58.5%	56.1%	25-39	40.0%	34.9%	29.9%	25-39	31.3%	24.4%	13.8%
40-54	55.4%	53.5%	54.0%	40-54	41.9%	32.7%	24.5%	40-54	34.4%	26.1%	15.7%
55-69	44.1%	49.6%	52.9%	55-69	38.5%	33.4%	23.8%	55-69	36.7%	28.1%	17.8%

Source: EU-SILC, LFS, Office National de l'Emploi, own calculations. • Created with Datawrapper

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Bulgaria

The Bulgarian unemployment system is a compulsory insurance scheme covering employees and financed by contributions. Unemployment can be voluntary or involuntary, and eligible persons must be registered, available and actively searching for work. The qualifying period is at least 12 months of insurance during the last 18 months before unemployment. There is no waiting period in

Bulgaria. Unemployment benefits depend on previous gross earnings and the reason for unemployment.

The unemployment benefit amounts to 60 percent of the average income of the 24 months before unemployment, but not less than BGN 9 (EUR 4.6) per working day. The maximum amount is BGN 74.29 (EUR 38) per working day. The benefit is also capped at 60 percent of the maximum contributory income, which was BGN 3,000 (EUR 1,534) per month in 2019. However, as the maximum amount is lower, this cap is not binding. If termination of the labour contract is voluntary, unemployment benefits equal the minimum amount. The same happens in cases of collective dismissals.

The duration of benefit payments ranges from four months for an insurance period less than three years up to 12 months for an insurance period of more than 15 years. If the labour contract is terminated voluntarily or in the case of a collective dismissal, the maximum duration of eligibility amounts to four months. An unemployment assistance scheme does not exist in Bulgaria. Unemployment benefits are neither taxable nor subject to social security contributions.

Table 16: Unemployment benefit eligibility and gross replacement rate in Bulgaria

	Eligibility				Gross Replacement rate		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	0.0%	-	-	15-19	0.0%	-	-
20-24	3.3%	7.9%	-	20-24	22.8%	29.6%	-
25-39	5.6%	21.4%	29.3%	25-39	34.4%	42.0%	23.6%
40-54	9.0%	27.5%	32.5%	40-54	39.5%	32.9%	40.0%
55-69	11.0%	27.1%	36.7%	55-69	26.1%	39.3%	36.0%

Source: EU-SILC, own calculations. • Created with Datawrapper

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EU-SILC data show, as provided in Table 16, that the rate of eligibility is significantly lower for low-skilled than for other skill groups, for which it amounts to one-quarter to one-third. The replacement rate is considerably lower than the statutory replacement rate of 60 percent, which can result from the lower benefits in cases of voluntary termination of a contract. As unemployment benefits generally are wage dependent, 'b00' from unemployment is set to zero.

Czechia

In Czechia, persons qualify for unemployment insurance benefits not only in the case of previous employment but also for other reasons, for example in case of rehabilitation or care responsibilities. The necessary period of contributions to the unemployment scheme amounts to twelve months within the last two years. The entitlement for unemployment benefits ends after five months if the beneficiary's age is below 50. For persons older than 50 years, the maximum duration raises to eight months (eleven in case of 55 years).

The benefit ratio amounts to 65 percent of previous net earnings (net of tax and social security contributions) in the first two months, 50 percent in the following two months and 45 percent in the remaining months. During retraining of disabled persons, the benefit recipient receives 60 percent of the last net earnings. In case of termination of the last job by the employee or by agreement without valid reason, the unemployment benefit shall be set to 45 percent of previous income for the entire support period. The maximum benefit equals 58 percent of the national average wage or

65 percent in case of retraining. Benefits received are not taxable and exempted from social security contributions.

Table 17: Unemployment benefit eligibility and gross replacement rate in Czechia

	Eligibility				Gross Replacement rate		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	0.0%	-	-	15-19	0.0%	-	-
20-24	1.2%	12.2%	-	20-24	11.6%	24.0%	-
25-39	16.3%	33.7%	28.5%	25-39	18.9%	23.5%	22.7%
40-54	16.3%	38.2%	42.5%	40-54	29.0%	27.4%	17.4%
55-69	19.7%	51.9%	44.6%	55-69	29.3%	31.8%	27.4%

Source: EU-SILC, own calculations. • Created with Datawrapper

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Eligibility and the replacement rate for the different age and skill groups are presented in Table 17. The eligibility rate is rather low, which can be explained by the short benefit duration in comparison to other countries. The replacement rate also seems to be rather low, but one must keep in mind that unemployment benefits are not taxable and are exempted from social security contributions, which implies a low replacement rate as benefits are related to gross labour income. The rate is higher if compared to net income.

Denmark

In contrast to most other European countries, unemployment insurance is voluntary in Denmark and accessible for employees and self-employed persons. Even though the system is voluntary, about 80 percent[15] of employed persons participate in the system. Benefits are eligible for persons between 18 and retirement age. For qualification, a minimum insured income of DKK 233,376 (2019) during three preceding years is required. For part-time workers the minimum income equals DKK 155,580 (2019). If the job loss was voluntary, benefits can be claimed three weeks after getting unemployed.

The benefit of the unemployment insurance amounts to 90 percent of gross earnings received before the unemployment spell, after deduction of 8 percent social security contributions. The maximum monthly benefit amounts to DKK 18,866 (2019). Young unemployed persons with graduate rights receive 71.5 percent (82 percent with a child) of the maximum amount; other young persons receive 50 percent. The maximum total benefit duration is two years (considering repeated unemployment events) within a three-year period. An extension by an additional year is possible if the recipient works at least half a year. To qualify for a new benefit period, 1,924 hours of work within 36 months for full-time insurance are necessary. An unemployment assistance system does not exist in Denmark. Unemployment benefits are subject to taxation but not to the labour market contribution. In addition, they are subject to contributions to the supplementary pension scheme (ATP).

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[15] See https://www.a-kasser.dk/stigende-andel-af-de-unge-er-medlem-af-en-a-kasse/index.html.

Table 18: Unemployment benefit eligibility and gross replacement rate in Denmark

	Eligibility				Gross Replacement rate		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	37.9%	-	-	15-19	48.6%	-	-
20-24	71.4%	68.6%	-	20-24	65.8%	43.4%	-
25-39	91.3%	91.2%	90.9%	25-39	49.8%	47.4%	42.3%
40-54	95.7%	93.0%	84.1%	40-54	51.4%	42.6%	31.3%
55-69	95.0%	92.0%	87.9%	55-69	48.4%	43.1%	31.6%

Source: EU-SILC, own calculations. • Created with Datawrapper

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Table 18 provides the relevant information about eligibility and the replacement rate for the model calibration. It shows that eligibility is very high with the exception of younger persons. This results from the required qualifying period. The high eligibility rate is also a consequence of a lower share of long-term unemployed persons in Denmark. The replacement rate based on EU-SILC calculations shows a much lower replacement rate as the statutory replacement rate of 90 percent would suggest. The maximum amount seems to dampen the replacement rate considerably.

Germany

In Germany, two types of unemployment benefits are available, unemployment insurance and unemployment benefits II. Unemployment insurance is compulsory and entitlement for benefits lasts between six and 24 months depending on the duration of the contribution period, as well as the age of the beneficiary. For eligibility, at least twelve months of contributions to the public unemployment system during the last two and a half years before unemployment are necessary. The ceiling for the reference income differs between the new and old federal states, amounting to EUR 6,700 for the new and EUR 7,100 for the old federal states in 2019. If a person receives unemployment insurance benefits, income from part-time work (at most 15 hours per week) reduces entitlement to unemployment benefits. An amount of EUR 165 is not considered. After the expiration of unemployment benefits, unemployed persons are eligible for unemployment benefits II. This benefit is a combination of unemployment assistance and social assistance with the aim to increase the labour force. Furthermore, unemployment benefit II is needs-based and means-tested.

The replacement rate in the unemployment insurance is 60 percent of previous net earnings or 67 percent for unemployed with at least one dependent child. Unemployment benefits II is flat rate, i.e., independent of former labour income, but dependent on the number of persons in the household and other social factors. It consists of a standard benefit to secure livelihood, additional needs allowances (e.g., for expectant mothers from the 13th week of pregnancy), housing and heating costs[16], one-off benefits and insurance contributions. An additional benefit is paid for support of school attendance. The lump-sum standard benefit for a single person amounts to EUR 424 (2019) per month and between 58 and 90 percent of this value for other household members. Unemployment insurance and unemployment benefits II are exempted from taxation and social security contributions.

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[16] Housing and heating costs are not included in the data presented here as it seems that they are not included in the unemployment benefits in the EU-SILC. They are taken into account as income maintenance benefits and partially allocated to 'b00'.

Table 19: Unemployment benefit eligibility and gross replacement rate in Germany

	xi1				brepl				b00 (as percent of gross labour income)		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	4.9%	-	-	15-19	55.0%	-	-	15-19	24.3%	-	-
20-24	11.1%	36.1%	-	20-24	54.5%	57.0%	-	20-24	24.4%	13.6%	-
25-39	11.8%	35.0%	40.3%	25-39	58.1%	46.2%	45.1%	25-39	29.2%	17.8%	7.5%
40-54	10.8%	31.4%	46.7%	40-54	53.1%	41.8%	34.7%	40-54	25.4%	15.9%	9.7%
55-69	21.0%	48.7%	61.1%	55-69	49.4%	36.3%	25.5%	55-69	23.7%	14.5%	7.5%

Source: EU-SILC, Bundesagentur für Arbeit, own calculations. • Created with Datawrapper

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Table 19 provides the calculated values for eligibility for unemployment insurance in Germany for different age and skill-groups, the replacement rate in the unemployment insurance and the average replacement income of persons not eligible for unemployment insurance benefits. The division of unemployed persons into those who receive unemployment insurance and those who receive unemployment assistance or no benefit is based on data of the 'Bundesagentur für Arbeit' (Federal Employment Agency), which provides information about unemployment insurance and unemployment assistance for different age groups and education levels in annual reports.

The share of unemployed persons receiving unemployment insurance benefits is comparably low, especially for low-skilled persons, it is markedly higher for high-skilled unemployed. Long-term unemployment plays an important role in all groups.

Fixed payments from unemployment assistance are calculated by using information on dependent children living in the household. Information concerning the amount of unemployment benefits II is drawn from MISSOC and OECD *Benefits and Wages* and relevant information about other social benefits is provided by the Federal Employment Agency. The corresponding nominal values are then related to the average gross labour income in the age and skill groups.

Estonia

The unemployment system in Estonia is a compulsory social insurance system for employees, financed by contributions. Voluntary insurance is not possible. The benefit is available for involuntarily unemployed persons between 16 and pensionable age. Beneficiaries must reside in Estonia and be available for work. To qualify for benefits, an employee must be insured for 12 months in the 36 months before unemployment. The qualifying period is independent of age. The waiting period for benefits is seven calendar days.

The unemployment benefit depends on previous earnings nine months before unemployment with a ceiling of three-times the national average income. It is based on the income used to calculate unemployment insurance contributions. The benefit amounts to 50 percent of reference earnings for the first 100 days of unemployment and 40 percent thereafter. There is also a minimum amount set to half of the national minimum earnings of the previous year.

The benefit is paid for 180 days for an insurance period of less than five years and up to one year for persons with an insurance period of ten years and longer.

Aside from the unemployment insurance an unemployment allowance is provided in Estonia. Persons who are voluntarily unemployed are eligible for the unemployment allowance. It is also available for persons with expired unemployment insurance and a benefit duration of less than 270

days. To qualify, 180 calendar days of work within 12 months before unemployment are required. The waiting period is also seven days. The unemployment allowance is a flat-rate benefit and amounts to EUR 5.65 per day (35 percent of the minimum wage of the previous year). The duration is generally 270 calendar days (including days of unemployment insurance benefits). Longer periods are available for older unemployed persons.

The unemployment insurance benefit is taxable; the unemployment allowance is not subject to taxation. Social security contributions are paid by the unemployment insurance fund (13 percent for health insurance and 2 percent to the mandatory pension fund).

Table 20: Unemployment benefit eligibility and gross replacement rate in Estonia

	xi1				brepl				b00 (as percent of gross labour income)		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	2.6%	-	-	15-19	45.8%	-	-	15-19	3.7%	-	-
20-24	2.8%	6.2%	-	20-24	45.8%	50.9%	-	20-24	3.2%	2.8%	-
25-39	7.1%	21.9%	31.9%	25-39	45.8%	50.9%	54.2%	25-39	4.9%	5.2%	5.0%
40-54	6.7%	25.7%	41.1%	40-54	47.9%	55.4%	54.9%	40-54	4.4%	2.7%	2.7%
55-69	11.7%	32.8%	43.2%	55-69	46.9%	54.0%	54.8%	55-69	10.5%	3.5%	4.0%

Source: EU-SILC, Eesti avaandmed, own calculations. • Created with Datawrapper   ECO AUSTRIA INSTITUTE FOR ECONOMIC RESEARCH

The unemployment system in Estonia, with income-dependent unemployment insurance and flat unemployment assistance, requires additional information about the composition of unemployed persons. According to the open-data portal in Estonia, the majority of unemployed persons receive unemployment insurance benefits, except for younger unemployed persons. Data about the skill-structure is not available. It is assumed here that low-skilled individuals are less eligible for unemployment insurance benefits than higher educated groups, a pattern which prevails in many countries. Eligibility for unemployment insurance benefits for low-skilled people is therefore very low. The replacement rate in the unemployment insurance in the model is close to the statutory rate of 40 to 50 percent. Unemployment assistance, reflected in '$b00$', is rather low as beneficiaries are only a minor share of all unemployed persons.

Ireland

The unemployment system in Ireland distinguishes between a jobseeker's benefit based on social insurance and a tax-financed jobseeker's allowance. In contrast to many other Member States, both benefit schemes are flat rate benefits. Insurance is provided to all employees aged 16 years and older, with exception of public servants (recruited before 1995) and persons with very low income.

To qualify for benefits, a person must have paid contributions for 104 weeks, of which 39 weeks must be allotted to the year before unemployment or 26 weeks to each of the two years before unemployment. The benefit is not available if an unemployed person quit their job without reasonable cause or received a high redundancy payment. The jobseeker's weekly benefit amounts to EUR 198 if previous weekly income was above EUR 300. If income was lower, the benefit decreases more than proportionally. The benefit is paid for nine months (six months in case of a short insurance period).

The jobseeker's allowance is dependent on residence and available for all jobseekers aged 18 and above. There is no qualifying period and the duration of the benefit is not limited. The allowance is

subject to a means test. The allowance amounts to EUR 198 per week, the same as the jobseeker's insurance. For new claimants aged between 18 and 25 the allowance is reduced. For tax reasons the first EUR 13 of the weekly benefit are tax exempted, the remaining benefit is taxable. The allowance is completely tax exempted. Neither benefits nor allowance are subject to social security contributions.

The corresponding values for the calibration of the model for Ireland are shown in Table 21. As there exist only flat unemployment benefits, 'xi1' is set to zero. The flat part 'b00' therefore reflects eligibility for insurance and assistance as well as the replacement rate in case of eligibility. The eligibility rate (not shown here) amounts to about two-thirds and is lower especially for young low-skilled unemployed (as a result of qualifying restrictions described above). The replacement rate decreases with age and skill-level given that the benefit and allowance are flat.

Table 21: Unemployment benefit eligibility and gross replacement rate in Ireland

	xi1				b00 (as percent of gross labour income)		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	0.0%	-	-	15-19	10.1%	-	-
20-24	0.0%	0.0%	-	20-24	19.4%	24.2%	-
25-39	0.0%	0.0%	0.0%	25-39	37.5%	30.2%	15.8%
40-54	0.0%	0.0%	0.0%	40-54	25.1%	25.4%	13.9%
55-69	0.0%	0.0%	0.0%	55-69	24.4%	21.3%	9.9%

Source: EU-SILC, own calculations. • Created with Datawrapper

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Greece

The unemployment insurance system in Greece covers employees and consists of unemployment insurance and unemployment assistance. It is not possible to insure voluntarily.

Eligibility for unemployment insurance requires being unemployed involuntarily. To qualify, an insurance period of 125 days within 14 months or 200 days within two years for first-time claimants before unemployment is necessary. There is also a maximum of 400 days for insurance claims within a four-year period. The waiting period for insurance benefits is six days.

The unemployment insurance benefit is flat (basic unemployment benefit), but the flat rate depends on previous wage income. If earnings before unemployment were higher than 12-times the average daily wage of a blue-collar worker (EUR 26.18) then the monthly benefit amounts to 55 percent of the daily blue-collar worker wage, times 25; that is, EUR 360 in 2019. If wage income is six-to-twelve–times the daily wage, the rate is 75 percent of six-times the daily wage for 25 days (EUR 270). For lower incomes, the replacement rate is 50 percent of six-times the daily wage (EUR 180). For each dependent family member, the benefit rises by 10 percent. The benefit duration ranges from five months for 125 days of employment before unemployment to 12 months for 250 days of employment.

Two different kinds of unemployment assistance exist in Greece, both flat rate. There is a special allowance for those unemployed subsequent to unemployment insurance eligibility, paid only once, and a special allowance for people registered as unemployed (without unemployment insurance benefits) after a three-month waiting period and 60 days of work before unemployment, paid three times at most. In both cases, annual net family income must be lower than EUR 11,445.34. The

unemployment assistance amounts to 13-times the daily unemployment benefit (in total EUR 187.20) in the first case and 15-times the daily unemployment benefit in the second case (EUR 216).

Unemployment benefits increase by 12.5 percent (one-and-a-half additional months of income) for Christmas and Easter financial aid. For long-term unemployed individuals, an additional period of 12 months of unemployment benefit of EUR 200 can be claimed. Unemployment benefits are subject to taxation if annual personal income is higher than EUR 10,000; social security contributions do not arise.

Table 22: Unemployment benefit eligibility and gross replacement rate in Greece

	xi1				b00 (as percent of gross labour income)		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	0.0%	-	-	15-19	0.0%	-	-
20-24	0.0%	0.0%	-	20-24	1.8%	1.9%	-
25-39	0.0%	0.0%	0.0%	25-39	4.1%	3.6%	2.8%
40-54	0.0%	0.0%	0.0%	40-54	4.3%	3.6%	3.1%
55-69	0.0%	0.0%	0.0%	55-69	2.6%	2.3%	1.6%

Source: EU-SILC, own calculations. • Created with Datawrapper

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As unemployment insurance and unemployment assistance are both independent of previous labour income, 'xi1' is set to zero. The variable 'b00' therefore includes both. However, the values are very low, especially due to the low share of unemployed individuals receiving benefits. For most age and skill groups, the share lies between 10 and 15 percent of unemployed persons. Total expenditures for unemployment benefits in Greece amount to less than half a percent of GDP, although unemployment is very high. This supports the low values for replacement benefits in the case of unemployment, as shown in Table 22.

Spain

The unemployment system in Spain can be characterised as a system of two types of support, unemployment insurance and unemployment assistance, where assistance is granted subsequently to insurance. In Spain, persons who voluntarily quit their employment do not qualify for unemployment benefits. The eligibility criterion is a minimum of 360 working days in the six years preceding unemployment. Unemployment insurance benefits are paid at most for 720 days, where the duration depends on the number of days contributed to the system within the last six years. The minimum duration amounts to 120 days. Subsequently, an unemployed person may qualify for unemployment assistance (especially older workers), which is income-tested. To be eligible, other earnings per household member must be below 75 percent of the interprofessional minimum wage. The benefit duration for unemployment assistance is between six and 18 months in most cases. Special regulations exist for certain groups and regions.

The unemployment insurance benefit amounts to 70 percent of reference earnings (average gross earnings over the last 180 days) for the first 180 days and 50 percent afterwards. The maximum contribution base is EUR 4,070.10 (2019). In addition, there exist minimum and maximum benefits,

which are defined as a percentage of the defined reference income IPREM.[17] For unemployed persons with no dependent child, the minimum amounts to 80 percent, and the maximum to 175 percent of the reference income IPREM. With two or more children the minimum and maximum increase to 107 and 225 percent. Unemployment assistance amounts to 80 percent of IPREM but excludes bonus payments of one-sixth. Unemployment insurance benefits are taxable and social security contributions amount to 4.7 percent (contributions for pension/sickness and invalidity insurance). Unemployment assistance benefits are also taxable; social security contributions do not arise.

Table 23: Unemployment benefit eligibility and gross replacement rate in Spain

	xi1				brepl				b00 (as percent of gross labour income)		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	0.5%	-	-	15-19	52.4%	-	-	15-19	0.5%	-	-
20-24	6.3%	12.1%	-	20-24	52.4%	53.9%	-	20-24	2.3%	1.4%	-
25-39	23.0%	25.5%	26.4%	25-39	52.4%	53.9%	41.8%	25-39	9.2%	6.4%	3.8%
40-54	20.7%	21.8%	22.0%	40-54	37.9%	42.1%	41.1%	40-54	12.7%	8.6%	4.9%
55-69	13.2%	13.0%	13.3%	55-69	37.2%	37.8%	39.4%	55-69	16.4%	10.5%	6.4%

Source: EU-SILC, SEPE Servicio Publico de Empleo Estatal, own calculations. • Created with Datawrapper

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Table 23 provides the results of the calibration of the Spanish unemployment system. Compared to other countries, eligibility for benefits is low. The qualifying restrictions, especially the requirement of involuntary job separation, may explain these differences. A relatively large share of all beneficiaries receives unemployment assistance.[18] The replacement rate in the unemployment insurance system 'brepl' decreases moderately across age and skill-groups. Only for older unemployed persons does it decrease as a result of the maximum benefit like in most other countries. The amount of unemployment assistance income is comparable to other countries.

France

Unemployment benefits in France consist of unemployment insurance and unemployment assistance, which is paid subsequently. Eligibility for unemployment insurance requires either an involuntary separation from the last job or a resignation for good cause. Unemployment insurance benefits are based on previous labour income, whereas unemployment assistance benefits are flat. The qualifying period for unemployment insurance is 610 working hours (88 days full-time) during the last 28 months (36 months for persons aged 53 and older). In general, unemployed individuals receive benefits after a waiting period of at least seven days. Longer waiting periods are foreseen if severance payments are higher than legally required. Unemployment insurance benefits are not means-tested. The duration for which unemployment insurance benefits are paid corresponds to the duration of contribution to the system with a minimum of four months and a maximum of 24 months (36 months for persons aged 55 and older).

Unemployment insurance benefits are the maximum of 40.4 percent of the reference daily wages with additional EUR 11.92 (2019) per day (at most 75 percent of the reference daily wage) and of

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[17] For 2019, the reference income IPREM amounts to EUR 537.84 per month. The reference income is increased by one-sixth to consider 13th and 14th bonus payments.

[18] Nearly 50 percent in the age group 25-to-54 and considerably more than 70 percent for older workers.

57 percent of the reference daily wage. Additionally, the minimum daily benefit amounts to EUR 29.06 (2019) per day.

Qualification for unemployment assistance (allowance of specific solidarity) requires five years of activity during the last ten years preceding unemployment. The benefit is granted for a period of six months but is renewable such that a longer duration is possible. The unemployment assistance pays a maximum of EUR 16.48 per day (2019, 30 days per month).

Benefits are subject to taxation with no special relief scheme. In addition, social security contributions must be paid for unemployment insurance benefits, consisting of 6.2 percent for the generalised social contribution, 0.5 percent for the contribution for the repayment of social debt and 3 percent for complementary pension contributions. In case of unemployment assistance these contributions do not arise.

France is among the group of countries with a non-income dependent unemployment assistance scheme which requires the calculation of 'b00'. To proxy the share of persons receiving unemployment assistance benefits of all persons receiving benefits, we use the share of long-term unemployed of all unemployed persons, defined as being unemployed for more than one year. Using EUR 16.48 per day or EUR 494.4 per month as a basis for unemployment assistance benefits, this enables calculation of 'b00' by taking into account the share of unemployed without any unemployment claims of all unemployed individuals. The relatively low level of 'b00' across all age and skill groups is also a matter of the comparably low share of unemployed persons with unemployment benefit claims. The policy parameter 'xi1' is derived by using EU-SILC information about eligibility and the share of short- and medium-term (less than one year) unemployed persons. The replacement rate in the unemployment insurance 'brepl' is calculated by using the average replacement rate of all persons receiving unemployment benefits, 'b00' and the according shares for unemployment insurance and unemployment assistance. The replacement rate fits very well to the statutory replacement rate of at least 57.4 percent and is similar across age and skill-groups. The values are presented in Table 24.

Table 24: Unemployment benefit eligibility and gross replacement rate in France

	xi1				brepl				b00 (as percent of gross labour income)		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	11.5%	-	-	15-19	47.8%	-	-	15-19	2.4%	-	-
20-24	21.1%	43.3%	-	20-24	53.3%	55.3%	-	20-24	3.5%	6.3%	-
25-39	31.9%	42.1%	47.3%	25-39	66.8%	64.6%	55.0%	25-39	9.1%	11.8%	8.4%
40-54	33.5%	45.2%	46.5%	40-54	59.1%	59.6%	47.3%	40-54	8.9%	11.3%	6.1%
55-69	42.5%	46.8%	47.5%	55-69	51.5%	59.6%	51.4%	55-69	12.1%	10.9%	5.4%

Source: EU-SILC, own calculations. • Created with Datawrapper

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Croatia

Unemployment insurance benefits in Croatia are available for employees and self-employed persons; unemployment assistance does not exist. Conditions for eligibility of benefits are involuntary unemployment and registration with the employment service. To qualify for benefits, nine months of employment or insurance contributions within the previous 24 months are necessary. There is no waiting period.

The reference income for unemployment benefits is the average gross earnings for the three months before unemployment. The replacement rate amounts to 60 percent for the first 90 days and 30 percent thereafter. The maximum benefit equals 70 percent (HRK 4,365.90) of the average net wage of the previous year for the first 90 days and 35 percent (HRK 2,182.95) for longer unemployment spells. The minimum benefit equals 50 percent of the minimum salary, minus mandatory insurance contributions (HRK 1,500).

The duration of unemployment insurance benefits is at least 90 calendar days and increases by 30 days for every two years of employment for employment spells of less than ten years. For longer employment spells, the duration increases by 30 days for every five years of employment, with a maximum of 450 days. Unemployment insurance benefits are neither taxable nor subject to social security contributions.

Table 25: Unemployment benefit eligibility and gross replacement rate in Croatia

	Eligibility				Gross Replacement rate		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	0.0%	-	-	15-19	0.0%	-	-
20-24	0.7%	4.1%	-	20-24	9.0%	27.8%	-
25-39	3.8%	7.2%	4.9%	25-39	22.8%	22.9%	16.7%
40-54	7.0%	9.8%	12.3%	40-54	28.5%	22.8%	21.0%
55-69	12.4%	17.1%	10.5%	55-69	26.9%	22.6%	17.5%

Source: EU-SILC, own calculations. • Created with Datawrapper

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The eligibility for unemployment benefits and the gross replacement rate are shown in Table 25. The restriction on the duration of unemployment benefits and the requirement of involuntary unemployment lead to a small share of unemployed persons receiving insurance benefits in Croatia. In general, less than 10 percent receive benefits. The replacement rate is lower than 30 percent, which can be attributed to the cap on unemployment benefits.

Italy

In Italy, unemployment insurance is a compulsory scheme, and unemployment assistance does not exist. The unemployment insurance benefit (Nuova Assicurazione Sociale per l'Impiego – NASpI) is available for persons being involuntary unemployed and having matured at least 13 weeks of unemployment insurance during four years before unemployment and 30 days within the last 12 months. A waiting period of eight days is implemented. The benefit (NASpI) is granted for half the number of weeks of contributions paid during the last four years.

Benefits are calculated on the basis of average monthly gross income during the last four years before unemployment with a monthly ceiling of EUR 1,314.30 (2018). The replacement rate in the NASpI amounts to 75 percent of monthly reference earnings below the ceiling of EUR 1,221.44 (2019) and 25 percent of income above the ceiling. The maximum payable amount is EUR 1,328.76 (2019). After three months the replacement rate is gradually reduced by 3 percentage points every month. All benefits are taxable but not subject to social security contributions.

Eligibility for unemployment benefits and the replacement rates for the different age and skill groups in Italy can be found in Table 26. Eligibility for unemployment benefits is low compared to

other countries[19] and increases with age (with the exception of the last age group). Given the maximum benefit criterion, the replacement rate is considerably lower than the statutory replacement rate of 75 percent.

Table 26: Unemployment benefit eligibility and gross replacement rate in Italy

	Eligibility				Gross Replacement rate		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	3.7%	-	-	15-19	39.8%	-	-
20-24	12.7%	15.6%	-	20-24	33.8%	37.4%	-
25-39	22.8%	28.8%	25.6%	25-39	44.4%	38.8%	32.8%
40-54	30.5%	30.2%	33.9%	40-54	44.9%	38.8%	31.0%
55-69	26.2%	26.8%	22.0%	55-69	43.3%	37.8%	26.2%

Source: EU-SILC, own calculations. • Created with Datawrapper

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Cyprus

Unemployment insurance in Cyprus is available for employees and benefits are earnings-related. Unemployment can be voluntary and involuntary. To qualify for benefits, a person must have been insured for at least 26 weeks before unemployment and paid at least 26-times the weekly basic insurable amount of EUR 175.11 (equals 0.5 insurance points). The waiting period is three days. An unemployment assistance scheme is not available.

The unemployment insurance benefit is split into two components, the basic benefit and the supplementary benefit. The basic benefit amounts to 60 percent of the weekly value of an insurance point times the number of insurance points. The replacement rate increases by 20 percentage points for the first dependant and by 10 percentage points for further dependants. The supplementary benefit equals 50 percent of the weekly value of insurance points. The maximum amount of the supplementary benefit cannot be higher than basic insurable earnings. The maximum duration of unemployment benefits equals 156 days. Unemployment insurance benefits are not taxable and not subject to social security contributions.

Table 27: Unemployment benefit eligibility and gross replacement rate in Cyprus

	Eligibility				Gross Replacement rate		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	3.1%	-	-	15-19	45.6%	-	-
20-24	10.5%	10.6%	-	20-24	36.1%	43.2%	-
25-39	19.2%	29.7%	32.5%	25-39	57.2%	47.6%	31.3%
40-54	29.2%	36.0%	43.7%	40-54	46.1%	38.7%	23.6%
55-69	37.6%	29.5%	30.5%	55-69	45.5%	39.4%	22.9%

Source: EU-SILC, own calculations. • Created with Datawrapper

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The unemployment insurance provides earnings-related benefits. For this reason, information for the flat part in the model is not necessary. The eligibility rate for benefits increases with age and

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[19] This result is also provided by the LFS.

skill in general, except for older low-skilled persons. The replacement rate decreases with age and skill as the replacement rate is capped. The values for Cyprus are shown in Table 27.

Latvia

Latvia provides unemployment insurance for all employees and allows for voluntary membership. To be eligible for unemployment insurance, a person must be registered at the public employment service and available for work. An unemployment assistance scheme does not exist.

To qualify for benefits, an unemployed person must be insured for at least one year and have paid contributions for at least 12 months in the 16 months before unemployment. In the case of involuntary unemployment, there is no waiting period; for voluntary unemployment, the waiting period is two months. The average contribution wage is based on the 12-month period ending two months prior to the month of unemployment.

The replacement rate depends on the insurance record and the duration of unemployment. For insurance periods less than ten years, the replacement rate amounts to 50 percent and it increases by 5 percentage points for every ten years of employment with a maximum of 65 percent. For the first three months of unemployment, the replacement rate equals 100 percent of this value, then decreases to 75 percent for the fourth to sixth months of unemployment, and to 50 percent thereafter. The maximum duration of benefit claims is nine months. Benefits are neither taxable nor subject to social security contributions.

Table 28: Unemployment benefit eligibility and gross replacement rate in Latvia

	Eligibility				Gross Replacement rate		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	7.1%	-	-	15-19	24.6%	-	-
20-24	7.6%	12.8%	-	20-24	13.7%	19.0%	-
25-39	22.6%	33.6%	52.2%	25-39	31.8%	24.2%	36.4%
40-54	17.2%	31.1%	56.3%	40-54	35.9%	31.3%	31.0%
55-69	19.0%	29.4%	41.4%	55-69	37.4%	30.4%	32.3%

Source: EU-SILC, own calculations. • Created with Datawrapper

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The share of persons eligible for unemployment insurance benefits increases significantly with the educational level as shown in Table 28. For high-skilled persons, about half of unemployed persons receive benefits whereas the share is less than one-fifth for low-skilled persons. The replacement rate is similar across skill groups and increases with age for low- and medium-skilled persons, reflecting longer employment and shorter unemployment spells.

Lithuania

Lithuania has a compulsory social insurance scheme covering employees and providing unemployment insurance benefits. An unemployment assistance scheme is not available. The benefit is provided in cases of involuntary and voluntary unemployment from 16 to retirement age. The qualifying period is 12 months of insurance during 30 months before unemployment. The waiting period is eight days in the case of involuntary unemployment and three months in cases of voluntary unemployment.

The unemployment insurance benefit consists of two parts. A non-earnings-related fixed component which equals 23.27 percent of the minimum monthly wage (EUR 129.15 in 2019) and a variable component depending on the average of previous insured income 30 months prior to unemployment. The replacement rate of the variable component depends on the length of the unemployment spell. For the first three months, the replacement rate equals 38.79 percent; it decreases to 31.03 percent for the next three months; and to 23.27 percent for the months seven to nine. The maximum benefit is 75 percent of the average national wage.

The maximum duration of eligibility is nine months but can be prolonged for two further months for elderly persons. Benefits are neither subject to taxation nor to social security contributions. The period of unemployment is considered for pension insurance.

Table 29: Unemployment benefit eligibility and gross replacement rate in Lithuania

	xi1				brepl				b00 (as percent of gross labour income)		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	4.6%	-	-	15-19	2.7%	-	-	15-19	0.5%	-	-
20-24	16.4%	14.9%	-	20-24	3.6%	13.7%	-	20-24	2.1%	2.4%	-
25-39	20.3%	28.7%	43.4%	25-39	9.5%	9.4%	7.2%	25-39	4.0%	5.2%	5.8%
40-54	13.9%	30.9%	40.1%	40-54	11.4%	8.7%	9.4%	40-54	2.4%	5.7%	4.6%
55-69	19.6%	26.5%	52.5%	55-69	11.4%	11.6%	10.8%	55-69	3.6%	4.9%	8.7%

Source: EU-SILC, own calculations. • Created with Datawrapper

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Unemployment benefits in the model are divided across non-earnings-related and earnings-related benefits (the latter are reflected in 'xi1' and 'brepl'). The share of unemployed persons receiving earnings-related insurance benefits increases with the skill level and generally ranges between 10 and 50 percent. The gross replacement rate is about 10 percent. The non-earnings-related part plays a minor role, but increases with the skill level.

Luxembourg

The unemployment system in Luxembourg is financed by taxes and available for employees, young persons after education and self-employed persons. Voluntary insurance is not possible. To be eligible, unemployment must be involuntarily. An unemployment assistance scheme does not exist. The qualifying period amounts to 26 weeks of employment during the previous 12 months; a waiting period does not exist. After the benefit has expired, repeated eligibility is possible 12 months thereafter at the earliest.

The reference income for the unemployment benefit is the average of gross earnings three months before unemployment, with no cap. The replacement rate amounts to 80 percent of the reference income. In the case of a dependent child, the replacement rate is increased to 85 percent. The maximum benefit in 2019 is initially EUR 5,177.75 per month and decreases to EUR 4,142.20 after 182 days of benefit claim. The maximum duration of eligibility is 365 calendar days. For persons particularly 'difficult' to place, 182 extra days are available and there are special rules for persons older than 50. In these cases, the maximum benefit decreases to EUR 3,106.65.

Unemployment benefits are subject to taxation and to health care, long-term care and pension insurance contributions.

Table 30: Unemployment benefit eligibility and gross replacement rate in Luxembourg

	Eligibility				Gross Replacement rate		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	3.6%	-	-	15-19	23.9%	-	-
20-24	24.6%	30.9%	-	20-24	75.2%	61.1%	-
25-39	52.0%	50.1%	38.7%	25-39	65.6%	56.3%	45.6%
40-54	66.9%	60.9%	52.1%	40-54	60.1%	42.7%	41.4%
55-69	63.6%	60.9%	51.5%	55-69	62.0%	51.0%	35.6%

Source: EU-SILC, own calculations. • Created with Datawrapper

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Eligibility and the gross replacement rate are higher than in many other Member States. In contrast to other countries, eligibility decreases to some degree with skill level, the replacement rate from about 60 percent for low-skilled to about 40 percent for high-skilled persons. As no flat benefits are granted, the unemployment part of 'b00' is set to zero. Table 30 shows the results for Luxembourg.

Malta

The unemployment system in Malta covers all employees and provides an unemployment insurance and assistance system. Benefits are flat rate in both schemes; voluntary insurance is not possible.

The qualifying period for unemployment insurance is 50 weeks, of which 20 must have been paid in the previous two years. In cases of involuntary unemployment there is no waiting period; in cases of voluntary unemployment the waiting period is set to six months. The unemployment insurance benefit amounts to EUR 12.61 per day (if the spouse is not full-time employed) and EUR 8.24 per day for a single person. The benefit is paid for six days per week. The duration of unemployment insurance in days equals the number of weeks of contributions with a maximum of 156 days. A special unemployment benefit is granted if a means test is satisfied. In this case the benefit amounts to EUR 21.17 per day for a married or single parent and EUR 13.97 per day for other persons.

An unemployment assistance scheme is available for heads of household who are registered and who satisfy a means test. The unemployment assistance equals social assistance and amounts to EUR 105.93 per week; it increases with the number of persons in the household. EUR 8.15 per week is paid for each additional member of the household. Twice a year, beneficiaries also receive a government bonus of EUR 135.10.

Unemployment insurance and assistance benefits are subject to taxation. Social security contributions do not arise.

Table 31: Unemployment benefit eligibility and gross replacement rate in Malta

	xi1				b00 (as percent of gross labour income)		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	0.0%	-	-	15-19	0.8%	-	-
20-24	0.0%	0.0%	-	20-24	1.8%	1.0%	-
25-39	0.0%	0.0%	0.0%	25-39	12.2%	5.0%	1.4%
40-54	0.0%	0.0%	0.0%	40-54	17.6%	7.9%	3.3%
55-69	0.0%	0.0%	0.0%	55-69	24.1%	7.0%	1.8%

Source: EU-SILC, own calculations. • Created with Datawrapper

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As unemployment insurance and unemployment assistance are flat and independent of previous earnings, eligibility for earnings-related benefits is set to zero for all age and skill groups, as shown in Table 31. Benefits are fully reflected in 'b00'. Benefits play a role for low-skilled unemployed persons, with gross replacement rates between 10 and 20 percent. For medium- and high-skilled persons, replacement income is significantly lower.

Hungary

The unemployment system in Hungary is a social insurance scheme covering employees and self-employed persons with an earnings-related insurance pillar and no unemployment assistance scheme. Benefits can also be claimed in cases of voluntary unemployment. The qualifying period is at least 360 days of insurance during the three years before unemployment; a waiting period does not exist.

The unemployment benefit is based on average contributory earnings in the four quarters before unemployment with no ceiling on reference earnings. The replacement rate equals 60 percent of reference earnings with a maximum benefit equal to the minimum wage (HUF 149,000 or EUR 463 in 2019). If reference earnings cannot be determined, they are set to 130 percent of the minimum wage.

Table 32: Unemployment benefit eligibility and gross replacement rate in Hungary

	Eligibility				Gross Replacement rate		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	7.1%	-	-	15-19	34.8%	-	-
20-24	41.2%	18.7%	-	20-24	27.8%	23.2%	-
25-39	48.1%	35.8%	30.3%	25-39	35.2%	27.3%	17.4%
40-54	54.5%	37.4%	30.3%	40-54	32.8%	25.7%	21.3%
55-69	57.6%	59.3%	26.1%	55-69	39.9%	26.2%	19.3%

Source: EU-SILC, own calculations. • Created with Datawrapper

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The maximum duration of benefit eligibility is one day for every ten days of prior insurance, up to a maximum of 90 days. It is independent of the reason for unemployment. The unemployment benefit is subject to a taxation and pension contribution of 10 percent, deducted from the benefit.

The model parameters for Hungary are shown in Table 32. The eligibility for unemployment insurance is highest for low-skilled unemployed persons and decreases with skill level. The same

holds for the gross replacement rate, with more than 30 percent for low-skilled and about 20 percent for high-skilled persons as benefits are capped at the minimum wage.

Netherlands

Unemployment insurance benefits in the Netherlands are earnings-related and insurance is compulsory for employees, unemployment assistance is not available. Supplementary benefits may be granted if the replacement income is below the minimum income. For eligibility, a person must have worked at least 26 within the last 36 weeks. This qualifies for a three-months benefit duration. Childcare activities for children under six years of age are treated as half a year of employment (under conditions). The benefit duration depends on the employment duration before unemployment. From 2016 on, the maximum duration was reduced from 38 to 24 months in 2019. One month of unemployment benefit is accrued for each year worked for the first ten years and half a month beyond that. As the replacement rate is based on gross income, unemployment benefits are taxable and social security contributions for the General Surviving Relatives Act (0.1 percent), the General Old-Age Pensions Act (17.9 percent), and the Long-Term Care Act (9.65 percent) are deducted.

The replacement rate in the unemployment insurance amounts to 75 percent of former gross earnings in the first two months and 70 percent in the following months up to a maximum of the daily wage of EUR 214.28 (2019).

In addition, the benefits amount to at least a certain fraction of the gross minimum wage per month if the total income of a beneficiary and their partner is less than the minimum guaranteed income. For a single person, the fraction amounts to 70 percent and for married persons and couples the benefit corresponds to the full amount.

Table 33: Unemployment benefit eligibility and gross replacement rate in the Netherlands

	Eligibility				Gross Replacement rate		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	11.2%	-	-	15-19	16.9%	-	-
20-24	26.5%	37.4%	-	20-24	68.0%	69.0%	-
25-39	25.3%	43.3%	62.2%	25-39	66.0%	63.0%	61.4%
40-54	38.8%	49.0%	71.5%	40-54	69.0%	61.8%	48.6%
55-69	41.5%	54.2%	60.6%	55-69	68.0%	55.9%	45.7%

Source: EU-SILC, own calculations. • Created with Datawrapper

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Compared to other EU-15 countries with income-related benefits, eligibility for low- and medium-skilled persons is rather low, as shown in Table 33. This modest rate may be a result of the dependence of benefit duration on the number of years in employment. However, this does not explain why the rate of older workers is not considerably higher. One reason may be the absence of an unemployment assistance scheme. The replacement rate fits very well to the statutory replacement rate considering the maximum benefit. It decreases with age and skill-level as labour income rises.

Austria

The Austrian public unemployment system is a compulsory insurance scheme for all employees with monthly earnings of more than the so-called 'Geringfügigkeitsgrenze' (monthly minimum

income limit) which amounts to EUR 446.81 (2019). The upper ceiling of income considered amounts to EUR 4,860 (2019). Self-employed persons can insure voluntarily; no such insurance exists for civil servants. To qualify for unemployment benefits, a person must have been in dependent contributory employment for at least one year in the last two years, or 28 weeks in a row in case of a repeated unemployment period. For persons aged below 25, only 26 weeks of employment in the last 12 months are necessary to qualify for benefit payments. The duration of eligibility depends on employment duration and the age of an unemployed person. It starts from 20 weeks and can be extended to 52 weeks if the unemployed person is aged 50 or more and was employed for at least 468 weeks in the previous 15 years[20]. For specific active labour market programmes longer periods are possible. In case of a resignation without good reason, a waiting period of four weeks takes effect. After the exhaustion of eligibility for unemployment insurance benefits, a person qualifies for unemployment assistance if this person is in need.[21] Unemployment assistance is granted for 52 weeks but can be extended repeatedly for further 52 weeks.

Unemployment insurance benefits are based on the average net income in the year before the unemployment spell and amount to 55 percent of the reference income. For low income persons, the replacement rate is raised to 60 percent (80 percent in households with dependants) if 55 percent of the reference income is below the supplementary pension amount ('Ausgleichszulagenrichtsatz'). In addition, for each dependent person an extra daily amount of EUR 0.97 is paid. Beneficiaries are allowed to receive work-related earnings up to the monthly minimum income limit ('Geringfügigkeitsgrenze') without any consequences for qualification for unemployment benefits. Unemployment assistance benefits, which are paid after the exhaustion of unemployment insurance benefits, amount to 92 percent of the basic unemployment insurance benefits, or 95 percent for low-income groups. Family supplements are also available in the unemployment assistance scheme. Unemployment insurance, as well as unemployment assistance benefits, are exempted from income taxation and social security contributions (as they are based on net income).

The data from the EU-SILC are presented in Table 34. They show that across all age and skill groups eligibility is rather high, so that most of the unemployed persons receive payments. The eligibility rate is lower only for young low-skilled persons, which reflects the presence of the required minimum contribution period. The replacement rate seems to be rather moderate, however one must keep in mind that no taxes and social security contributions are levied on unemployment benefits, or on unemployment assistance payments. The much lower rate for older, medium and high-skilled individuals results from tax exemption as well as the upper ceiling in the unemployment insurance.

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[20] The duration may be extended to 78 weeks if the unemployed person participates in rehabilitation measures.

[21] Since July 2018, spousal income is no longer considered.

Table 34: Unemployment benefit eligibility and gross replacement rate in Austria

	Eligibility				Gross Replacement rate		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	51.8%	-	-	15-19	64.9%	-	-
20-24	61.9%	83.5%	-	20-24	46.3%	43.5%	-
25-39	76.5%	84.1%	71.9%	25-39	47.5%	42.4%	31.5%
40-54	88.6%	87.9%	87.9%	40-54	39.2%	33.7%	25.1%
55-69	86.7%	91.4%	78.8%	55-69	42.3%	29.6%	18.3%

Source: EU-SILC, own calculations. • Created with Datawrapper   ECO AUSTRIA INSTITUTE FOR ECONOMIC RESEARCH

Poland

Poland has a compulsory insurance scheme that provides a flat-rate benefit, but no unemployment assistance. Persons are eligible if they are ready to work, at least 18 years old, and have not reached retirement age. To qualify, an unemployed person must have been employed for at least 365 days during the 18 months preceding the day of registration. The maximum benefit duration depends on the unemployment rate in the region, the number of eligibility periods, and family circumstances. It ranges from six to twelve months. Benefit recipients are not allowed to receive income in excess of 50 percent of the national minimum wage.

If qualified for benefits, an unemployed person receives a benefit that is paid monthly as a percentage of the 'Basic Unemployment Allowance', which was PLN 847.80 (year 2019) for the first three months and PLN 665.70 thereafter. Persons insured for less than five years receive 80 percent of that benefit, persons with five to 20 years receive 100 percent and persons with more than 20 years receive 120 percent of the basic unemployment allowance. Benefits are taxable and contributions for health care, old-age, invalidity and survivors' insurance are deducted from the benefit. For older workers, persons aged over 55 (women) or 60 (men) respectively, specific arrangements exist.

The flat nature of the benefit implies that 'xi1' is set to zero in the model; that is, no income-dependent unemployment benefit. The flat part of the unemployment benefit, 'b00', is also very low. This follows from the very low rate of eligibility for unemployment benefits, also confirmed by the low rate in the LFS.

Table 35: Unemployment benefit eligibility and gross replacement rate in Poland

	xi1				b00 (as percent of gross labour income)		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	0.0%	-	-	15-19	0.6%	-	-
20-24	0.0%	0.0%	-	20-24	0.9%	0.9%	-
25-39	0.0%	0.0%	0.0%	25-39	1.7%	2.4%	2.7%
40-54	0.0%	0.0%	0.0%	40-54	2.3%	3.3%	3.0%
55-69	0.0%	0.0%	0.0%	55-69	5.5%	7.3%	4.9%

Source: EU-SILC, own calculations. • Created with Datawrapper

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Portugal

The unemployment system in Portugal consists of an earnings-related unemployment insurance and a flat unemployment assistance scheme. Both schemes are financed by contributions of employees and employers. The unemployment insurance scheme is available for persons involuntarily unemployed and for some groups of self-employed persons.

The qualifying period for insurance benefits is at least 360 contributory days within two years before unemployment. As benefits are only available for involuntarily unemployed persons, there is no waiting period. The reference income is the average daily gross wage 12 months before the two months prior to the unemployment spell. The daily reference wage includes holiday and Christmas bonuses. There is no ceiling for the reference wage. The unemployment benefit equals 65 percent of the reference wage with a lower bound equal to the value of the reference social support index IAS (EUR 428.90). The amount is increased by 10 percent if both spouses with dependent children are unemployed. The maximum cannot be higher than 75 percent of the net value of the reference income or 2.5-times the IAS.

The benefit duration depends on the age of the unemployed person and the length of contribution to the system. The maximum duration for a contribution period of less than 15 months ranges from 150 days for persons aged less than 30 years to 270 days for a person aged 50 years or more. For a contribution period of more than 24 months, the duration is 330 days for young unemployed persons and 540 days for older persons. In addition, additional duration is granted for every five years of registered income.

To be eligible for the unemployment assistance, at least 180 days of paid employment in the year before unemployment is necessary. The benefit is means tested (monthly household income less than 80 percent of IAS; moveable assets less than 240-times IAS). The benefit amounts to the IAS for unemployed people with dependants and 80 percent of the IAS for persons living alone. The duration of the benefit is the same as the duration for unemployment insurance benefits. If unemployment insurance was granted before, the duration is halved for beneficiaries aged less than 40 years.

Unemployment insurance and assistance benefits are not taxable and no social security contributions are applied.

Table 36: Unemployment benefit eligibility and gross replacement rate in Portugal

	xi1				brepl				b00 (as percent of gross labour income)		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	1.0%	-	-	15-19	62.1%	-	-	15-19	0.1%	-	-
20-24	5.6%	6.2%	-	20-24	57.8%	55.3%	-	20-24	0.6%	0.7%	-
25-39	20.4%	23.4%	24.4%	25-39	55.2%	46.1%	41.3%	25-39	2.8%	2.8%	2.0%
40-54	25.7%	30.9%	36.8%	40-54	50.8%	43.9%	34.6%	40-54	3.3%	3.1%	2.3%
55-69	37.6%	35.5%	39.6%	55-69	51.2%	41.4%	31.9%	55-69	4.6%	2.6%	1.6%

Source: EU-SILC, Ministério do Trabalho, Solidariedade e Segurança Social, own calculations. • Created with Datawrapper

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The division between unemployment insurance benefits and unemployment assistance is based on information from the ministry 'Ministério do Trabalho, Solidariedade e Segurança Social'. Data contain information about the age structure of beneficiaries for the different benefit schemes. Together with the eligibility ratio of benefits in general from the EU-SILC and assumptions about the skill structure, it is possible to derive the relevant parameters for the model. Unemployment benefits are largely based on the unemployment insurance system, as shown in Table 36. About 80 percent of unemployed beneficiaries receive unemployment insurance benefits.

Romania

The unemployment system in Romania is based on an unemployment insurance scheme; an unemployment assistance scheme does not exist. Unemployment insurance is compulsory for employees and civil servants and voluntary for self-employed people and their spouses. To be eligible, unemployment must be involuntarily. The qualifying period amounts to 12 months of contributions in the 24 months before unemployment. There is no waiting period. Reference earnings are gross monthly earnings in the last 12-month contribution period.

The insurance benefit is largely flat. It amounts to 75 percent (for graduates, 50 percent) of the reference social indicator (RON 500, EUR 107 in 2019) and 3 to 10 percent of the average gross income. For a contribution period of three-to-five years, the replacement rate amounts to 3 percent of previous income; it increases to 5 percent for five-to-ten years contributions; it is 7 percent between 10 and 20 years, and 10 percent for longer contribution periods.

The duration of eligibility for unemployment insurance also depends on the contribution period and ranges from six months (one-to-five years of contributions), to nine months (five-to-ten years of contributions), up to 12 months for longer contribution periods. For graduates, the duration is set to six months. Unemployment insurance benefits are neither subject to taxation nor to social security contributions.

Table 37: Unemployment benefit eligibility and gross replacement rate in Romania

	xi1				b00 (as percent of gross labour income)		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	0.0%	-	-	15-19	0.7%	-	-
20-24	0.0%	0.0%	-	20-24	0.8%	1.5%	-
25-39	0.0%	0.0%	0.0%	25-39	0.7%	1.5%	0.5%
40-54	0.0%	0.0%	0.0%	40-54	1.2%	2.1%	1.7%
55-69	0.0%	0.0%	0.0%	55-69	1.6%	3.1%	2.0%

Source: EU-SILC, own calculations. • Created with Datawrapper

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Eligibility for unemployment benefits in Romania is especially low. This is also reflected in considerably low expenditures for unemployment benefits at the aggregate level. As unemployment insurance is flat and independent of previous earnings, 'xi1' is set to zero. The flat part, 'b00', is also very low. Based on this data, public unemployment benefits do not play an important role in replacing income in cases of unemployment.

Slovenia

The Slovenian public unemployment system is a compulsory insurance scheme, financed by taxes and contributions. It covers employees, self-employed and other recipients, like persons receiving sickness benefits. In addition, voluntary insurance is possible for certain groups but not relevant for the model, like citizens employed in a foreign country. Persons receiving unemployment benefits are obliged to search actively for a job, must be able to work, registered with the Employment Service, and willing to accept appropriate employment. Farmers, students, retirees, and self-employed do not qualify for unemployment benefits. To qualify for unemployment benefits, recipients must have been insured for nine months in the previous 24 months. If an unemployed person is younger than 30 years old, six months of insurance are sufficient.

The duration of the unemployment benefit depends on the length of insurance and on the age of insured persons. An insurance period of nine months up to five years leads to a benefit duration of at most three months. An insurance period of five to 15 years leads to benefit duration of six months; and between 15 and 25 years, benefits are paid for nine months. For a longer insurance period, benefits are granted for 12 months (19 months if older than 50 and 25 months if older than 55). For unemployed persons younger than 30 years old, an insurance period of six months leads to two months of benefits.

Unemployment benefits are based on monthly earnings eight months before unemployment (reference earnings). For the first three months, 80 percent of reference earnings are granted, 60 percent from the fourth to the twelfth month, and 50 percent afterwards. There are also lower and upper ceilings for benefits. The lower ceiling corresponds to EUR 350 per month (2019), the upper ceiling to EUR 892.50 (2019). Benefits are not means tested and there is no waiting period for payments. Unemployment benefits are subject to income taxation and social security contributions for health- (5.96 instead of 6.56 percent), pension- and invalidity-insurance (15.5 percent).

Table 38: Unemployment benefit eligibility and gross replacement rate in Slovenia

	Eligibility				Gross Replacement rate		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	0.9%	-	-	15-19	20.6%	-	-
20-24	10.8%	26.4%	-	20-24	20.6%	27.7%	-
25-39	13.1%	29.8%	33.1%	25-39	30.0%	31.0%	24.9%
40-54	18.3%	37.2%	44.2%	40-54	37.5%	32.3%	21.1%
55-69	26.8%	51.3%	62.5%	55-69	44.3%	34.7%	20.6%

Source: EU-SILC, own calculations. • Created with Datawrapper

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Data from EU-SILC and calculations by the authors are presented in Table 38. They reveal that unemployment benefit eligibility is low for low-skilled unemployed persons. This may be explained by the maximum benefit duration. For older workers with longer contribution periods and therefore a longer maximum benefit duration, eligibility is much higher.

Slovakia

Unemployment insurance is mandatory for employees and voluntary for self-employed persons. Unemployment insurance is also mandatory for part-time employees. The benefit does not vary with age or family status or the reason of the job loss of an employee (voluntarily or laid-off). An insured person is eligible for payments if she or he was insured for at least two years within the last four years. The benefit duration amounts to six months at most. After three months an unemployed person can cancel their registration as jobseeker and obtain 50 percent of the remaining three months.

Unemployment insurance benefits amount to 50 percent of gross labour income in the contribution period. Benefits are restricted by a maximum daily assessment base of EUR 62.73 (year 2019). In addition, benefits are paid for persons participating in active labour market policy measures and for young unemployed persons. The benefits are not taxable and not subject to social security contributions.

Table 39: Unemployment benefit eligibility and gross replacement rate in Slovakia

	Eligibility				Gross Replacement rate		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	2.6%	-	-	15-19	20.6%	-	-
20-24	2.6%	10.9%	-	20-24	23.0%	29.6%	-
25-39	3.0%	16.3%	14.3%	25-39	23.0%	33.0%	39.3%
40-54	6.9%	12.7%	24.4%	40-54	23.0%	37.8%	32.5%
55-69	11.1%	14.3%	17.3%	55-69	32.4%	36.6%	34.3%

Source: EU-SILC, own calculations. • Created with Datawrapper

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Table 39 contains the relevant information for the calibration of unemployment benefits in Slovakia. Eligibility is comparably low, like in other Member States that joined the EU in 2004 or later. One important reason is the short period of benefit duration with at most six months and no subsequent unemployment assistance period. The qualifying condition may imply the low eligibility of young workers. The replacement rate lies below the statutory rate of 50 percent.

Finland

In Finland, unemployment insurance consists of two parts: a basic benefit, which is independent of former earnings; and an optional earnings-related benefit. The earnings-related unemployment insurance is a voluntary insurance. In addition to unemployment insurance, an unemployment assistance (labour market subsidy) is available. This focuses on job seekers entering the labour market for the first time, as well as on persons re-entering the labour market or persons for whom the unemployment insurance has expired.

To qualify for unemployment insurance payments, a minimum of 26 weeks of employment (at least 18 hours per week) in the last 28 months must be fulfilled. For earnings-related benefits the same requirements apply.

The basic benefit amounts to EUR 32.40 per day (2019), five days per week. The earnings-related benefit consists of the basic benefit plus 45 percent of the daily reference earning in excess of the basic benefit up to a monthly reference earning of EUR 3,078 (2019, 95-times the basic amount) and 20 percent for the part of daily earnings in excess of it. The maximum amount is 90 percent of reference earnings. If an unemployed person participates in an employment promotion measure, an increased benefit is paid (55 and 25 percent instead of 45 and 20 percent of reference income). In addition to the basic and earnings-related benefit, a flat child supplement is granted. The reference earning is measured as gross earning minus 60 percent of employee pensions, unemployment, and earned-income contributions.

Unemployed persons can work, whereby unemployment benefits are reduced by 50 percent of earned gross income. The maximum amount of benefit and income must not exceed 100 percent of the reference earning.

The unemployment insurance is granted for a maximum period of 400 days (300 days if employment history is shorter than three years). The earnings-related insurance is granted for a maximum of 500 days for unemployed persons aged 58 and older and meeting work requirements.

The unemployment assistance scheme labour market subsidy is granted for persons not eligible for unemployment insurance benefits and willing to and actively seeking work. In general, benefits are subject to an income test, which is suppressed for older workers meeting employment conditions before unemployment and during employment promotion measures. The maximum benefit amounts to the basic benefit in the unemployment insurance plus child supplements. Unemployment benefits are subject to taxation and social security contributions of 1.45 percent.

Finland is one of the countries with a wage-independent unemployment assistance scheme. In addition, the basic benefit is also independent from previous labour income, only income above the first threshold of EUR 32.40 leads to additional income-related benefits. Therefore, more information is needed to derive the necessary input for the calibration. For this reason, we use information from Suomen virallinen tilasto, the official statistics of Finland, to disentangle the different groups of beneficiaries according to age. This enables us to derive the income-dependent replacement rate 'brepl' as stated in Table 40. The Table shows that the share of unemployed persons with income-related benefits increases considerably with age. In contrast, the replacement rate is similar across age and skill groups. This result depends on two counteracting effects. On the one hand, if income rises then a higher share of income will be considered in the calculation of the replacement rate, which raises the replacement rate as a percentage of gross labour income. On

the other hand, higher income will imply that a larger share of the income will be multiplied by the lower replacement rate of 20 percent, which decreases the overall replacement rate. Overall both effects seem to neutralise each other to a large extent.

Table 40: Unemployment benefit eligibility and gross replacement rate in Finland

	xi1				brepl				b00 (as percent of gross labour income)		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	0.5%	-	-	15-19	67.3%	-	-	15-19	26.2%	-	-
20-24	7.3%	9.9%	-	20-24	67.3%	67.3%	-	20-24	24.1%	28.7%	-
25-39	19.8%	21.7%	18.6%	25-39	57.0%	67.3%	67.3%	25-39	21.9%	24.9%	16.4%
40-54	28.6%	28.3%	28.3%	40-54	47.4%	66.8%	60.9%	40-54	24.2%	23.0%	16.4%
55-69	44.8%	47.2%	40.7%	55-69	58.0%	57.8%	47.6%	55-69	20.1%	20.3%	10.8%

Source: EU-SILC, Suomen virallinen tilasto, own calculations. • Created with Datawrapper

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The policy parameter 'b00' includes the labour market support benefit, as well as the basic benefit amount. For this reason, 'b00' as a percentage of gross labour income is rather high compared to other countries. This follows from the low share of unemployed with income-related benefits.

Sweden

The unemployment system in Sweden is based on an income-related and voluntary unemployment insurance scheme and a flat-rate unemployment assistance, covering uninsured persons. For unemployment insurance, a beneficiary must have worked at least six months (with at least 80 hours per month) during the last 12 months or 480 hours during a continuous period of six months (with at least 50 hours each month) during the last 12 months. In addition, an insured person (employee or self-employed) must be a member of the 'Unemployment Insurance Society' for at least 12 months. The maximum duration of benefits is 300 days (450 for persons with dependent children) after a six-day waiting period. After the expiration of the benefit, an unemployed person can take part in the active labour market programme or in the job and development guarantee for an additional 450 days.

The gross replacement rate in the unemployment insurance amounts to 80 percent of previous earnings for the first 200 days and 70 percent afterwards. There is also a maximum daily benefit of SEK 910 for the first 100 days and SEK 760 for the remaining days and a minimum benefit of SEK 365 (values for 2019). The benefit is reduced proportionally if the person worked part-time before unemployment. The job and development guarantee pays 65 percent of previous earnings with the same limits. Benefits in the unemployment assistance correspond to a daily flat-rate benefit of SEK 365, the minimum payment in the unemployment insurance scheme. For part-time workers the benefit is reduced proportionally. Unemployment insurance and assistance benefits are taxable, but no social security contributions are deducted.

Although unemployment insurance is voluntary, eligibility for this type of benefit is rather high and increases with age. For younger persons the eligibility is markedly lower. Like eligibility, the replacement rate 'brepl' is similar for unemployed persons aged 25 and above. The decrease in the replacement rate for high-skilled individuals can be attributed to the maximum benefit level.

Table 41: Unemployment benefit eligibility and gross replacement rate in Sweden

	xi1				brepl				b00 (as percent of gross labour income)		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	0.0%	-	-	15-19	0.0%	-	-	15-19	0.0%	-	-
20-24	8.8%	9.6%	-	20-24	52.6%	50.9%	-	20-24	1.7%	1.4%	-
25-39	40.9%	30.2%	31.2%	25-39	42.7%	42.9%	38.2%	25-39	3.6%	1.9%	1.8%
40-54	44.3%	66.3%	49.8%	40-54	45.1%	47.2%	35.9%	40-54	1.7%	3.4%	1.4%
55-69	64.2%	67.0%	66.5%	55-69	51.8%	45.8%	31.3%	55-69	1.9%	1.8%	1.3%

Source: EU-SILC, LFS, Swedish Unemployment Insurance Board, own calculations. • Created with Datawrapper

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The level of the fixed unemployed assistance is calculated by dividing the monthly replacement income of SEK 7,930 by average gross labour income in the different age and skill groups. In this calculation also the average number of hours worked in the different groups is taken into account as unemployment assistance depends on the number of hours worked before unemployment. In addition, as unemployed individuals without any benefits are considered in this calculation as well, with a replacement income of zero, 'b00' is very low.

EU-27

The EU-27 level of eligibility and replacement rate is derived from individual results for the Member States. The EU-27 value equals the weighted average, with weights based on income level (Mincer equation), the average number of hours worked, the number of unemployed persons and $xi1$, $brepl$ or $b00$. The parameters for the model are provided in Table 42.

Table 42: Unemployment benefit eligibility and gross replacement rate in EU-27

	xi1				brepl				b00 (as percent of gross labour income)		
	low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled		low skilled	medium skilled	high skilled
15-19	4.8%	-	-	15-19	49.3%	-	-	15-19	5.4%	-	-
20-24	12.9%	20.3%	-	20-24	48.3%	49.9%	-	20-24	5.8%	4.7%	-
25-39	23.1%	26.7%	29.7%	25-39	52.6%	50.4%	45.6%	25-39	9.4%	7.8%	5.1%
40-54	24.3%	27.4%	32.8%	40-54	46.6%	46.6%	39.5%	40-54	9.3%	7.7%	5.5%
55-69	23.2%	32.5%	36.4%	55-69	47.1%	44.3%	37.6%	55-69	11.4%	8.1%	5.4%

Source: EU-SILC, LFS, own calculations. • Created with Datawrapper

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2.9. Pension Benefits

General Information

Pension systems have a prominent role in providing social security to households. The systems differ significantly across Member States, for instance with respect to their generosity, but also concerning the breakdown between public and private pension provision and other institutional settings. In many European countries, the pension system is basically a public PAYG system financed by contributions and/or taxes. In some countries, the public system is complemented by a mandatory or voluntary funded pillar that is often managed privately or by occupational pension systems. One should keep in mind, however, that even if a pension system is managed privately to

a large extent, governments still play an important role by setting a regulatory framework or by subsidising private saving.

The following short overview of pension systems in the calibrated countries is primarily based on the OECD's *Pensions at a Glance 2021* (OECD, 2021), which provides information on country-specific institutional settings in 2020, the MISSOC database of the European Commission as well as country fiches prepared by the Member States for European Commission's Ageing Report. If necessary, these sources are complemented by national sources. We do not intend to give a complete picture of pension schemes but provide a basic overview and present necessary information how to set parameters in LMM.

Many countries have reformed their pension systems in recent years or decades, often in order to improve their sustainability given demographic ageing. These reforms are accompanied by transition periods between the 'old' and the 'new' system, which poses challenges for a macroeconomic model. As a basic approach, we implement the parameters of the 'new' system which is in place after the transition period has ended. In our view, this method ensures an adequate representation of labour market incentives for individuals currently participating in the labour market. In order to reflect the fact that current pension systems are frequently more generous (resulting in higher current public expenditures and household income), we top up pension benefits by a flat (non-earnings-related) pension amount.

Given some standard assumptions that we also apply in LMM (such as rational expectations and perfect capital markets), funded pension systems can be seen as perfect substitutes to private savings. Households will reduce private savings one-by-one if mandatory contributions to the funded system increase. In addition, as shown in Keuschnigg (2005), a funded system does not distort labour market incentives under these conditions. One could therefore refrain from modelling funded pension systems. Nevertheless, our approach is to include (quasi-)mandatory funded respectively occupational pension systems in the model. This is, for instance, caused by the fact that governments treat pension benefits as well as the taxation of contributions and benefits quite differently to private savings in many countries.

LMM is a macroeconomic model for the 27 EU Member States and many different institutional features of the individual countries (e.g., unemployment, pension and social benefits, taxes and social security contributions, EPL) are modelled. Given this broad focus, the calibration of the model needs, to some extent, to abstract from too-detailed institutional settings for particular groups. Concerning pension benefits, this implies, for instance, that we implement parameters for the largest group of employees (and neglect, for example, an explicit modelling of pension schemes for self-employed). Furthermore, we implement 'standard' deductions of benefits for early retirement (and do not take into account, for instance, special lower deductions for individuals with long careers).

Belgium

Belgium has an earnings-related public pension scheme with a minimum pension and a means-tested safety net. The statutory retirement age is currently 65 for men and women and increases to 67 until 2030. Drawing a full pension requires a career of 45 years. The mandatory public system is complemented by occupational pension schemes. Given that these are voluntary (the decision to set up an occupational pension plan is made by the employer/sector), they are not modelled in LMM.

Earnings-related pension benefits are based on lifetime income. The annual accrual rate depends on family status. It is 0.6/45 for a single or a married person without a dependent spouse, whereas it is 0.75/45 for a married person with dependent spouse. According to MISSOC, the ceiling of annual pensionable earnings was EUR 58,447 in 2019. Basically, past earnings are revalued in line with prices. In addition, there is an annual holiday payment for pensions.

Under certain conditions, non-contributory periods such as certain periods of career interruption or maternity leave are credited ('assimilated periods'). Periods of unemployment with eligibility for insurance benefits are also credited. These credits are based on earnings prior to the period of unemployment. For subsequent periods of unemployment (apart from some exceptions, the so-called '3rd period' and for new pensioners from 2019 also the '2nd period'), credits are based on the 'minimum annual credit'. According to the OECD, pensions in payment are indexed to a consumer price index (which excludes some goods), but some discretionary adjustments are made frequently.

Early retirement before the statutory retirement age is possible under the condition that a certain number of years of contributions has been reached. There is no actuarial reduction of pension benefits. Disability pensions cover workers who, as a result of sickness or infirmity, cannot earn more than one-third of the normal earnings of a worker in the same category. The benefit is dependent on the family situation and foregone earnings.

Bulgaria

The Bulgarian pension system has been subject to substantial structural reforms since the late 1990s. The traditional pay-as-you-go system was transformed into a three-pillar system by introducing mandatory and voluntary funded schemes. The statutory retirement age is gradually rising and will reach 65 years in 2037. In 2022, it is 64 years and five months for men and 61 years and ten months for women, with a required length of service of 39 years and two months for men and 36 years and two months for women. Insured persons who do not meet these qualifying conditions may be eligible for an old-age pension at an age of 66 years and ten months (men and women), with at least 15 years of insurance.

The pay-as-you-go scheme covers all economically active persons. The accrual rate currently is set to 1.2 percent and the pension benefit is based on the relation of the individual and the average insurable income. The income ceiling to pension contributions was BGN 3,000 per month in 2019. Periods in which individuals receive social insurance benefits, e.g., for unemployment, are credited as fully-insured periods. Given the calculation formula for a pension benefit, past earnings are implicitly valorised with average earnings growth rates. Pensions are indexed according to 50 percent of the increase in CPI and 50 percent of the insurance income growth of the previous year.

The second pillar is a supplementary mandatory funded pension scheme managed by private insurance companies, with a possibility of opting out of this scheme into the first pillar since 2015. The Universal Pension Funds (UPF) cover all persons born from 1960. The contribution rate is 5 percent, which is deducted from the total pension contribution rate. In addition, the Professional Pension Funds (PPF) are mandatory funds financing early retirement for people working in hazardous environments, and there is also a supplementary voluntary pension scheme.

Apart from early retirement possibilities for persons working under hazardous and unhealthy working conditions, or special groups, a reduced early retirement possibility was introduced for individuals within 12 months of the statutory retirement age, with a reduction of the pension benefit by 0.4 percent per month of early retirement. Disability pensions are payable to insured persons who have lost at least 50 percent of their ability to work. Benefits are based on the individual income and the degree of disability.

Czechia

Public pensions in Czechia consist of a basic element and an earnings-related part and are complemented by voluntary private pensions. The statutory retirement age of men and women is gradually increasing to 65 years. In 2022, the retirement age is 64 years for men and for women without children; the retirement age for women with children is lower. The minimum requirement for the eligibility of pension benefits is 35 years (or 30 years without non-contributory periods), but under certain conditions individuals can receive pension benefits with lower contributory periods five years later than the statutory retirement age.

The basic pension benefit was CZK 39,240 per year in 2019, which amounts to 10 percent of the average wage. The assessment base for the earnings-related benefit is starting from the calendar year after reaching the age of 18. In principle, the accrual rate in the earnings-related part is 1.5 percent. However, not all earnings are fully included in the assessment base, which results in a progressive formula. Income is incorporated by 100 percent up to monthly earnings of CZK 14,388 (in 2019) and by much lower values above. Earlier years' earnings are revalued by the growth of economy-wide average earnings.

Several non-contributory periods, such as childcare, education or invalidity are taken into account for the calculation of benefits. Periods of earnings-related unemployment insurance benefits as well as unemployment spells without entitlements (for a certain period) are credited. According to the OECD, the unemployment period credited is 80 percent of the actual spell of unemployment. Pension benefits in payment are indexed to prices plus half of real wage growth.

Under certain conditions, it is possible to retire three years before the statutory retirement age. According to the OECD, the actuarial adjustment for early retirement is 3.6 accrual points per year in the first 360 days of early retirement, 4.8 points in the next 360 days, and 6 points thereafter. In the pension system, disability is handled within three different degrees of invalidity. Disability benefits consist of two elements: a basic amount and an earnings-related part based on average earnings and the years of insurance.

Denmark

Denmark has a rather complex pension system that consists of a public basic scheme with a targeted pension supplement; a mandatory, fully funded occupational scheme (ATP); and a 'quasi-compulsory' occupational scheme that covers around 90 percent of the employed workforce. Both the ATP scheme and the occupational scheme are taken into account in LMM. In 2021, the standard retirement age is 66.5 years, but it is set to gradually increase to 69 until 2035.

In 2019, the full basic pension amounts to DKK 75,924 and the full pension supplement to DKK 83,076 per year for singles and DKK 41,436 for married or cohabiting pensioners. Both schemes require 40 years of residence in Denmark between the age of 15 and the pensionable age, with a proportional reduction for shorter periods of residence. The supplement is tested

against all sources of personal income (including ATP and occupational pensions) apart from public pensions. According to OECD, if personal income is in excess of DKK 88,700 for singles (DKK 177,700 for couples; 2020 values), the pension supplement is reduced by 30.9 percent (16 percent) of the excess income. Public old-age pensions are adjusted annually in line with average earnings.

The occupational schemes are fully funded defined-contribution schemes which are agreed between the social partners, and cover approximately 90 percent of the employed workforce. We follow the OECD by assuming that the average contribution rate for these schemes is 12 percent.

ATP is a statutory, fully funded, defined-contribution scheme which covers almost all wage earners and almost all recipients of social security benefits, whereas self-employed individuals can voluntarily join. According to the OECD, coverage is almost universal. The contribution to the ATP scheme is a fixed amount that varies only with the number of hours worked (and not with income). A full-time employee contributed DKK 3,408 in 2019, two-thirds of which is paid by the employer and one-third by the employee. The contribution is adjusted when the social partners decide to do so. During unemployment, the unemployment insurance takes over the contributions of the employer and ATP contributions are paid at a double rate when receiving unemployment benefits. We assume that these funded schemes earn a usual rate of return.

There are several different early retirement programmes in Denmark. One of them is linked with unemployment insurance and pays benefits between 62 (gradually increasing to 65) and the normal retirement age. In order to qualify, an individual must have been a member of the unemployment insurance system for at least 30 years and have paid voluntary early-retirement contributions during this period. The benefit corresponds to unemployment benefits, with a limit of 91 percent of the maximum rate of unemployment benefits. It is also possible to defer old age pensions. The increment for deferring public pension benefits is proportionate to the shortening of the expected pay-out period.

Invalidity pensions offer a tax-financed universal protection for all inhabitants. They cover the risk of a permanent reduction of the capacity to work to an extent that the person cannot ensure their subsistence. If income does not exceed a certain level, the benefit is DKK 226,500 per year for persons living alone and DKK 192,528 for married or cohabiting pensioners in 2019. The pension is automatically converted into an old-age pension at the pensionable age.

Germany

The statutory public pension system in Germany is an earnings-related PAYG-system with means-tested supplements for low-income pensioners. Pension eligibility requires at least five years of contributions. The statutory retirement age is gradually increasing to 67 until 2031. For people born in 1956, the retirement age is 65 years and 10 months. There is a complementary voluntary private pension system ('Riester-Rente').

The valuation of individual contributions is dependent on personal income relative to average earnings: if a worker earns the average income, she earns one point in the public pension system. In 2019, employees contribute up to a ceiling of EUR 80,400 of gross annual wage earnings (respectively EUR 73,800 in the new federal states). At retirement age, accumulated points are multiplied by the value of a point. In January 2019, the annual value of one point was EUR 384.36 (the value in the new federal states is already close and the gap will be closed in 2024).

During the first period of unemployment ('Arbeitslosengeld I'), entitlements are earned on the basis of 80 percent of previous gross earnings. If unemployment benefit II ('Arbeitslosengeld II') is paid, there are no financial contributions to the pension scheme, but the time period is accounted for ('Anrechnungszeiten'). In principle, pension payments are indexed to gross wages. However, there are additional factors in the 'Rentenanpassungsformel' that usually result in lower indexation to improve the sustainability of the pension system.

Early retirement is possible from an age of 63 (this requires 35 years of contributions). In this case, deductions of 3.6 percent per year of early retirement are applied. In addition, there are further possibilities (e.g., for exceptionally long-term insured persons) to retire earlier without penalties. Each year of deferred pension benefit after the statutory retirement age leads to an increment of 6 percent. Disability pensions are paid in case of reduced earnings capacity.

Estonia

The Estonian pension system combines a flat-rate basic element, an earnings-related public scheme, contributions to funded pensions and a safety net. The statutory retirement age is gradually increasing to 65 years by 2026 for both men and women and will be linked to increases in life expectancy thereafter. The qualifying condition for a pension benefit is at least 15 years of pensionable service.

The base amount has been EUR 235.3 per month since April 2021. The earnings-related part of old-age pension is based on the amount of contributions paid on an individual's behalf, relative to the average contribution paid. The accumulation of these insurance components is multiplied by the value of one year of pensionable service (which was EUR 7.104 in April 2020) to calculate pension benefits. There is no income ceiling for contributions. Pensions in payment are indexed to 20 percent of consumer price changes and 80 percent of contribution revenue growth. From 2021, the 'compound' part of the pension was introduced. Since the reform, a person who receives twice the average wage will be granted 1.5 points (instead of 2 points before that), while a person earning half the average wage receives 0.75 points (instead of 0.5). For the second pillar funded pension, an individual pays 2 percent of their gross salary to the pension fund, which is complemented by a 4 percent contribution rate from the social tax. Until 2021, participation in the funded pension system was mandatory for people born in 1983 or later but since 2021 there has been a possibility of opting out. However, in line with the AWG pension group, we still treat the second pillar as mandatory. According to the description of the unemployment system in MISSOC, the Unemployment Insurance Fund pays the contribution to the funded pension system for people receiving the unemployment insurance benefit (but not for those receiving the allowance).

Pension benefits are flexible in the sense that individuals can choose their retirement date, suspend their pension benefits or take only part of the pension and the pension benefit is adjusted in an actuarially neutral way in that case. Disability benefits are based on an assessment of work ability. In 2019, the benefit was EUR 12.72 per day for an individual with no working ability, but lower for persons with partial working ability or with income above a certain threshold.

Ireland

The public pension scheme in Ireland provides flat rate pension benefits for those individuals who meet contribution conditions. In addition, there is a means-tested pension for low-income

individuals. Furthermore, voluntary occupational pension schemes have a coverage of around half of employees.

Full entitlement to the basic State pension requires an annual average of 48 weeks' contributions paid or credited over the entire working life and the pension is reduced for incomplete contribution histories. In 2019, the full basic pension is EUR 243.3 per week. This amount is increased by an extra allowance for pensioners aged 80 and over and a further allowance if the individual is living alone. Furthermore, there is an extra allowance if the pensioner has an adult dependent. For low-income elderly, there is an additional means-tested State pension.

The State pension is payable from the age of 66 years. The pensionable age was set to increase to 68 years by 2028 but the government has deferred this increase and set up a Commission to examine sustainability and eligibility issues. The State pension cannot be claimed before the pensionable age.

Provided that at least 520 weeks of contributions are paid over the course of the working life, public pension entitlement is not affected by some non-contributory periods. Subject to conditions, credited contributions may be rewarded, for instance, for periods of sickness, maternity, disability or unemployment periods.

In addition to the State pension, there are private pensions which have a coverage of around half of employees. However, given that they are voluntary, they are not implemented in LMM.

Invalidity Pension is a payment for insured people who are permanently incapable of work because of illness or incapacity. Like the State pension, it is a flat-rate payment (of EUR 203.5 per week in 2019) plus a Christmas bonus and several allowances depending on the family situation of the pensioner.

Greece

Public pensions in Greece are comprised of a flat part (the national pension), a contributory earnings-related pension and a supplementary public and mandatory insurance. The statutory retirement age is 67 for both men and women with at least 15 years of contributions; insured persons with a long contribution record can retire at 62.

The *national pension* is not earnings-related and is financed directly from the state budget. Its full amount is EUR 384 per month in 2019, which is reduced for individuals with less than 40 years residence in Greece or less than 20 years of insurance. Concerning the *contributory pension*, the pensionable earnings ceiling is EUR 6,500 per month from February 2019. Accrual rates vary according to the number of insurance years; they increase from 0.77 percent for the first 15 years to 2.55 percent for the 36th-to-40th year. Beyond 40 years of insurance, they are reduced to 0.5 percent. Past earnings are inflated with consumer prices for the period until 2024 and with wage changes from 2025 onwards. The indexation of benefits in payment is based on half the change of GDP and half the change of consumer prices but must not exceed the change of consumer prices. The *supplementary pension* is based on an NDC (notionally defined contribution) system from 2015 onwards, where the contribution rate was reduced to 6.5 percent (3.25 percent employee and employer each) in 2019. Periods during which unemployment (and e.g., sickness) benefits are paid are credited for the pension system but they are only used for the purpose of assessing entitlement to a pension and not for the calculation of the amount.

Early retirement with reduced pension benefits is possible from the age of 62 with a reduction of 1/200 for each missing month. Similar to old age pensions, disability pensions are comprised of the flat national pension and an earnings-related part.

Spain

The public pension system in Spain consists of an earnings-related benefit with a means-tested minimum pension. In 2021, the statutory retirement age is 65 years for men and women with at least 37 years and three months of contributions and 66 years for others. In order to qualify for a benefit, 15 years of contributions are necessary.

From 2022, the benefit is defined by dividing the last 300 months (25 years) of earnings prior to retirement by 350. Earnings are valorised with prices (apart from the last two years which are not uprated). The contribution ceiling was EUR 48,841 in 2019. Benefits accrue according to a schedule so that maximum accrual of 100 percent is reached after 37 years of contributions, a rate of 50 percent is applied after 15 years (and in between, each additional month of contributions increases the accrual).

Several non-contributory periods such as parental leave or leave to take care of relatives are credited. During periods of receipt of unemployment benefits, the government takes over the employer's contributions and the worker pays employee's contributions to the pension insurance scheme. Accrual is based on previous earnings. Periods of unemployment assistance are not credited except for individuals aged 52 years or older. Pension benefits in payment are indexed according to a new adjustment index calculated according to several different factors.

Early retirement is possible in Spain. Conditions depend on whether unemployment is involuntary or voluntary. Actuarial reductions of pension benefits vary from 6 percent to 8 percent per year depending on the length of contributions. There also is partial retirement. Disability pensions are dependent on the degree of incapacity and previous earnings.

France

The French pension system for private sector employees has two tiers: a defined benefit public pension scheme and a mandatory occupational tier. Additionally, the public system features two kinds of minimum pensions. The minimum legal pension age for the earnings-related pension is 62 years for individuals born in 1955 or later.

The public pension targets a replacement rate of 50 percent after a full career; each missing quarter of a year of contributions reduces the pension pro rata. Benefits are calculated on the basis of the 25 years of highest earnings, where earlier years' earnings are valorised in line with price inflation. In 2019, the ceiling for eligible earnings was EUR 40,524. Periods of unemployment benefits are credited for the state pension if unemployment benefits are received. Periods of unemployment without unemployment payments are also credited, but at a lower rate. Pension benefits in payment are indexed to price inflation.

There are different occupational schemes. In line with the OECD, we focus on the Agirc-Arrco scheme, which covers private and agriculture sector employees. Below the social security ceiling (EUR 40,524), claims accumulate by 6.2 percent of earnings, whereas they accumulate by 17 percent of earnings between the ceiling and three-times the ceiling. The number of points earned per year is determined by the value of these contributions divided by the costs of a point

(EUR 17.3982 in 2020). At retirement, the accumulated points are converted into benefits by multiplying them with the value of a pension point (EUR 1.2714 in 2020). Uprating of the costs and the value is agreed between the social partners. Following the approach of the OECD, we assume that this implies an increase of the costs of a point in line with earnings and of the value in line with prices. This uprating policy affects both indexation of pensions in payment and uprating of earlier years' earnings. Periods of unemployment entitle to pension benefits in the occupational system if the person had contributed to one of the plans prior to the unemployment period. These points are based on the last wage before unemployment.

Early retirement is possible under certain conditions in the public scheme. In the occupational schemes, early retirement is possible as well, subject to deductions depending on the age and/or the years of contributions. According to MISSOC, disability benefits are provided to persons who have a reduction in the capacity to work of at least two-thirds. The benefit is dependent on the salary during the ten years with the highest income and the amount of incapacity.

Croatia

Following comprehensive structural reforms implemented, inter alia, in 1999 and 2002, Croatia's pension system consists of three pillars: a public earnings-related pay-as-you-go scheme, a mandatory private funded scheme and voluntary funded schemes. In 2022, the statutory retirement age was 65 years for men and 63 for women. The pensionable age for women will gradually increase to 65 years by 2030. The minimum contributory period is 15 years, for both men and women.

The earnings-related first pillar is mandatory for all employees and self-employed persons. It is a points system in which each individual earns points dependent on his/her earnings relative to average earnings. As individuals can opt out of the second pillar and transfer the assets to the public scheme at the moment of retirement, the calculation of the earnings-related pension benefits differs between 'mono-pillar' and two-pillar claimants. Given that the public scheme mostly has provided more beneficial pensions, the vast majority of individuals in the past decided to transfer their assets to the public scheme. The AWG pension group assumes an increasing share of individuals that keep their assets in the funded scheme in the future. According to information from the Croatian government, unemployed persons are entitled to pension insurance. The valorisation of past earnings and the indexation of benefits in payment is determined by the 'actual pension value' (APV), which amounted to HRK 67.97 (per month) in the second half of 2019. According to the AWG group, a 'simple interpretation' of the mechanism is that it is adjusted by a 70–30 proportion of wage and price increases, where the 70-percent weight is given to the indicator that increases more strongly. The second pillar is a mandatory (for all individuals born in 1962 or later) fully-funded defined contribution scheme which was established in 2002 but, as mentioned above, individuals can opt out of the scheme and transfer their assets to the public scheme at retirement and a majority of individuals currently prefer this option.

Early retirement is possible five years prior to the statutory retirement age upon condition of a minimum contributory period of 35 years (or less for women until 2030). In this case, the pension benefit is reduced by 0.2 percent per month of early retirement. Disability pensions are paid to individuals who have lost a certain amount of earning capacity. The benefit is calculated in a similar manner as the earnings-related old-age pension, but takes into account the type and cause of invalidity.

Italy

The Italian pension system is in a transition from a defined benefit system to a notionally defined contribution (NDC) pension scheme. The NDC is fully effective for people who entered the labour market after 1995. Currently, pro rata pension benefits are paid from the defined benefit and the NDC scheme. The legal retirement age is 67 years for men and women in all sectors.

The contribution-based NDC regime is financed by a rate of 33 percent, of which around one-third is paid by the employee and two-thirds by the employer. The annual salary ceiling was EUR 102,543 in 2019. The pension benefit is calculated as a product of accumulated lifelong contributions (past contributions are valorised with the nominal GDP growth rate) and the transformation coefficient. The coefficient is mainly determined by the probability of death, the probability of leaving a widow or widower and the expected number of years that a benefit will be withdrawn. It is possible to defer pension benefits after age 67 and a higher transformation coefficient ensures that benefits increase to achieve actuarial adjustment.

Non-contributory periods of illness, maternity, military service, unemployment and the receipt of redundancy pay are credited in the public pension system. The indexation of pension payments is progressive and rather complex. In 2020, benefits below a threshold of three-times the minimum pension have full price indexation; higher pensions are only partly indexed to a so-called 'cost-of-life' index.

Invalidity benefits are paid to people who have a reduced ability to work due to sickness or disability (physical or mental). For periods of contributions accrued from 2012, the pension amount is calculated on basis of the total contribution amount and an actuarial coefficient.

Cyprus

The public pension system in Cyprus comprises the General Social Insurance Scheme (GSIS), a compulsory earnings-related pension scheme which covers everyone employed (in the public and private sectors, including self-employed people), an income-tested social scheme and a supplementary pension scheme for civil servants. The pensionable age is 65 years for both men and women in 2022, but an automatic adjustment of the statutory retirement age every five years, in line with changes in life expectancy at the retirement age, was introduced in 2018. In order to qualify for a pension, a person must have been insured for at least 780 weeks and must have basic insurance of at least 15 insurance points, earned from paid contributions.

In 2019, the maximum insurable earnings for GSIS contributions amounted to EUR 54,648. Insurable earnings are converted into insurance points by dividing an individual's earnings by basic insurable earnings (which is EUR 9,106 in 2019). The first insurance point grants a basic insurance, while insurance points in excess of one lead to supplementary insurance. An old-age pension benefit consists of (i) a basic pension, which is equal to 60 percent of the value of the average number of insurance points earned in basic insurance (this number is increased to 80, 90 or 100 percent, depending on the number of dependants) and (ii) a supplementary pension, which is equal to 1.5 percent of the total number of insurance points earned in supplementary insurance. The basic pension is adjusted in line with the change of average earnings, while the supplementary pension is indexed to the CPI. Several periods of replacement income, e.g., periods of receiving unemployment benefits or invalidity benefits, represent so-called assimilated insurance earnings and contribute to higher pension benefits.

Early retirement is currently possible at the age of 63 years, upon condition that the number of points in the basic insurance is sufficiently high, with an actuarial reduction of 0.5 percent per month of early retirement. Invalidity pensions are payable to individuals who are expected to remain permanently incapable of work. The invalidity benefit is calculated similarly to old-age pension benefits, but takes into account the extent of the loss of earnings capacity.

Latvia

The new Latvian pension system combines an earnings-related notional accounts scheme with mandatory contributions to a funded pension system. The schemes are complemented by a safety-net pension. In 2022, women and men who have reached the age of 64 years and three months and who have at least 15 years of insurance were entitled to an old-age pension. The retirement age will increase to 65 years in 2025 and the minimum insurance period will be extended to 20 years.

Pension contributions of 20 percent of earnings[22] are devoted to the NDC scheme and the mandatory funded scheme. The contribution rate to the funded scheme has been changed frequently in recent years. It was set to 6 percent from 2016 so that the NDC rate is equal to 14 percent. The state covers social security contributions on behalf of recipients of unemployment benefits. To derive the NDC pension benefit at retirement, the notional capital (past contributions are uprated in line with the covered wage bill) is divided by the 'G-value' (which is calculated annually using projected life expectancy at retirement with a unisex life table). The part of the pension in payment not exceeding 50 percent of the average wage is indexed with inflation and 50 percent of the wage index for individuals with less than 30 years of insurance (the percentage of the wage index is higher for individuals with a higher number of insurance years). People under the age of 30 in 2001 must contribute to the funded pension scheme (people aged between 30 and 49 in 2001 could choose whether or not to join the funded system). At retirement, the accumulated capital can be transferred into the notional accounts system or paid out as a life annuity.

Early retirement is possible for individuals with longer insurance periods (not less than 30 years) or for particular groups (such as individuals who have worked under hazardous conditions or who have been politically repressed). Invalidity pensions are paid to people with a certain degree of incapacity to work. Depending on the level of incapacity, there is a fixed amount or the amount is dependent on the contributions paid to the system.

Lithuania

The new Lithuanian pension system has a two-tier public scheme: a basic pension benefit and an earnings-related part. In addition, there is a quasi-mandatory defined contribution funded pension scheme. The pensionable age was 64 years and four months for men and 63 years and eight months for women in 2022 and it will reach 65 years by 2026. Individuals must have 15 years of coverage to receive a pension.

The basic pension is a 'flat-rate contributory' benefit. In 2019, the monthly full-rate basic pension was EUR 164.59, which is proportionally adjusted for longer or shorter contribution periods. The earnings-related part is a points-based system. Pension points are calculated as the ratio of individual social security contributions to the average in the country. Since 2018, the average wage

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[22] Further costs, such as for minimum pensions and administrative costs are included in the total pension contribution rate of 24.5 percent.

earner accrues 1 point per year theoretically, but practically this number is 1.1 because there is a lower average wage used for the calculation. The maximum ceiling per year is set to 5 points. In 2019, the value of a pension point was EUR 3.52 per month. Periods of unemployment benefit claims are taken into account (up to a maximum of nine months) both for the qualifying period and for calculating the amount of the pension. The basic pension and the pension point value are adjusted each year by the growth of the wage fund in the economy. All employees below 40 years are automatically enrolled in the funded pension scheme, but they can opt out under some conditions. From 2019, the contribution rate has been 3 percent of the gross wage and the state pays an additional contribution of 1.5 percent.

In cases of early retirement, pensions are reduced by 0.32 percent for each month of early retirement. Analogously to old-age pensions, invalidity pension benefits are comprised of a 'flat' basic and an earnings-related part.

Luxembourg

The public pension scheme in Luxembourg has a basic (flat-rate) and an earnings-related part with a minimum pension benefit. The standard retirement age is 65 years both for men and women with at least 120 months of contributions. Earlier retirement is possible with substantially longer contributory periods.

The basic pension benefit is flat-rate and amounted to EUR 496.96 per month in 2019. In addition, there is an 'end-of-year allowance' which adds EUR 786.6 (per year) to the pension. Both of these amounts are valid for an individual with 40 years of insurance; the benefits are proportionally reduced for shorter insurance periods. For the earnings-related part, the accrual rate amounts to 1.788 percent in 2022 and is gradually declining to 1.6 percent by 2052. The accrual rate is higher for older workers with longer contribution periods.[23] In 2019, the maximum amount subject to contributions is EUR 10,355 per month. Unemployment benefits are subject to contributions so that these periods count for pension eligibility and affect the basic and the earnings-related part of the pension. For the calculation of a new pension, the total contributory income is derived to a given (past) reference year. Then, the resulting pension benefit is fully indexed to prices and mostly to real wage evolution (up to the fourth year preceding entitlement) via a revaluation mechanism. Pension benefits in payment are indexed to changes in living costs; the degree of adjustment to real wage growth depends on the financial situation of the pension scheme.

As described above, early retirement is possible with longer contributory periods. There is no actuarial adjustment of the pension benefit apart from the higher accrual rate for longer periods and older individuals. Invalidity pensions are paid to insured persons who have lost working ability to a certain degree. Similar to old-age pension benefits, these pensions are comprised of a basic and an earnings-related part.

Hungary

The pension system in Hungary is a uniform pay-as-you-go system which combines an earnings-related pension with a minimum pension benefit. The statutory retirement age for both men and women is increasing gradually and was 65 years in 2022. In order to qualify for the earnings-

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[23] In 2022, it is increased by 0.014 percentage points for each year that the sum of the individual's age and number of contributory periods exceeds 94, but the maximum accrual rate is 2.05 percent per year.

related and the minimum pension, 20 years of service are necessary (there is a partial pension with 15 years).

The accrual rate of the earnings-related pension depends on the number of insurance years. The pension is calculated as 43 percent of average earnings for an individual with 15 years of coverage. Each additional year from 15 to 25 years adds 2 percent (1 percent for years from 25 to 36, 1.5 percent from year 36 to 40, and 2 percent thereafter). Differently to most other Member States, the earnings base is net salary (i.e., gross salary minus employee contributions and income tax). Past earnings are valorised to the year preceding retirement with economy-wide average earnings. There is a progressive reduction of the accrual rates' assessment base in the sense that only 90 resp. 80 percent of earnings are taken into account for higher earnings (above HUF 372,000 per month). As from 2012, pension benefits in payment are indexed to the CPI. In 2021, a 13th monthly pension was introduced (increasing from one-quarter of a monthly pension in 2021 to one month of extra pension in 2024) and we follow the AWG group by assuming that this increase is valid long-term. Concerning unemployed individuals, periods of unemployment are qualified as pensionable service and the earnings measure is the more favourable of (i) the unemployment benefit and (ii) an average of previous and subsequent earnings.

The payment of pension benefits before the statutory retirement age has largely been eliminated in recent years; a large exception being women who have at least 40 years of insurance. Disability pension benefits are financed by the Health Insurance Fund and depend on previous average income and the health/rehabilitation status of an individual.

Malta

The current public pension scheme in Malta consists of two basic schemes, a universal Contributory Scheme and a Non-Contributory Scheme that is means-tested. The pension system has undergone several steps of reform and, analogously to other countries and as described in the introduction of this chapter, we focus on the description of the system that is valid for the working-age population. In Malta, the pension system differs for people born in 1962 or later from those born earlier. The statutory pension age is gradually increasing from 61 years for men and 60 for women before the reform of 2006 to 65 years for people born in 1962 and later. In order to qualify, a claimant must have been employed or self-employed for at least ten years and made an average of at least 15 weekly contributions over a certain time.

The contributory Two-Thirds Pension is defined as two-thirds of the pensionable income, corrected for the number of contributionary periods. For employees born in 1962 or later, pensionable income is defined as the average of the highest basic salaries earned in any ten years, adjusted by cost-of-living increases. There is a maximum pensionable income that is increased annually by the change of average wages (70 percent) and inflation (30 percent) and amounted to EUR 24,194 in 2019. Credited contributions are, inter alia, provided for a person who is entitled to sickness, injury or unemployment benefits or to an invalidity pension. Pension benefits are indexed according to 70 percent of the increase of the average wage and 30 percent of the inflation rate (for an individual born in 1962 or later).

Early retirement is possible from the age of 61 for individuals who have paid/credited sufficiently contributionary periods. In that case, pension benefits are reduced by 5 percent if an individual retires one year earlier (this number increases to 10.5, 16.5 and 23 percent for two-to-four years). Eligibility for disability pensions is based on the extent to which a person's ability to perform work

and everyday tasks is impaired. The benefit is flat in the sense that it is not dependent on previous earnings (but it varies with the contribution period and in accordance with the degree of invalidity).

Netherlands

The Dutch pension system has three main pillars: a basic flat-rate public scheme (AOW); funded occupational pension plans; and individual saving schemes. Even though there is no statutory obligation for employers to offer an occupational scheme, coverage is almost universal (according to the OECD, 89 percent of employees). The statutory retirement age is 66 years and seven months in 2022 and will rise to 67 years in 2024.

For each year an individual lives or works in the Netherlands, the basic benefit accrues at two percent of the full amount. According to the Dutch Ministry of Finance, the full annual pension benefit was EUR 15,578 for a single person and EUR 21,450 for a couple in 2019. The benefit is linked to changes of the minimum wage, which is uprated biannually. The basic pension is not paid before the pensionable age.

We basically follow the OECD in setting parameters of the occupational pension scheme. The majority of individuals have an earnings measure that is based on lifetime earnings. We assume an accrual rate of 1.875 percent. The ceiling on earnings was EUR 107,593 in 2019. However, pensionable earnings are derived by subtracting a deductible amount ('franchise') of EUR 13,785 in 2019. The idea is that the deduction is covered by the AOW pillar. There is no legal requirement for valorisation of earlier years' earnings and indexation of pensions in payment. According to previous versions of *Pensions at a Glance*, past earnings are uprated with growth of average earnings for the majority of individuals, while inflation is used for the remainder. Around 28 percent of pensions in payment are indexed to wage growth and around 65 percent of pensions are indexed to prices. The occupational pension plans usually do not provide credits for periods of unemployment. The rules on pension deferral vary between the different occupational plans. For the modelling, we assume actuarial adjustment of claims in case of early retirement.

The current invalidity pensions scheme covers the risk of work incapacity for employees unable to work. Benefits depend, among other features, on previous wages of the disabled person.

Austria

Austria runs a compulsory pension scheme providing earnings-related pension benefits, in large part financed by contributions of employees and employers, with a means-tested top-up for low-income retirees. Currently, the statutory retirement age is 65 for men and 60 for women, but the pension age for women will incrementally increase to 65 until 2033. The qualifying condition for a pension benefit depends on the year of birth and whether insurance months have been acquired before 2005.

Benefits are determined by the amount of income, the duration of insurance, and the age of application. The pension benefit currently accrues at 1.78 percent of the calculation base (gross income), more generous older arrangements have been transferred to the new system. Contributions are payable up to a ceiling of an annual income of EUR 73,080 (2019). Past earnings are revalued according to wage growth. Periods in which an individual receives unemployment benefits or assistance are treated as number of pensionable years and entitlements are based on 70 percent of the last gross labour income before unemployment (64 percent in case of unemployment assistance). In principle, the law envisages that pension benefits in payment are

indexed to CPI (even though there are discretionary adjustments frequently). In line with the OECD, we do not take into account contributions to and benefits from the 'Mitarbeitervorsorgekasse' that is replacing the former severance payment system and can be used for accumulating pension claims.

Early retirement is currently possible three years before the statutory retirement age, under the condition of at least 40 years of insurance ('Korridorpension'). For each year of retirement before the regular retirement age, benefits are reduced by 5.1 percent. In addition, certain groups benefit from more beneficial types of early retirement. Disability pensions are mainly dependent on previous labour income.

Poland

In 1999, a new pension system was introduced in Poland which is based on a first pillar pay-as-you-go NDC pension scheme and a funded second pillar (OFE). In 2016, the parliament decided to reverse previous increases of the retirement age so that it is 65 for men and 60 for women again. For the old-age pension without a guaranteed minimum pension, there is no minimum qualifying period. There is, however, also a minimum pension that requires 25 years (for men) and 20 years (for women) of contributory and non-contributory periods.

Initially, people born in 1969 and later were obliged to participate in the funded scheme; people born between 1949 and 1968 could choose to opt in. However, several reforms since 2011 have significantly reduced the relevance of the funded pension scheme. These measures include, for instance, a reduction of the contribution rate from 7.3 percent to 2.92 percent. In 2014, the public NDC scheme was defined as the default option and workers have to opt in to the funded system. Current plans foresee a complete termination of OFE. The assets of those who stayed in the funded system are gradually transferred to the public system.

In the earnings-related NDC part, 19.52 percent of earnings (or 16.6 percent for those who are still in the funded tier) are credited to individuals' notional accounts. The ceiling to contributions is set to 2.5-times the average base amount, which corresponded to PLN 142,950 in 2019. The notional interest rate of the earnings-related part is defined as 100 percent of the growth of the covered wage bill (and no less than price inflation). The benefit is calculated by dividing the accumulated notional capital by the average life expectancy at retirement age ('g-value').

The public employment service pays the contributions to the pension system during unemployment (based on the unemployment benefit). Further non-contributory periods are, for instance, sickness allowance, parental leave, university education, and caring for dependent persons. According to MISSOC, the indexation of pensions in payment corresponds to an average annual index of consumer goods and services in the preceding calendar year, increased by at least 20 percent of the real growth of earnings.

There are no general provisions for early retirement in the pension system. A bridging pension system allows people to retire up to five years before the legal retirement age under strict limits, but this is being phased out.

Eligibility to invalidity pensions is related to an individuals' total or partial loss of capacity to work because of illness or disability. Invalidity benefits depend, inter alia, on the reference wage, the number of years of insurance and the extent of incapacity.

Portugal

The public pension system in Portugal consists of an earnings-related pension scheme complemented by a means-tested safety net. The normal pension age varies with the increase of life expectancy at the age 65, starting from the year 2015, and was set to 66 years and seven months in 2022, both for men and women. The minimum contribution period for an old-age pension is 15 years.

The earnings-related old-age benefit is primarily determined by reference earnings and the accrual rate. For the calculation of reference earnings, past monthly salary is adjusted according to the CPI (without housing prices) and the best 40 years are taken into account.[24] The pension accrues at 2 percent for each year of contributions for 20 or fewer years. With more than 20 years of contributions, the accrual rate varies between 2.3 percent for low and 2 percent for high earnings. Periods of unemployment (and 'social unemployment') benefit claims are taken into account to calculate pension benefits, and credits for these periods are based on earnings before unemployment. Pension benefits are paid 14 times a year, which is consistent with 14 salaries paid. The indexation of pension benefits is based on the CPI, but varies to some extent with the amount of the pension benefit and real GDP growth, i.e., a lower pension benefit and a higher GDP growth rate imply a higher indexation of pension benefits.

An early old-age pension may be claimed under certain conditions, e.g., for very long careers (such as a career length of 48 years), long-term unemployment, and an 'old-flexibility' and a 'new-flexibility' scheme for individuals with at least 40 years of contributions. For individuals falling under the new-flexibility scheme, a pension penalty applies, while a so-called sustainability factor is no longer valid. The pension penalty is equal to 0.5 percent for each month of retirement before the 'personal retirement age'. Disability benefits are paid to individuals with absolute invalidity (complete and permanent incapacity to carry out any working activity) and relative invalidity (in case of inability to earn more than one-third of a normal wage). Similar to old-age pensions, disability pension benefits are based on reference earnings and accrual rates.

Romania

Romania's national pension system consists of three pillars: (i) a mandatory public scheme including old-age disability, (partial) early retirement and survivors pension and a social allowance for pensioners below a certain income level; (ii) a mandatory private defined contribution scheme; and (iii) voluntary private pensions. The standard retirement age is 65 years for men. For women, it will increase to 63 years by 2030 and was 61 years and nine months in 2022. The minimum contribution period is 15 years.

A major change to the Romanian public pension system was drafted in 2018 and legislated in 2019. Differently to pension reforms in many other countries that go along with long transitional periods, the legislated reform has rather strong short- and medium-term impacts both for pensions already in payment and for accrual rates. According to the AWG pension group, the average impact of the recalculation of pension benefits according to the new pension law will be a 14 percent increase compared to the old system. On the other hand, the new law defines more restrictive rules regarding contribution periods. Under the new law, the pension benefit is defined as the individual's number of pension points multiplied by the 'reference point value' (RPV, defined as the pension

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[24] The adjustment of some earnings of the 2000s is somewhat higher.

point value divided by 25). This calculation has been changed not only for new pensions, but also for pensions in payment. From September 2021, the RPV stands at RON 75 (=1,875/25). Under the new law, the pension point value is indexed with inflation plus 50 percent of the real average gross wage growth of the previous year. According to MISSOC, the State pays social contributions on behalf of recipients of unemployment benefits so that we implement accrual of pension rights for periods of receiving unemployment benefits in the LMM.

The second pillar scheme was introduced in 2007. The contribution rate currently is 3.75 percent (which is subtracted from the contribution to the public system). The scheme is compulsory for individuals aged up to 35 years and optional for people aged 35 to 45 years. Under certain conditions, individuals have an option to transfer assets to the first pillar, but very few have done that so far.

Disability pensions are paid to individuals who have lost their capacity to work, totally or partially. Analogously to old-age pensions, the benefit is determined by a pension points scheme, but the calculation takes into account the extent of invalidity. There is an early retirement pension for individuals whose contribution period is at least eight years longer than the full contributory period. For individuals whose contributory periods are one-to-eight years longer, there is a partial early retirement benefit with deductions to the pension benefit (which depend on the number of contribution years exceeding the full contributory period). Unlike many other countries, these deductions are only valid until the individual reaches the statutory retirement age.

Slovenia

Slovenia runs a compulsory PAYG pension scheme providing earnings-related pension benefits combined with a minimum pension. With less than 40 years of contributions, the legal retirement age is 65 years both for men and women. However, there is a preferential entitlement to early pensions with 40 contributory years. From 2019 on, 15 years of insurance are necessary to qualify for a pension benefit.

Pension benefits are determined by previous earnings, the number of insurance years and the age of retirement. The pension rating base (PRB) is calculated using the best 24 consecutive years of wages. The PRB is based on net earnings. Past net earnings are uprated with the growth of nominal net wages. This earnings-related pension scheme gives 29.5 percent of the PRB once qualifying conditions have been met. For each additional year, the accrual rate is 1.36 percent. Therefore, total accrual after 40 years of contribution is 63.5 percent. There is a minimum pension rating base which is equal to 76.5 percent of the average monthly salary. On the other hand, there is also an upper ceiling for pensionable earnings set at four-times the minimum pension rating base.

Periods of receipt of unemployment insurance benefits qualify for a pension and the Employment Agency pays the contributions. The value of unemployment benefits is taken into account for the calculation of pension benefits.

Like old-age pensions, early pensions are based on PRB. The pension benefit decreases by 0.3 percent for each month of early retirement. In principle, the law envisages that pension benefits in payment are indexed with 60 percent of gross average wage growth and 40 percent of consumer price inflation.

Invalidity is defined as a reduction in the capacity for work because of an injury or illness related and unrelated to work which cannot be reversed by medical treatment or rehabilitation. The invalidity benefit is based on how and when invalidity occurred as well as on previous earnings.

Slovakia

The public pension system in Slovakia basically consists of an earnings-related points system and includes a minimum pension, as well as social assistance benefits. At the beginning of 2005, defined-contribution plans were introduced. The statutory pension age is gradually increasing to 64 years for men and women (without children) born in 1966 or later; it is 62 years and 10 months for individuals born in 1959. Based on the number of children, the retirement age for women with children is lower. Eligibility to pension benefits of the first pillar requires 15 years of pension insurance.

Contributors to the earnings-related pension scheme earn annual pension points based on the ratio of individual earnings to economy-wide average earnings. The pension system features a so-called 'solidarity formula'. This means that pension points below 1 are increased and pension points above 1.25 are decreased. Benefits at retirement are calculated by multiplying the number of points by the pension-point value, which is indexed to average earnings. Following the OECD, this is equivalent to an accrual rate in a defined-benefit scheme of 1.25 percent. There are several non-contributory periods, such as caring for children or sickness absence, which are credited. However, spells of unemployment are not credited in the pension system. From 2018, indexation of pensions in payment followed the development of consumer prices for pensioner's households.

The government introduced a defined-contribution system in 2005. Its contribution rate is gradually increasing to a value of 6 percent in 2024. For workers who joined these plans, benefits under the public earnings-related scheme are adjusted proportionally (as their contribution rate to the earnings-related scheme is reduced).

Under some conditions, early retirement is possible, and benefits are reduced by approximately 6.5 percent per year of early retirement. An individual is entitled to an invalidity pension as a consequence of a long-term, severe health condition. Among other details, disability benefits depend on the level of incapacity and lifetime earnings.

Finland

The public pension system in Finland provides an income-tested basic state pension (national pension) and a range of earnings-related schemes (with very similar rules for different groups). The pensionable age for the national pension is 65, the retirement age for the earnings-related pension is currently increasing from 63 years to 65 years by 2027.

The full amount of the basic pension is between EUR 558 and EUR 629 per month in 2019, depending on marital status. A full pension requires at least 80 percent of residency in Finland between the age of 16 and 65 and the benefit is reduced proportionally if this requirement is not fulfilled. The basic pension is withdrawn against income from the earnings-related scheme.[25] Following the OECD, we cover the earnings-related scheme for private sector employees (TyEL). From 2017, the accrual rate amounts to 1.5 percent of annual earnings but, during a transitional period, the accrual rate is 1.7 percent for individuals aged 53 to 62. Earlier years' earnings are

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[25] Details for the withdrawal can be found in OECD (2021) and the MISSOC database.

valorised in line with a mix of inflation (20 percent) and wage growth (80 percent). Since 2010, new earnings-related pensions are adjusted to account for increases in life expectancy after 2009. For instance, for people born in 1958, this reduces pensions by 4.6 percent.

Several non-contributory periods are credited. Earnings-related unemployment benefits accrue rights based on 75 percent of the income on which the unemployment benefit is based. After the period of earnings-related unemployment benefits, a flat-rate unemployment assistance can be claimed, but unemployment assistance does not entitle a person to pension rights. Earnings-related pensions in payment are indexed by a mix of inflation (80 percent) and earnings growth (20 percent).

According to MISSOC, earnings-related pensions can be claimed before the statutory retirement age and pensions are permanently reduced by 4.8 percent per year of early retirement. Invalidity pensions are also comprised of a basic pension and an earnings-related part.

Sweden

The Swedish public pension system consists of an earnings-related part based on notional accounts and a smaller mandatory defined-contribution funded pension system. There is also an income-tested top-up, the 'guarantee pension'. Furthermore, quasi-mandatory occupational pension plans cover more than 90 percent of employees.

Contributions of 18.5 percent of pensionable earnings are credited on the accounts. As pensionable pay is defined as earnings minus the employee contribution to the pension system, this corresponds to an effective contribution rate of 17.21 percent of gross earnings. Whereas 14.88 percent of earnings are devoted to the notional-accounts system, 2.33 percent are paid to the funded pension scheme. According to MISSOC, contributions are levied up to a ceiling of annual earnings of SEK 519,708 in 2019. In the earnings-related part, earlier years' contributions are uprated with the development of average earnings. The earnings-related pension benefits are calculated by converting the accumulated notional capital into an annuity. Earnings-related pension benefits in payment are indexed with average earnings growth minus an imputed interest rate of 1.6 percent. For the defined contribution system, individuals can choose between an annuity to avoid investment risk and a variable annuity where funds continue to be invested. In LMM, we assume that funds are paid as annuities indexed to price inflation.

In addition, there are four major occupational schemes in Sweden that are estimated to cover more than 90 percent of employees. We follow the OECD by modelling ITP1, a funded defined-contribution plan. The contribution rate is 4.5 percent of salary for an income up to 7.5 income base amounts and 30 percent of salary in excess of that value.

Several non-contributory periods are credited for pension entitlements. Unemployment benefits (and activity grants paid to unemployed individuals) count as pensionable income, and the government takes over the contribution of the employer.

The Swedish pension system allows for a flexible retirement age. The earliest age for withdrawing the earnings-related pension is 62 years in 2021; this figure will gradually increase. The pension system includes an automatic actuarial reduction of earnings-related benefits for early retirement. The income-tested guarantee pension, however, cannot be claimed before the age of 65. Disability pensions are dependent on the three highest annual incomes earned during a certain period before

the time of disability as well as on the degree of incapacity. For persons with low pension income, there is also a guaranteed compensation.

Aggregate Pension Expenditures as in the LMM

Aggregate pension expenditures as in the LMM are shown in Table 43. Generally speaking, this number includes public as well as mandatory or 'quasi-mandatory' occupational pensions. It must be noted that these numbers can deviate from public expenditures published by the OECD and Eurostat, as we include some schemes (such as occupational pension systems) in LMM which are not included in the OECD's and Eurostat's public pension expenditures (see also the description above). Pension expenditures in LMM vary among the modelled countries. They range from 5 percent of GVA in Ireland to less than or around 10 percent in many Eastern Member States to 18 percent of GVA in Italy and around 20 percent in Greece.

Table 43: Pension expenditures as in the LMM as a percentage of GVA, average 2015–2017

Country		Country	
EU-27	13.58	Latvia	8.69
Belgium	13.53	Lithuania	7.56
Bulgaria	9.73	Luxembourg	9.82
Czechia	9.41	Hungary	10.87
Denmark	16.29	Malta	8.09
Germany	11.44	Netherlands	15.31
Estonia	9.31	Austria	15.54
Ireland	4.90	Poland	12.90
Greece	20.67	Portugal	16.48
Spain	11.53	Romania	9.90
France	16.51	Slovenia	12.31
Croatia	12.70	Slovakia	9.31
Italy	17.92	Finland	15.45
Cyprus	12.18	Sweden	11.35

Numbers shown here may deviate from expenditures published by the OECD as we include expenditure items (in particular occupational pension schemes) in force in LMM but not included in OECD's public pension expenditures

Source: OECD Database, ESSOSS, own calculations • Created with Datawrapper

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2.10. Other Social Benefits

In addition to public unemployment and pension insurance, other social benefits for private households are available in all modelled countries. The main source used to assign the different benefits across age and skill groups is the EU-SILC. Given the availability of data the following cash transfers are considered:

- Education allowances;
- Sickness benefits;
- Family allowances;
- Social exclusion;
- Housing allowances.

Some of these benefits are defined on an individual level (education allowances, sickness benefits), whereas others are available on the household level. Benefits for which data are only available on the household level are assigned across the household members in the following way for the calibration of the model. Each person in the household aged 25 or older, and each person of a lower age whose mother and father are not members of the same household, receive the same amount of the total household benefit. This means that these benefits are divided equally upon non-dependent members of a household. The level of aggregate expenditures is largely based on information of the OECD Social Expenditure Statistics. The last year for which data are available is 2017. In general, we use the average of expenditures as a percentage of GVA of the years 2015 to 2017. If a country is not a member of the OECD, ESSOSS is used as source for total expenditures for the different social expenditure categories.

Data of the EU-SILC about education allowances are regrouped for the model as education is ongoing for younger age groups. Without adjustment the share of allowances granted would be too high for low- and medium-skilled persons whereas high-skilled persons would receive grants only after having finished tertiary education. For this reason, we divide education allowances for 15 to 19-year-old persons according to the population share in the model between medium- and high-skilled persons. For 20 to 24-year-old persons, we assign all benefits to high-skilled persons. For older age groups we use the data directly without any corrections.

Sickness benefits are assigned only to employed persons or persons receiving unemployment benefits. In addition, we assume that the amount paid to employed and unemployed persons is the same, if unemployed individuals are eligible. Sickness benefits are reflected in the model in the variables 'zw' and 'zu' as well as 'b00', which reflect fixed transfers if a person is employed or unemployed. 'zu' includes sickness benefits for unemployed persons receiving income-dependent unemployment benefits; 'b00' includes sickness benefits of unemployed persons receiving wage-independent benefits.

Benefits for social exclusion are divided between three groups of persons: persons in retirement, persons not participating on the labour market, and persons in unemployment. The assignment is based on EU-SILC data by using information about how many months a person spent in these states. Only persons spending the entire year in one of these states and with positive social exclusion benefits are considered for the model. This may distort the result to some extent but will, in our opinion, lead to a more trustworthy result than dividing income arbitrarily by counting all persons receiving social assistance. Social exclusion benefits for retired persons enter the model as lump-sum payments to private households. Benefits for inactive persons are included in 'ynonpar0' and benefits for social exclusion for unemployed persons are included in 'b00'.

Information about the age- and skill structure of social expenditures is based on the EU-SILC. Total expenditures for the different social expenditure categories are taken from the OECD Social Expenditure Dataset or ESSOSS database and are used to scale benefits derived by EU-SILC. Although EU-SILC also provides information about total expenditures by aggregating individual or household data, small sample sizes may lead to an imprecise approximation of total expenditures.[26] However, total expenditures for education allowances are taken directly from EU-

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[26] It is also the case that the OECD Social Expenditure Database contains additional expenditures not included in EU-SILC. Implicitly, the same EU-SILC age and skill structure is assumed for these expenditures. For Italy, EU-SILC does not contain sickness benefits. They are assigned across age and skill groups in the same way as in Spain, as total expenditures in both countries in the EU-SILC are similar. In Denmark, income maintenance benefits are missing in the

SILC as the OECD Social Expenditure Dataset does not provide any information about this type of allowance. Total expenditures for education allowances as a percentage of GVA for the modelled countries are shown in Table 44. There are significant differences in total expenditures with values ranging from 0.01 to nearly 1.4 percent. In the Northern countries, the transfers are significantly higher than in the other countries.

Table 44: Total expenditures for education allowances as a percentage of GVA

Country	Education allowances	Country	Education allowances
EU-27	0.16%	Latvia	0.10%
Belgium	0.04%	Lithuania	0.04%
Bulgaria	0.01%	Luxembourg	0.15%
Czechia	0.02%	Hungary	0.07%
Denmark	1.36%	Malta	0.26%
Germany	0.14%	Netherlands	0.25%
Estonia	0.17%	Austria	0.09%
Ireland	0.12%	Poland	0.05%
Greece	0.01%	Portugal	0.10%
Spain	0.09%	Romania	0.01%
France	0.07%	Slovenia	0.28%
Croatia	0.08%	Slovakia	0.02%
Italy	0.10%	Finland	0.39%
Cyprus	0.35%	Sweden	0.83%

Source: EU-SILC, Eurostat, own calculations. • Created with Datawrapper

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Table 45: Total public expenditures for different social events as a percentage of GVA

Country	Paid sick leave	Family allowances	Housing assistance	Income maintenance	Country	Paid sick leave	Family allowances	Housing assistance	Income maintenance
EU-27	0.46%	1.35%	0.32%	0.55%	Latvia	0.61%	1.52%	0.09%	0.11%
Belgium	0.73%	1.94%	0.00%	0.48%	Lithuania	0.77%	0.92%	0.07%	0.30%
Bulgaria	0.57%	1.30%	0.00%	0.18%	Luxembourg	0.30%	2.54%	0.36%	0.39%
Czechia	0.50%	1.63%	0.27%	0.16%	Hungary	0.51%	1.95%	0.40%	0.12%
Denmark	0.60%	1.56%	0.79%	1.26%	Malta	0.07%	0.79%	0.06%	0.75%
Germany	0.42%	1.22%	0.12%	0.32%	Netherlands	0.36%	0.96%	0.52%	1.14%
Estonia	0.36%	2.36%	0.08%	0.08%	Austria	0.25%	2.18%	0.13%	0.32%
Ireland	0.59%	1.38%	0.55%	0.10%	Poland	0.92%	1.80%	0.06%	0.07%
Greece	0.21%	1.08%	0.03%	0.31%	Portugal	0.39%	0.87%	0.02%	0.21%
Spain	0.91%	0.56%	0.11%	0.15%	Romania	0.27%	0.80%	0.00%	0.19%
France	0.57%	1.65%	0.92%	0.66%	Slovenia	1.15%	1.44%	0.03%	0.67%
Croatia	0.43%	1.35%	0.03%	0.33%	Slovakia	0.45%	1.24%	0.04%	0.25%
Italy	0.17%	0.67%	0.04%	0.22%	Finland	0.54%	1.53%	0.87%	0.60%
Cyprus	0.43%	1.23%	0.43%	0.49%	Sweden	1.04%	1.48%	0.47%	0.81%

Paid sick leave: in the Netherlands based on the year 2017 as expenditures decrease significantly and fit better with EU-SILC benefits; Income maintenance: distorted by refugee support in 2016 and partially 2017, therefore without refugee support in Austria, France, Italy and the Netherlands based on the year 2015, year 2016 neglected in Germany and Sweden; Housing assistance and Income maintenance in Malta based on EU-SILC.

Source: OECD.Stat, EU-SILC, own calculations. • Created with Datawrapper

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For the other categories of social expenditures, aggregate public expenditures are based on information provided by the OECD Social Expenditure Statistics or ESSOSS database. An overview of total public expenditures as a percentage of GVA is presented in Table 45. These numbers include cash transfers as well as benefits in-kind. In Germany housing transfers linked

EU-SILC. The age and skill structure and division between unemployed and inactive persons is based on the share of these persons in the population.

with ALG II (unemployment benefits II) are assigned to social expenditures, being divided across unemployed and inactive persons in the same way as transfers for income maintenance. In the following, we describe the different systems for family allowances, housing allowances, and social exclusion in the modelled countries.

Belgium

Sickness benefits in Belgium are provided by a compulsory social insurance scheme. In case of sickness, the employer must provide continued payment for one month.[27] The compensation rate of the benefit equals 60 percent of previous earnings with a maximum daily amount of about EUR 143. The maximum period of payment is one year. Benefits are subject to taxation but not to social security contributions.

Family benefits consist of child benefits, parental leave benefits, allowances and grants. The child benefit is granted to the active population (also including persons receiving integration income) with an age limit of the child of 18 years (25 years in case of vocational training or further education). The monthly amount depends on the region. In Flanders and Wallonia and Brussels for example, the benefit amounts to about EUR 95 for the first child, EUR 175 for the second and EUR 260 for the third and subsequent children.[28] For single parents whose professional or replacement income is below EUR 2,452.41, a supplement of about EUR 48 per month for the first child is paid, decreasing to EUR 24 for the third and subsequent children. In addition, a monthly age supplement (ranging from EUR 16.5 to EUR 29) is paid, depending on the age of the child.

Parental leave benefits are paid to persons leaving the labour market for child-raising reasons (maximum four months when interrupting a full-time job, eight months when working half-time during leave). To be eligible a person must be on leave from the time of childbirth and before the child reaches the age of 12. The benefit is flat rate and amounts to EUR 818.56 or EUR 1,129.61 for a single person (in case of half-time interruption, the amount depends on age). In addition, birth and adoption grants of EUR 1,122 can be claimed. Special allowances are granted for children with disabilities, for school, and for people with disabilities. Family allowance, birth and adoption grants are not subject to taxation, but parental leave benefits are taxable (but no social security contributions).

Social assistance in Belgium, called integration income, is an individual right and paid to persons who prove willingness to work. Eligibility requires an age of 18 (different rules for special cases). The amount of the integration income depends on the family situation and is means-tested. A person living alone receives EUR 910.52 per month (year 2019), a single parent or couple EUR 1,254.82 and a cohabitant EUR 607.01. Family benefits are granted in addition to the minimum. Benefits are not taxable and not subject to social security contributions. For persons aged 65 or above, there is a 'Guarantee of Income', which is means-tested. It amounts to EUR 1,118.36 per month for a single person and EUR 1,491.14 (values for 2019) for a two-person household. For this type of benefit a tax reduction is allowed; no social security contributions accrue. Income maintenance is granted for an indefinite period; a mandatory annual revision is foreseen. Direct housing benefits are not available, but there exist schemes to assist the access to property.

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[27] Two weeks in case of disability of a worker.

[28] From 2019 on, an amount of EUR 163.20 is paid for each child.

Bulgaria

Sickness benefits are provided within a social insurance scheme. The scheme is compulsory for employees; self-employed persons can join voluntarily. There is no earnings ceiling for coverage in Bulgaria. To qualify for benefits, six months of insurance are necessary. In the case of sickness, the first three days of payments are covered by employers with a replacement rate of 70 percent. Benefits are granted from the fourth day onwards until recovery or the establishing of invalidity and amount to 80 percent of average gross salary within the 18 months before the sickness. If earnings are lower than the minimum contributory income, then the replacement rate is 100 percent. Unemployed persons are also eligible for sickness benefits. Benefits are neither taxable nor subject to social security contributions.

Family benefits are available for Bulgarian citizens if their children live in the country. Upon the birth of a child, mothers are entitled to a one-off payment of BGN 250 (in 2019, EUR 128) for the first child, BGN 600 for the second, BGN 300 for the third and BGN 200 for each subsequent child. A means-tested monthly allowance is granted for raising a child until graduation from high school up to the age of 20. To be eligible, the average monthly gross income per family member must not exceed BGN 500. Between BGN 400 and BGN 500, the benefits are 80 percent of the full amount. The monthly allowance for raising a child amounts to BGN 40 for families with one child, BGN 90 for two children, and up to BGN 145 for four children. For each subsequent child the amount increases by BGN 20. If the mother is uninsured, a monthly allowance of BGN 100 for raising a child under one year of age is available. Additionally, several one-off benefits are available, for instance for pupils enrolled in the first grade of school. Benefits are not subject to taxation or social security contributions.

Maternity and paternity benefits are granted via a compulsory social security scheme for employees; self-employed persons can join voluntarily. To qualify for benefits, 12 months of insurance are required. Insured parents are entitled to pregnancy and childbirth leave of 410 days, of which 45 must be taken before confinement. Fathers are entitled to 15 days after birth. In addition, from the sixth month of age of the child, six months of maternity leave can be transferred to fathers. The pregnancy and childbirth benefit amounts to 90 percent of the contributory income of the 24 months before leave. It amounts to at least the statutory minimum income. If mothers return to work after six months of birth, they receive 50 percent of the benefit. If mothers are not insured, a one-off benefit for low-income persons is eligible. After expiry of the pregnancy and childbirth benefit, a mother (or father) is entitled to an additional period of childcare leave before the child reaches the age of two, if childcare facilities are not claimed and the mother has been insured for at least 12 months. The benefit amounts to BGN 380 per month. Benefits are not taxable and not subject to contributions.

In Bulgaria there are two schemes for social assistance. Both schemes require a minimum period of residence in Bulgaria of five years. To be eligible for the general scheme an unemployed person must be registered with the employment office for at least six months, with several exemptions like for parents with young dependents. The benefit is defined as a percentage of the guaranteed minimum income of BGN 75 per month. For a person below the age of 65 living alone, this amounts to 73 percent of the minimum income. For a person cohabiting, it equals 66 percentage points for each partner, for a child younger than 16 (20 in the case of students) the guaranteed minimum rises by 91 percentage points. A special scheme, the social pension, exists for old-age

retirees with an age of 70 years or older. The monthly amount of the social pension is BGN 125.58. Housing benefits in Bulgaria are available for persons with a monthly income of less than 250 percent of the minimum income, who live in a publicly owned accommodation, and who are either orphans aged under 25, lone elderly people of 70 or older, or single parents. In this case, part of the rent is paid by social funds. Minimum resources are not taxable and not subject to social security contributions.

Czechia

Sickness benefits in Czechia are granted via a compulsory social insurance scheme with earnings-related benefits. Self-employed persons can join voluntarily. There is a minimum monthly income for eligibility of CZK 3,000 (year 2019). Benefits for the first two weeks of sickness are paid by the employer, public benefits step in afterwards. The replacement rate is 60 percent for the first 15 days, 66 percent for the next 30 days, and 72 percent of the daily assessment base afterwards. The assessment base is 90 percent for the first CZK 1,090 of daily income and decreases to 30 percent for income between CZK 1,635 and CZK 3,270. Earnings above are not considered. The benefit is paid for 380 days. The benefit is also available for caring for a sick child or adult family member for nine to 16 days. Sickness benefits are neither subject to taxation nor social security contributions.

Family benefits consist of the child allowance, the parental allowance and a birth grant. The child allowance is provided to children until completion of compulsory school and longer if a child invests in full-time education up to an age of 26. Entitlement requires that family income is below 2.7-times the family's living minimum. The child allowance amounts to CZK 500 per month for a child below the age of six, CZK 610 between six and 15 years, and CZK 700 for an older child. An increased rate (by CZK 300) is granted if one of the family members has income from work of at least the individual living minimum or receives specific social benefits. The parental allowance is granted to a parent who provides full-time and regular care for the youngest child up to an age of four years. The allowance is provided until the total amount of CZK 220,000 is drawn or the child reaches the age of four. In case of multiple births, the total amount increases to CZK 330,000. A parent may choose the monthly amount within limits and therefore the length of the allowance if at least one parent in the family is insured against sickness. Otherwise it amounts to CZK 7,600.

The birth grant is related to the first and second born children and only to families whose income does not exceed 2.7-times the family living minimum. The amount of the birth grant is CZK 13,000 for the first child and CZK 10,000 for the second child. A higher amount is paid to families in case of multiple births. All three benefits are not taxable and not subject to social security contributions.

Maternity and paternity benefits are based on a compulsory social insurance system for employees and a voluntary system for self-employed persons. For eligibility, 270 days of insurance are necessary. The maternity benefit starts six-to-eight weeks before birth and lasts 28 weeks (37 weeks in case of multiple births). A paternity leave of one week within the first six weeks after birth is possible. The benefit amounts to 70 percent of the daily assessment base, which is the same as for the sickness benefit. The benefit is neither taxable nor subject to social security contributions.

The social assistance or living allowance provides support for citizens who are in need of assistance (means-tested) and the overall social and economic situation prevents a person or family from increasing income from work. In case of unemployment, the person must be registered at the public employment service. A supplement for housing is granted for persons or families not

capable of covering housing costs. The amount of the housing supplement is determined by how much the difference of income and living minimum covers reasonable housing costs, which include rent, services related to housing and energy costs. The living minimum amounts to CZK 3,410 (values 2019) for a single person, CZK 3,140 for the first person in a household and CZK 2,830 for the second and further adults in the household. The minimum for a dependent child lies between CZK 1,740 (under six years) and CZK 2,450 (15 to 26 years old). The subsistence minimum is available for persons who are out of work for more than six months and amounts to CZK 2,200.

The housing allowance supports low-income households to cover housing expenditures. Eligibility requires that 30 percent of the household income is not enough to cover housing costs and that 30 percent of the household income is lower than the prescriptive housing costs. The allowance does not cover total housing costs. It is derived as the difference between the prescriptive housing costs and 30 percent of the relevant household income. If actual housing costs are lower than the prescriptive housing costs, the actual costs are used for the calculation. Social assistance benefits and the housing allowance are not taxable and not subject to social security contributions.

Denmark

Sickness benefits in Denmark are tax financed and available for employees and self-employed persons. The first 30 days of sickness benefits are paid by the employer (two days in case of small firms are possible). Sickness benefits to unemployed persons are paid for the first 14 days of sickness. To qualify for benefits, employment of 240 hours within the last six months or eligibility for unemployment benefits are necessary. The benefit is based on income during the three months before sickness with a maximum weekly amount of DKK 4,355. The maximum period of benefits is 30 weeks (including 30 days of continuation of payments by the employer). Sickness benefits are subject to taxation and the supplementary pension scheme (ATP).

Family benefits, and Child and Youth benefits, are available in Denmark for all children below the age of 18. In contrast to many other countries, the benefit decreases with the age of the child. The annual payment is DKK 18,228 for children between 0 and two, DKK 14,436 between three and six and DKK 11,352 for older children. This benefit is means-tested and decreases with an annual income above DKK 782,600. There is a study supplement of DKK 7,568 for each parent who is studying (income-tested). In addition, a child allowance of DKK 5,764 per child is available. For single parents the amount is raised by DKK 5,876 per year and household. For low-income households, day-care of children is subsidised. Benefits are neither taxable nor subject to social security contributions.

The duration of social assistance is unlimited. However, the benefit decreases if a person can work but does not meet a minimum work requirement. Entitlement is a subjective right. Benefits can be claimed for two reasons. Activation measures and benefits (social assistance) and educational assistance are provided for persons without temporarily sufficient means to meet basic needs. Integration benefits are available for persons in a situation of need. Social assistance is available for persons aged from 30 years (18 years old in the case of completion of vocational education) to retirement age, educational assistance from 18 to 29 years of age. The integration benefit can be claimed by 18-year-olds up to retirement age. Social assistance requires the participation in activation measures. Benefits are means tested.

The benefit amounts to 60 percent of the maximum unemployment benefit (DKK 11,423 in 2019) for a person without dependent children and 80 percent for a person with children (DKK 15,180).

For married couples the amount depends on the income and savings of both spouses. The education allowance depends on age, family status and other aspects. A person aged 20 or more without children enrolled in higher education is entitled to DKK 6,259 per month. The integration benefit is DKK 5,997 per month for a single person and DKK 8,393 for a couple. In addition to social assistance, a household may receive a special housing benefit if the net rent (rent minus general housing benefits) is in excess of DKK 3,050. For families with children, the net rent exceeding DKK 4,400 per adult (reduced by DKK 850 for the second and further children) is paid. The sum of social assistance (after tax) and special housing benefits has to be lower than 90 percent of previous net labour income for the first three months. Afterwards the sum has to be lower than the maximum unemployment benefit after tax. Benefits are subject to taxation and the supplementary pension scheme ATP, of which one-third is paid by the beneficiary and two-thirds by the municipality.

In Denmark, there exist two types of housing benefits, 'boligsikring' and 'boligydelse'. 'Boligsikring' is available for households with children or households with high rent and low-income (usually singles). 'Boligydelse' is granted to persons receiving old-age pensions. The housing benefit depends on household income, rent, the number of children, and other individual characteristics. The rent is adjusted according to an indicative size of the accommodation. In 'boligsikring' the maximum annual rent subsidised is DKK 81,500 and increases by 5 percent for each child. The subsidy is calculated as 60 percent of the rent diminished by 18 percent of annual household income above DKK 145,200 (plus DKK 38,300 for each child). For a household without children or retirees the subsidy cannot exceed 15 percent of the rent. Housing benefits are not taxable.

Germany

Sickness benefits in Germany are available for all employees with annual gross income of up to EUR 60,750; opting out is possible for higher income. For low-income employees (EUR 450 per month) insurance is not compulsory either. If employment lasts for at least four weeks, continuation of payment by employers lasts six weeks with full compensation. After six weeks, sick persons can claim benefits amounting to 70 percent of gross income, not exceeding 90 percent of net income of the last three months preceding sickness. Sickness benefits for a child's sickness for 10 working days (20 days for single parents) are also available. Sickness benefits are not subject to taxation but subject to social security contributions (with the exception of sickness insurance).

Family benefits consist of the family tax credit ('Kindergeld'), the parental allowance (plus) ('Elterngeld (plus)'), and the supplementary child allowance. The family tax credit is granted to children up to the age of 18 (21 in case of unemployment) or 25 in case of education. The tax credit is independent of income and amounts to EUR 194 per month for the first and the second child, EUR 200 for the third, and EUR 225 for the fourth and subsequent children. The parental allowance is granted to persons who take care of their children and work at most part-time. It amounts to 67 percent of net labour income between EUR 1,000 and EUR 1,200 before the birth of the child. The rate increases further for lower income but decreases to 65 percent for higher income. The allowance is granted at most for the first 14 months after the birth of the child. Parental allowance plus allows the recipient to double the period but cuts the benefit in half. If only one parent applies for the grant, it is paid for 12 months. If both work for four months at the same time, both receive an additional four months of a possible benefit claim (partnership bonus). The supplement child allowance is available for persons able to finance their own living costs, but who

do not have sufficient resources available for their children. The allowance depends on the income of the family, the rent, and additional needs and is at most EUR 170 per month and child. Benefits are tax exempted and no social security contributions are obliged. The parental allowance is subject to progression. Maternity leave exists in Germany for a period of six weeks before and eight weeks after the birth of a child (12 weeks in case of multiple births or disability). The benefit amounts to the net-wage of the insured person. The benefit is not subject to taxation.

Social assistance in Germany is divided into subsistence benefits, assistance for the elderly and for persons with reduced earning capacity, and unemployment assistance for jobseekers. Whereas the first ones are generally an individual right and are administered at the federal level, the unemployment assistance for jobseekers is household related and administered mostly by the Federal Employment Agency together with local authorities. The benefit (year 2019) amounts to EUR 424 per month for persons living alone or for single parents, EUR 382 for cohabiting spouses, and between EUR 245 (children younger than six years) and EUR 322 (children older than 15 years) for children. In addition, actual costs for housing and heating of an appropriate dwelling, education benefits and benefits for increased requirements are paid. Social assistance is provided for an unlimited period. Benefits are not subject to taxation, health and long-term care insurance is covered by the competent authority.

Housing benefits are disposable for persons with low income and high rent. Persons receiving social assistance are not eligible for housing benefits as the benefits already include a benefit for housing costs. The housing allowance is determined by the size of the household, eligible income, and housing costs by using a formula. Benefits are not taxable.

Estonia

In case of sickness for employees and self-employed persons, a compulsory social insurance scheme is available. If insured, there is no qualifying period. From the fourth to the eighth day of sickness, employers continue payments. Public sickness benefits are paid from the ninth day onwards. The replacement rate typically amounts to 70 percent of average wages during the previous 12 months. When taking care of a sick child aged under 12, 80 percent of the wage is replaced. The full amount is paid in cases of work accidents and occupational disease, in the case of pregnancy and some other cases. The benefit duration is 182 days in the case of illness. Benefits are subject to taxation but not to social security contributions.

Several family benefits are available, covering all residents. The family allowance is paid to families with children aged less than 16 (19 in the case of students). The family allowance amounts to EUR 60 per month for the first and second child and increases to EUR 100 for additional children. For large families (six or more children) an additional allowance of EUR 300–400 exists. The family allowance is not means tested. In addition, a parental leave benefit can be claimed before the child reaches age 3. Only one parent can receive the benefit at one time. However, it is also paid if both parents work, so it is independent of the work status of the parents. The benefit is paid for 435 days and amounts to 100 percent of the reference wage with a minimum of EUR 540 and a maximum of EUR 3.319,8 per month. If the parents did not work before the child's birth, they can claim a flat-rate benefit of EUR 500 per month. Subsequently, a child care allowance for children up to the age of 3 is available, amounting to EUR 38.36 per month. A childbirth allowance of EUR 320 can also be claimed. For single parents, the family allowance increases by EUR 19.18 per month. Benefits are neither taxable nor subject to social security contributions.

Social allowance benefits are granted for persons or families whose net income, after deduction of fixed expenses for housing, is below the subsistence level. Several additional deductions are possible, like grants and benefits supporting studying or working or expenditures covering primary needs. The subsistence level is based on minimum expenses for goods and services satisfying primary needs. It equals EUR 150 (in 2018) for single persons and the head of the household. Each additional adult increases the subsistence level by EUR 120, each child (below the age of 18) by EUR 180. Housing expenses take into account rent and operating costs (including costs for electricity and gas) up to limits of specific standards (18 m² for each household member and 15 m² for the household). For retirees living alone, an annual allowance of EUR 115 is paid if the monthly net pension is less than 1.2-times the average old-age pension.

Maternity benefits are available for employees and self-employed persons; paternity benefits are available for employees with permanent employment. Maternity leave is paid for 140 calendar days, of which 30 days are reserved for the period before confinement. Paternity leave is paid for ten working days within two months before or after confinement. Adoption leave (for children below the age of ten) is granted for 70 days. The maternity and adoption benefit amounts to the reference wage without ceilings; the paternity benefit also equals the reference wage but is limited to three-times average gross monthly earnings. Benefits are taxable but not subject to social security contributions.

Ireland

Sickness benefits in Ireland are based on a compulsory insurance system for all employees, without the possibility of voluntary insurance for other groups. There is no earnings ceiling for eligibility. To qualify for benefits a minimum insurance period is required (104 weeks since starting to work, 39 weeks in the last year or 26 weeks in each of two previous years). There is no continued payment by the employer in Ireland. The waiting period for the benefit is six days. The flat rate benefit amounts to EUR 198 for persons with average earnings of at least EUR 300 per week and decreases to EUR 88.90 for persons with earnings of less than EUR 150. For a dependent child a supplement of EUR 31.80 is paid; for a dependent adult EUR 131.40 per week. The sickness benefit is limited only for persons with short insurance periods (less than 260 weeks). A maternity and paternity benefit is available for insured employees and self-employed. The maternity benefit is paid for 26 weeks, the paternity benefit for two weeks within six months after birth. The benefit amounts to EUR 240 per week. Parental leave is unpaid. Benefits are subject to taxation but not to social security contributions.

Child benefits are available in Ireland for all children under the age of 16 (18 in case of full-time education). The benefit equals EUR 140 per child per month. The allowance is higher in case of multiple births. Childcare allowances are not available. For single parents, a means tested (EUR 198 per week) supplement of EUR 31.80 can be claimed. For low-income workers, working at least 19 hours per week, a family income supplement exists. The amount is 60 percent of the difference between family income and the income limit of the corresponding family size. Benefits are neither subject to taxation nor to social security contributions.

Guaranteed minimum resources are available for persons with insufficient means to finance needs. There is no age limit for the supplementary welfare allowance, but persons must actively look for a job. The determined monthly minimum income level is EUR 849.33 for a single person,

EUR 569.40 for an additional qualified adult, and EUR 137.80 for each child. For claimants aged 25 or younger, lower rates are applied. There is no duration limit for the benefit.

To support housing costs, a rent supplement and a housing assistance payment is available. According to OECD *Benefits and Wages*, the rent supplement was largely replaced by the housing assistance payment and is only available in specific cases. However, to be eligible for housing assistance, an eligibility to the rent supplement is required, for example, receipt of social welfare benefit and an appropriate tenant. The tenant pays a weekly contribution to the local authority, which is based on household income. The way the rent contribution is calculated differs between local authorities. Social assistance and housing benefits are neither taxable nor subject to social security contributions.

Greece

Sickness benefits are available for all employees; voluntary insurance is not possible. The waiting period before benefits can be claimed is three days; continuation of payments by employers does not exist. The duration of sickness benefits in Greece depends on the duration of contribution payments. The maximum duration ranges from 182 days of illness for 120 days of contribution payments, to 720 days for 4,500 days of insurance. The benefit amounts to 50 percent of the average daily wage of the insurance class the insured belongs to (based on earnings in the last 30 days of the previous year). For each dependent, the benefit rises by 10 percentage points with a maximum of 70 percent or the daily wage of the 8th insurance class. For the first 15 days it is only half of this value. The benefit is taxable, but no social security contributions arise.

Child benefit in Greece is granted to permanent residents of at least five years, depending on the number of children and equivalent family income (annual family income before income tax, divided by the weighted number of family members). The benefit is paid if the child is unmarried and aged under 18 (24 in case of higher education). For low-income families (up to EUR 6,000) the benefit is EUR 70 for each of the first two children and EUR 140 for every additional child. For families with higher income (between EUR 10,000 and EUR 15,000) the benefit decreases to EUR 28 (EUR 56 respectively). Parental leave is possible for all employees up to four months until the child reaches six years of age. However, no benefit is paid. The child benefit is subject to taxation but not to social security contributions.

Maternity and paternity leave benefits are only eligible for employees. To qualify for the benefit, 200 days of insurance contributions during the last two years before birth are required. Maternity leave amounts to 119 days, of which 56 are assigned to the prenatal and 63 to the postnatal period. A special maternity leave scheme allows extension of the leave up to six months. For paternity leave, two days paid by the employer are possible. There is no flexibility to shift days of leave between parents. The maternity benefit amounts to 50 percent of the wage of the corresponding insurance class plus 10 percent of this amount for each child, with a maximum of 40 percent. The minimum amount is two-thirds of the wage of the insured woman; the maximum amount is EUR 47.47 per day (EUR 66.46 for four dependent children). The special maternity leave amounts to EUR 586.08 per month (EUR 510.95 if the mother is younger than 25 years). If mothers work part-time (four hours or less per day) before maternity leave, the benefit is cut by half. Uninsured mothers receive EUR 440.20 (half before and half after birth). Benefits are subject to taxation (except for the special maternity leave) and social security contributions (old-age, sickness and supplementary pension).

The Social Solidarity Income provides social assistance for low-income households in Greece. The guaranteed minimum resources are determined at the household level, where household members are weighted by the internationally used equivalence scale. Working-age beneficiaries must register at the unemployment office. The benefit is means-tested where 20 percent of actual net income from employment is excluded. Minimum resources depend on the number and age of household members. For a single-person household, this amounts to EUR 200 per month, EUR 100 for each additional adult and EUR 50 for each child. The maximum amount is EUR 900 per month. For uninsured elderly persons aged 67 or older, a special scheme exists. A housing benefit to help low-income households can be granted and is set to EUR 70 monthly for a single person household and increased by EUR 35 for each additional household member (maximum EUR 210 and limited by actual rent). For uninsured and low-income elderly persons over 65, a housing allowance amounting to EUR 362 exists. Social assistance benefits are neither taxable nor subject to social security contributions.

Spain

Sickness benefits in Spain are based on a compulsory insurance scheme for employees and a special scheme for self-employed persons. To be eligible, a contribution period of 180 days within five years prior to sickness is necessary, except in case of an accident. After a waiting period of three days, employers must provide a continued payment up to the 15th day of sickness before insurance benefits are available. The replacement rate is 60 percent up to the 20th day of sickness and 75 percent thereafter. The maximum contribution base is EUR 4,070.10 (year 2019), the maximum duration is 365 days with a possible extension by a further 180 days. Sickness benefits are taxable and subject to social security contributions. A child care leave allows to reduced working hours of one of the parents by 1 hour per day for 30 months, or 2 for the first 12 months and 1 hour for the following 6 months.

Child benefits are available for dependent children (under the age of 18, or older if disabled) and for multiple births or adoption (one-off lump-sum payments). The child benefit is granted if annual income is below EUR 12,313 (higher amounts for large families). The economic allowance amounts to EUR 24.25 per month and child. Benefits for disabled children depend on the degree of handicap (EUR 83.33 for a degree of 33 percent or more for children below 18, EUR 392 for a child above 18 and a degree of handicap of 65 percent or more, and EUR 588 for a degree of 75 percent and more). The multiple birth grant for birth or adoption amounts to EUR 3,600 for two children and rises to EUR 10,800 for four and more children. In addition, large families, lone parent families or disabled mothers receive an additional amount of EUR 1,000. Family benefits are not taxable and not subject to social security contributions.

The social assistance scheme 'Ingreso Minimo/Renta Minima de Insercion' (MII) is implemented on the regional level, following the principle to alleviate poverty by cash benefits. Persons aged between 25 and 65 or older without public pension entitlement are eligible. In Madrid,[29] the basic amount of MII is EUR 400 per month, the amount for the second and further persons is considerably lower (e.g., in Madrid the supplement for the second earner is set to EUR 112.67 and EUR 75.11 for the third person). The benefit is means tested and the claimant must actively search for a job. The benefit is taxable. Housing allowances amount to EUR 525 per year to reduce rent

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[29] Following the OECD Tax Benefit Model for Spain.

costs, if a person is entitled to a non-contributory old-age or invalidity pension, lacks home ownership and is not related to the owner.

France

Sickness benefits in France are based on a compulsory social insurance scheme. There are no ceilings for earnings. To be eligible a minimum payment of contributions is necessary (2,030-times the hourly minimum wage within the preceding 12 months). The benefit amounts to 50 percent of the basic daily earnings of the last three months, capped at 1.8-times the minimum wage, or two-thirds from the 31st day onwards for beneficiaries with three children. The difference to the preceding wage income is paid by the employer.[30] Sickness benefits are taxable and subject to the generalised social contribution of 6.2 percent and the contribution for the repayment of social debt of 0.5 percent.

Several family benefits exist in France. The Child Benefit is granted for children up to the age of 20 and is paid only if there are two or more children. The benefit amounts to EUR 131.16 for two children per month and increases to EUR 467.24 for four children. Each further child is granted EUR 168.04. Contribution to the reimbursement of social debt is already deducted in these amounts. There is no income-test for this benefit. For children over 14 years old,[31] a supplement of EUR 65.91 can be claimed and a flat rate allowance of EUR 83.35 for one year for large families is granted.

The Infant Welcome Benefit consists of two parts. One part of the benefit is granted for a birth or adoption and a second for the child education choice or childcare choice. The Birth or Adoption Grant amounts to EUR 941.66 before the end of the second month of birth or EUR 1,883.31 in case of an adoption. The benefit is means-tested. In addition, the Basic Allowance of EUR 170.71 (2019) is paid for the first three years after birth or adoption. Since 2015, allowances are only 50 or 25 percent of these values for high-income families. The second type of benefit is granted for child-raising or childcare. The child-raising allowance is not means-tested but previous labour market activity is necessary. Beneficiaries must have at least one child under the age of three. The amount of the benefit is EUR 396.01 per month (partial amounts for part-time activity). The childcare allowance is a partial contribution to care costs for children younger than six years and requires a professional activity generating a minimum income. The benefit decreases to 50 percent for a child between the ages of three and six. Social contributions of a hired maternal assistant are paid entirely and to 50 percent if a person who takes care of the child at home is hired. For single parents a Single Parent allowance is granted (income-tested on a differential basis) to guarantee minimum income. The monthly amount is EUR 943.29 for a single parent with one child, EUR 1,179.11 for two children and EUR 235.82 for each subsequent child. The New School Year allowance is paid for children aged between six and 18. It is an annual payment and is means-tested. The amount depends on the age of the child (EUR 367.73 for a child between six and ten years up to EUR 401.47 for a child between 15 and 18 years). Family benefits are not subject to taxation but are subject to the 0.5 percent contribution for the repayment of the social debt (single parents receiving single parent allowance are exempted).

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[30] Alternatively, payments according to the collective agreement conditions are also possible if more favourable.

[31] Except for the first child.

Maternity and paternity leave is provided by the health insurance scheme for employees for 16 weeks (six weeks before birth and 10 afterwards). After the third birth the time span is extended to 26 weeks. Longer periods are granted for multiple births. Paternity leave is possible for 11 consecutive days within four months after childbirth. The benefit amounts to previous gross income (up to a ceiling) minus a 21 percent fee rate (social security contributions and other contributions). The minimum amounts to EUR 9.53 per day, the maximum to EUR 87.71. The benefit is taxable and subject to the generalised social contribution and repayment of social debt.

Social assistance in France is an individual right, taking into account the family situation, implying that a differential amount is paid. Persons are eligible if they are at least 18 years old. There is also a connection to the labour market, as the person must be willing to undertake training, integration or employment activities. The Guaranteed Minimum Resources (RMI) is determined at the national level. The active solidarity income provides supplemental income from work and amounts to EUR 550.93 for a single person and EUR 1,156.96 for a couple with two children. The allowance of specific solidarity guarantees a minimum income for persons capable of working. The full rate is EUR 16.48 per day. Special schemes exist for elderly and disabled persons. With the exception of the allowance of specific solidarity, benefits are not taxable. No social security contributions are applied.

The housing allowance is means tested and granted to tenants and home-buyers. For the calculation of the allowance the rent (upper limit) and the family situation as well as the resources of the family and the place of residence are taken into account.

Croatia

In Croatia, employees and self-employed persons are eligible for sickness benefits. To be eligible, nine months of consecutive insurance or 12 months (with interruptions) within the last two years are necessary. For employees there is no waiting period; for self-employed persons, the waiting period is 42 days. The waiting period for self-employed persons is the same as the period of continuation of payments by the employer. The sickness benefit cannot be lower than 70 percent of average net earnings in the six months preceding sickness. In certain cases (e.g., nursing a sick child aged less than three years, or quarantine) the replacement rate is 100 percent. The minimum benefit amounts to HRK 831.50 (EUR 112) per month. The maximum benefit equals HRK 4,257.28. After 12 months of benefit claims, the beneficiary must submit a claim for invalidity pension; after 18 months the benefit is reduced by 50 percent. Sickness benefits are not taxable and not subject to social security contributions.

The child benefit in Croatia is a tax-financed and means-tested benefit that varies with income. The child must reside in Croatia. The benefit is paid for children aged 15 or younger (19 in the case of secondary school attendance). It amounts to HRK 299.34 per child if monthly income per household member is less than HRK 543.14. It decreases to HRK 199.56 if income is above HRK 1,119.53 and below HRK 2,328.20. Higher income households are not entitled to child benefits. For sole parents, the amount is 15 percent higher; for a disabled child 25 percent. Parental leave is available for employed, self-employed, unemployed and inactive persons. For employed and self-employed persons, parental leave is granted for four months per parent for the first and second child (until the age of 8). For the third and each subsequent child it is 15 months per parent. Two months can be transferred between parents. For unemployed and inactive persons, parental leave can be claimed from the child's sixth month, up to one year. The benefit

amounts to previous earnings in the case of employed persons, with a maximum of 120 percent of the State Budget Base (HRK 3,991.20). In all other cases, the benefit amounts to 70 percent of the State Budget Base. Additional benefits are new-born child assistance and a birth grant for the third child, both a one-off payment, and a special allowance for children with disabilities. Benefits are neither taxable nor subject to social security contributions.

Maternity benefits are granted to the employed and self-employed, but also to unemployed and inactive women. Paternity leave benefits are not available. For employed and self-employed women an insurance period of 12 months or 18 months with interruptions is necessary. For others, permanent residency is required. In the case of employment, 28 days of prenatal leave is compulsory. Postnatal leave of six months after birth is possible (70 days compulsory in the case of employment). The benefit amounts to 100 percent of monthly earnings. For self-employed, unemployed and inactive women, the benefit equals HRK 2,328.20 per month. Benefits are neither taxable nor subject to social security contributions.

Social assistance is determined on a household level. Eligible persons capable of work (but younger than 65 years or less than five years from retirement age) must be registered at the employment service. Several allowances are not considered for the means test. The living minimum is a multiple of the base value of HRK 800. For a single person not capable of work, it is 115 percent of the basis, and 100 percent for a single person capable of work. For an additional adult household member, 60 percent of the base value is granted, 40 percent for a child and 55 percent for a child of a single parent. The average income of the last three months is taken into account and offset from the living minimum. In addition, a benefit for energy buyers with low income of HRK 200 and a one-time-allowance can be granted. Benefits are not taxable and not subject to social security contributions.

Italy

Sickness benefits in Italy are based on a compulsory social insurance scheme, voluntary insurance is not possible. There is no earning ceiling for eligibility. The benefit period is at most 180 days per year. Benefits are paid by the employer but can be deducted from other insurance contributions. The benefit amounts to 50 percent of net earnings for the first 20 days and two-thirds for the following days. Benefits are neither taxable nor subject to social security contributions.

There are three types of family benefits, a family allowance, an allowance to households with at least three children and a birth allowance. The family allowance is not only granted to households with children but also to low-income couples with no children, as long as they are not self-employed or former self-employed retirees. The transfer covers different household types and varies also with respect to the level of income of the household. Eligibility requires that at least 70 percent of household income is income from employment (inclusive of unemployment benefits). For an annual income up to EUR 14,198.48, the monthly benefit amounts to EUR 258.33; for an income above EUR 78,640.85, no benefit is granted. The allowance for households with at least three children below the age of 18 amounts to EUR 144.42 (2019) per month. The allowance is means tested and is paid for 13 months (renewable). The birth allowance is paid for one year after birth, amounting to EUR 960 if ISEE (equivalent economic situation indicator) reference income is below EUR 25,000. The benefit is higher for significantly lower reference income and for subsequent births. All three allowances are tax exempt and not subject to social security contributions.

The system in Italy also grants vouchers to families. One voucher is granted for childcare activities with a monthly amount of EUR 600 for six months following maternity leave. Another voucher is the Kindergarten voucher. It is granted for mothers who are not exempted from payments for public nursery services. The annual amount is EUR 1,000 granted over a period of 11 months.

The social-insurance-based maternity (paternity) benefit amounts to 80 percent of earnings and 100 percent for a compulsory four-day leave. The maternity leave is granted for one-to-two months prior to birth and three-to-four months afterwards. In total five months of leave are possible. The paternity leave is granted for six days. For non-working mothers and mothers with low income two additional allowances are possible, which can be cumulated. The allowance for non-working mothers is paid for five months. The benefit for non-working mothers amounts to EUR 421.84, the allowance for low-income mothers to EUR 342.62. The allowances are granted if reference income is below a threshold.

In Italy, no universal support scheme exists except for 'Assegno sociale' covering persons aged 66 years and seven months and older. The 'Assegno sociale' is paid on a differential basis to a defined minimum income, where additional household members are scaled by an equivalent factor. For a single person, annual minimum income is EUR 6,000 plus a determined amount for rent. The inclusion income support is available for claimants if unemployment benefits have been exhausted. One of the following requirements is necessary: being unemployed with an age over 55, being a pregnant woman, being a disabled member of a family, or at least one member of the family being aged under 18. The benefit depends on the household composition and the age of household members. Social assistance benefits are neither taxable nor subject to social security contributions.

Housing benefits are available for those who buy a residence as well as persons who rent it. Buyers are subsidised by a tax allowance for mortgage loan interests, rebates on the property transfer tax and low interest rates for loans. The rent allowance is available for low-income households.

Cyprus

Sickness benefits may be granted for employees and self-employed persons. To qualify, a person must be insured for at least 26 weeks (0.5 insurance points, of which 0.39 in the relevant year) before sickness. Beneficiaries have to be aged between 16 and 63 years. If conditions for the statutory pension are not fulfilled, payments until the age of 65 are possible. The waiting period for employees is three days, and nine days for self-employed persons. A continuation of payments by employers is not available in Cyprus. The benefit amounts to 60 percent of earnings below the Basic Insurable Earnings (equals one insurance point), increased by 20 percentage points for the first dependant and 10 percentage points for other dependants in the household. For income above the Basic Insurable Earnings the replacement rate equals 50 percent, with a maximum benefit equal to the Basic Insurable Earnings. The duration of eligibility is 156 days, with a possible extension to 312 days. Benefits are not subject to taxation and social security contributions.

The child benefit in Cyprus depends on the number of eligible children and the level of family income in the previous year. Eligibility requires that children reside in Cyprus. The benefit is independent of a child's age and is granted up to age 18 (20 if attending secondary education). The maximum yearly income level is set to EUR 49,000 for one dependent child, EUR 59,000 for two children, and an additional EUR 5,000 for every further child. The benefit per child increases significantly with the number of children, from EUR 482.17 for one child to EUR 1,700.29 for four

children for households with family income below EUR 19,500. The benefit decreases for higher income levels (e.g., EUR 1,152.14 per child for families with four children). For single parents an additional allowance of EUR 162.42-182.72 is granted. Parental leave of up to 18 weeks is possible; however no benefits are available. In addition, a one-off birth benefit is granted. Benefits are neither taxable nor subject to social security contributions.

Maternity and paternity benefits are based on a compulsory social insurance scheme and available for employees and self-employed persons. To be eligible, 26 weeks of insurance (0.5 insurance points, of which 0.39 in the relevant year) are necessary. The possible duration of maternity leave is 18 weeks, of which two-to-nine weeks must be before the confinement. The possible duration of paternity leave is two consecutive weeks within the first 16 weeks after birth. The transfer of periods between parents is not possible. The benefit equals to 72 percent of the weekly value of insurance points. Replaced income up to one insurance point is increased to 80, 90 or 100 percent according to the number of dependants in the household. The benefit is tax exempted and social security contributions do not arise.

Eligibility for social assistance benefits is based on household income and requires an age of 28 or more (exceptions exist, e.g., for married couples, single parents, disabled persons). An applicant has to participate in training or accept job offers. Income considered for comparison with minimum resources is defined in gross terms; only some benefits, like social benefits due to disability, are excluded. The basic amount of guaranteed minimum income is EUR 480 for the head of a household, EUR 240 for every dependent person aged 14 and older, and EUR 144 for younger dependent persons. The benefit equals the difference between household income and guaranteed income. A housing allowance is granted for renters and owners paying mortgage interest. The allowance depends on the composition of the family (55 m² for a single person or couples and additional 20 m² for every two additional minors of the same sex) and the district of residence. The housing benefit amounts to EUR 1.75/m² in Paphos to EUR 2.80/m² in Nicosia. Benefits are not taxable and not subject to social security contributions.

Latvia

Sickness benefits are organised within a compulsory social insurance for all employees and self-employed persons. Voluntary membership is possible. To qualify for benefits, three months of insurance within the six months (or six months within 24 months) before sickness are required. Employers are obliged to provide continued payments to employees for ten days. The benefit amounts to 80 percent of average gross wages in the year preceding sickness. The duration of benefits is 26 weeks or 52 weeks within a three-year period. Sickness benefits are subject to taxation but not to social security contributions.

The child benefit in Latvia is granted to children at least one year old until the age of 15 (20 in the case of education in secondary or vocational school). The benefit is not means-tested, independent of the income level and amounts to EUR 11.38 per month for the first child. It is twice and three-times this amount for the second and third child, and 4.4-times this amount for the fourth and further children. For families with two or more children, a supplement of EUR 10 for two children, EUR 66 for three children and EUR 50 for each further child is granted. For parental leave, two benefits are available. The child-raising allowance paid to persons raising children up to an age of two years is tax-financed and the parental benefit is financed by the social insurance. The child-raising allowance amounts to EUR 171 per month for children below 18 months old and EUR 42.69

up to the age of two years. The social insurance benefit equals to 60 percent of average gross wages during the previous 12 months, up to the child's first year, or 43.75 percent if the benefit is claimed up to an age of one year and six months. If a person works, the rate amounts to 30 percent. The child-raising allowance and the parental benefit can both be claimed. Additional family benefits are available for childbirth (EUR 421.17), for disabled children and in case of adoptions. Benefits are not taxable and not subject to social security contributions.

Maternity leave benefits are granted for 112 days (one-half before and one-half after birth). An additional 12 days are available in the case of continuous medical care before the 12th week of pregnancy. Paternity leave amounts to ten days. The benefit amounts to 80 percent of average gross earnings within the previous year. Minimum and maximum payments do not exist. Benefits are neither taxable nor subject to social security contributions.

Guaranteed minimum resources are available for persons with permanent residency in Latvia. People capable of work must register with the State Employment Agency. Social assistance is based on household income and the benefit equals the difference of the guaranteed minimum income of EUR 53 times the number of household members and household income. Certain benefits and types of income are deducted from household income. Eligibility rules and the amount for housing benefits are determined at the local level. Benefits are not taxable and social security contributions are not payable.

Lithuania

Sickness benefits in Lithuania are based on a social insurance scheme and are compulsory for employees and self-employed persons. To qualify for the benefit, a minimum period of insurance of three months during the previous 12 months, or six months during the previous two years, is necessary. Employers are required to provide a continuation of payments for the first two days of sickness. The social benefit is paid from the third day onwards. The amount of the benefit equals 62.02 percent of the average wage three months preceding sickness. It cannot be lower than 11.64 percent and not higher than twice the national average monthly wage. The duration of the benefit equals four months but can be extended to 244 days in the case of periodic inability to work. With respect to nursing of family members, seven days of absence is possible (14 days for children under 14 years). In general, sickness benefits are not granted to unemployed persons. Sickness benefits are subject to a lower income tax (15 percent) and health social security contributions (6 percent).

To be eligible for the child benefit, children have to reside permanently in Lithuania or have a temporary residence permit. The benefit is available as long the child is younger than 18 (or 21 if studying). The benefit amounts to EUR 50.16 (1.32 of Basic Social Benefit) and EUR 69.92 for disabled children. For low-income families (EUR 183) and families with three or more children, a supplement of EUR 20.14 is granted. In addition, an income-related childcare benefit for insured employees for at most two years after birth is available. The amount depends on the duration of leave. If childcare takes place up to the child's first birthday, then 77.58 percent of the previous wage is granted. In the case of a longer duration of childcare, the allowance is 54.31 percent until the first birthday and 31.03 percent afterwards. The minimum benefit is six-times the Basic Social Benefit, the maximum twice the average monthly wage. An unpaid third year of leave is possible. In this case, contributions for the unemployment and pension systems are granted. Further benefits

are birth and adoption grants (lump-sums of EUR 418) and a monthly benefit for multiple births (EUR 152) up to age two. Benefits are neither taxable nor subject to social security contributions.

Maternity and paternity insurance is compulsory and available for employees and certain groups of self-employed persons. To qualify, 12 months of insurance during the previous 24 months are necessary. The duration of maternity leave equals 70 days before and 56 days after birth. Paternity leave is granted for one month at most, within the first three months after the child's birth. The benefit amounts to 77.58 percent of the average wage for the three months before the month of birth. The considered wage is limited by two-times the national average monthly wage. Rules for taxation and social security contributions are the same as for sickness benefits.

Social assistance is provided at a household level and requires residency in Lithuania, registration at an employment service, or being a student, disabled or taking care of a sick child younger than three years old. To be eligible, the working time has to be less than two-thirds of a full-time equivalent. Depending on family status, 15-to-35 percent of net income is not considered for calculation of the social assistance benefit. For a single household, the defined minimum level of income is the State Supported Income of EUR 122 per person and month; 80 percent of the minimum level is granted for the second household member and 70 percent for the third and additional members. Housing benefit is not available. However, means-tested support for heating, drinking water and warm water costs is granted. For retirees, a special social assistance scheme exists. Benefits are not taxable and no social security contributions arise.

Luxembourg

Sickness benefits in Luxembourg are financed via a compulsory social insurance scheme, covering all active persons. There is no earnings ceiling for coverage. To qualify for the benefit, no minimum insurance period is required. Employers are obliged to provide continuation payments until the end of the month of the 77th day of sickness (on average, 13 weeks). Employers are compensated with a refund of 80 percent by the social insurance. In the case of a longer absence, the insurance pays sickness benefits up to a maximum of 78 weeks. The replacement rate equals the wage of the insured person, with a minimum of the social minimum wage and a maximum of five-times this amount. Unemployed persons are not entitled. If an insured person takes care of a sick child, the maximum duration equals 12 days if the child is younger than four years old and up to 18 days for older children (for children older than 13 years, five days are available). Continuation payments are subject to taxation and health care, long-term care and pension insurance.

The child benefit requires residency of the child in Luxembourg and is paid until age 18 (25 years in case of education or serious disability) of the child. The monthly amount per child is EUR 265 with an additional allowance of EUR 20 for children older than six years or EUR 50 for children older than 12 years respectively. The benefit is independent of income. Parental leave is available for employees and self-employed persons. The duration is four-to-six months if employment is fully suspended (8-to-12 weeks in the case of a 50 percent reduction). The child must be younger than six years. Parental leave is available for each parent but cannot be shared. The benefit amounts to income 12 months before leave, with a minimum of EUR 2,071.10 and a maximum of EUR 3,451.83 per month. In addition to these benefits, a one-off birth grant of EUR 1,740.09, a new school year allowance and benefits for children with disabilities are available. Benefits are neither taxable nor subject to social security contributions.

Maternity leave is possible for employees and self-employed women eight weeks before and 12 weeks after birth. Paternity leave is granted for ten days. The benefit amounts to the wage received before leave with a minimum of EUR 2,071.10 per month and a maximum of EUR 10,335.50. Benefits are taxable and subject to social security contributions.

Guaranteed minimum resources in Luxembourg are a personal right; however, the household situation is considered. To be eligible, a person must be 25 or older (younger if pregnant, disabled or raising a child), have resided in Luxembourg for at least five years during the previous 20 years, and must be looking for a job. Gross employment income of 25 percent is not taken into account for the calculation of the benefit. Minimum resources vary between communities. The benefit comprises a flat rate per adult (EUR 726.61), per child (EUR 225.59), an amount for common household expenses (EUR 726.61), an increase per child in the case of single-parent households (EUR 66.70) and an increased amount for common expenses in the case of a child (EUR 109.05). For low-income households, a rent subsidy is available, independent of the social assistance scheme, and amounts to a maximum of EUR 300. Social assistance benefits are taxable and subject to health and long-term care insurance contributions; housing benefits are not taxable.

Hungary

Sickness benefits in Hungary are based on a compulsory insurance scheme for employees and self-employed persons. Voluntary insurance is possible. There is no ceiling for insurance coverage and no qualifying period. The continuation of payments by employers happens for 15 days per year with a replacement rate of 70 percent of gross earnings. The sickness benefit amounts to 60 percent of the earnings of the previous 180 days (50 percent in case of inpatient treatment or an employment history of less than two years). The maximum daily benefit amounts to 200 percent of the daily minimum wage. The maximum duration is set to one year; unemployed persons are not entitled to the benefit. The support is also granted to take care of a sick child (14 to 83 days, depending on the age of the child). The benefit is subject to taxation but not to social security contributions.

Maternity and paternity benefits are granted to employees and self-employed persons with at least one year of insurance within the last two years. Maternity leave is granted for 24 weeks (four weeks before and 20 weeks after birth), paternity leave is possible for five working days. The benefit equals 70 percent of the average gross earnings of the previous 180 days. Benefits are taxable but not subject to social security contributions.

Child benefits are available for all residents but depend on residency of the child in Hungary. The benefit is granted from birth until the end of participation in the compulsory educational system (usually 18 years). In case of participating in secondary education or vocational training, an extension to 20 years is possible. The monthly benefit per child rises with the number of children in the family and is higher for single parents. It ranges from HUF 12,200 for one child to HUF 17,000 for three or more children for a single parent. The amount for disabled children is higher. In addition, there are two parental leave schemes. The childcare allowance is tax financed and covers all residents; the childcare fee is available for previous employees and self-employed persons. The childcare allowance is provided for parents taking care of their children up to three years of age. Employment activities are not possible until the child reaches an age of half a year. Subsequently, there is no restriction. The monthly benefit equals the minimum old-age pension (HUF 28,500), independent of the number of children. The childcare fee requires an insurance period of 365 days

within the last two years before birth. Restrictions on employment are the same as for the childcare allowance. The benefit amounts to 70 percent of the average gross earnings during 180 days before. The maximum is set to double the minimum wage (HUF 298,000). The fee is granted after expiry of the maternity (paternity) benefit and until the child reaches two years of age. Both benefits can be received on a part-time basis and transferred between parents. The one-off birth grant (HUF 64,125) is an additional family benefit. Except for the childcare fee, benefits are not subject to taxation. No social security contributions arise for child benefits and the birth grant; childcare benefits are subject to pension contributions.

Social assistance in Hungary is divided into two schemes. The scheme for persons in active age (18 to the retirement age) is further split into an employment-substituting benefit (with the requirement to be registered as jobseeker and to take up public jobs) and a benefit for people suffering from health problems or taking care of a child. The benefit equals the difference between minimum resources and income at the household level, where certain benefits and forms of employment income are not taken into consideration. Minimum resources in the case of the employment-substituting benefit equal 80 percent of the minimum old-age pension (HUF 22,800) times a consumption unit factor. In the case of health problems or taking care of a child, the guaranteed minimum is set to 95 percent of the minimum old-age pension (HUF 27,075) times the consumption unit factor. The factor reflects the composition of the household and is 1 for the first adult (1.2 for single parents). It increases by 0.9 for a spouse or partner, by 0.8 for the first and second child, and 0.7 for the third child and further children. The second scheme provides a guaranteed minimum to old-age households. This minimum is set to HUF 25,630 per month if the person lives with a spouse. For a single person it amounts to HUF 30,150 if the individual is younger than 75 years old (HUF 40,700 if older than 75 years). There are no general housing allowances in Hungary. However, local governments can provide financial assistance. Social assistance benefits are neither taxable nor subject to social security contributions.

Malta

Sickness benefits in Malta are based on a compulsory insurance scheme for employees and self-employed persons. Voluntary insurance is not possible. To qualify for benefits, 50 weeks of contributions (at least 20 within the previous two years) are required. The number of days of sickness paid by the employer is determined by law or collective agreement. For the following days (up to a maximum number of 156 working days), the social insurance pays a fixed amount of EUR 13.46 per working day (five or six days per week) for a single person and EUR 20.79 for a single parent or a married person whose spouse is only employed part-time. Benefits are subject to taxation but not to social security contributions.

Maternity benefits are granted for 14 weeks with universal entitlement. In the case of employees, the employer pays 100 percent of earnings. In addition, employees and self-employed persons can receive benefits for an additional four weeks, conditional on the return to work of the woman. Paternity benefits are not available. Six weeks of maternity leave must be taken after birth. The universal benefit amounts to EUR 94.35 per week, the additional four weeks are granted EUR 175.84. Benefits are neither taxable nor subject to social security contributions.

Child benefits in Malta are related to household income. The benefit is granted to families with children younger than 16 years old (21 in the case of students). Certain types of income are not considered, like social assistance benefits. The yearly child benefit amounts to 6 percent for each

child (2 percent for students) of the difference between EUR 25,045 and household income (with a minimum household income of EUR 5,780 considered). The minimum child benefit amounts to EUR 450 per year. For single parents the child allowance is paid at maximum rate. Parental leave benefits are not available in Malta. An in-work benefit for families with children is also granted but considered in the determination of income tax rates. Benefits are not subject to taxation and social security contributions.

Social assistance is a subjective right and provided by the central government. Eligibility requires an age between 18 and 60 years and to be registered at the public employment service. The minimum level of income is 60 percent of the national minimum wage (EUR 105.93) for the first adult per week. For each additional household member, EUR 8.15 per week is granted. In addition, a bonus of EUR 135.10 twice a year and EUR 3.12 per week is paid. For low-income households, a supplementary allowance depending on family status can be claimed. The maximum benefit is EUR 12.54 per week for couples and EUR 4.57 for single households. To cover housing costs, a rent allowance of up to EUR 38 per week is available. Social assistance and housing benefits are not taxable and not subject to social security contributions.

Netherlands

In the Netherlands, a continuation of payment by the employer for two years in case of sickness is determined. The continued payment amounts to 70 percent with a maximum daily wage of EUR 214.28. However, there is a safety net if an employer no longer exists, with the same rules for replacement income. In addition, a step-up can be claimed if the replacement income is below the social minimum.

A person qualifies for child benefits if they are insured and have one or more children below the age of 18. The amount of the benefit depends on the age of the child. A child counts for two children if they live away from home or there is need for extensive care. The benefit amounts to EUR 219.97 per quarter for a child with an age below five, EUR 267.10 for a child with an age between six and eleven, and EUR 314.24 for an older child up to the age of 17.

The child-related allowance is an additional benefit, which can only be claimed if the family also receives the child benefit. The amount depends on family income and size. The maximum of the annual benefit ranges from EUR 1,166 for one child up to EUR 2,447 for three children. For each additional child an amount of EUR 292 is granted. The amount is increased by EUR 239 for children aged 12 to 15 and EUR 427 for children aged between 16 and 17. Single parents receive an additional benefit up to EUR 3,139 per year. The benefit is withdrawn at a rate of 6.75 percent if income exceeds EUR 20,451. The benefits are not taxable. Childcare is financed by employers, employees and the government. Childcare benefits are calculated as a share of total costs of expenditures and decrease with the income level of the parents. The share is set to 95.5 percent for low-income parents (up to EUR 17,553) and decreases to one-third for an income level above EUR 113,016 for the first child. For other children it decreases only to 85 percent for an income of more than EUR 162,936. Childcare benefits are not taxable and no social security contributions arise. In the Netherlands, a maternity leave of 4-to-6 weeks before birth is compulsory, and 10-to-12 weeks after birth. A paternity leave of five days within four weeks after birth is optional. For maternity leave a benefit exists with 100 percent of daily wages with a ceiling of EUR 214.28 per day. The benefit is also granted for self-employed persons with a ceiling of the minimum monthly wage (EUR 1,615.80). Paternity leave is financed by the employer.

Social assistance guarantees a minimum income for persons who are no longer entitled to benefits under the social insurance schemes. Beneficiaries must apply and accept jobs and must be registered with the local employment agency. Social assistance can also be provided to top up other benefits or income. The benefit is intended to cover the normal costs of living. Married couples/cohabitants receive 100 percent of the subsistence minimum, single households/parents 70 percent. The monthly benefit amounts to EUR 1,025.55 for a single household or lone parents and to EUR 1,465.07 for married couples/cohabitants. In addition, a holiday allowance of 5 percent is granted. Benefits are not taxable and not subject to social security contributions.

The housing benefit is restricted by minima and maxima and depends on taxable family income. Part of the rent is always paid by the household and amounts to about EUR 225 ('standard rent'). Monthly rents up to EUR 720.42 qualify for benefits; for a full benefit only rents up to EUR 424.44 are accounted for. Households are eligible for benefits if their income is lower than EUR 22,700 (EUR 30,825) for a single person younger than 65 (a household in which the highest earner is younger than 65). For households with older persons the values are comparable. The benefit is not taxable.

Austria

Sickness benefits in Austria are granted for all employees, unemployed and voluntarily insured persons. There is no upper limit for coverage. There is a waiting period of three days. For the first 6 to 12 weeks, employers are responsible for continued payment of wages. For the following four weeks, 50 percent are paid by the employer and 50 percent by the public health insurance. From the 43rd day of sickness, 60 percent income replacement with an upper ceiling of EUR 5,220 is granted. The duration of sickness benefit is at most 26 weeks with a possible extension to 78 weeks in certain cases. Sickness benefits are taxable and subject to old-age insurance contributions. In addition, there is a rehabilitation benefit and a reintegration benefit after a long-term illness. Rehabilitation benefits are granted for persons whose pension application has been rejected because invalidity is not permanent but lasts at least six months. The rehabilitation benefit is the same as the sickness benefit but cannot be lower than a minimum threshold. Conditions for the reintegration benefit are, amongst others, an employment relationship of at least three months, a sick leave of at least six weeks, and a reduced working time of a quarter to a half. The reintegration benefit amounts to 60 percent of the assessment base (gross earnings of the reduced working time).

The main family benefits are the child benefit ('Familienbeihilfe') and the child-raising allowance ('Kinderbetreuungsgeld'). The child benefit is paid for families with dependent children and is differentiated with respect to age and the number of children. The benefit amounts to EUR 114 per month for a child below the age of three, EUR 121.90 for a child up to the age of ten, EUR 141.50 up to the age of 19 and EUR 165.10 up to the age of 24 (in general). If there is more than one child, a supplement is paid, amounting to EUR 14.20 for two children to EUR 364 for seven or more children. In addition, for three or more children an additional increase of EUR 20 per month and child is granted if income is below EUR 55,000. In September, EUR 100 are granted for children between six and 15 to cover schooling costs. Family benefits are not taxable and are not means-tested.

To subsidise childcare, parents can claim a childcare allowance ('Kinderbetreuungsgeld'), which is available for child-raising reasons. Two general options are available, a flat benefit and an income-

dependent benefit. The duration of the flat benefit can be chosen by the beneficiary between one year and 28 months. The benefit is scaled such that the total amount of the benefit is independent of the duration. In case of a one-year entitlement, the benefit is EUR 33.38 per day. The income-dependent variant requires employment prior to benefit eligibility and replaces 80 percent of previous income with a maximum of EUR 66 per day. If both parents claim childcare allowance, the duration and therefore the total amount of the benefit is extended by one-sixth. There is a ceiling for additional annual earnings amounting to EUR 16,200. The childcare allowance is not taxable and not subject to social security contributions. Lone parents and married couples on low income can apply for a supplementary allowance amounting to EUR 6.06 per day. Maternity leave is compulsory eight weeks before and after birth. The benefit replaces total labour income. In case of unemployment, 180 percent of unemployment benefits are paid. A parental leave bonus for fathers can be claimed for at most 31 days during the first 91 days following birth. The amount equals to EUR 22.60 per day.

In Austria, two types of social assistance exist, the needs-oriented guaranteed minimum resource and the supplementary pension (Ausgleichszulage). The latter is paid to retirees or persons incapable of working to guarantee a minimum income. The needs-oriented guaranteed minimum resource is granted at the regional level and differs between regions. The transfer in Styria, for example, amounts to EUR 863.04 (2019) per month for a single person, EUR 1,203.94 for a couple, and EUR 155.35 for a child. In addition, there is a subsidy for housing rent, which is a quarter of the total benefit. Persons receiving the benefit must be available to take up a job. General assistance entitlement depends on household resources, that is, it is means- and income-tested. The benefit is not taxable and not subject to social security contributions.

The system of housing benefits is rather complex in Austria. The amount of benefit depends on the region. The 'Wohnbeihilfe', for example, subsidises housing costs for rented flats. Eligibility requires income above a threshold. Benefits are not taxable. There are also subsidies and subsidised credits for the creation of living space.

Poland

Sickness benefits in Poland are available for employees (compulsory) and self-employed (voluntary). There is no ceiling for insurance coverage. Qualification requires 30 days of insurance for employees and 90 days in case of voluntary insurance. For the first 33 days of sickness of a year the employer pays 80 percent of the reference wage (14 days in case of persons aged 50 or above). The benefit paid afterwards amounts to 80 percent in general. In case of hospitalisation, 70 percent are paid; 100 percent in special cases. The duration of eligibility is 182 days. The child-minding allowance is paid to employees who must look after a sick child under the age of 14 (maximum 60 days) or another member of the family (maximum 14 days per year). The benefit amounts to 80 percent of the reference wage for sickness benefits. A rehabilitation benefit is available if sickness lasts longer than the maximum period of 182 days or rehabilitation is necessary to rehabilitate a person. The benefit amounts to 90 percent for the first three months and 75 percent afterwards. Benefits are subject to taxation.

A family allowance is granted for children below the age of 18 (21 if the child is in education or 24 if disabled and in education). The family benefit is means-tested (in 2019 family income per capita must be lower than PLN 674 per month). The family allowance depends on the age of the child and amounts to PLN 95 monthly for a child below the age of five, PLN 124 for a child between five and

18 years and PLN 135 for a child between 18 and 24 years. The benefit for bringing up children pays a monthly amount of PLN 500 for each child (except the first one) up to an age of 18. The benefit for the first child can only be claimed if family income per capita is below PLN 800. Lone parents receive an additional supplement of PLN 193 per child with a maximum of PLN 386 per family. In addition, a birth supplement of PLN 1,000 per child is granted if net income per family member is below a threshold. Benefits are not taxable and not subject to social security contributions.

Maternity leave is compulsory for all insured women and voluntary for self-employed women. The duration is generally 20 weeks in the case of a single birth, of which 14 weeks are after birth. A paternity leave of two weeks is possible within 24 months after birth. The allowance is 100 percent of the reference wage (gross earnings 12 months before leave), but at least PLN 1,000 per month. The benefit is taxable and subject to social security contributions.

A voluntary parental leave benefit is available for all insured women. The duration of the parental leave is 32 weeks. Afterwards a child-raising leave is available with a duration of 24 months (36 months in case of multiple births or a single parent). In the latter case monthly income per family member must not exceed 25 percent of the average wage of the previous year. There is some flexibility with respect to the division between two parents. The parental leave benefit is 100 percent of the reference wage (the same as for maternity allowance) for the first six weeks and 60 percent afterwards. The child-raising supplement amounts to PLN 400 per month. For uninsured persons, a parental benefit amounting to PLN 1,000 per month for one year after birth is available. The child-raising supplement is subject to social security contributions but not taxable.

The social assistance system in Poland consists of benefits from the social welfare system. Benefits are granted to persons with insufficient means for living. The minimum level of income is defined as PLN 701 monthly for a single and PLN 528 for a family member. The benefit can either be permanent (age, disability or permanent illness) or temporary (e.g., poverty, unemployment). Benefits from the social insurance institutions are payments to persons unable to work due to invalidity, which occurred already before age 18. The minimum temporary (permanent) benefit amounts to PLN 20 (PLN 30), the maximum to PLN 418 (PLN 701). Benefits are neither taxable nor subject to social security contributions.

Housing benefits are paid at the local level to low-income households. Benefits are based on the difference between what is considered reasonable expenditure for housing and actual housing costs. Housing costs cannot exceed a maximum amount depending on the household size and the size of the flat. Households have to cover housing costs by themselves to a certain amount, 15-to-20 percent of household income for a single household, 12-to-15 percent for a two-to-four-person household and 10-to-12 percent if five or more persons live in the household, depending on household income. To be eligible, household income must be below 175 percent of the minimum retirement pension for a single person and 125 percent for each person for families. If the income is higher only the difference between the income criteria and the benefit is paid. The benefit is not taxable.

Portugal

Sickness insurance in Portugal covers employees and self-employed persons with no income ceiling for insurance coverage. To qualify, six months of paid insurance is necessary, of which 12 days must occur within the four months before sickness. There is no continuation of payments by

employers and there is a waiting period of three days. The replacement rate with respect to the average wage within six months before sickness depends on the length of the sickness period. It amounts to 55 percent for the first 30 days and increases stepwise to 75 percent for periods after one year of sickness. If the reference earning is lower than EUR 500, an additional 5 percentage points for the first 90 days is granted. The maximum period is 1,095 days. Taking care of children is possible for 30 days for a child under 12 years old and for 15 days for older children. Benefits are not subject to taxation and social security contributions.

Maternity and paternity benefits are available for all insured employees and self-employed persons with six months of contributions to social security. Initial parental leave can be taken for 120 or 150 consecutive days, and simultaneously by both parents. Part of the leave is reserved for the mother, 30 days (voluntarily) before and six weeks after birth. Paternity leave of 15 days is compulsory, of which five days must be taken immediately after birth. The maternity benefit amounts to full employment income (Christmas and holiday bonuses not considered), with a minimum of 50 percent of the reference social support income (EUR 435.76 monthly). The paternity benefit equals 80 percent of earnings. Benefits are neither taxable nor subject to social security contributions.

Child benefits are granted to resident children until age 16. In case of education, the limit can be extended to 24 years. The benefit depends on household income relative to the reference social support index and the age of the child. There are five earnings levels, with no entitlement for families belonging to the fifth level (household income of more than 2.5-times the reference index). For low-income households, the benefit is equal to EUR 148.32 for children younger than one year, EUR 110.77 for children between one and three years, and EUR 37.08 for older children. In the fourth level (1.5-to-2.5–times the reference index) children receive a monthly benefit of EUR 38.31 up to age three. The birth of further children leads to a supplement for each child aged between one and three years (EUR 147.85 in the first level). For single parents the benefit is increased by 35 percent. With respect to parental leave two schemes are available. The extended parental benefit extends the initial parental benefit for a duration of three months and amounts to 25 percent of average income with a minimum of 40 percent of the reference social support index. The childcare leave is available subsequently for two years but no benefit is paid. Benefits are not taxable and not subject to social security contributions.

Social assistance is a subjective right and organised at the national level. The means test is based on the household level. The social minimum income is available for persons aged 18 or older. To claim the benefit the claimant must accept the obligations of the integration contract and must be registered with a job centre. Regarding the means test, total household income is taken into account, with the exception of family-, disability- and long-term care benefits and 20 percent of work-related income after deduction of social security contributions. If the household benefits from social housing, income is increased by EUR 15.45-46.36, depending on the subsidy duration. Guaranteed minimum income is based on the composition of the household, with a weight of 1 for the claimant, 0.7 for an additional adult and 0.5 for each child. The base value equals EUR 186.68 and is indexed using the reference social support index. The benefit equals the difference between guaranteed minimum income and actual income. There are no housing and heating allowances in Portugal. Additional minimum income schemes exist for pension claimants and disabled persons. Benefits are not taxed by the income tax and not subject to social security contributions.

Romania

Sickness benefits in Romania are based on a compulsory social insurance scheme for employees and self-employed persons. There are no earnings ceilings for coverage, but at least one month of contributions is necessary for qualification. Employers must pay for the first five days of sickness before social benefits can be claimed. The monthly benefit equals 75 percent of gross earnings within the last six months before sickness; the maximum duration of benefit payment is 183 days in a one-year period. The benefit is also available when taking care of a sick child aged under seven years (18 in case of disability). The replacement rate in this case is higher and amounts to 85 percent. The benefit is not taxable but subject to invalidity-, old-age-, and survivor pension contributions.

Maternity and paternity benefits in Romania are based on a compulsory social insurance scheme for employees and self-employed persons. To be eligible for maternity benefits, one month of insurance within the last 12 months is necessary. The duration of maternity leave amounts to 63 days before and 63 days after birth. Paternity leave is possible for five working days. Days of leave cannot be transferred between parents. The benefit for maternity leave equals 85 percent of the average wage within the previous six months. The maximum assessment base is 85 percent of 12-times the minimum wage. The replacement rate for paternity leave is 100 percent. Similar to sickness benefits, the benefit is not taxable but subject to invalidity-, old-age-, and survivor pension contributions.

In Romania, two child benefit schemes exist, the state allowance for children and the family support allowance. The first is granted to children living with parents, the second for children of school age. Both benefits are granted up to the age of 18. The state allowance equals 40 percent of the reference social indicator (RON 500) up to age two and 16.8 percent for older children. The family support allowance is paid to low-income households. If net income per family member is less than 40 percent of the reference social indicator, the benefit amounts to 16.4 percent of the reference indicator per child, 15 percent per child for income levels up to 1.06-times the reference indicator. For single parents, the family support allowance is 30 percent higher. For parental leave, the child-raising benefit is available. Leave duration is two years after childbirth (three years in the case of a disabled child). The benefit amounts to 85 percent of the average net income during the year before confinement. The maximum benefit is RON 8,500. The return-to-work bonus is an alternative to the child-raising benefit up to the age of two years (three years in the case of disability) and amounts to RON 650 per month. Benefits are neither taxable nor subject to social security contributions.

To guarantee minimum resources, several benefits are granted in Romania, including social aid, a heating energy allowance, a natural gas allowance and an oil allowance. Individual persons and households are eligible. The minimum age to claim social aid is 18 years; it is 16 years for the heating allowance. There is no maximum age. One of the household members is obliged to work for the local authority if the person is capable of work. Household income takes into account all income except some benefits like scholarships and family benefits. An individual or household is in need if monthly income is less than guaranteed income. The minimum income equals 28.3 percent of the reference social indicator for an individual, 51 percent for a household with two members and rises to 105.4 percent for a household with five members. If one of the family members works, then the amount rises by 15 percent. The different energy allowances depend on the income of the

household. The heating energy allowance for instance varies between 5 and 90 percent of the heating costs. Housing benefit is not available in Romania. Benefits are not taxable and not subject to social security contributions.

Slovenia

In Slovenia, insurance against sickness is a compulsory social insurance scheme, financed by employees and self-employed contributions. It guarantees continuation of work-related income in case of incapacity to work or the nursing of an immediate family member. The first 30 days are paid by the employer. The benefit amounts to the average monthly gross wage in the previous year of employment for occupational diseases or accidents at work, 90 percent for reasons of illness, and 80 percent for an injury unrelated to work or nursing. For the next 90 days, the replacement rate is 10 percentage points lower. There is no limitation for the duration of the benefit. Benefits are subject to taxation and social security contributions.

The Slovenian system of support for families consists of maternity, paternity and family benefits. Maternity leave lasts a total of 105 days: four weeks (28 days) before the birth and 11 weeks following the birth. It is obligatory to take 15 days of leave. The level of maternity allowance is determined using the average pay received by the mother over the preceding 12 months of employment. Regarding paternity leave, in 2019, a father has the right to paternity leave of 30 calendar days. At least 15 days of paid leave may be taken as full-time or part-time after the end of maternity leave; the rest of the paid leave (maximum 15 days) may be taken as full-time or part-time leave until the time at which the child completes the first grade of primary school. The level of paternity allowance amounts to the father's average pay during the 12 months prior to the leave. Benefits are also subject to taxation and social security contributions.

Family benefits consist of several grants to families. Child benefit in Slovenia depend on income and the number of children. It is paid for children residing in Slovenia. The monthly average income per family member must be lower than EUR 1,034.14 to qualify for child benefits. The benefit per child decreases with the level of income and rises with the number and age of children. The minimum benefit amounts to EUR 19.88, the maximum to EUR 137.18. The age limit for the benefit is 18. Single parent families (30 percent) and missing childcare services (20 percent) lead to higher benefits.

The parental benefit is paid during 260 days of childcare leave and equals gross income with a maximum of two and a half monthly average wages. Additional grants are reductions for nursery school fees, birth- and adoption grants, special allowances for children with disabilities and a large family allowance. Family benefits are not subject to taxation and social security contributions (with the exception of parental benefit).

Financial social assistance (FSA) is granted to persons and families to meet minimum needs. Entitlement requires a permanent residence in Slovenia. The assistance is available for persons with insufficient income, that is, lower than minimum income, if no other social claims (e.g., social insurance) are available and the person is active in seeking solutions to the current problem (i.e., claimants must search for a job). The FSA is means tested, with income as well as real and moveable property considered. The FSA amounts to EUR 392.75 for the first adult. If this person is economically active between 60 and 128 hours per month, the assistance rises to EUR 494.87 and EUR 593.05 for more than 128 hours. For every next adult person in the household (working less than 60 hours) the assistance amounts to EUR 223.87. The FSA is granted for three months at

longest for the first time and can be prolonged for an additional six months. For older persons (65 for men, 63 for women) a supplementary allowance is available. The benefit amounts to the difference of income to the defined minimum level of EUR 566.02. Benefits are exempted from taxation and social security contributions.

According to *Benefits and Wages*, the housing benefit supports low-income households to finance rents. The benefit ranges from 1 percent to 80 percent of the rent. Eligibility requires the income of the household to be below a threshold. The upper limit of the benefit ranges between EUR 85 for one household member to EUR 235 for six household members. Housing benefits are not taxed.

Slovakia

Sickness benefits in Slovakia are a compulsory insurance scheme for employees and self-employed persons with no earnings ceiling and no qualifying period. Employers are obliged to continue payment for the first 10 days of sickness. The insurance benefit steps in afterwards with a maximum duration of the benefit of 52 weeks. The benefit amounts to 55 percent of the assessment base (daily earnings of the previous year with a ceiling of two-times the national average monthly wage). For unemployed persons, no benefit is granted. In addition, a maximum of 10 days of care of relatives are granted.

To be eligible for the maternity leave benefit 270 days of insurance are necessary. Maternity leave is provided for 34 weeks, of which six-to-eight weeks are before birth. There is no paternity leave but there is the possibility of transferring maternity leave rights to the father. The benefit is 75 percent of the assessment base (defined in the same way as the sickness benefits) with at least the same amount as the parental allowance (see below). Neither sickness benefits nor maternity leave are subject to taxation or social security contributions.

The child allowance is paid up to the age of 16 of the child (25 for full-time vocational training and university students). The benefit is set to EUR 24.34 per child per month. For childcare, a parental allowance is granted up to the age of three years (six years for handicapped children) for proper care of the child. Employment is a necessary requirement and the benefit is paid irrespective of whether parental leave is taken or not. The monthly allowance is set to EUR 220.70. Also, a childcare allowance up to an age of five is available with an amount of up to EUR 280 per month and a birth grant of EUR 829.86. Benefits are neither taxable nor subject to social security contributions.

Social assistance guarantees the provision of basic living conditions for citizens in material need and is income-tested. The following persons are jointly assessed, namely husband and wife, parents and their dependent children within one household, and parents and their children up to the age of 25 if they live within one household and have no income. The benefits differ with respect to the number and type of jointly assessed persons. For example, a single person receives EUR 61, a childless couple EUR 107.10 and a couple with a maximum of four children EUR 160.40. For a pregnant woman (from the fourth month of pregnancy) and for persons with a child up to one year of age, the benefit increases by EUR 13.50. In addition, housing-, protective- and activation-allowances are granted. The housing allowance is set to EUR 55.80 for a single person and EUR 89.20 for a household with an additional jointly assessed person. The activation allowance (EUR 63.07 monthly) is provided for a person in material need and jointly assessed persons for measures which increase employability. The protective allowance (EUR 63.07 monthly) is granted for different living arrangements, like old-age, disability, lone parents with a child younger than 31

weeks, unfavourable health, and so on. Income reduces the benefit one by one, where income is modified to some extent. For example, 25 percent of different forms of income are deducted for the income test. The benefit is exempted from taxation. In addition, subsidies for food, materials and scholarships for pre-primary and primary schools are granted. Housing allowances are provided for assistance of households in material need. A general scheme does not exist.

Finland

Sickness benefits in Finland cover employees, unemployed, self-employed persons, students and others. There is no earnings ceiling for eligibility. Employers are obliged to pay full salary for the first nine days before the insurance steps in. The daily amount is EUR 27.86 for annual earnings below EUR 1,453. Earnings above are replaced by 70 percent (for earnings below EUR 30,962) or EUR 72.20 plus 20 percent (for income above). The duration is limited to 300 days within two years for the same illness. If a person receives unemployment benefits for at least four months the benefit equals 86 percent of the unemployment benefit. A partial sickness allowance is available for employees and self-employed persons who work part-time (40 to 60 percent of previous working time). In this case the benefit amounts to 50 percent of the sickness benefit and is available for 120 days within a two-year period. Sickness benefits are subject to taxation and pension (1.45 percent) and other social security contributions.

Maternity or paternity leave requires an insurance period of 180 days. Maternity leave is available for 105 consecutive days (without Sundays) of which 30 to 50 days must be consumed before childbirth. Paternity leave of 54 days is also available. Parental leave can last 158 days, increased by 60 days in case of multiple births. Benefits amount to 70 percent for annual earnings up to EUR 37,861. Parts of the income above this threshold are replaced by 40 percent, 20 percent for earnings above EUR 58,252.[32] Rules for taxation and social security contributions are the same as for sickness benefits.

Child benefits are paid for children below the age of 17 who live in Finland. The amount depends on the number of children in the household; supplements are available for lone parents. The amount per child increases from EUR 94.88 for one child to EUR 172.69 for five and more children. Lone parents receive an additional benefit of EUR 53.30 per child per month.

Families with children under three years of age who do not use public day care can claim a home care allowance. This amounts to EUR 338.34 per month for the first child, EUR 101.29 for any other child below the age of three and EUR 65.09 per month for children between three and six years old. In addition, there is a home care supplement amounting to at most EUR 181.07, which is means-tested. There is also a private day care allowance consisting of a care-allowance (EUR 172.25 per child per month) and an income-tested supplement (EUR 144.85 per child per month). For parents working part-time a flexible care allowance can be claimed. Benefits, with the exception of childcare allowances, are not taxable but subject to social security contributions.

Social assistance is a residual final safety net. The benefit is means-tested and eligibility is tested year by year. For the income-test 20 percent, up to a maximum of EUR 150 per month is deducted from family income. Social assistance consists of a basic amount and an additional amount. If the amount is higher than households' net income, the difference is paid as benefit. Housing costs are covered by an additional allowance. The basic monthly amount of the social assistance is

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[32] The replacement rate for the first 56 days of maternity leave is higher. The minimum benefit is EUR 27.86 per day.

EUR 497.29 for a single, and EUR 547.02 for a lone parent. Each person of a couple receives 85 percent of this amount (EUR 422.70). For a child older than 18, 73 percent of this amount is granted, 70 percent for a child older than ten and 63 percent for a younger child. For each additional child in the family the basic amount decreases by 5 percentage points. An additional allowance is granted to cover reasonable housing costs, home insurance, expenditures for electricity, child day-care fees and larger health-care costs. The benefit is not taxable and not subject to social security contributions.

The general housing allowance corresponds to 80 percent of the difference between the rent and the deductible amount, which is determined by the family type, the geographical location and increases with income. The rent is determined by the maximum area of the dwelling depending on the household size and the area of living, but also age and size of the flat. The benefits are not taxable.

Sweden

Sickness benefits in Sweden are available for employees, self-employed and unemployed persons with no ceiling on earnings for eligibility. To be eligible a person must be insured and earn an income above a minimum threshold (SEK 11,100 per year). Continued payment by the employer is available for the first 14 days of illness with a replacement rate of 80 percent. Sickness benefits amount to 80 percent of 97 percent of the income, with a ceiling of SEK 372,000. There is no maximum duration of the benefit but a reduction of the replacement rate to 75 percent after 364 days can take place. Sickness benefits are subject to taxation but not to social security contributions.

The pregnancy cash benefit is paid for leave between the 60th and the 11th day before birth. A parental benefit of 480 days (240 days for each parent) can be claimed for the time after birth. Ninety days are reserved for each of the parents; the remaining days can be shifted between parents. The pregnancy cash benefit amounts to 80 percent of previous earnings with a maximum of SEK 348,750. The parental benefit equals SEK 250 per day for 390 days und SEK 180 for the other 90 days. Taxation is the same as for sickness benefits.

For each child below the age of 16, or until compulsory education is finished, a child benefit is paid. The benefit is neither means- nor income-tested and amounts to SEK 1,250 per month and child. Supplements are paid if the parents have more than one child. The supplement is SEK 150 for the second child, SEK 730 for the third child, SEK 1,740 for the fourth and SEK 1,250 for the fifth and all subsequent children. The benefit is not taxable. In addition, a significant childcare allowance is granted at the municipal level. Family benefits are neither taxable nor do social security contributions arise.

Social assistance in Sweden is locally administered, means-tested and the beneficiary is required to actively search for a job. The norm for social assistance is calculated annually and has an individual part (marital status, age of the child) and a household part (size of the household). The individual rate is SEK 3,090 per month for a single person and EUR 5,570 for a married couple. For each child the rate increases with age, from SEK 2,130 for a child younger than one year to SEK 3,910 for a child between an age of 19 and 20. The household rate increases with the number of persons in the household, from SEK 990 to SEK 2,220 for a household with seven persons. The benefit is not taxable and not subject to social security contributions.

Housing benefits for rented accommodation consist of the income-tested housing allowance, a supplement for social assistance claimants and an income-tested housing supplement for pensioners. The condition for receipt of the housing allowance is low-income and varies with the number of children. The housing benefit depends on age and family status as well as housing costs. The housing benefit is not taxable.

2.11. Update of Empirical Estimates

Scientific literature provides empirical estimates about the behaviour of households and firms. During the current project, we update the main parameters to take into account recent empirical research. In this section, we discuss the update of (extensive and intensive) labour supply and retirement elasticities, the elasticity of job search intensities, elasticities of substitution in the production function, and the responsiveness of educational decisions of households.

Labour Supply Elasticities

The analysis of labour supply elasticities remains a topic of interest for economists, producing insights into how labour reacts to, for example, wage changes. Section 9.2.5. of Part II of the Berger et al. (2009) report includes an overview of empirical literature. For the update of the model, we exploit elasticities by Bargain et al. (2014), who develop comparable estimates across several countries. Broadly speaking, their estimates confirm the values used in the LMM so far.

The authors compute own-wage labour supply elasticities for 17 European countries and the United States. They use a harmonised approach that nets out possible measurement differences arising from data, periods, and methods while applying it to a dataset that uses similar definitions of variables. This leads to comparable estimates across countries. The authors implement a discrete choice labour supply model, similar to the one used in Chetty et al. (2011). They choose the Maximum Likelihood method for own-wage elasticities and income elasticities of individuals in couples and single individuals, decomposed for the extensive and intensive margin. The authors find that labour supply elasticities are small. Especially for the intensive margin, they are close to zero. There are small differences in magnitude across countries, which they attribute to differences in work preference rather than to demographic or tax characteristics of a country after performing related tests. On the extensive margin they find estimates of own-wage labour supply elasticities for married men and married women between close to zero and 0.2 and between 0.1 and 0.6 respectively. For single men and women, they are between close to zero and 0.6 and 0.1 and 0.6 respectively. Income elasticities are extremely small and close to zero in each of their estimates. Furthermore, the estimates suggest larger labour supply elasticities in countries with a low female labour market participation rate.

Although there is no clear consensus about the magnitude of labour supply elasticities, especially between micro- and macroeconomic-based estimates, our literature review broadly confirms the magnitude of the range of elasticities found in Bargain et al. (2014). Chetty et al. (2011) summarise and compare micro- and macroeconomic labour supply

elasticities. They recommend Hicksian and Frisch elasticities of 0.25 on the extensive margin and elasticities on the intensive margin of 0.3 and 0.5 for the Hicksian and the Frisch elasticity respectively. Bargain and Peichl (2016) perform a meta-analysis of intensive and extensive labour supply elasticities, where they compare 282 estimates from 92 studies and then perform meta regressions. They focus on differences in elasticities arising from methodically differing approaches. They suggest elasticity parameters between 0.12 for men and 0.59 for married women and single mothers. Keane (2011) focuses on how differences in models and methods generate different elasticity parameters and confirms a consensus in the literature on smaller estimates for men than for women; for example, he finds an average Hicksian elasticity of 0.31 for men.

For the calibration of LMM, we use the Bargain et al. (2014) estimates for intensive and extensive labour supply elasticities according to family status (married women, married men, single women, single men) and by income quintile. Using EU-SILC, we calculate weighted averages of these estimates for age and skill groups.[33]

The results are illustrated in Table 46. Intensive labour supply elasticities are very small and slightly lower than in the previous LMM calibration (where they ranged from 0.08 for high-skilled to 0.1 for low-skilled individuals). Extensive labour supply elasticities are higher than intensive elasticities and the estimates show more dispersion between the countries. The lowest estimates are found for Portugal (close to 0.05), while they are much higher in many other countries and close to 0.5 for Ireland. Still, the elasticities are in a similar range than in the previous LMM (where we calibrated an average extensive *semi*-elasticity of around 0.15).

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[33] Basically, we make three adjustments to this approach. First, we arbitrarily set a lower boundary of 0.03 of intensive labour supply elasticities even though the Bargain et al. (2014) estimates find even lower estimates in some cases. This is done to improve convergence of the model routine, but intensive labour supply reaction remains very low in this case. Second, Bargain et al. do not provide estimates for the EU-average, BG, CZ, HR, CY, LV, LT, LU, MT, RO, SI, and SK. Thus, we take estimates of economically/socially related countries. Third, the authors produce very high extensive elasticities for a few groups of low-income individuals. We suggest that these high elasticities are partly determined by the educational decisions of young individuals (i.e., if current wages for low-skilled individuals are low, they will invest more time in education and reduce hours worked). Given that this margin is implemented in the educational decision in the LMM, we set an upper boundary of 0.7 for these extensive elasticities.

Table 46: Intensive and extensive labour supply elasticities in LMM

	Intensive			Extensive		
	low	medium	high	low	medium	high
EU-27*	0.05	0.05	0.05	0.25	0.21	0.19
Belgium	0.10	0.09	0.09	0.39	0.32	0.29
Bulgaria*	0.03	0.03	0.03	0.12	0.12	0.10
Czechia*	0.03	0.03	0.03	0.15	0.13	0.12
Denmark	0.03	0.03	0.03	0.35	0.30	0.27
Germany	0.06	0.06	0.06	0.29	0.24	0.20
Estonia	0.03	0.03	0.03	0.17	0.15	0.14
Ireland	0.08	0.08	0.06	0.50	0.44	0.36
Greece	0.03	0.03	0.03	0.29	0.30	0.31
Spain	0.05	0.05	0.06	0.31	0.28	0.25
France	0.03	0.03	0.03	0.30	0.26	0.22
Croatia*	0.03	0.03	0.03	0.14	0.13	0.11
Italy	0.05	0.05	0.05	0.29	0.28	0.27
Cyprus*	0.03	0.03	0.03	0.27	0.27	0.29
Latvia*	0.03	0.03	0.03	0.13	0.11	0.09
Lithuania*	0.03	0.03	0.03	0.13	0.09	0.07
Luxembourg*	0.04	0.03	0.04	0.33	0.27	0.23
Hungary	0.03	0.03	0.03	0.19	0.17	0.14
Malta*	0.04	0.04	0.04	0.32	0.26	0.22
Netherlands	0.07	0.07	0.09	0.14	0.13	0.13
Austria	0.07	0.07	0.07	0.18	0.15	0.14
Poland	0.03	0.03	0.03	0.07	0.06	0.06
Portugal	0.03	0.03	0.04	0.03	0.04	0.05
Romania*	0.03	0.03	0.03	0.16	0.14	0.13
Slovenia*	0.03	0.03	0.03	0.12	0.11	0.08
Slovakia*	0.03	0.03	0.03	0.15	0.14	0.13
Finland	0.03	0.03	0.03	0.33	0.26	0.22
Sweden	0.07	0.06	0.05	0.20	0.16	0.12

Given different family status according to age, elasticities differ by age in LMM. For convenience, we do not show this differentiation in this Table.
Lower boundary of 0.03 for the intensive labour supply elasticity.
*no estimates for EU-average, BG, CZ, HR, CY, LV, LT, LU, MT, RO, SI and SK in Bargain et al. (2014). Thus, we apply estimates for economically/socially related countries.
Source: own calculations based on Bargain et al. (2014) • Created with Datawrapper

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Retirement Elasticities

In previous LMM model versions, the responsiveness of the retirement age with respect to incentives was based on two different empirical estimates. Börsch-Supan et al. (2004) provide econometric evidence for the impact of retirement incentives using German SOEP micro-data. They find that introducing 'actuarial' adjustments of 3.6 percent per year of early retirement increases the average retirement age by eight months. Duval (2003) performs a macroeconometric panel analysis on the impact of old-age pension systems. In his preferred specification, a 10 percentage point decline of the implicit tax rate on continued work reduces the fall in participation rates between two consecutive age groups by 1.5 percentage points. Based on these two estimates, the calibration of previous LMM versions replicated an impact of approximately five months for the 'Börsch-Supan' reform (i.e., a smaller impact than in the empirical estimate) and an impact of around 2 percentage points for the 'Duval' reform (i.e., a more pronounced impact) on average of the countries modelled.

In a similar analysis, Bassanini and Duval (2006) find a slightly smaller impact than Duval (2003). They estimate that a 10 percentage point cut of the implicit tax rate raises the

employment rate of older workers by 1 percentage point. In a more recent analysis, Manoli et al. (2015) analyse retirement decisions by using Austrian micro-data and policy variations from five pension reforms between 1984 and 2003. They find that the 'income effect' (i.e., changed retirement decisions because of higher lifetime income) is moderate, but the 'price effect' (i.e., different retirement decisions because of marginal incentives for continued work) is larger. In particular, according to the empirical model which includes the full control variable set, a 1 percent increase in pension accrual (i.e., the change of pension wealth when retiring one year later) decreases the hazard rate by 2.9 percent, which can be interpreted as an increase of the retirement age by 1.4 months.

We set parameters of the disutility function in such a way that the 'Börsch-Supan reform' increases the retirement age by 5.7 months, while the impact of the 'Duval reform' is 1.7 percentage points for the unweighted average of the 27 country results. Accordingly, this calibration fits rather well to the Manoli et al. (2015) result for Austria.

Elasticities of Search Intensities

As described in Berger et al. (2009), the curvatures of firms' costs of posting vacancies and of households' disutility of job search are main parameters for LMM's responsiveness concerning labour market reforms. We maintain the assumption of a cubic function of hiring costs as found for instance in Merz and Yashiv (2007). Estimates of the effects of an increase of the unemployment benefit replacement rate on the unemployment rate seem to be rather robust. Nickell et al. (2005) cite several empirical estimates and state an average of a 1.11 percentage point increase of the equilibrium unemployment rate in response to a 10 percentage point rise of the replacement rate. Bassanini and Duval (2006) perform a panel data estimation based on a sample of 21 OECD countries for the period 1982-2003. In their baseline estimate, a 10 percentage point reduction of unemployment benefits results in a drop of the unemployment rate by 1.2 percentage points. Orlandi (2012) uses a panel of 13 EU countries over the period 1985-2009 to estimate the impact of several labour market structural indicators on the NAWRU. They generate an indicator for the unemployment benefit replacement rate by using the OECD's rates across two income and three family situations and by applying exit probabilities out of unemployment. In their preferred specification, an increase of the gross replacement rate by 10 percentage points raises the unemployment rate by 0.7 percentage points, while the estimate is 1.7 percentage points for the net replacement rate.[34,35]

In the updated version of the LMM, the unemployment rate increases by 0.9 percentage points if the benefit replacement rate increases by 10 percentage points on (unweighted)

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[34] The latter two papers are also used for the calibration of the QUEST model; see for instance Varga and in 't Veld (2014).

[35] An alternative approach to the calibration of the LMM could be the application of estimates of the elasticity of job search with respect to unemployment benefits. For instance, the well-known Meyer (1990) paper estimates an elasticity of job search of -0.9 for the United States. Hunt (1995) finds similar estimates for Germany. Addison et al. (2008) use a structural search model for European countries and find a more elastic (-1 and more) response of job search. For the United States, Krueger and Mueller (2010) find an elasticity of between -1.6 and -2.2. Given the LMM calibration as described in this section, the (unweighted) average search elasticity is -0.33 in the LMM. The lower value may be reasonable, however, as empirical estimates analyse the job search of unemployed individuals (who react responsively to unemployment benefits), whereas the 'LMM job search elasticity' additionally includes employed individuals changing their job (who are less responsive to a change in unemployment benefits).

average of the 27 Member States. It should be noted that the impact differs quite pronouncedly between the Member States. This is, in particular, caused by very different eligibility for unemployment benefits, see Section 2.8.

Production Function

LMM's production function includes physical capital and three differently skilled labour inputs. As described in Berger et al. (2009), it allows for the feature of capital-skill complementarity, which implies that high-skilled labour and capital are more complementary than low-skilled labour and capital.

The calibration of previous LMM versions was, inter alia, based on the seminal work by Krusell et al. (2000) who use US time series data for capital and labour from 1963 to 1992. Their results support capital-skill complementarity as they find an elasticity of substitution (EOS) between skilled labour and equipment capital of 0.67 and between unskilled labour and the skilled-labour-capital-nest of 1.67.[36] These values are, inter alia, used in the CGE-model of Jaag (2005), who assumes EOS of 0.6 (capital stock to high-skilled labour), 1.2 (medium-skilled to capital-high-skilled-nest) and 1.8 (low-skilled labour to medium-and-high-skilled-capital-nest). Recently, Ohanian et al. (2021) re-estimate Krusell et al. (2000) by using US data up to 2019. They find strong evidence for continued capital-skill complementarity for several specifications. In their specification when the labour share is measured using income net of capital depreciation, they find an EOS between skilled labour and capital of 0.72 and an EOS of 1.73 between unskilled labour and the high-skilled-capital-nest. This means that the estimates are very similar to their previous paper.

In addition to these elasticities of substitution, the parameters of the production function are calibrated to ensure a reasonable reaction of physical investment to investment incentives. Empirical research mostly estimates the elasticity of investment or the capital stock with respect to the user costs of capital (UC), which determine the necessary return of an investment before taxes. For a Cobb-Douglas production function, this elasticity is -1. For previous LMM calibrations, Hassett and Hubbard (2002) was a valuable source. They argued that empirical analysis had reached a consensus that the elasticity is between -0.5 and -1. Harhoff and Ramb (2001) for Germany and Chirinko et al. (1999) for the United States, however, find lower elasticities of -0.42 and -0.24, respectively. Gilchrist and Zakrajsek (2007), who employ a panel of about 900 firms in the United States covering the period 1973-2005, find that the long-run elasticity of the capital stock w.r.t. the UC is close to -1. This result is robust to a number of different specifications. More recently, Dwenger (2014) argues that many empirical estimates ignore that capital, sales and UC contain a unit root and are cointegrated, resulting in an underestimated response to investment incentives. She uses German panel data of manufacturing firms from 1998 to 2007, applies an Error Correction Model, and finds that the long-run elasticity of the capital stock w.r.t. the UC is -0.9 (while the estimate is -0.5 if she doesn't control for these features).

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[36] In the main specification, they define skilled labour as college completion or higher.

As we set the EOS to 1.4 (low-skilled to medium-high-skilled-capital-nest), 0.7 (medium-skilled to high-skilled-capital-nest) and 0.3 (high-skilled to capital), we aim for a reasonable compromise between the Krusell et al. (2000) respectively Ohanian et al. (2021) estimates and the UC elasticity literature. That way, the LMM EOS are lower than in Ohanian et al. (2021) to some extent and the unweighted average long-run elasticity of investment w.r.t. UC is -0.85 across the countries modelled.

Educational Decision

In previous LMM versions, the responsiveness of the educational decision to incentives was based on two papers. In a discussion paper, Steiner and Wrohlich (2008) analyse the impact of financial student aid on enrolment in higher education by using the German SOEP and a detailed tax-benefit microsimulation approach. They find that an increase in scholarships by EUR 1,000 per year would increase the enrolment rate to university by 2.2 percentage points. Nielsen et al. (2010) estimate the response of enrolment to changes in student aid in a Danish reform. Using register-based micro-data, they find that a USD 1,000 stipend would change enrolment by 1.35 percentage points.

In their journal paper, Steiner and Wrohlich (2012) find that the EUR 1,000 per year scholarship increases the enrolment rate by 1.5 percentage points, which is, to some extent, lower than their estimate in the discussion paper. Bruckmeier and Wigger (2014) study the impact of an introduction of tuition fees of (up to) EUR 500 per semester in Germany. They find a significant negative effect of these fees in simple regressions. The treatment effect of these fees becomes insignificant, however, when they include additional control variables. The point estimate (even though insignificant) is of a very similar magnitude as the Steiner and Wrohlich (2012) and Nielsen et al. (2010) estimates respectively. Sneyers and De Witte (2018) perform a meta-analysis of the effects of higher education policies. They find that a EUR 1,000 increase of need-based grants increases enrolment in higher education (as well as graduation) by 2.5 percent, which is a somewhat larger effect than in Steiner and Wrohlich (2012) and Nielsen et al. (2010). It should be noted, though, that the studies considered by the authors investigate need-based grants and include research for the United States (which typically has higher tuition fees). It can be argued that both features imply a higher responsiveness to financial support than for the general increases for European countries considered in Steiner and Wrohlich (2012), Nielsen et al. (2010), and the LMM calibration.

For the calibration of LMM, we set the exponent of the educational cost function, ε_D, in order to replicate a responsiveness of the educational decision close to, but slightly lower than the Steiner and Wrohlich (2012) and Nielsen et al. (2010) estimates. We interpret these estimates as a 'short-run' effect. In the long-run, the higher number of high-skilled workers reduces their future productivity and wages and has a negative impact on employment opportunities compared to the initial situation. As individuals consider this for their educational decision, the medium- and long-run effect is less pronounced than the short-run impact.

3. List of Variables

LMM's detailed representation of institutional settings and economic behaviour implies that it features numerous parameters and variables, reducing transparency. The attached 'List of Variables' is intended to improve the clarity of the programme code and of the data processing procedure and to facilitate the work with the model for the staff of the Commission and helps to perform future updates.

In previous projects, a documentation of the different variables was provided in 'List of Variables' (see, for instance, Table 26 in Berger et al., 2016), 'List of Variables that have to be Updated' (Table 36), and in the Excel files 'DataInputCountry' (and linked-in Excel files). Following the tender specifications, we merge the comprehensive 'List of Variables' and the 'List of Variables that have to be Updated' for the current report. As this merging adds several columns to the list, we no longer include it in the report, but provide a separate Excel file.

Basically, the list of variables consists of two parts. The first columns deal with the interpretation of the different variables in the model. The second part provides information on how to perform an update of the calibration for those parameters and variables that need to be re-calculated for an update of LMM.

For all the variables listed, the first part contains (i) a short description of the variable, (ii) its type, (iii) its dimension, (iv) the dimension/unit and (v) the source for the code. The column 'Type' indicates whether a variable is determined endogenously or exogenously outside the code or whether it is an input for deriving a variable in calib. Exogenous parameters can be differentiated further: they can either be assigned to institutional/policy parameters, and thus can be changed in a policy reform scenario. Alternatively, they can represent completely exogenous parameters such as preference or technological parameters. Furthermore, the model includes some 'technical terms' which simplify the notation in the programme code. The column 'Dimension' specifies whether the variable is defined as (in one particular period) scalar or matrix. The latter indicates that the value of the variable varies (potentially) for different age and skill groups.[37] The column 'Dimension/Unit' provides information on how to interpret the values in the model. Basically, we distinguish 'nominal values', 'factors/rates' and 'exponents' of functional forms. When interpreting nominal values, one must keep in mind the normalisation of the model. For each of the individual countries, we normalise two variables. First, population is set to 100 in calib. Second, gross value added (GVA) is set to 100 in calib. Accordingly, this implies that GVA per capita is normalised to 1 in calib. Thus, all the nominal values must be interpreted relative to this normalisation. This holds true for aggregate values (such as public revenues, trade balance,…), which should be interpreted relative to GVA (which is 100 in calib) or GDP, as well as for individual values (such as labour income, social benefits,…) which can be interpreted relative to GVA per capita (which is 1 in calib).

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[37] For some variables, we include additional information in brackets. For instance, the entry for human wealth (hwv) is 8x3 (5x3). This means that the variable is a 8x3-matrix in the programme code but that only 5x3 entries are different from zero (as human wealth is zero for retirees).

The last column of the first part of the list of variables, 'Source for Code' describes the way in which the variable is initially set/calibrated. Basically, this can happen in four different ways in the model. First, the file 'param' contains parameters being the same for all countries, for example the elasticity of intertemporal substitution or the elasticities of substitution in the production function. Second, the Excel-files 'DataInputXX.xls' contain country specific data, for example the participation rate, the average number of hours worked or institutional parameters.[38] The country code for which a simulation is performed is set in 'lmm' or 'lmmloop'. Depending on the country code, the programme imports country specific input data from the relevant 'DataInputXX.xls' file. In addition to these two files, other variables are initially determined in the programme 'Code' calib as they can be derived from model equations (given the data input provided in param and 'DataInputXX.xls'). Finally, the categorisation 'Root' indicates a special way of the 'Code' categorisation. It implies that the variable is derived as a root of the calibration procedure. For instance, the subjective discount factor beta is derived in a way so that, for a given interest rate, asset markets clear, i.e., aggregate supply of assets by private households equals aggregate demand of assets (consisting of public debt, foreign assets and assets invested in firms).[39] Sometimes, the categorisation is mixed, i.e., in the term 'DataInput+Root' or 'DataInput+Code'. This indicates that the variable is initialised in the 'DataInputXX.xls' file, but is subsequently adjusted during the calibration procedure (in the 'calib' file). For instance, the age- and skill-specific structure of the income tax rate 'tw' is set in the 'DataInputXX.xls' file. Adjacently, these tax rates are adjusted in the 'calib' file in order to replicate aggregate public revenues from this tax. Thus, this variable is categorised as 'DataInput+Root'.

The second part of the 'List of Variables' provides information on the data collecting and the calibration of variables defined in 'DataInputXX.xls' or 'param'. First, the 'Unit/Scale for Calibration' column presents the interpretation of the parameter for the calibration of the model, such as 'in percent' or 'in percent of GVA'. Furthermore, the table includes the 'Data Source', the 'Years of Reference' and the way the parameter was 'calibrated'. Finally, the list contains the 'Reference' for each variable, which presents the source where the parameter was calculated or described.

The last column of the 'List of Variables' contains some remarks.

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[38] For these variables, the second part of the list contains information on the data gathering and their calibration.

[39] This 'root' categorisation is complemented by information, which condition/equation is solved via the adjustment of the variable.

4. Illustrative Scenarios

4.1. Tax Structure: Tax Shift from Income to Consumption Taxes

We assume a change of the tax structure among all the EU Member States in this scenario. A cut of the personal income tax (PIT) is balanced by (i) negative lump-sum transfers and (ii) an increase of the value added tax (VAT).

Labour income is a very important source of 'taxation'. According to Figure 1, revenues based on social security contributions and the income tax amount to 27.3 percent[40] of GVA in the EU-27 countries. Revenues from the income tax amount to 10.1 percent of GVA and finance an important portion of government expenditures. According to economic theory, income taxation distorts decisions of private households (e.g., participation decisions or decisions about the number of hours worked) and influences the wage level in the economy as employees bargain over net wages after deducting income tax. It therefore influences the investment decisions and labour demand of firms as well. Besides that, income taxation influences human capital investment decisions and the level of private consumption in the economy.

On the other hand, taxation of consumption has an impact on labour supply, labour demand and investment as well. A higher consumption tax rate (e.g., VAT) increases inflation, deflates labour income and has an impact on the labour supply of private households. Higher inflation raises the wage demands of employees, decreasing labour demand. The lower level of employment in turn dampens investment demand. From an economic point of view, the channels of income- and consumption taxes are similar with respect to economic activity.

However, the tax base of the income tax depends on income generated by production within a country. The tax base of consumption taxes is the consumption in an economy, independent of the source of financing. Therefore, consumption taxes deflate not only labour income but also other sources of income, like returns of private savings or public transfers. Overall, a combined cut of the PIT balanced via a VAT increase strengthens incentives to participate in the labour market.

Economic theory and the results of empirical research into the growth impact of different taxes also confirm the very pronounced effect of the personal income tax. Arnold et al. (2011) and Arachi et al. (2015) show that income taxes have the strongest impact on growth. According to Alinaghi and Reed (2017), personal and corporate income taxes dampen economic growth considerably more strongly than other tax categories. Besides the direct effect, taxes on disposable income have the strongest impact on the behaviour of persons, strengthening the negative impact on the economy considerably. Bordignon et

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[40] The share deviates to some extent from the results based on National Tax Lists as social security contributions also include contributions to other items (such as occupational pensions and mandatory private pension systems) in some countries.

al. (2019) and Hristov und Roeger (2020) find a positive impact of a reduction of the tax wedge on employment associated with a reduction of the natural unemployment rate.

We start by presenting the results for a cut in the personal income tax in the Member States and the EU as a whole and analyse the total impact of the reform by considering public budget balancing (i) in a neutral way via lump-sum transfers and (ii) by an adjustment of consumption taxes (i.e., the VAT). The cut in the personal income tax is assumed to equal 0.2 percent of GDP in each Member State. Comparable tax shifts have been performed by DG ECFIN several times by applying the QUEST-model; see for example Varga and in't Veld (2014).

Cut in Personal Income Tax

In this scenario, a cut in the personal income tax of 0.2 percent of GDP is assumed. The personal income tax determines to a considerable extent the tax wedge between labour costs of firms and take-home pay of employees. The income tax is also applied to other sources of income, especially on pension income in most of the Member States. However, average income tax rates on pension benefits are typically lower than tax rates on employment income.

We assume a proportional adjustment of income tariff rates such that the tax rate decrease is on average more pronounced for high-skilled persons (as they on average have higher wages) than for low-skilled persons. To balance the public budget, we assume a lump-sum payment from each person in the economy (i.e., each person pays the same amount). As lump-sum payments do not distort the labour market decisions of households and firms, from an economic point of view, the simulation shows the pure effect of the personal income tax rate cut. The decrease of the personal income tax rate decreases the tax wedge and increases, therefore, the share of value added of a worker (job rent) which can be distributed between workers and firms at the cost of government revenues. Wage bargaining between firms and workers determines the distribution between them depending on their bargaining power.

As part of the income tax cut can be claimed by firms, wage costs decrease, which boosts the demand for labour. Firms offer a higher amount of open vacancies to hire additional workers. On the other hand, higher net wages provide an additional incentive for workers to supply labour along several margins. Along the intensive margins, the incentive rises to increase the average number of hours worked. Given that the elasticity is rather small in many countries, the effect will be rather minor. On the extensive margin, participation of households on the labour market and search intensity of unemployed persons rises. The latter comes from the fact that higher net-wages increases the difference to unemployment benefit payments. If replacement income (e.g., pension benefits or unemployment benefits) is also taxed, the labour supply effect is smaller as replacement income increases as well. In equilibrium, the overall increase of labour supply meets expanded open vacancies such that employment rises.

The expansion of employment incentivises investment demand of firms. Higher employment decreases the capital-labour ratio, expanding productivity of capital and raising profits. This boosts investment to regain labour productivity and a higher capital stock.

From a distributional point of view, the scenario with a proportional reduction of the income tax rates reduces the tax burden in a more pronounced way for high- than for low-skilled, as well as for older than for younger persons. Nevertheless, younger and low-skilled persons benefit from the scenario for several reasons as well. First, capital-skill complementarity in the production function implies that the capital stock should react strongly to changes in high-skilled employment. The higher level of investment also raises the productivity of and labour demand for low-skilled and younger employees. Second, the labour supply reaction is more elastic for low-skilled and younger persons, implying more pronounced labour supply and employment of this group. Third, the tax decrease raises the rate of return of education and as a consequence educational attainment in the population. More medium- and high-skilled and less low-skilled persons dampen the pressure on the remaining low-skilled employees through reducing the unemployment rate and through higher wages. Although such demographic changes unfold the full consequences in the long-run, the expansion of educational attainment decreases labour supply in the young cohorts already in the short- to medium-term.

In this section, the long-run effects of the reform are presented. The economic channels by which the reform influences the behaviour of persons is the same for each country modelled in the LMM. However, country-specific institutions, elasticities, demography and economic structure lead to different outcomes in the Member States. Employment across all EU Member States (EU-27) is boosted by 0.16 percent (see Figure 2). The employment effect is particularly strong in Ireland (more than 0.4 percent), Hungary (0.26 percent) and Denmark (0.23 percent) compared to the baseline scenario without a personal income tax cut. On the other hand, a significantly lower employment effect compared to the EU-27, according to the simulation results, can be found in Portugal (0.09 percent), Bulgaria, Poland (both 0.11 percent) and Latvia (0.12 percent).

Figure 2: Cross-country employment effect of a PIT cut

Country	Employment	Country	Employment
EU	0.16%	LV	0.12%
BE	0.19%	LT	0.16%
BG	0.11%	LU	0.18%
CZ	0.16%	HU	0.26%
DK	0.23%	MT	0.18%
DE	0.20%	NL	0.18%
EE	0.17%	AT	0.16%
IE	0.43%	PL	0.11%
EL	0.14%	PT	0.09%
ES	0.15%	RO	0.14%
FR	0.16%	SI	0.13%
HR	0.15%	SK	0.17%
IT	0.16%	FI	0.16%
CY	0.13%	SE	0.16%

Source: Simulation results with LMM • Created with Datawrapper

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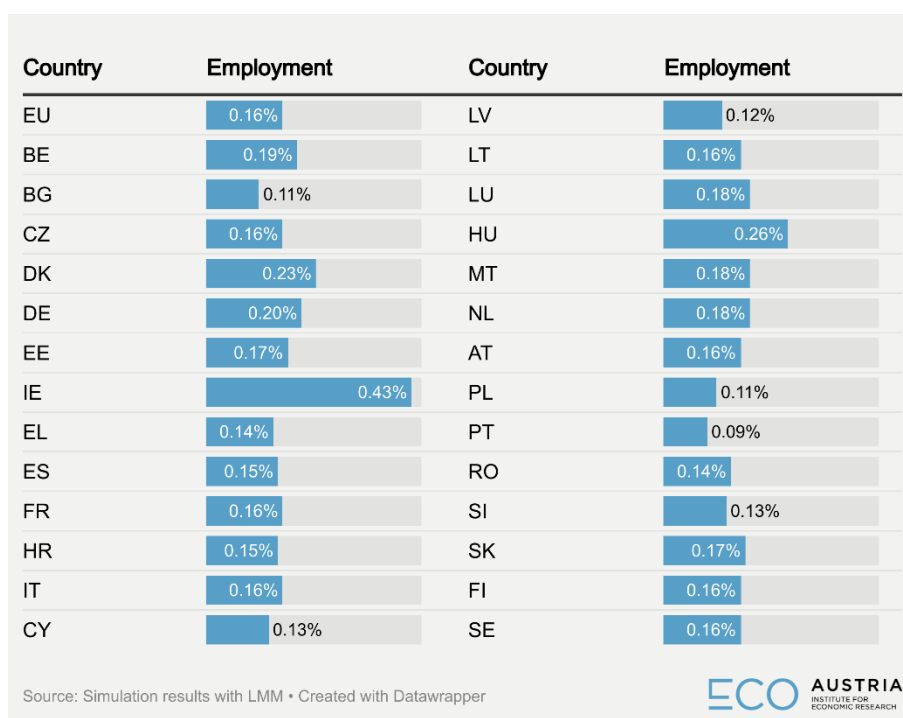
The employment effects are to a large extent the result of the change in labour supply. Ceteris paribus, the higher the extensive (intensive labour supply elasticities are very small in general) labour supply elasticity, the stronger the employment effect in a country. Labour supply elasticities are presented in Table 46 in Section 2.11. This influences the employment effect positively, especially in Ireland[41], Luxembourg, Belgium, and Denmark and negatively in Portugal, Bulgaria, Poland, and Latvia. The correlation between employment and average participation elasticity is shown in Figure 3. Furthermore, if the income tax schedule is less progressive, the tax relief is more important for low-skilled and younger persons, who both have, in general, a higher labour supply elasticity. This effect is especially important in Hungary.

But there are also other aspects determining the employment effect. A low unemployment rate goes hand in hand with a higher employment probability if a person participates in the labour market. For this reason, a low unemployment rate supports labour supply and therefore also the employment impact of the reform. Unemployment is especially pronounced in Greece and Spain, leading to a smaller employment effect. In addition, the higher the capital share, the lower the share of compensation of employees. Given that the income tax cut equals 0.2 percent of GDP in all countries, the increase of net wages is more pronounced in countries with a higher capital share.

The strong effect of the reform in Ireland, compared to the other 26 Member States, is also a result of the distortions of GDP due to foreign direct investment. GDP based on the

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[41] However, the strong effect in Ireland can be attributed to other determinants as well, see below for a discussion.

production function in the model is about 65 percent of official GDP. Therefore, the reform in Ireland amounts to 1.55-times the reform in other countries.

Figure 3: Average participation elasticity and employment effect of a PIT cut

Source: Simulation results with LMM • Created with Datawrapper
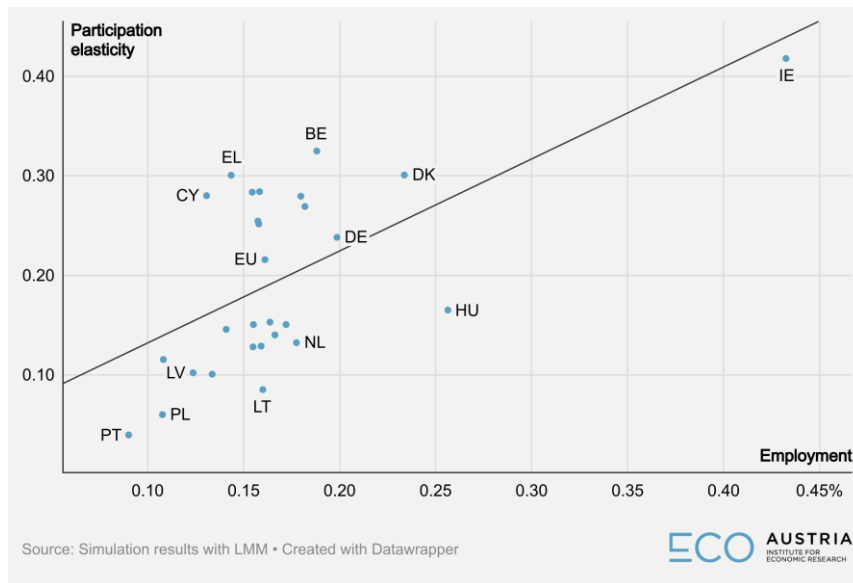
The tax reform also influences the composition of labour. As the income tax cut has a stronger impact on the take-home pay of skilled persons, employment of medium- and high-skilled persons rises by more than average. This shift is reinforced by the educational decision of younger workers and to a moderate extent by demand for further training by worker- and firm-sponsored training. This leads to additional supply of medium- and high-skilled persons (see change of new-borns in the comparative results table).

The boost in employment as a result of the income tax cut raises the productivity of capital installed. Higher rates of return incentivise the investment activities of firms, leading to additional investment activities. Across all EU-27 countries, real investment rises by 0.25 percent. Compared to the additional employment effect, investment rises by more. The more pronounced investment effect is mainly caused by capital-skill complementarity in the production function. The increase of skilled labour in production leads to additional investment incentives. As the capital stock rises by more, this implies higher wages for workers, also for low-skilled workers. The net-wage of low-skilled workers rises in general slightly less than average wages, but more than the direct effect of the tax cut would suggest.

In the Netherlands, the investment effect is especially pronounced. This is caused by a stronger skill shift and therefore an employment effect on medium- and high-skilled persons compared to other countries. In Ireland on the other hand, the real investment effect (0.31 percent) is smaller than the employment impact (0.43 percent). The deviation from other countries is the result of the high share of foreign direct investment in Ireland and the high level of investment as a proportion of GDP. Compared to the level of investment in the production function (without distortions of FDI) the increase would be

0.62 percent. The moderate investment boosts in Bulgaria, Latvia, and Poland are related to comparably small effects in employment.

Figure 4: Cross-country real investment effect of a PIT cut

Country	Real Investment	Country	Real Investment
EU	0.25%	LV	0.16%
BE	0.30%	LT	0.20%
BG	0.13%	LU	0.29%
CZ	0.22%	HU	0.29%
DK	0.27%	MT	0.29%
DE	0.31%	NL	0.37%
EE	0.23%	AT	0.26%
IE	0.31%	PL	0.15%
EL	0.23%	PT	0.23%
ES	0.26%	RO	0.20%
FR	0.22%	SI	0.22%
HR	0.28%	SK	0.20%
IT	0.26%	FI	0.20%
CY	0.21%	SE	0.21%

Source: Simulation results with LMM • Created with Datawrapper

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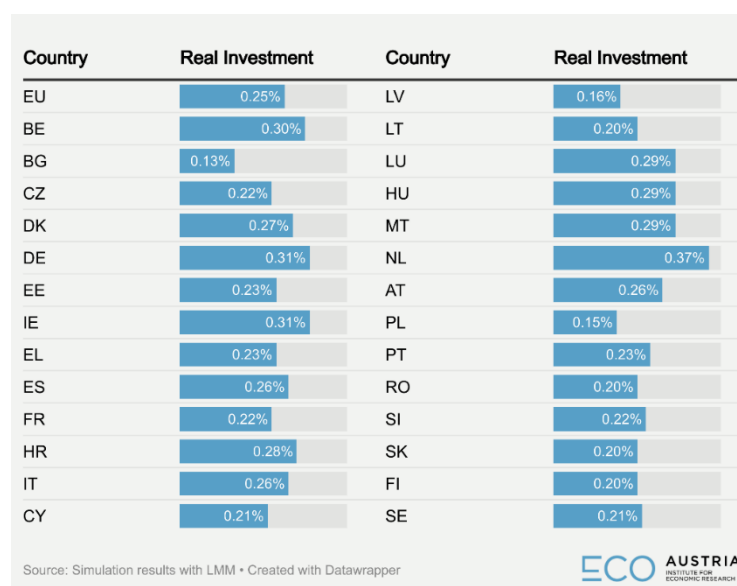
The impact of the tax cut on GDP follows the employment and investment effect of the reform. GDP in the EU-27 would rise by about 0.2 percent, very much in line with the size of the tax cut (0.2 percent of GDP). Real output would grow significantly more strongly in Ireland, the Netherlands, Hungary, Belgium, and Germany and significantly more weakly in Bulgaria, Poland, and Latvia. This result mainly follows employment and investment effects, taking into account the change in skill composition in these countries. As the reform increases the income of private households, private consumption is also boosted. However, given that the tax reform is financed by lump-sum transfers to balance the public budget, additional income and consumption is mainly determined by the higher production level. Figure 6 relates the long-run impact of private consumption growth to GDP growth. Deviations from the trend line can to a large extent be related to the capital share in the economy (the higher the capital share, the less the growth in private consumption) and the share of income tax cut falling upon retirees. Both conditions hold especially for Cyprus, Italy, and Portugal.

Figure 5: Cross-country real GDP effect of a PIT cut

Country	Real GDP	Country	Real GDP
EU	0.21%	LV	0.14%
BE	0.27%	LT	0.19%
BG	0.12%	LU	0.21%
CZ	0.19%	HU	0.27%
DK	0.25%	MT	0.25%
DE	0.27%	NL	0.29%
EE	0.21%	AT	0.22%
IE	0.38%	PL	0.12%
EL	0.17%	PT	0.16%
ES	0.22%	RO	0.18%
FR	0.20%	SI	0.17%
HR	0.21%	SK	0.19%
IT	0.20%	FI	0.19%
CY	0.16%	SE	0.19%

Source: Simulation results with LMM • Created with Datawrapper

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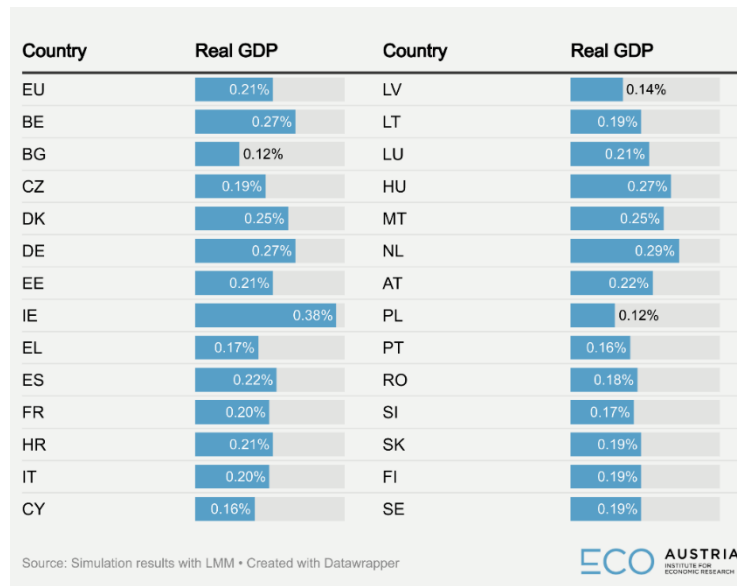
Figure 6: Private consumption and GDP impact of a PIT cut

Source: Simulation results with LMM • Created with Datawrapper

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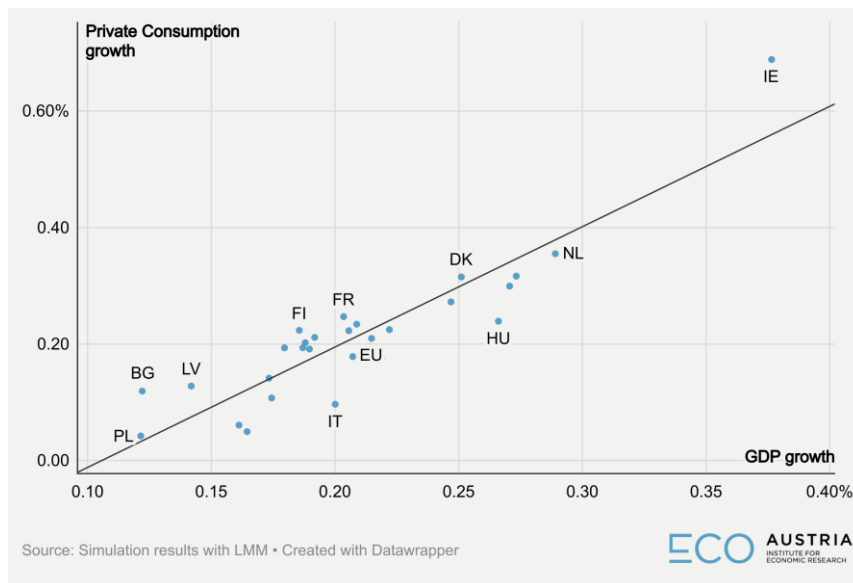
Table 47: Simulation results for a PIT cut (0.2 percent of GDP)

	EU	BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR	HR	IT	CY	LV
GDP	0.21%	0.27%	0.12%	0.19%	0.25%	0.27%	0.21%	0.38%	0.17%	0.22%	0.20%	0.21%	0.20%	0.16%	0.14%
Capital Stock	0.25%	0.30%	0.13%	0.22%	0.27%	0.31%	0.23%	0.39%	0.23%	0.26%	0.22%	0.28%	0.26%	0.21%	0.16%
Consumption	0.21%	0.32%	0.12%	0.19%	0.32%	0.30%	0.22%	0.69%	0.11%	0.22%	0.25%	0.18%	0.10%	0.05%	0.13%
Trade Balance (change in % of GDP)	0.05%	0.04%	0.02%	0.04%	0.05%	0.05%	0.03%	0.04%	0.07%	0.04%	0.02%	0.04%	0.10%	0.09%	0.03%
Gross wage rate (Labour costs per hour)	-0.03%	-0.02%	-0.05%	-0.07%	-0.05%	-0.04%	-0.05%	-0.04%	-0.03%	-0.01%	-0.02%	-0.02%	-0.03%	-0.02%	-0.05%
-low	0.10%	0.16%	-0.03%	0.08%	0.02%	0.14%	0.08%	0.41%	0.12%	0.11%	0.07%	0.15%	0.08%	0.09%	0.03%
-medium	0.05%	0.08%	-0.03%	-0.01%	-0.04%	0.05%	0.01%	0.18%	0.04%	0.03%	0.06%	0.12%	-0.01%	0.10%	-0.01%
-high	-0.17%	-0.15%	-0.08%	-0.22%	-0.09%	-0.24%	-0.14%	-0.27%	-0.18%	-0.13%	-0.12%	-0.34%	-0.21%	-0.13%	-0.12%
Net wage rate	0.45%	0.44%	0.42%	0.53%	0.46%	0.48%	0.50%	0.78%	0.38%	0.42%	0.41%	0.45%	0.39%	0.38%	0.43%
-low	0.38%	0.36%	0.43%	0.37%	0.47%	0.33%	0.45%	0.77%	0.32%	0.30%	0.35%	0.25%	0.32%	0.18%	0.33%
-medium	0.44%	0.43%	0.44%	0.52%	0.45%	0.47%	0.48%	0.69%	0.35%	0.37%	0.40%	0.42%	0.38%	0.28%	0.42%
-high	0.44%	0.44%	0.39%	0.53%	0.46%	0.48%	0.49%	0.78%	0.39%	0.45%	0.41%	0.46%	0.38%	0.42%	0.43%
Average number of hours worked per worker	0.02%	0.04%	0.01%	0.01%	0.01%	0.03%	0.01%	0.06%	0.01%	0.02%	0.01%	0.01%	0.02%	0.01%	0.01%
Participation rate - 15-69 yrs. (change in pp)	0.06	0.09	0.04	0.05	0.09	0.07	0.06	0.18	0.06	0.06	0.06	0.05	0.06	0.05	0.03
-low	0.06	0.07	0.03	0.04	0.10	0.06	0.06	0.19	0.06	0.06	0.06	0.03	0.05	0.03	0.03
-medium	0.06	0.09	0.04	0.06	0.09	0.08	0.07	0.17	0.06	0.06	0.07	0.05	0.07	0.05	0.04
-high	0.05	0.07	0.03	0.05	0.07	0.05	0.05	0.15	0.06	0.06	0.05	0.04	0.06	0.06	0.03
Employment (no. of workers)	0.16%	0.19%	0.11%	0.16%	0.23%	0.20%	0.17%	0.43%	0.14%	0.15%	0.16%	0.15%	0.16%	0.13%	0.12%
-low	0.00%	-0.04%	0.08%	-0.01%	0.13%	-0.01%	0.00%	-0.22%	-0.04%	0.01%	0.03%	-0.04%	0.02%	0.02%	0.04%
-medium	0.14%	0.15%	0.10%	0.14%	0.24%	0.17%	0.15%	0.34%	0.13%	0.17%	0.12%	0.09%	0.18%	0.08%	0.10%
-high	0.27%	0.29%	0.13%	0.25%	0.27%	0.33%	0.24%	0.63%	0.26%	0.26%	0.24%	0.35%	0.28%	0.21%	0.16%
Unemployment rate (change in pp)	-0.06	-0.05	-0.04	-0.08	-0.10	-0.10	-0.08	-0.14	-0.04	-0.06	-0.05	-0.07	-0.05	-0.05	-0.07
-low	-0.07	-0.06	-0.08	-0.14	-0.12	-0.11	-0.11	-0.18	-0.03	-0.05	-0.06	-0.05	-0.05	-0.05	-0.09
-medium	-0.06	-0.05	-0.04	-0.08	-0.10	-0.09	-0.09	-0.13	-0.03	-0.05	-0.06	-0.07	-0.04	-0.05	-0.08
-high	-0.04	-0.03	-0.02	-0.05	-0.09	-0.09	-0.06	-0.12	-0.02	-0.04	-0.04	-0.04	-0.03	-0.04	-0.05
new persons - low	-0.19%	-0.25%	-0.08%	-0.24%	-0.16%	-0.22%	-0.21%	-0.78%	-0.18%	-0.15%	-0.14%	-0.17%	-0.13%	-0.09%	-0.11%
new persons - medium	-0.02%	-0.04%	-0.01%	-0.02%	0.01%	-0.04%	-0.04%	-0.06%	-0.01%	0.03%	-0.04%	-0.06%	0.04%	-0.05%	-0.03%
new persons - high	0.15%	0.15%	0.07%	0.13%	0.07%	0.17%	0.10%	0.27%	0.13%	0.13%	0.11%	0.24%	0.17%	0.07%	0.07%

Source: Simulation results with LMM • Created with Datawrapper

Table 47 (contd.): Simulation results for a PIT cut (0.2 percent of GDP)

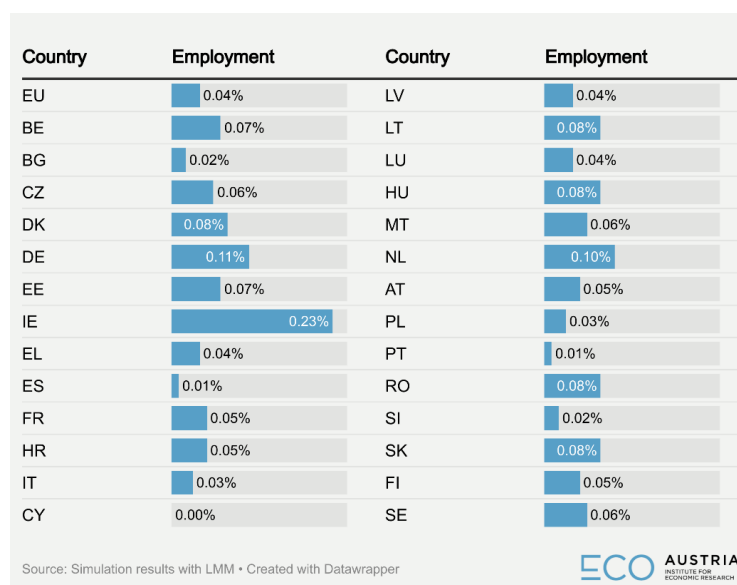|	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE	min	max
GDP	0.19%	0.21%	0.27%	0.25%	0.29%	0.22%	0.12%	0.16%	0.18%	0.17%	0.19%	0.19%	0.19%	0.12%	0.38%
Capital Stock	0.20%	0.29%	0.29%	0.29%	0.37%	0.26%	0.15%	0.23%	0.20%	0.22%	0.20%	0.20%	0.21%	0.13%	0.39%
Consumption	0.19%	0.23%	0.24%	0.27%	0.36%	0.18%	0.04%	0.06%	0.19%	0.14%	0.20%	0.22%	0.21%	0.04%	0.69%
Trade Balance (change in % of GDP)	0.03%	0.04%	0.08%	0.03%	0.05%	0.06%	0.07%	0.08%	0.01%	0.05%	0.03%	0.02%	0.04%	0.01%	0.10%
Gross wage rate (Labour costs per hour)	-0.05%	-0.01%	-0.07%	-0.01%	0.01%	-0.05%	-0.04%	-0.01%	-0.04%	-0.04%	-0.07%	-0.03%	-0.05%	-0.07%	0.01%
-low	0.05%	0.18%	-0.01%	0.11%	0.29%	0.12%	0.02%	0.11%	0.03%	0.13%	0.01%	0.07%	0.05%	-0.03%	0.41%
-medium	0.02%	0.07%	-0.07%	0.01%	0.17%	0.04%	0.00%	0.03%	0.00%	0.07%	-0.04%	0.06%	-0.02%	-0.07%	0.18%
-high	-0.12%	-0.14%	-0.11%	-0.15%	-0.24%	-0.21%	-0.12%	-0.20%	-0.17%	-0.21%	-0.15%	-0.10%	-0.10%	-0.34%	-0.08%
Net wage rate	0.51%	0.46%	0.59%	0.49%	0.54%	0.41%	0.42%	0.39%	0.54%	0.49%	0.58%	0.47%	0.46%	0.38%	0.78%
-low	0.41%	0.27%	0.55%	0.40%	0.49%	0.28%	0.38%	0.27%	0.50%	0.42%	0.39%	0.44%	0.39%	0.18%	0.77%
-medium	0.48%	0.39%	0.60%	0.45%	0.51%	0.39%	0.43%	0.37%	0.55%	0.46%	0.57%	0.45%	0.43%	0.28%	0.69%
-high	0.52%	0.49%	0.58%	0.49%	0.52%	0.43%	0.40%	0.41%	0.50%	0.49%	0.62%	0.48%	0.49%	0.38%	0.78%
Average number of hours worked per worker	0.02%	0.02%	0.02%	0.02%	0.03%	0.03%	0.01%	0.01%	0.01%	0.01%	0.02%	0.01%	0.02%	0.01%	0.06%
Participation rate - 15-69 yrs. (change in pp)	0.04	0.07	0.08	0.08	0.05	0.04	0.03	0.02	0.07	0.04	0.06	0.07	0.05	0.02	0.18
-low	0.03	0.06	0.07	0.08	0.05	0.04	0.03	0.02	0.06	0.04	0.04	0.07	0.06	0.02	0.19
-medium	0.04	0.07	0.08	0.08	0.05	0.05	0.03	0.03	0.07	0.05	0.06	0.07	0.06	0.03	0.17
-high	0.04	0.07	0.06	0.07	0.04	0.04	0.02	0.02	0.06	0.04	0.05	0.06	0.05	0.02	0.15
Employment (no. of workers)	0.16%	0.18%	0.26%	0.18%	0.18%	0.16%	0.11%	0.09%	0.14%	0.13%	0.17%	0.16%	0.16%	0.09%	0.43%
-low	0.04%	-0.07%	0.18%	0.03%	-0.23%	-0.03%	0.02%	-0.04%	0.06%	-0.10%	0.10%	0.06%	0.05%	-0.23%	0.18%
-medium	0.12%	0.17%	0.26%	0.22%	0.12%	0.12%	0.08%	0.13%	0.13%	0.09%	0.15%	0.12%	0.16%	0.08%	0.34%
-high	0.21%	0.29%	0.28%	0.31%	0.38%	0.27%	0.16%	0.25%	0.22%	0.25%	0.21%	0.21%	0.20%	0.13%	0.63%
Unemployment rate (change in pp)	-0.09	-0.07	-0.13	-0.06	-0.10	-0.08	-0.06	-0.05	-0.03	-0.06	-0.07	-0.05	-0.08	-0.14	-0.03
-low	-0.11	-0.08	-0.22	-0.07	-0.19	-0.09	-0.09	-0.05	-0.05	-0.08	-0.12	-0.05	-0.09	-0.22	-0.03
-medium	-0.11	-0.06	-0.14	-0.05	-0.10	-0.09	-0.06	-0.05	-0.03	-0.07	-0.07	-0.05	-0.08	-0.14	-0.03
-high	-0.07	-0.07	-0.08	-0.04	-0.05	-0.07	-0.04	-0.04	-0.01	-0.04	-0.05	-0.05	-0.08	-0.12	-0.01
new persons - low	-0.16%	-0.25%	-0.21%	-0.17%	-0.51%	-0.20%	-0.14%	-0.12%	-0.09%	-0.26%	-0.15%	-0.13%	-0.15%	-0.78%	-0.08%
new persons - medium	-0.06%	0.00%	0.00%	0.06%	-0.05%	-0.04%	-0.03%	0.03%	-0.01%	-0.06%	-0.01%	-0.05%	0.00%	-0.06%	0.06%
new persons - high	0.08%	0.12%	0.11%	0.17%	0.27%	0.14%	0.08%	0.17%	0.13%	0.15%	0.08%	0.07%	0.05%	0.05%	0.27%

Source: Simulation results with LMM • Created with Datawrapper

Tax Shift from PIT to VAT

The second simulation in this scenario deals with closing the public budget through a rise in the value added tax (VAT) instead of lump-sum transfers. The value added tax, as mentioned above, exerts negative incentive effects on economic activity. It deflates labour income,[42] whereas the real value of home-production stays the same. This leads to a negative labour supply effect and higher labour costs for firms as the consumption tax is considered in the wage bargaining between workers and firms. The increase of the VAT therefore works in the opposite direction to the income tax cut. However, the tax base differs between these taxes, being broader[43] for the VAT.

Financing the reform via a VAT increase decreases the positive employment effect of the PIT cut significantly, e.g., from 0.16 percent in the EU-27 to 0.04 percent (based on employment figures in 2021 in the EU, this amounts to about 82,000 additional employed persons). The impact seems to be rather small. However, one must also consider that the tax shift of 0.2 percent of GDP is a minor reform. The employment effect varies considerably between Member States, ranging from more than 0.2 in Ireland to 0 in Cyprus. In Germany and the Netherlands, employment would rise by about 0.1 percent. The comparably small impact in Bulgaria, Cyprus, Portugal, and Slovenia is to a large extent the result of a lower employment effect of the personal income tax cut. In addition, the share of private consumption in GDP differs between countries. Ceteris paribus, if the share of private consumption is lower, the tax rate must increase more heavily (in percentage points) to finance public expenditures and to balance the budget. This is for example the case in Hungary.

Figure 7: Cross-country employment effect of a tax shift

Country	Employment	Country	Employment
EU	0.04%	LV	0.04%
BE	0.07%	LT	0.08%
BG	0.02%	LU	0.04%
CZ	0.06%	HU	0.08%
DK	0.08%	MT	0.06%
DE	0.11%	NL	0.10%
EE	0.07%	AT	0.05%
IE	0.23%	PL	0.03%
EL	0.04%	PT	0.01%
ES	0.01%	RO	0.08%
FR	0.05%	SI	0.02%
HR	0.05%	SK	0.08%
IT	0.03%	FI	0.05%
CY	0.00%	SE	0.06%

Source: Simulation results with LMM • Created with Datawrapper

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[42] The required real rate of return of firms is kept constant.

[43] In the sense that additional sources financing private consumption are taxed.

Expenditures for real investment are positively affected by the tax shift reform, but also to a lower extent compared to the personal income tax cut. For the overall European Union, real investment rises by 0.1 percent, ranging from more than 0.25 percent in the Netherlands[44] to nearly nothing for Bulgaria. For most countries, the impact is very similar to the EU average. In Germany and Ireland, investment increases significantly as well. In Germany this goes hand in hand with higher employment; in Ireland it is especially the result of a comparably stronger reform (see discussion above).

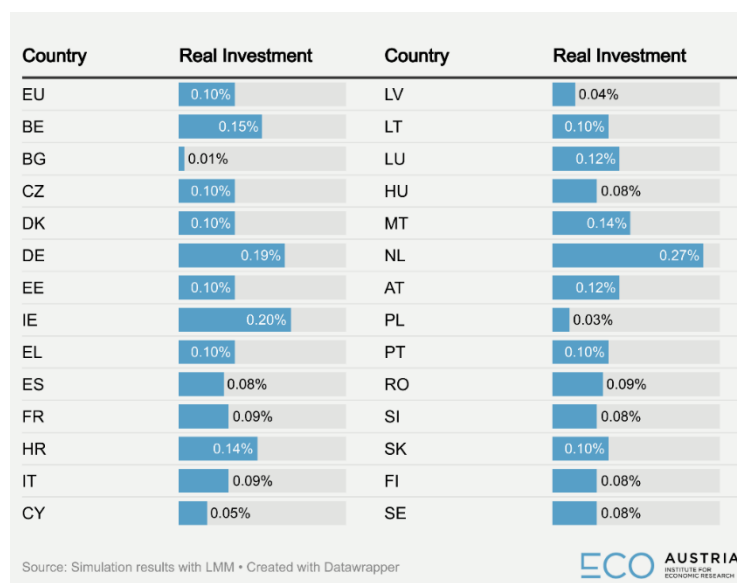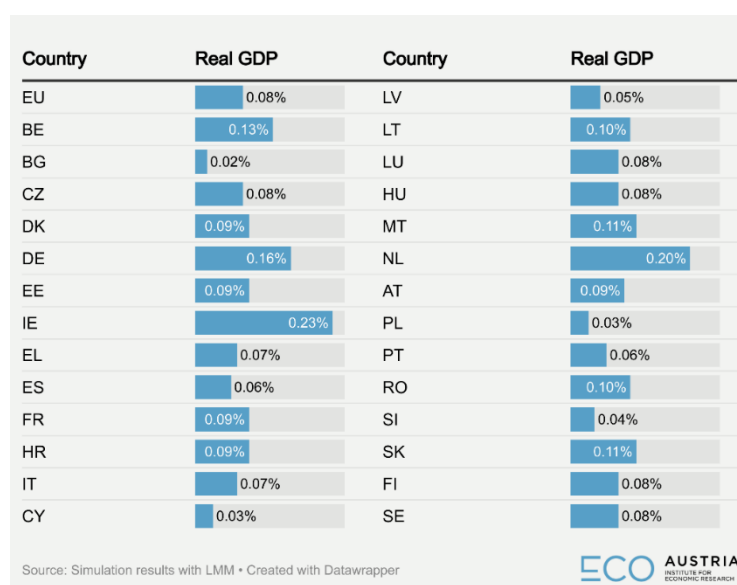**Figure 8: Cross-country real investment effect of a tax shift**

Country	Real Investment	Country	Real Investment
EU	0.10%	LV	0.04%
BE	0.15%	LT	0.10%
BG	0.01%	LU	0.12%
CZ	0.10%	HU	0.08%
DK	0.10%	MT	0.14%
DE	0.19%	NL	0.27%
EE	0.10%	AT	0.12%
IE	0.20%	PL	0.03%
EL	0.10%	PT	0.10%
ES	0.08%	RO	0.09%
FR	0.09%	SI	0.08%
HR	0.14%	SK	0.10%
IT	0.09%	FI	0.08%
CY	0.05%	SE	0.08%

Source: Simulation results with LMM • Created with Datawrapper

Figure 9: Cross-country real GDP effect of a tax shift

Country	Real GDP	Country	Real GDP
EU	0.08%	LV	0.05%
BE	0.13%	LT	0.10%
BG	0.02%	LU	0.08%
CZ	0.08%	HU	0.08%
DK	0.09%	MT	0.11%
DE	0.16%	NL	0.20%
EE	0.09%	AT	0.09%
IE	0.23%	PL	0.03%
EL	0.07%	PT	0.06%
ES	0.06%	RO	0.10%
FR	0.09%	SI	0.04%
HR	0.09%	SK	0.11%
IT	0.07%	FI	0.08%
CY	0.03%	SE	0.08%

Source: Simulation results with LMM • Created with Datawrapper

The impact on real GDP is determined by changes in employment and investment. Across all EU Member States, real GDP would rise by nearly 0.1 percent, ranging from about 0.2

[44] The Netherland had the highest impact already when balancing via lump sum transfers, see above.

percent in Ireland and the Netherlands to a very small impact in Bulgaria, Cyprus, and Poland. In general, the resulting growth effect of the reform is to a large extent related to the consequence of the PIT cut as shown in Figure 10, which plots the growth outcome of both reforms.

Figure 10: GDP effect of a PIT reform and a tax shift reform

Source: Simulation results with LMM • Created with Datawrapper
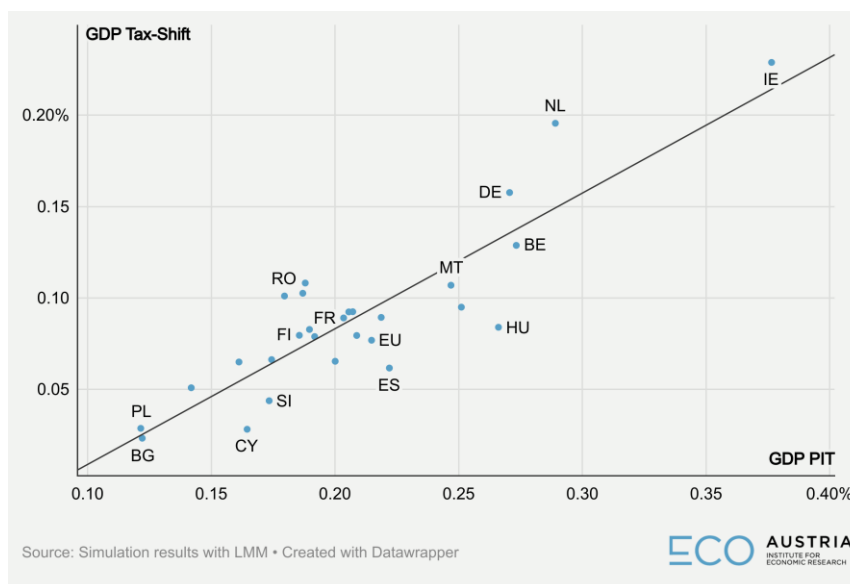
To conclude, a balanced tax shift away from the personal income tax towards the value added tax would lead to a boost of economic activity in the EU-27. The distribution of the effects is different for the Member States. It ranges from a small effect in Bulgaria, Cyprus, and Poland to a significant impact in Germany, the Netherlands, and Ireland. The reason for the diverting outcomes depends, inter alia, on the labour supply elasticities in the countries. Other reasons, like the way GDP is measured (e.g., in Ireland), the labour share in an economy, or the share retirees contribute to income tax or value added tax revenues, are important as well.

Furthermore, the simulations show that the reform favours medium- and high-skilled persons, implying a larger investment than employment effect due to capital-skill complementarity in the production function. But, additional employment and investment also favours low-skilled persons by improving the productivity of this group. This effect is reinforced, as the reform is associated with an increase in the skill-premium incentivising educational- and life-long training effort. This decreases the share of low-skilled persons and together with higher labour demand, the reform is also beneficial for persons with lower skills. As the volume of the supposed tax shift is small and a balanced budget is required, the total effect is of minor importance. However, a larger reform would have a larger impact and could strengthen economic activity in a significant way. The long-run effects are summarised in Table 48.

Table 48 (contd.): Simulation results for a tax shift

	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE	min	max
GDP	0.10%	0.08%	0.08%	0.11%	0.20%	0.09%	0.03%	0.06%	0.10%	0.04%	0.11%	0.08%	0.08%	0.02%	0.23%
Capital Stock	0.10%	0.12%	0.08%	0.14%	0.27%	0.12%	0.03%	0.10%	0.09%	0.08%	0.10%	0.08%	0.08%	0.01%	0.27%
Consumption	0.21%	0.10%	0.12%	0.13%	0.24%	0.06%	0.01%	0.04%	0.25%	0.01%	0.23%	0.17%	0.13%	-0.01%	0.42%
Trade Balance (change in % of GDP)	-0.05%	0.01%	0.01%	0.01%	0.03%	0.03%	0.01%	0.02%	-0.08%	0.02%	-0.04%	-0.03%	0.00%	-0.08%	0.03%
Gross wage rate (Labour costs per hour)	-0.03%	0.03%	-0.03%	0.01%	0.02%	-0.02%	-0.01%	0.01%	-0.02%	0.00%	-0.04%	0.00%	-0.01%	-0.04%	0.03%
-low	0.03%	0.21%	0.00%	0.11%	0.28%	0.11%	0.01%	0.09%	0.00%	0.11%	0.02%	0.07%	0.05%	-0.04%	0.41%
-medium	0.00%	0.09%	-0.05%	0.03%	0.17%	0.05%	0.00%	0.03%	-0.02%	0.09%	-0.02%	0.06%	0.01%	-0.05%	0.21%
-high	-0.06%	-0.09%	0.00%	-0.11%	-0.21%	-0.16%	-0.03%	-0.12%	-0.05%	-0.12%	-0.09%	-0.06%	-0.05%	-0.25%	0.01%
Net wage rate	0.53%	0.50%	0.64%	0.51%	0.55%	0.44%	0.45%	0.41%	0.55%	0.54%	0.61%	0.49%	0.49%	0.41%	0.81%
-low	0.40%	0.29%	0.56%	0.39%	0.48%	0.28%	0.37%	0.25%	0.47%	0.40%	0.40%	0.43%	0.40%	0.18%	0.77%
-medium	0.46%	0.42%	0.62%	0.47%	0.52%	0.40%	0.42%	0.37%	0.54%	0.48%	0.58%	0.45%	0.46%	0.27%	0.71%
-high	0.57%	0.54%	0.69%	0.54%	0.55%	0.48%	0.49%	0.49%	0.62%	0.58%	0.69%	0.52%	0.54%	0.45%	0.82%
Average number of hours worked per worker	0.01%	0.01%	0.01%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	0.01%	0.00%	0.04%
Participation rate - 15-69 yrs. (change in pp)	0.02	0.01	0.03	0.02	0.03	0.01	0.01	0.01	0.04	0.01	0.03	0.02	0.02	0.00	0.09
-low	0.01	-0.01	0.02	0.01	0.02	-0.01	0.00	0.00	0.03	-0.01	0.01	0.01	0.02	-0.03	0.08
-medium	0.02	0.01	0.03	0.03	0.03	0.01	0.01	0.01	0.04	0.00	0.03	0.02	0.02	-0.01	0.06
-high	0.02	0.03	0.02	0.03	0.02	0.01	0.01	0.01	0.04	0.01	0.03	0.03	0.02	0.01	0.08
Employment (no. of workers)	0.08%	0.04%	0.08%	0.06%	0.10%	0.05%	0.03%	0.01%	0.08%	0.02%	0.08%	0.05%	0.06%	0.00%	0.23%
-low	0.01%	-0.20%	0.05%	-0.06%	-0.28%	-0.08%	0.01%	-0.06%	0.06%	-0.12%	0.04%	-0.03%	-0.02%	-0.36%	0.06%
-medium	0.07%	0.03%	0.10%	0.09%	0.05%	0.03%	0.02%	0.04%	0.08%	-0.02%	0.08%	0.02%	0.05%	-0.03%	0.15%
-high	0.09%	0.13%	0.06%	0.16%	0.30%	0.14%	0.03%	0.11%	0.08%	0.10%	0.11%	0.09%	0.08%	-0.01%	0.41%
Unemployment rate (change in pp)	-0.05	-0.01	-0.04	-0.02	-0.06	-0.04	-0.01	-0.01	-0.01	-0.01	-0.04	-0.02	-0.03	-0.09	0.00
-low	-0.04	0.00	-0.06	-0.02	-0.14	-0.02	-0.01	0.01	-0.02	-0.01	-0.05	-0.01	-0.02	-0.14	0.02
-medium	-0.05	0.00	-0.04	-0.01	-0.07	-0.04	-0.01	-0.01	-0.01	-0.01	-0.04	-0.01	-0.02	-0.08	0.01
-high	-0.05	-0.02	-0.03	-0.02	-0.02	-0.03	-0.01	-0.02	-0.01	-0.01	-0.03	-0.02	-0.03	-0.07	-0.01
new persons - low	-0.05%	-0.18%	-0.05%	-0.10%	-0.46%	-0.09%	-0.01%	-0.05%	-0.01%	-0.12%	-0.05%	-0.07%	-0.08%	-0.65%	0.03%
new persons - medium	-0.01%	0.01%	0.02%	0.04%	-0.06%	-0.03%	0.00%	0.02%	0.00%	-0.03%	0.00%	-0.02%	0.01%	-0.06%	0.04%
new persons - high	0.01%	0.07%	-0.01%	0.10%	0.25%	0.08%	0.00%	0.07%	0.01%	0.08%	0.02%	0.04%	0.02%	-0.04%	0.25%

The net wage rate does not take into account the increase of the value added tax.

Source: Simulation results with LMM • Created with Datawrapper

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4.2. Enhancing Employment of Older Workers

Enhancing the labour market participation of older workers is a key issue in order to sustain economic growth, foster social cohesion and improve the sustainability of social security systems across the European Union. Europe's population structure is undergoing significant demographic shifts. According to the baseline scenario of the EUROPOP2019 population projection, the working age population (defined here as the population aged from 20 to 64 years) will decline from 265 million people in 2019 to 247 million in 2035 (i.e., by -6.7 percent compared to 2019) and 221 million in 2060 (-16.6 percent). As Figure 11 illustrates, projections are quite different for the EU Member States. While there will be five countries (Ireland, Cyprus, Luxembourg, Malta and Sweden) with an increasing working age population, many other Member States, in particular Eastern European countries, will see a massive decline of the workforce.

On the other hand, the population aged 65 years and older will grow steadily. According to EUROPOP2019, the old-age dependency ratio (defined as the population aged 65 years and older relative to the population aged between 20 and 64 years), will increase from 34.1 percent in 2019 to 47.2 percent in 2035 (+13.1 p.p.) and 59.2 percent in 2060 (+25.1 p.p.) in the European Union. Put differently, while 2.9 people of working age face one older individual today, this number is projected to decline to 1.7 in 2060. Again, this development will be quite different among Member States, as Eastern European countries are projected to age faster than the average.

Enhancing the employment of older workers is one important means to promote economic growth and improve the sustainability of social security systems. There has already been progress in this direction in the past. In the European Union, the employment rate of elderly workers (aged 55 to 64 years) increased from 43.2 percent in 2009 to 60.5 percent in 2021.[45] The rate currently ranges from 43.8 percent in Romania to 76.9 percent in Sweden. Still, the average effective labour market exit age according to the OECD is pronouncedly lower than the normal retirement age, at 62.6 years (compared to 64.3 years normal age) for men and 61.9 years (compared to 63.5) for women in the EU average.
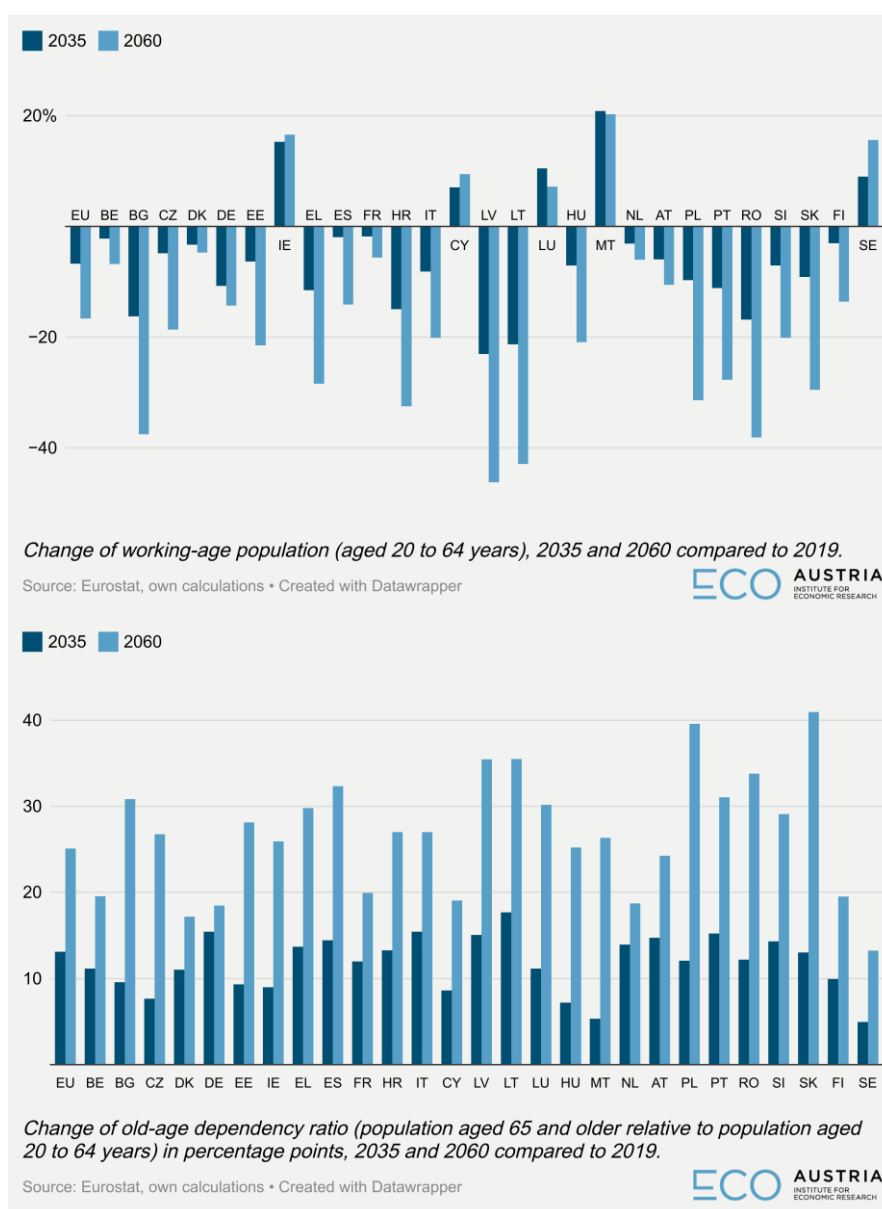
The following policy scenario illustrates the potential labour market and economic effects of incentivising employment for older workers. To do so, we assume an in-work benefit for all employed individuals aged 55 years or older. We simulate a yearly benefit amounting to 1 percent of average yearly labour costs in each of the three skill groups.[46] The benefit only subsidises employment and does not, for instance, increase (the assessment base of) unemployment benefits. For the overall EU-model, the budgetary impact of the in-work benefit amounts to 0.12 percent of GDP (ex-ante, i.e., before taking into account that, for instance, public revenues from taxes on labour income may rise as a result of the

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[45] At the same time, the unemployment rate of people aged 55 years and more declined by 1 percentage point.

[46] This means that the benefit for low-skilled individuals amounts to 1 percent of average labour costs of 55+ low-skilled individuals, the benefit for medium-skilled persons refers to labour costs of medium-skilled workers, etc. This is done in order to provide similar labour market incentives for all educational groups and abstract (to some extent) from distributional impacts of the policy reform in this illustrative scenario.

employment gains that are associated with the policy reform). It is assumed that the benefit is financed via a reduction of lump-sum transfers so that labour market decisions are not distorted by this means of public budget balancing. Furthermore, we concentrate on long-run effects and do not discuss the short- and medium-term impact of the policy reform.

Figure 11: Change of working-age population (upper part) and old-age dependency ratio (lower part), 2035 and 2060 compared to 2019

Change of working-age population (aged 20 to 64 years), 2035 and 2060 compared to 2019.

Source: Eurostat, own calculations • Created with Datawrapper

Change of old-age dependency ratio (population aged 65 and older relative to population aged 20 to 64 years) in percentage points, 2035 and 2060 compared to 2019.

Source: Eurostat, own calculations • Created with Datawrapper

As described in more detail in Part II of the initial project 'Modelling of Labour Markets in the European Union' (Berger et al. 2009), incentives for postponing retirement (i.e., staying in the labour force) can be summarised in an implicit tax rate on retirement/participation. Simplifying to some extent here, this implicit tax rate consists of taxes and social security contributions on labour income minus (in-work) benefits for employed individuals minus unemployment benefits and assistance, augmented by the effective foregone net retirement income if an individual stays in the labour market for

longer. In the case of a higher effective retirement age, an individual 'loses' the net pension benefit, but might benefit from an increase in future pension benefits.[47]

The implicit retirement tax of individuals in the mixed group (i.e., the individuals aged 55 to 69 years who endogenously choose their retirement age) at the EU-level amounts to 21.3, 40.6 and 52.1 percent for low-, medium- and high-skilled persons. Medium-skilled individuals effectively lose 40.6 percent of their gross labour income when they decide to stay in the labour market and postpone retirement. Implicit taxes related to the labour market (e.g., taxes on labour income, unemployment benefits, etc.) contribute 25.6, 39.2 and 50.2 percentage points to the retirement tax. This means that the pension-system-related part has an impact on the retirement tax that is close to zero and even slightly negative for low-skilled persons. According to the model calibration, the deductions for early retirement (of around 4.5 percent per year of early retirement) and the accrual of pension rights largely offset the impact of foregone pension benefits in the calibration of the overall EU-model.

The simulation results for the policy scenario for the EU and the 27 Member-States are shown in Table 49. Given that the in-work benefit is set to 1 percent of labour costs in each of the three skill groups, the 'general equilibrium' implicit tax rate is reduced by somewhat more than 1 percentage point. The reduction strengthens participation incentives for the mixed group and their participation rate increases by 0.18 percentage points. This corresponds to an increase of the effective retirement age of close to 0.4 months. As we follow empirical evidence and implement less elastic labour supply for high-skilled individuals, the impact is slightly less pronounced for high-skilled elderly workers.

Table 49 identifies that the policy reforms have a positive impact on participation rates of the mixed group across all the 27 Member States. However, while the impact is 0.18 percentage points in the overall EU-model, it ranges from a minimum of 0.13 percentage points (in France, Spain and Finland) to maximum values in Denmark, Estonia and Italy (around 0.25 percentage points) and Romania (0.32 percentage points).

Figure 12 depicts a scatterplot of the initial implicit retirement tax and the reform impact on participation rates for elderly medium-skilled individuals and thus illustrates the main driving force of cross-country differences. A high value of the initial implicit retirement tax implies that the public system entails pronounced disincentives to remain in the labour market. The highest value of the retirement tax can be found in Romania at 73 percent for medium-skilled individuals. On the other hand, Spain has the minimum value with 16 percent. Inter alia, this is related to low effective deductions for early retirement (of less than 2 percent per year) in Romania and high values (of 7 percent) in Spain according to the model calibration. Figure 12 illustrates that the reform impact is stronger in the countries where it eases pronounced disincentives to remain in the labour market. The slope of the regression line of the scatterplot indicates that a 10 percentage points higher

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[47] This increase of future pension benefits consists of the impact of actuarial deductions for early retirement. Furthermore, additional pension rights can be accrued by the longer contribution period to the pension system.

initial retirement tax is associated with a 0.03 percentage points more pronounced impact on the participation rate in this policy reform.

Figure 12: Implicit retirement tax vs. participation rate effect of in-work benefit for older workers (for medium-skilled workers aged 55 to 69 years)

Source: Simulation results with LMM • Created with Datawrapper
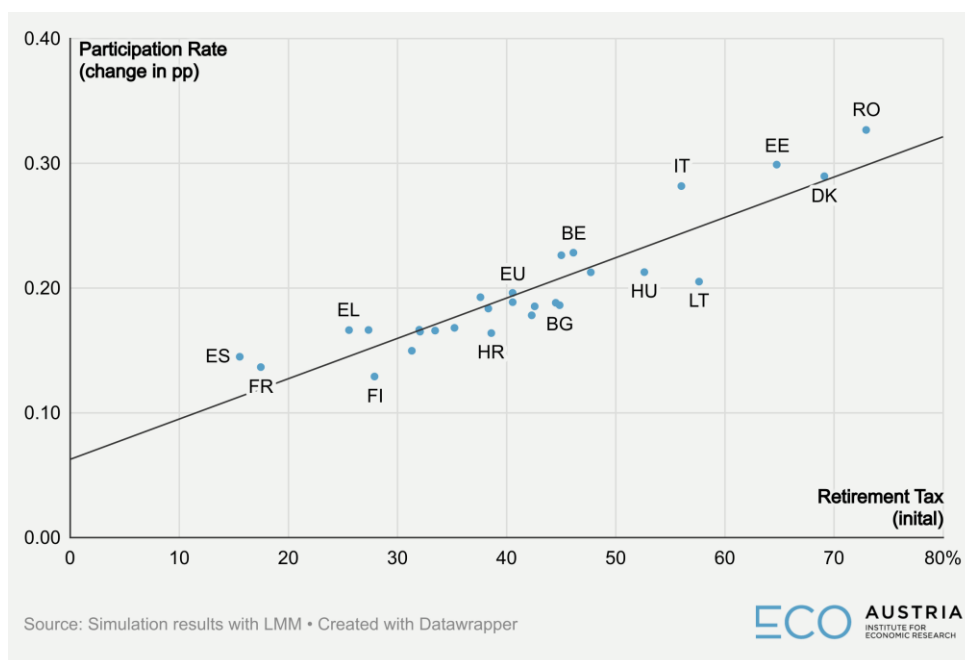
The in-work benefit is only provided to employed individuals, whereas unemployment benefits are not directly affected. Therefore, unemployed individuals increase their search intensity for a job, which reduces unemployment. In addition, the in-work benefit increases the rent of a firm-worker match. This higher rent can be allocated between firm and worker in the bargaining process. This results in a reduction of firms' labour costs for older workers by -0.33 percent and a reduction by -0.04 percent across all age groups.[48] This incentivises labour demand of firms so that the policy reform reduces the unemployment rate of individuals aged 55 and older by 0.12 percentage points according to the LMM results.
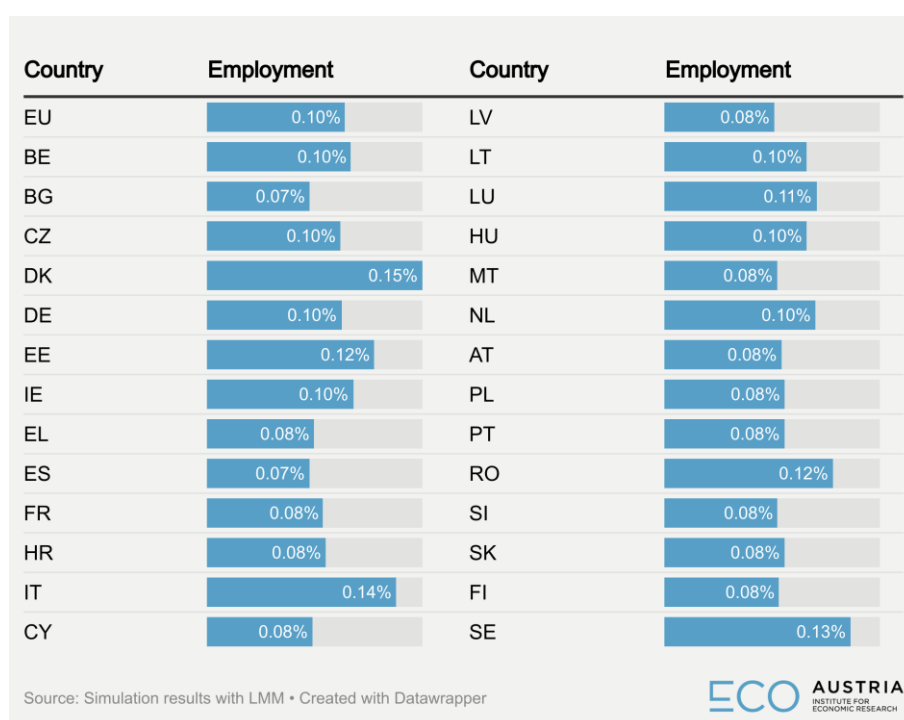
As both participation of older workers increases and their unemployment rate declines, employment of elderly workers rises pronouncedly. In the overall EU-model, the policy reform implies an increase of employment for older workers by 0.5 percent in the long-run. Cross-country differences of the employment impact for older workers are closely related to the participation rate impact. While the most pronounced impact occurs in Romania (0.84 percent), the value is lowest for Spain (0.33 percent) as well as for Cyprus and Finland.

The policy reform induces no direct impact on people aged below 55 years. Thus, labour market outcomes of this group are only affected by indirect effects. Accordingly, the policy reform implies moderate, but non-negligible positive overall labour market outcomes. On

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[48] Note that compositional effects are relevant. The policy reform increases employment of older workers while employment of prime-age workers essentially remains unchanged. Therefore, the share of elderly workers in the workforce increases. Due to above-average wages of this group, this increases average wages as well.

aggregate, the participation rate increases by 0.04 percentage points while the unemployment rate declines by 0.03 percentage points in the overall EU-model. Thus, employment improves by 0.1 percent in the long-run according to the LMM simulation. The employment impact of the policy reform across the Member States is illustrated in Figure 13. The in-work benefit implies positive effects in all the countries, but there is some variation that closely follows the impact on participation rates discussed above. The most pronounced employment effects of around or slightly below 0.15 percent can be found in Denmark, Italy, Romania, and Sweden.

Figure 13: Cross-country employment effect of in-work benefit for older workers

Country	Employment	Country	Employment
EU	0.10%	LV	0.08%
BE	0.10%	LT	0.10%
BG	0.07%	LU	0.11%
CZ	0.10%	HU	0.10%
DK	0.15%	MT	0.08%
DE	0.10%	NL	0.10%
EE	0.12%	AT	0.08%
IE	0.10%	PL	0.08%
EL	0.08%	PT	0.08%
ES	0.07%	RO	0.12%
FR	0.08%	SI	0.08%
HR	0.08%	SK	0.08%
IT	0.14%	FI	0.08%
CY	0.08%	SE	0.13%

Source: Simulation results with LMM • Created with Datawrapper

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Employment rates of more skilled older workers are higher. As the in-work benefit is provided to all employed individuals aged 55 years or more and as the benefit is proportional to average labour costs per skill group, it provides positive incentives to invest into education. In the long-run, the number of high-skilled people rises by 0.07 percent while the number of low-skilled declines by a similar amount. As a result, even though the positive impact on participation and unemployment rates is slightly less pronounced for high-skilled individuals than on average, the number of people in employment (+0.14 percent) increases more strongly than on average (+0.1 percent).

Table 49: Simulation results in-work benefit for older workers

	EU	BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR	HR	IT	CY	LV
GDP	0.12%	0.12%	0.07%	0.09%	0.17%	0.11%	0.11%	0.08%	0.09%	0.11%	0.10%	0.09%	0.16%	0.09%	0.07%
Investment	0.14%	0.14%	0.09%	0.11%	0.20%	0.13%	0.13%	0.07%	0.11%	0.12%	0.11%	0.11%	0.20%	0.11%	0.08%
Consumption	0.06%	0.07%	0.03%	0.03%	0.11%	0.05%	0.05%	0.06%	0.02%	0.06%	0.03%	0.06%	0.06%	-0.03%	0.02%
Trade Balance (change in % of gdp)	0.06%	0.05%	0.04%	0.05%	0.07%	0.06%	0.05%	0.03%	0.06%	0.05%	0.05%	0.03%	0.09%	0.08%	0.04%
Gross wage rate (labour costs per hour)	-0.04%	-0.04%	-0.04%	-0.06%	-0.08%	-0.05%	-0.06%	-0.05%	-0.03%	-0.01%	-0.07%	-0.03%	-0.04%	-0.03%	-0.04%
-low	0.02%	0.03%	-0.02%	0.01%	-0.02%	-0.01%	0.02%	0.04%	-0.01%	0.03%	-0.03%	0.00%	0.03%	-0.01%	0.00%
-medium	-0.01%	0.01%	-0.02%	-0.02%	-0.05%	-0.02%	-0.04%	-0.02%	0.00%	-0.02%	-0.03%	0.00%	-0.03%	-0.02%	-0.02%
-high	-0.10%	-0.10%	-0.07%	-0.14%	-0.12%	-0.12%	-0.09%	-0.08%	-0.06%	-0.04%	-0.11%	-0.09%	-0.12%	-0.05%	-0.07%
Net wage rate	0.33%	0.31%	0.20%	0.23%	0.37%	0.33%	0.26%	0.33%	0.27%	0.37%	0.29%	0.21%	0.40%	0.33%	0.21%
-low	0.27%	0.22%	0.16%	0.15%	0.35%	0.27%	0.19%	0.32%	0.23%	0.27%	0.23%	0.16%	0.29%	0.25%	0.12%
-medium	0.31%	0.28%	0.19%	0.21%	0.35%	0.31%	0.24%	0.30%	0.25%	0.34%	0.26%	0.20%	0.39%	0.31%	0.19%
-high	0.36%	0.34%	0.20%	0.25%	0.38%	0.35%	0.29%	0.34%	0.29%	0.41%	0.31%	0.23%	0.46%	0.35%	0.23%
Participation rate - 15-69 yrs. (change in pp)	0.04	0.05	0.04	0.04	0.06	0.04	0.06	0.04	0.04	0.03	0.03	0.04	0.07	0.04	0.04
-low	0.05	0.05	0.03	0.03	0.08	0.05	0.06	0.05	0.05	0.04	0.04	0.04	0.06	0.04	0.03
-medium	0.05	0.06	0.04	0.05	0.08	0.05	0.07	0.05	0.04	0.04	0.04	0.04	0.07	0.04	0.04
-high	0.03	0.04	0.03	0.03	0.04	0.03	0.04	0.03	0.03	0.02	0.02	0.03	0.05	0.03	0.03
Participation Rate - 55-69 yrs. (change in pp)	0.18	0.20	0.16	0.18	0.24	0.17	0.25	0.15	0.16	0.13	0.13	0.16	0.26	0.14	0.16
-low	0.18	0.17	0.13	0.13	0.28	0.18	0.24	0.14	0.18	0.12	0.13	0.15	0.20	0.14	0.13
-medium	0.20	0.23	0.19	0.18	0.29	0.19	0.30	0.17	0.17	0.14	0.14	0.16	0.28	0.17	0.18
-high	0.14	0.18	0.13	0.16	0.17	0.13	0.17	0.12	0.12	0.10	0.10	0.15	0.25	0.12	0.13
Employment (no. of workers)	0.10%	0.10%	0.07%	0.10%	0.15%	0.10%	0.12%	0.10%	0.08%	0.07%	0.08%	0.08%	0.14%	0.08%	0.08%
-low	0.04%	0.03%	0.06%	0.05%	0.05%	0.05%	0.05%	-0.02%	0.06%	0.02%	0.07%	0.06%	0.07%	0.05%	0.04%
-medium	0.09%	0.08%	0.07%	0.08%	0.15%	0.08%	0.12%	0.10%	0.07%	0.09%	0.07%	0.07%	0.15%	0.07%	0.07%
-high	0.14%	0.14%	0.09%	0.14%	0.20%	0.13%	0.14%	0.13%	0.10%	0.10%	0.10%	0.12%	0.19%	0.09%	0.09%
Unemployment rate (change in pp)	-0.03	-0.02	-0.01	-0.03	-0.06	-0.03	-0.04	-0.04	-0.01	-0.02	-0.03	-0.02	-0.02	-0.02	-0.02
-low	-0.03	-0.03	-0.03	-0.05	-0.09	-0.05	-0.04	-0.05	-0.02	-0.03	-0.05	-0.02	-0.03	-0.02	-0.03
-medium	-0.03	-0.02	-0.02	-0.03	-0.06	-0.03	-0.04	-0.04	-0.01	-0.02	-0.03	-0.02	-0.02	-0.02	-0.03
-high	-0.02	-0.01	-0.01	-0.02	-0.04	-0.02	-0.03	-0.03	-0.01	-0.01	-0.02	-0.01	-0.01	-0.01	-0.01
Unemployment rate (change in pp) 55+	-0.12	-0.07	-0.08	-0.17	-0.25	-0.13	-0.16	-0.14	-0.04	-0.06	-0.15	-0.09	-0.06	-0.08	-0.10
- low	-0.14	-0.14	-0.15	-0.30	-0.33	-0.18	-0.19	-0.15	-0.05	-0.09	-0.28	-0.12	-0.10	-0.11	-0.21
-medium	-0.13	-0.07	-0.08	-0.19	-0.29	-0.13	-0.18	-0.13	-0.06	-0.06	-0.15	-0.11	-0.06	-0.10	-0.13
-high	-0.10	-0.06	-0.05	-0.12	-0.20	-0.12	-0.14	-0.13	-0.03	-0.04	-0.12	-0.07	-0.04	-0.06	-0.07
new persons - low	-0.08	-0.11	-0.03	-0.07	-0.18	-0.08	-0.09	-0.19	-0.04	-0.08	-0.05	-0.04	-0.07	-0.04	-0.05
new persons - medium	-0.01%	-0.03%	-0.01%	-0.02%	-0.02%	-0.02%	-0.02%	-0.01%	-0.02%	0.02%	-0.02%	-0.02%	0.02%	-0.02%	-0.02%
new persons - high	0.07%	0.08%	0.04%	0.07%	0.10%	0.07%	0.05%	0.07%	0.05%	0.06%	0.05%	0.06%	0.10%	0.03%	0.04%
Volume (in % of GDP)	0.12%	0.12%	0.10%	0.09%	0.13%	0.13%	0.11%	0.09%	0.11%	0.14%	0.12%	0.08%	0.14%	0.14%	0.09%

Source: Simulation results with LMM • Created with Datawrapper

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Table 49 (contd.): Simulation results in-work benefits for older workers

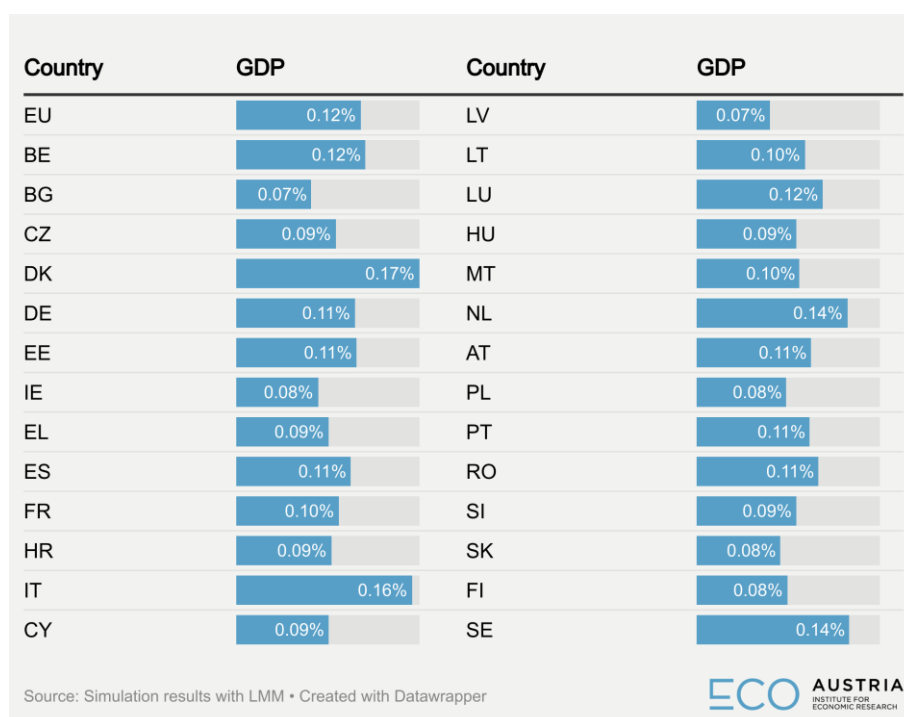|	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE	min	max
GDP	0.10%	0.12%	0.09%	0.10%	0.14%	0.11%	0.08%	0.11%	0.11%	0.09%	0.08%	0.08%	0.14%	0.07%	0.17%
Investment	0.12%	0.16%	0.11%	0.12%	0.17%	0.13%	0.10%	0.13%	0.13%	0.11%	0.09%	0.10%	0.17%	0.07%	0.20%
Consumption	0.02%	0.10%	0.04%	0.06%	0.08%	0.02%	0.00%	0.01%	0.06%	0.05%	0.02%	0.02%	0.05%	-0.03%	0.11%
Trade Balance (change in % of gdp)	0.07%	0.04%	0.05%	0.04%	0.07%	0.06%	0.06%	0.07%	0.04%	0.04%	0.05%	0.05%	0.07%	0.03%	0.09%
Gross wage rate (labour costs per hour)	-0.04%	0.00%	-0.03%	-0.02%	-0.02%	-0.05%	-0.03%	-0.02%	-0.02%	-0.02%	-0.04%	-0.05%	-0.08%	-0.08%	0.00%
-low	0.02%	0.05%	-0.02%	0.02%	0.06%	0.00%	0.01%	0.00%	0.00%	0.02%	-0.03%	0.00%	-0.03%	-0.03%	0.06%
-medium	-0.01%	0.04%	-0.02%	-0.02%	0.01%	-0.01%	-0.01%	-0.03%	0.00%	0.02%	-0.02%	-0.03%	-0.06%	-0.06%	0.04%
-high	-0.07%	-0.05%	-0.07%	-0.05%	-0.08%	-0.11%	-0.07%	-0.06%	-0.06%	-0.08%	-0.10%	-0.08%	-0.12%	-0.14%	-0.04%
Net wage rate	0.28%	0.32%	0.21%	0.26%	0.44%	0.32%	0.24%	0.34%	0.20%	0.25%	0.23%	0.32%	0.45%	0.20%	0.45%
-low	0.18%	0.20%	0.13%	0.19%	0.34%	0.22%	0.16%	0.25%	0.19%	0.19%	0.15%	0.25%	0.36%	0.12%	0.36%
-medium	0.25%	0.25%	0.20%	0.25%	0.41%	0.29%	0.22%	0.32%	0.20%	0.22%	0.21%	0.29%	0.41%	0.19%	0.41%
-high	0.30%	0.35%	0.25%	0.28%	0.48%	0.36%	0.27%	0.39%	0.20%	0.28%	0.26%	0.35%	0.49%	0.20%	0.49%
Participation rate - 15-69 yrs. (change in pp)	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.07	0.04	0.04	0.03	0.05	0.03	0.07
-low	0.03	0.05	0.04	0.04	0.05	0.03	0.04	0.04	0.07	0.04	0.03	0.04	0.05	0.03	0.08
-medium	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.05	0.07	0.04	0.05	0.04	0.06	0.04	0.08
-high	0.04	0.03	0.04	0.03	0.03	0.03	0.03	0.04	0.06	0.03	0.03	0.03	0.04	0.02	0.06
Participation Rate - 55-69 yrs. (change in pp)	0.20	0.18	0.20	0.15	0.16	0.15	0.18	0.18	0.32	0.16	0.18	0.13	0.20	0.13	0.32
-low	0.10	0.16	0.16	0.15	0.17	0.12	0.15	0.17	0.30	0.16	0.13	0.11	0.17	0.10	0.30
-medium	0.21	0.19	0.21	0.17	0.17	0.15	0.19	0.21	0.33	0.17	0.19	0.13	0.23	0.13	0.33
-high	0.19	0.16	0.17	0.12	0.12	0.13	0.15	0.15	0.28	0.15	0.16	0.12	0.18	0.10	0.28
Employment (no. of workers)	0.10%	0.11%	0.10%	0.08%	0.10%	0.08%	0.08%	0.08%	0.12%	0.08%	0.08%	0.08%	0.13%	0.07%	0.15%
-low	0.03%	0.03%	0.08%	0.04%	0.00%	0.03%	0.05%	0.06%	0.11%	0.03%	0.08%	0.02%	0.06%	-0.02%	0.11%
-medium	0.08%	0.09%	0.09%	0.10%	0.10%	0.06%	0.07%	0.10%	0.11%	0.06%	0.07%	0.07%	0.12%	0.06%	0.15%
-high	0.12%	0.15%	0.12%	0.11%	0.15%	0.12%	0.10%	0.11%	0.13%	0.11%	0.11%	0.10%	0.15%	0.09%	0.20%
Unemployment rate (change in pp)	-0.03	-0.04	-0.03	-0.02	-0.04	-0.03	-0.02	-0.02	-0.01	-0.02	-0.02	-0.03	-0.06	-0.06	-0.01
-low	-0.03	-0.06	-0.07	-0.03	-0.09	-0.05	-0.03	-0.03	-0.01	-0.02	-0.04	-0.03	-0.06	-0.09	-0.01
-medium	-0.03	-0.03	-0.03	-0.01	-0.04	-0.03	-0.02	-0.02	-0.01	-0.02	-0.02	-0.03	-0.05	-0.06	-0.01
-high	-0.03	-0.03	-0.01	-0.01	-0.03	-0.01	-0.01	-0.01	0.00	-0.01	-0.01	-0.02	-0.05	-0.05	0.00
Unemployment rate (change in pp) 55+	-0.14	-0.19	-0.18	-0.08	-0.17	-0.12	-0.10	-0.09	-0.02	-0.09	-0.10	-0.13	-0.23	-0.25	-0.02
- low	-0.15	-0.38	-0.58	-0.12	-0.37	-0.26	-0.14	-0.12	-0.03	-0.08	-0.26	-0.12	-0.23	-0.58	-0.03
-medium	-0.16	-0.16	-0.19	-0.07	-0.14	-0.13	-0.12	-0.09	-0.03	-0.11	-0.11	-0.15	-0.22	-0.29	-0.03
-high	-0.12	-0.16	-0.08	-0.05	-0.14	-0.07	-0.07	-0.06	-0.01	-0.06	-0.06	-0.12	-0.24	-0.24	-0.01
new persons - low	-0.06	-0.11	-0.06	-0.06	-0.18	-0.08	-0.05	-0.03	-0.02	-0.07	-0.04	-0.09	-0.09	-0.19	-0.02
new persons - medium	-0.02%	-0.02%	-0.01%	0.02%	0.00%	-0.03%	-0.02%	0.01%	-0.01%	-0.02%	-0.02%	-0.02%	-0.01%	-0.03%	0.02%
new persons - high	0.03%	0.06%	0.05%	0.06%	0.08%	0.07%	0.04%	0.05%	0.04%	0.06%	0.05%	0.04%	0.04%	0.03%	0.10%
Volume (in % of GDP)	0.11%	0.10%	0.07%	0.10%	0.13%	0.12%	0.09%	0.12%	0.07%	0.10%	0.08%	0.12%	0.14%	0.07%	0.14%

Source: Simulation results with LMM • Created with Datawrapper

According to Mincer regressions, workers aged above 55 years, who are the beneficiaries of the simulated in-work benefit, have above-average wages that are associated to above-average individual productivities in the LMM calibration. Thus, the employment gain 'in productive units' is slightly more pronounced than the employment gain 'in persons'. As the employment gain increases the rate of return of investment, it is complemented by a long-run increase of the capital stock by 0.14 percent in the overall EU-model. As the input factors capital stock and (low-, medium- and high-skilled) employment rise, GDP grows by 0.12 percent as a result of the policy reform. Even though the in-work benefits are financed via a reduction of lump-sum transfers, the increase of employment implies

that disposable income of private households increases. Therefore, private consumption rises by 0.06 percent in the overall EU-model.

Cross-country GDP effects of the in-work benefit are illustrated in Figure 14. Again, there are positive GDP effects for all Member States, but there is some variation in magnitude. According to the LMM simulations, the most pronounced effects of around 0.15 percent can be found in Denmark, Italy, the Netherlands, and Sweden. These cross-country differences closely follow the employment effects. However, it is useful to analyse Romania in a bit more detail to illustrate that other characteristics of the LMM calibration can have an impact as well. Romania is among the countries where participation and employment effects of the reform are highest. However, according to Mincer regressions, Romania has a flatter wage profile in the sense that average wages of older workers are only moderately higher than the countrywide average. Given that 'individual productivities' are associated with wages in the LMM, this characteristic implies a less pronounced GDP impact than in other countries. Thus, while employment effects are among the highest in Romania, the GDP impact is modest.

Figure 14: Cross-country GDP impact of in-work benefit for older workers

Country	GDP	Country	GDP
EU	0.12%	LV	0.07%
BE	0.12%	LT	0.10%
BG	0.07%	LU	0.12%
CZ	0.09%	HU	0.09%
DK	0.17%	MT	0.10%
DE	0.11%	NL	0.14%
EE	0.11%	AT	0.11%
IE	0.08%	PL	0.08%
EL	0.09%	PT	0.11%
ES	0.11%	RO	0.11%
FR	0.10%	SI	0.09%
HR	0.09%	SK	0.08%
IT	0.16%	FI	0.08%
CY	0.09%	SE	0.14%

Source: Simulation results with LMM • Created with Datawrapper

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4.3. Migration

The third part of the illustrative LMM simulation scenarios concerns the labour market and macroeconomic impact of migration towards the European Union.[49]

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[49] Note that the current analysis is done with the base migration version of EU-LMM. In this base version, it is assumed that migrants in a particular age-and-skill group share the same labour market characteristics as their native counterparts.

In a nutshell, the theoretical and empirical literature on labour market effects of inward migration can be summarised in the following way. In a standard model with one type of labour, higher labour supply can decrease wages and/or increase the unemployment rate in the short-run, as long as there are rigidities like for the adjustment of the capital stock; see for instance Levine (1999) and Boeri and Brücker (2005). However, as e.g., the capital stock adjusts to the supply shock in the medium- and long-run, the impact on wages and unemployment vanishes and employment and GDP rise in line with the working-age population (see e.g., Barrell et al. 2006 and Brücker and Jahn 2011). This fundamental result is, however, adjusted in the literature for several reasons. Among them, the skill structure of migrants being different to the native population, (more pronounced) mismatch of migrants' qualifications and job requirements and the issue of (im-)perfect substitution or complementarity between migrants and natives[50] can be mentioned.

In our 'standard migration scenario', we analyse short- and medium-term effects of the same relative magnitude of migration inflows to the overall EU and to each of the 27 Member States. It is assumed that a total number of 1 percent of EU-LMM's age groups that form the working-age population (i.e., the 15-to-69 year olds) migrates towards the EU, within a period of two years (i.e., 0.5 percent in each of the years). Furthermore, we assume that these people have exactly the same age and skill structure as the EU's resident population. This means that 21 percent of migrants are low-, 46 percent are medium- and 33 percent are high-skilled individuals. As a consequence of this assumption, we abstract from compositional effects for the EU-model that is analysed in a first step. In a second step, we will illustrate cross-country results and assume that the migrants are allocated towards the 27 Member States according to the population size. The skill structure of migrants is therefore the same for all countries, but it differs from the respective resident population.

Simulation Results for the EU-model

The positive labour supply shock induced by migration is not fully absorbed in the short-run, in particular due to a delayed adjustment of the capital stock and labour adjustment costs.[51] Thus, we observe a short-run increase of the unemployment rate of 0.09 percentage points in the EU-model, see Figure 15.[52] However, the hike disappears when the economy adjusts to the supply shock. The unemployment impact is fairly evenly distributed across the three educational groups. Given that the adjustment of the capital stock due the additional labour supply takes some time, the capital-labour ratio declines in

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[50] This issue is, for instance discussed among Borjas (2003) and Ottaviano et al. (2006).

[51] Note that we do not adjust the variable *'empl'* in this illustrative policy scenario. This variable depicts the share of participating individuals who have a job right at the beginning of a period without the need to find a match in the job-search-vacancy-framework in our 'static matching' model. In the context of migration, this modelling approach implies that a considerable number of the migrants who enter the economy and participate in the labour market will find a job without the need for matching. In a more detailed modelling exercise that is beyond the scope of the current illustrative scenario, one might reflect the extent to which the variable *'empl'* should be adjusted to take into account this feature.

[52] A remark concerning the timing of migration in EU-LMM is necessary here. In year 1 of a dynamic analysis, the demography is the same as the calibrated demography. This means that the model allows for migration changing the demography from year 2 of a dynamic simulation. Given that individuals and firms have perfect foresight in the model, they already 'know' that migration takes place and firms partially adjust their capital stock 'in advance'.

the short-run. Due to capital-skill-complementarity, the lower capital-labour ratio implies a more pronounced productivity and wage decline for skilled individuals. Thus, firms demand for high-skilled individuals rises less pronouncedly than for lower-skilled individuals and labour supply incentives of high-skilled individuals decline to some extent. This results in a stronger reaction of the unemployment rate for high-skilled individuals. However, as the labour market for high-skilled people is less responsive to incentives than the labour market for lower-skilled people, this dampens the non-even impact.

Figure 15: Unemployment rate impact of 'standard migration shock', EU-model
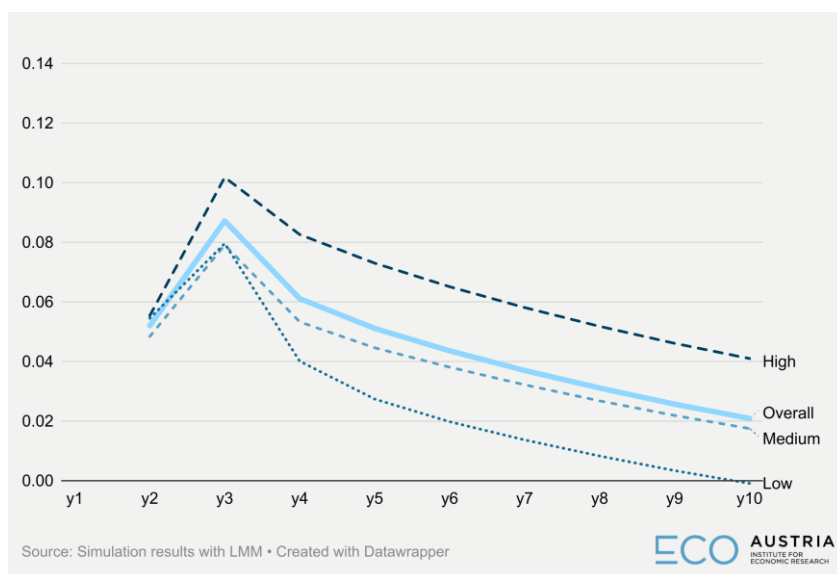
The positive labour supply shock exerts a significant influence on employment, as illustrated in Figure 16. As the adjustment of the economy and the labour market takes time (in particular due to labour and capital adjustment costs), the employment impact in period 3 (0.79 percent) is less than 1 percent.[53] In the following years, two counteracting effects prevail. On the one hand, the impact of frictions becomes less pronounced (see also the impact on the unemployment rate in Figure 15), which strengthens the employment impact. On the other hand, as we assume exactly the same demographic structure of migrants as for the resident population, some older migrants leave the labour market within a few years, which dampens the employment impact. Thus, the overall employment impact is close to 0.9 percent and 'remains' at this level in the following years. The employment increase is fairly evenly distributed across the three different educational levels. As discussed above, the impact is slightly less pronounced for high-skilled individuals due to capital-skill complementarity.

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[53] Note that we assume the same labour market characteristics (e.g., participation and unemployment rates per age- and skill-group) for migrants and the resident population. Thus, the employment impact would be 1 percent if there were no general equilibrium or 'displacement' effects.

Figure 16: Employment impact of 'standard migration shock', EU-model

Source: Simulation results with LMM • Created with Datawrapper
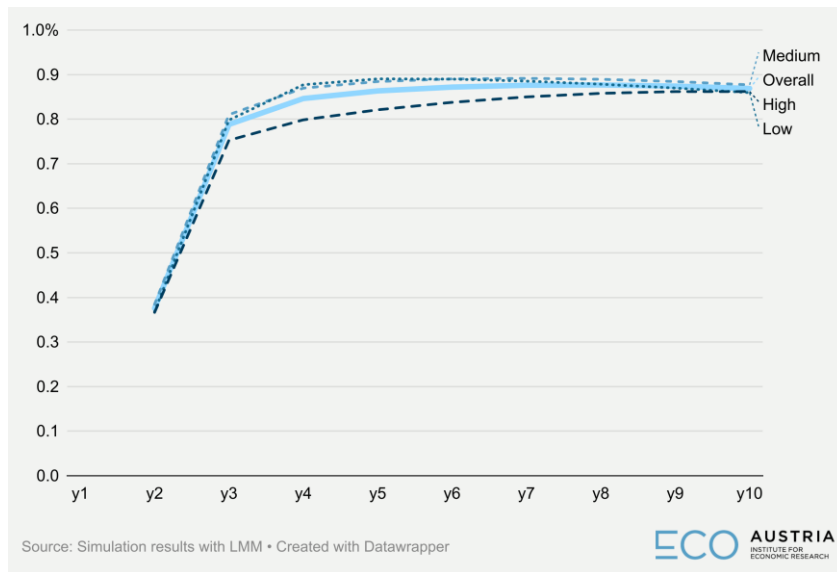
The temporary decline of the capital-labour ratio reduces labour productivity leading to lower wages (this can be called 'displacement effect'). The aggregate wage impact is most pronounced in year 3 with -0.54 percent in the overall EU-model. The wage effect declines over time as the capital stock adjusts to the labour supply shock and reaches -0.18 percent in year 10 (and further declines in the following years). Again, the impact is more pronounced for high-skilled individuals. According to the LMM simulations, their wages decline by 0.69 percent in year 3 (compared to 0.54 percent overall, 0.42 percent for medium-skilled and 0.31 percent for low-skilled individuals).

Figure 17: Wage impact of 'standard migration shock', EU-model

Source: Simulation results with LMM • Created with Datawrapper
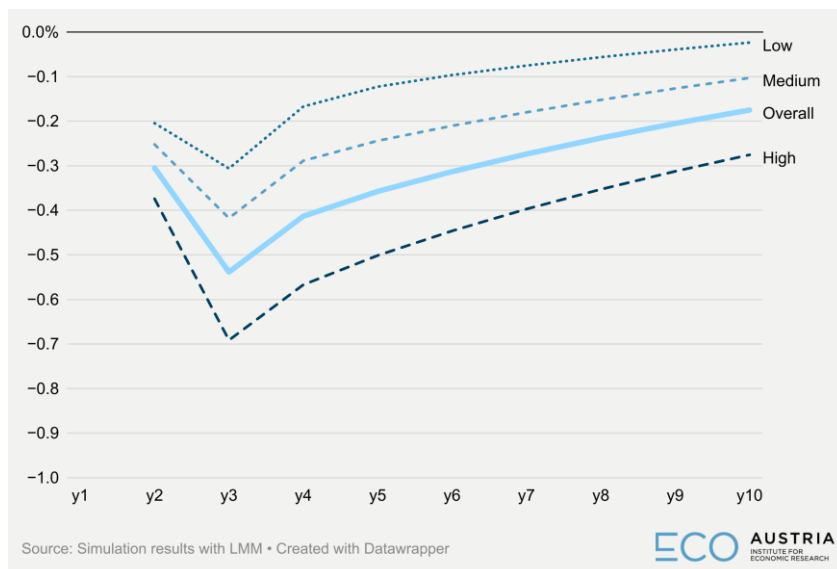
The impact on macroeconomic aggregates is illustrated in Figure 18. As the gradual adjustment of the capital stock (due to installation costs) reduces average labour productivity, the short- and medium-run impact on GDP is less pronounced than the

employment impact. In year 3, GDP rises by 0.61 percent according to LMM simulations, compared to employment with 0.79 percent. The ongoing adjustment of the capital stock implies that GDP rises by 0.81 percent in year 10. This can be compared to an increase of the 'working-age population' (aged between 15 and 69 years) by 1 percent and an increase of the total population by 0.7 percent caused by the migration shock. While GDP per working-age population declines to some extent in the short- and medium-term, GDP per capita increases somewhat in the medium-term.

Figure 18: Macroeconomic impact of 'standard migration shock', EU-model
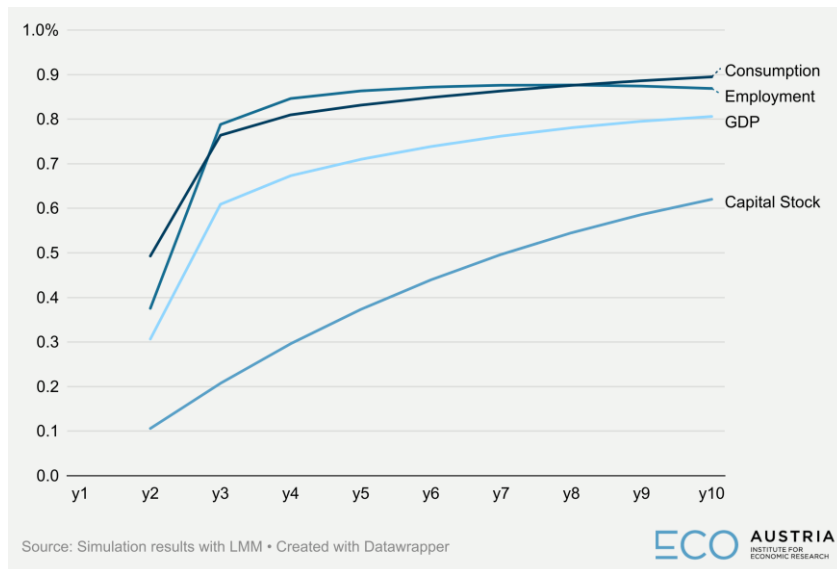
The gradual adjustment of the capital stock is illustrated in Figure 18 as well. The migration shock implies higher investment and an increase of the capital stock by 0.21 percent in year 3 and 0.62 percent in year 10. Given that the analysed migration scenario improves the fiscal position in the short- and medium-term, revenues above the threshold to balance the budget are returned to private households via lump-sum transfers. Accordingly, the impact on private consumption is more pronounced than the GDP impact.

Table 50: Simulation results 'standard migration shock', EU-model

	y1	y2	y3	y4	y5	y6	y7	y8	y9	y10
GDP		0.31%	0.61%	0.67%	0.71%	0.74%	0.76%	0.78%	0.80%	0.81%
Investment		1.58%	1.50%	1.42%	1.34%	1.27%	1.20%	1.14%	1.08%	1.03%
Capital Stock		0.11%	0.21%	0.30%	0.37%	0.44%	0.50%	0.55%	0.59%	0.62%
Consumption		0.49%	0.76%	0.81%	0.83%	0.85%	0.86%	0.88%	0.89%	0.89%
Trade Balance (change in % of gdp)		−0.38%	−0.29%	−0.23%	−0.19%	−0.15%	−0.12%	−0.10%	−0.07%	−0.06%
Gross wage rate (labour costs per hour)		−0.30%	−0.54%	−0.41%	−0.36%	−0.31%	−0.27%	−0.24%	−0.21%	−0.18%
-low		−0.20%	−0.31%	−0.17%	−0.12%	−0.10%	−0.08%	−0.06%	−0.04%	−0.02%
-medium		−0.25%	−0.42%	−0.29%	−0.24%	−0.21%	−0.18%	−0.15%	−0.13%	−0.10%
-high		−0.37%	−0.69%	−0.57%	−0.50%	−0.45%	−0.40%	−0.35%	−0.31%	−0.28%
Net wage rate		−0.30%	−0.53%	−0.40%	−0.35%	−0.30%	−0.27%	−0.23%	−0.20%	−0.17%
-low		−0.20%	−0.30%	−0.17%	−0.12%	−0.10%	−0.08%	−0.06%	−0.04%	−0.03%
-medium		−0.25%	−0.41%	−0.29%	−0.24%	−0.21%	−0.18%	−0.15%	−0.13%	−0.10%
-high		−0.37%	−0.69%	−0.56%	−0.50%	−0.44%	−0.40%	−0.35%	−0.31%	−0.27%
Participation rate - 15-69 yrs. (change in pp)		−0.04	−0.07	−0.04	−0.02	−0.01	0.00	0.01	0.02	0.02
-low		−0.04	−0.06	−0.03	−0.02	−0.02	−0.01	−0.01	−0.01	−0.01
-medium		−0.04	−0.07	−0.03	−0.02	−0.01	0.00	0.01	0.02	0.02
-high		−0.05	−0.08	−0.05	−0.03	−0.01	0.01	0.03	0.04	0.05
Employment (no. of workers)		0.38%	0.79%	0.85%	0.86%	0.87%	0.88%	0.88%	0.87%	0.87%
-low		0.37%	0.80%	0.88%	0.89%	0.89%	0.89%	0.88%	0.87%	0.86%
-medium		0.38%	0.81%	0.87%	0.88%	0.89%	0.89%	0.89%	0.88%	0.88%
-high		0.37%	0.75%	0.80%	0.82%	0.84%	0.85%	0.86%	0.86%	0.86%
Unemployment rate (change in pp)		0.05	0.09	0.06	0.05	0.04	0.04	0.03	0.03	0.02
-low		0.05	0.08	0.04	0.03	0.02	0.01	0.01	0.00	0.00
-medium		0.05	0.08	0.05	0.04	0.04	0.03	0.03	0.02	0.02
-high		0.06	0.10	0.08	0.07	0.07	0.06	0.05	0.05	0.04

Source: Simulation results with LMM • Created with Datawrapper

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**Simulation Results for Individual Member States**

In a second step, we replicate the standard migration shock for each of the 27 Member States. We assume an inward migration of 1 percent of EU-LMM's age groups that form the working-age population (i.e., the 15-to-69 year olds) and that these migrants are allocated to the Member States according to population size. Furthermore, the age and skill structure is exactly the same as the 15-to-69 year old resident population in the overall EU-model.

Even though the assumed migration scenario does not alter the skill structure in the overall EU-model, it may have an impact at a Member States' level. For countries with a high share of low-skilled individuals in the resident population, it shifts the population structure towards higher skills and vice versa for countries with a low share. However, one should keep in mind that this shift is rather moderate. For instance, the share of low-skilled individuals declines from 44.6 to 44.4 percent in Portugal.

Figure 19 illustrates the employment impact of the standard migration inflow for the overall EU-model, the five most populous Member States (Germany, France, Italy, Spain, and

Poland) and the two countries with the strongest (Portugal) and weakest impact (Lithuania) after five years. In general, the employment impact is rather similar across all 27 Member States, but there is some dispersion across countries. While it is 0.86 percent in the overall EU-model in year 5, it ranges from 0.74 percent in Lithuania to 0.93 percent in Portugal. The three countries with an employment impact of more than 0.9 percent are Portugal, Italy, and Malta, while the employment impact is less than 0.8 percent in Lithuania, Slovakia, Ireland, Hungary, and Latvia. The main factor of cross-country differences is the skill structure in the resident population. For instance, Portugal, Malta, and Italy have the highest shares of low-skilled individuals in the resident population, see also Table 10 in chapter 2.2. Thus, the migrants are on average more highly educated than the resident population, which is associated with more beneficial labour market integration in terms of participation and unemployment rates. This implies more-than-average employment impacts of the migration shock.

Figure 19: Employment impact of 'standard migration shock', individual MS

Source: Simulation results with LMM • Created with Datawrapper
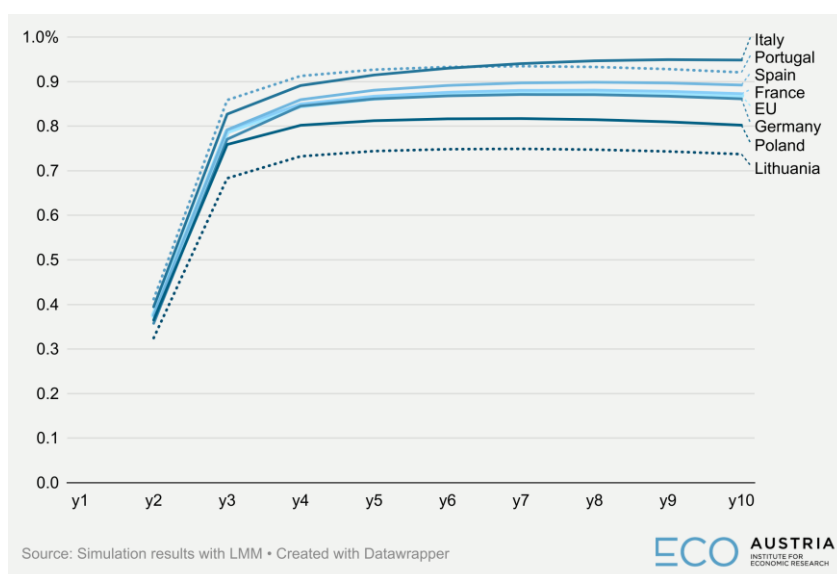
Similarly, Figure 20 illustrates the impact on wages (average labour costs per hour worked) in the five most populous countries and in the countries with the most (Romania) and least pronounced (Denmark) wage impact in year 3 (which is the year with the strongest deviation from baseline values). While the wage effect is -0.54 percent in year 3 in the EU-model, it ranges from -0.43 percent in Denmark to -0.68 percent in Romania. As already discussed above, the average wage impact declines to -0.18 percent in year 10, but some dispersion remains (the impact ranges from -0.12 percent in Denmark to -0.23 percent in Romania).

Figure 20: Wage impact of 'standard migration shock', individual MS

Source: Simulation results with LMM • Created with Datawrapper
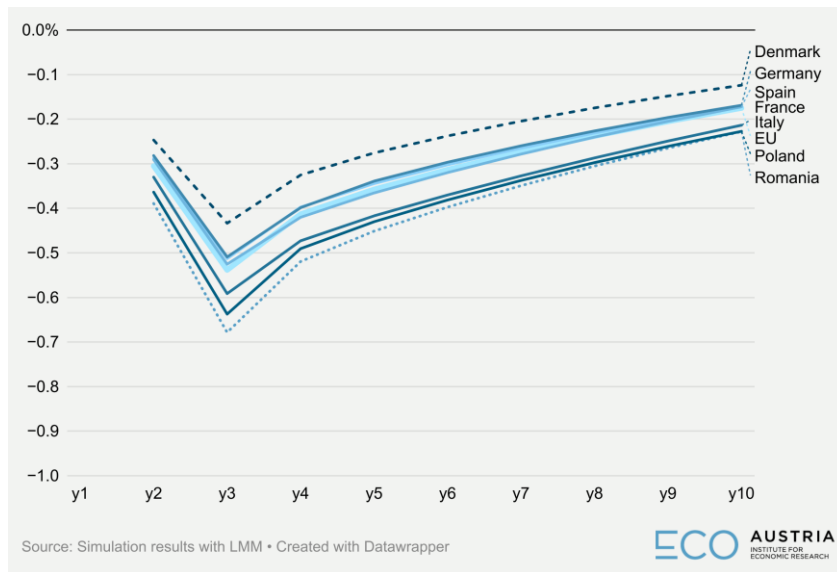
Figure 21: Difference in skill structure vs. wage impact in year 3, 'standard migration shock'

Skill Structure: Absolute Difference of Migrant vs. Resident Population, in percentage points

Source: Simulation results with LMM • Created with Datawrapper
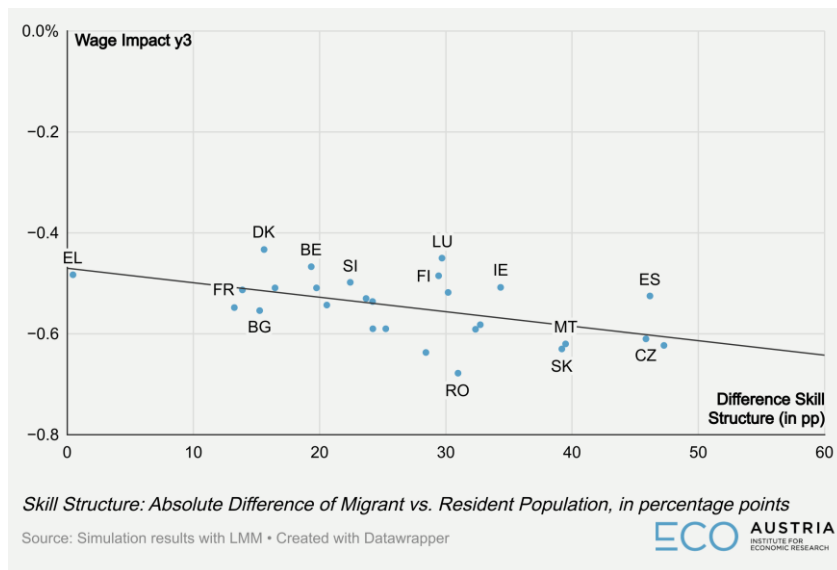
The influence of the skill structure on wages is shown in Figure 21. As a proxy, we sum the 'absolute difference in the skill structure' of migration versus the resident population. For instance, this absolute difference is 2.5 (21 minus 18.5 for low-skilled, see Table 10) plus 4.5 (46.3 minus 41.8) plus 6.9 (absolute of 32.8 minus 39.7), i.e., 13.9 percentage points for France. If the migration structure is very different to the population structure, this implies a more pronounced impact on the skill structure of workers. As a result, marginal productivities and thus wages decline more pronouncedly in the short- and medium-run when the economy has not yet adjusted to the migration shock.

Finally, the GDP impact in the Member States is shown in Figure 22. Ireland is a special case again. As GDP based on the model's production function is about 65 percent of official GDP and as the migration shock boosts only this part of GDP, this reduces the

official GDP impact. However, if we neglect Ireland, cross-country differences with respect to GDP are slightly more pronounced than for employment. The GDP effect in year 5 is 0.71 percent for the EU-model and ranges from 0.56 percent for Lithuania to 0.82 percent in Portugal. In Portugal, for instance, the educational level of migrants is higher than the resident population. Apart from higher employment rates, this results in higher productivity, which boosts GDP. The argumentation is vice versa for Member States with an already highly educated population. Similar to employment, the GDP impact is most pronounced for Portugal and Italy.

Figure 22: GDP impact of 'standard migration shock', individual MS

Source: Simulation results with LMM • Created with Datawrapper
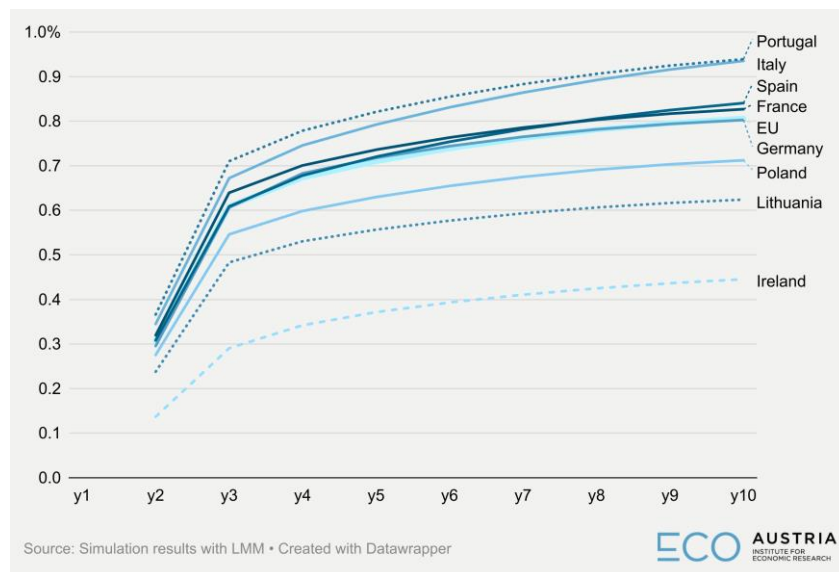
5. Annex: Specific Information for Modelling Experts

5.1. Corrections for Ireland and Countries with a High Trade Balance

The model distinguishes between gva and $gva*$ (as well gdp and $gdp*$, i and $i*$, k and $k*$, and tb and $tb*$). In most countries the values of the corresponding variables are set to the same value and it does not matter which one to take. In five countries, the values differ and reflect special circumstances. The countries are Ireland, Luxembourg, Malta, the Netherlands, and Slovenia. In all countries, the high value of the trade balance implies implausible private assets[54] if the model is calibrated without adjustments. There are also good justifications (see discussion in Section 2.1) for these adjustments. We assume that part of the high positive trade balance, named $tbcorr$ in the model, cannot be attributed to output of the production function within a country but is caused by accounting rules in the System of National Accounts. If a policy scenario is simulated, the variable $tbcorr$ is kept constant. The trade balance based on production is assigned to tb and $tb*$ equals the trade balance of the System of National Accounts, i.e., $tb* = tb + tbcorr$. As the trade balance also influences the value of GVA and GDP, these variables are also adjusted, i.e., $gva* = gva + tbcorr$ and $gdp* = gdp + tbcorr$. As $tbcorr = 0$ in most countries, the corresponding values are the same.

For Ireland, not only the trade balance but also the level of investment is adjusted due to the massive inflow of foreign direct investment. In the same way as for the trade balance, the level of investment related to the production within the country is labelled by i, whereas $i*$ also includes depreciation of foreign direct investment capital stock and $icorr$ being used in production in other countries. The capital stock k is based on i and the corresponding depreciation rate δ (all three variables related to production in Ireland itself), the variable $k*$ is defined as $k* = k + kcorr$, with $kcorr$ reflecting the capital stock related to $icorr$ and δcorr. As this adjustment influences GVA and GDP we derive the System of National Account's GVA and GDP in Ireland by $gva* = gva + tbcorr + icorr$ and $gdp* = gdp + tbcorr + icorr$.

5.2. Income Taxation and Social Security Contributions

This section provides information on the implementation of country-specific institutional details concerning income taxation and social security contributions in LMM.

Belgium

The non-earning spouse allowance (which implies that a notional amount of income can be transferred between spouses under certain conditions) is taken into account in the

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[54] This results from the balanced growth path assumption in calibration.

calibration of tax rates. It is explicitly considered in the Stata-File, so that this procedure involves a non-standard way of deriving the parameter-file TaxBelgium.xlsx.[55]

Czechia

The assessment base for income taxation is gross earnings augmented with employer social security contributions, a possibility that is not explicitly implemented in the labour market model. Our approach is to implement

$$xtax = -\frac{tf}{ts} => \text{ } taxable \text{ } income = (1 - xtax * ts) * incgross = (1 + tf) * incgross,$$

where '*tf*' and '*ts*' are employer and the employee contribution rates.

Denmark

Differently to the previous update for Denmark in Berger et al. (2012), we now include the Labour Market Contribution in the income tax rate (and not in social security contributions) as this was also changed in the OECD TaxBEN-model.

The flat social security contributions of employees are deductible from taxable income, but a flat, deductible contribution is not included in LMM. Thus, we calculate a 'net flat' contribution of '*(1-tw)*flat*', which is reflected in '*zw*' and '*zu*' in the model. Furthermore, as we do not assume deductibility of the flat contribution in the calibration of the tax rates (TaxDenmark-file), this allowance is implicitly taken into account via lower income tax rates. This approximation replicates the system in sufficient detail. Differently to the previous Denmark LMM update, employee contributions to unemployment insurance are no longer defined as social security contributions in Danish national accounts. Thus, they are no longer included in the calibration of '*revenssc*' in LMM.

As we take into account occupational pensions in LMM, which are not considered in the OECD-TaxBEN-model, we increase the employer contribution rate by 12 percentage points (the average contribution rate according to *Pensions at a Glance*) times the coverage of 90 percent in the TaxDenmark-file.

Germany

The TaxBEN model does not include the statutory occupational insurance for work injuries 'as it is not possible to identify a representative contribution rate'. It is, however, implicitly implemented in the calibration of the LMM as we increase contribution rates in order to replicate aggregate social security revenues.

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[55] For instance, application of the TaxBEN model of the OECD for a couple with one earner would take into account the spouse allowance in the parameter file. As we consider the allowance on our own in the Stata-File, we do not want this reduction of income taxes to be included in the parameter file TaxBelgium. Therefore, we use the 'Single' sheets for the '1Earner' and the 'Principal' sheets.

Ireland

The Family Income Supplement is a support for low-income families in which the principal earner and/or the spouse are in full-time employment. Following the OECD TaxBEN model, we implement it as an in-work benefit decreasing income tax rates. Following Euromod (see Doorley and McTague, 2021), we assume a take-up rate of the benefit of 33 percent.

Spain

In general, individuals are taxed separately in Spain, but families can opt to be taxed as married couples or as heads of households. Notice, however, that this is different to a splitting system. The TaxBEN model calculates tax liabilities on the basis of these different options and assumes that households opt for the more beneficial situation. That way, this system is also taken into account when calibrating tax rates in LMM.

France

Social security contributions in the TaxBEN model include 'other' contributions such as the supplemental pension, the CEG and the CET. These contributions also take into account reductions of employer-paid social insurance contributions. The supplemental pension is also taken into account in the modelling of the pension system; see Section 2.9.

CSG and CRDS are part of the income tax in the TaxBEN model and in *Revenue Statistics.* The assessment base of the CSG and the CRDS is 98.25 percent of gross pay and CSG is partly deductible for income taxation. We follow the OECD and categorise these two contributions as income tax. For simplicity, we assume that these contributions have the same assessment base as the income tax. Given that we make this assumption both in the TaxFrance-file and in LMM, this method delivers appropriate results. Compulsory employer and employee contributions are deductible for income taxation (except for CSG and CRDS). As the latter two are part of our income tax, we can set '*xtax*'=1.

The in-work benefit to promote a return to full-time work for low-income households is taken into account in the calibration of average tax rates. However, application of the standard OECD-TaxBEN-results-into-EU-SILC-data-approach would result in much too high expenditures of the in-work benefit. Thus, we rescale the in-work benefit rates in order to get the right amount of aggregate expenditures, which is done in the file 'EUSILC_variables_fr2022.xlsx'.

Netherlands

The TaxBEN model includes several contributions (premia to occupational pensions, employee contributions for basic health insurance, employer contributions for medical care) which are interpreted as NTCP ('non-tax-compulsory-payment'). We follow this approach and include them in LMM. For simplicity, we model basic health insurance as an earnings-dependent contribution. Even though it is a flat contribution, the care benefit

compensates individuals with lower income for the contribution (the benefit declines with higher income), so that it can be seen as earnings-related.

Poland

The contribution to the National Health Fund is included as an income tax in LMM. Basically, this has the advantage that we do not have to do a complex derivation of '*xtax*'.

Portugal

Couples can opt for joint taxation based on an income-splitting system in Portugal. Based on the OECD TaxBEN model, which chooses the most favourable of the two options, the calibration of the LMM relies on the income-splitting system.

As described in chapter 2.6, there is a standard deduction of EUR 4,104, but if social security contributions are higher than this amount, the deduction will equal the amount of those contributions. Modelling kinks like these can hardly be implemented in a macro-model. Given that the standard deduction is relevant for the majority of individuals (approximately up to two-times the average worker according to the OECD), we implement the standard relief in the calibration of the LMM and set '*xtax*'=0.

Finland

The earned income tax credit is implicitly taken into account in average income tax rates.

For employees aged 53 to 62, the pension insurance contribution increases from 6.75 percent to 8.25 percent. This is taken into account in the Stata-File.

Sweden

The EITC is taken into account in LMM via lower income tax rates. In Sweden, a tax credit equal to 100 percent of compulsory employee social security contributions is granted, which is also included in LMM via lower tax rates. As these contributions are not deductible for income taxation, we set '*xtax*' equal to zero in LMM. This issue is, however, somehow tricky to implement in the case of policy reforms. The amount of the tax credit (i.e., the average income tax rate) is changed if the employees' rate changes because of a policy reform, which is implemented in the file '*taxpreparationtess*'.[56]

Occupational pensions are included in the model by using information from *Pensions at a Glance*. For simplicity, we assume that 92 percent of all employees are covered by the ITP scheme, which has a contribution rate of 4.5 percent below the threshold and 30 percent above.

5.3. Revenue Statistics

This section provides information on adjustment to data from *Revenue Statistics* that were carried out, for instance, because LMM includes items (such as occupational pensions) that are not

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[56] Assume, for example, an increase of the employee rate (in order to finance higher social expenditures). Given the institutional setting, this implies a one-for-one decrease of income tax revenues (as the tax credit increases in line with the increase of the employee's rate).

included in *Revenue Statistics* or because contributions are classified differently in the model and *Revenue Statistics*.

Bulgaria

Contributions to the second pillar Universal Pension Funds are included in LMM. Information about revenues are available at Bulgaria's Financial Supervision Commission.

Denmark

Contributions to occupational pension schemes agreed between the social partners are not included in *Revenue Statistics*. We approximate contributions to these schemes in the calibration of LMM via the modelling assumption of *Pensions at a Glance* and a comparison with the revenues from Labour Market Contributions.

In contrast to most other countries, there are fixed (non-earnings related) social security contributions (unemployment, supplementary pension) in Denmark, which are included in the variables '*zw*', '*zu*' and '*zf*'. However, the variables '*zw*' and '*zu*' also include sickness benefits, which makes it difficult to distinguish these flat social security contributions and sickness benefits in the model. Therefore, we diminish social security revenues by the expenditures for sickness benefits (taken from the Social Expenditures database of the OECD). The 'voluntary social security contributions' for unemployment and early retirement schemes are both included in LMM.

Germany

Individuals who have earnings above the contribution ceiling can opt out of the mandatory public health and care insurance and choose a private insurance provider instead. Their contributions to the private system are not included in *Revenue Statistics*. Therefore, LMM Revenues from the item 'Social Security' are increased by numbers (for the 'Krankheitsvollversicherung' and the 'Pflegeversicherung') derived from the 'Gesundheitsberichterstattung des Bundes' (Federal Health Monitoring).

Estonia

Contributions to the second pillar pension fund are included in the LMM. Information on revenues is provided in the National Tax List.

France

According to INSEE, occupational pension schemes (such as the ARRCO scheme for most private-sector employees) are included in the public sector in the national accounts. Thus, we do not increase public revenues by occupational pension premia.

Croatia

As Croatia's funded pension scheme is included in the LMM, we increase 'Social Security' revenues for the calibration of the model by an amount based on the Country Fiche of the AWG group.

Lithuania

As Lithuania's funded pension scheme is included in LMM, we increase 'Social Security' revenues in the model by an amount taken from the OECD's Pension Fund Indicators.

In 2019, there was a pronounced shift of public revenues from employers' contributions to employees' contributions and income taxes. For the calibration of LMM, we use the aggregate of income taxes and social security contributions in each year of 2015–2019 and allocate them according to 2019 revenues.

Netherlands

Occupational pension schemes are not included in *Revenue Statistics.* 'Social Security' revenues in the model are increased by an appropriate amount, taken from Vidlund et al. (2016).

Poland

Revenues of the National Health Fund are included in the item 'Social Security Contributions' in *Revenue Statistics*. However, given that this contribution is part of the income tax rate in LMM, these revenues (which are taken from NHF publications) are redirected to the item 'Income' for the calibration of the model.

'Social Security' in *Revenue Statistics* does not include contributions to the defined contribution scheme ('Open Pension Funds'). Therefore, 'Social Security' revenues in the model are increased by an appropriate amount. Data for this adjustment is taken from the OECD's Funded Pension Indicators.

Romania

As Romania's funded pension scheme is included in the LMM, we increase 'Social Security' revenues in the model by revenues based on the OECD's Pension Fund Indicators.

In 2018, there was a pronounced shift of public revenues from employers' to employees' contributions, which has an impact on income taxation as well. For the calibration of the LMM, we use the aggregate of income taxes and social security contributions in each year of 2015–2019 and allocate them according to 2018 and 2019 revenues.

Slovakia

The OECD considers the contributions to the funded second pillar of Slovakia's pension scheme as a non-tax compulsory payment. As this pension type is included in LMM, we increase 'Social Security' revenues in the model by an amount taken from the OECD's Pension Fund Indicators.

Sweden

Category 2000 ('Social Security') in *Revenue Statistics* does not include contributions to occupational pension schemes. Data on these contributions are taken from the Orange Reports, which are annual reports of the Swedish Pensions Agency. 'Social Security' revenues in LMM are increased by an appropriate amount.

5.4. Pension System

This section provides some details on how pension systems are modelled in LMM. We provide some insights concerning the general approach as well as some country-specific issues.

General Information

Many countries explicitly link future adjustments of pension benefits to increasing life expectancy. Given that life expectancy is kept constant in a standard LMM simulation, we do not take into account these reductions of future pension benefits. However, when explicitly analysing the impact of demographic ageing, this approach should be reconsidered.

Pension benefits credited for childcare (and some other non-contributory periods like long-term care) are not explicitly implemented in LMM as fertility decisions are no explicit choice variable. These benefits are implicitly taken into account via the adjustment of the flat pension benefit ('*p00adjustment*'), see Section 2.9. Analogously, we do not explicitly implement means-tested minimum pensions, but they are implicitly reflected in the flat pension benefit.

In some countries (Poland for instance), pension benefits are only eligible from the statutory retirement age onwards. In contrast to that, LMM's approach assumes that individuals also receive pension benefits if they retire earlier (see, for instance, the first order condition for retirement in the model documentation). At first sight, one would assume that these two approaches do not match. However, if we implement actuarially fair deductions to pension benefits, our approach is in line with these institutional settings, both in terms of pension expenditures of the government and labour market incentives (both incentives to acquire pension rights and retirement incentives).

LMM includes occupational pension schemes for some countries, which are not included in the OECD's Social Expenditure data. The R file '*OccupationalPensionExp*' includes expenditure calculations of these occupational systems within the LMM. Subsequently, aggregate pension expenditures are adjusted by this amount for the calibration.

Belgium

Given that the maximum amount of the holiday pension payment is fairly low, it is not explicitly included in LMM and thus implicitly taken into account in the flat pension benefit p00.

Denmark

The basic pension benefit is only reduced if income from work exceeds a threshold. The pension supplement is tested against all sources of income (apart from public pensions), but the threshold for reduction is fairly high. Therefore, we explicitly include the basic pension and the supplement and model a 'smaller than actual share' of ATP and occupational pensions that we determine via the income shares by which the supplement is reduced.

Under some conditions, early retirement is possible in Denmark via a voluntary early retirement programme linked with unemployment insurance. We include both the contributions to and the benefits from this system in the model. Technically, this benefit is modelled as a flat pension '*p00*' in case of early retirement. Given that this benefit is higher than the basic flat pension, we correct for too high benefits by subtracting the appropriate difference from lump-sum transfers to the households; see also the file Pensions.xlsx.

Germany

The pension point value is uprated annually in line with gross wages as a starting point. However, different factors in the 'Rentenanpassungsformel' can reduce the size of annual adjustment of the value. According to a calculation performed in the Generationencheck (see for instance Berger et al. 2019), the long-run growth rate of the real Rentenwert is approximately 30 percent lower than the growth rate of real earnings. This value is implemented in LMM.

For simplicity, we do not credit periods of Arbeitslosengeld II receipt ('Anrechnungszeit').

Estonia

From 2021, there has been a possibility to opt out the funded pension system in Estonia. Lacking valid information on how this impacts households decisions, we follow the European Commission's AWG and treat the second pillar as fully mandatory.

Ireland

The flat-rate state pension is paid from the pensionable age of 66 years. Basically, we implement it via '*p00*' in the model. However, for the mixed group in LMM, *p00* is paid from the effective retirement date (that is determined via the retirement decision). Thus, if we gave *p00* to the mixed group, this would distort lifetime income and retirement incentives as, for example, a 65-year-old individual would receive it in case they do not participate in the labour market. Thus, we pay *p00* in Ireland only from the age of 70 and increase the amount by a factor that is determined via the expected pay-out-phase. Given the LMM assumptions (e.g., perfect foresight, perfect capital markets), lifetime income, consumption and retirement incentives are reflected in the right way.

Greece

The flat-rate national pension is paid from the pensionable age of 67 years. However, as *p00* is paid from the effective retirement date in the LMM, we calibrate the model analogously to Ireland. We pay *p00* only from the age of 70 and increase the amount by a factor that is determined via the expected pay-out phase.

Spain

For the calculation of the accrual rate, we take an approach similar to the method for France (see 'Pensionses.xlsx').

France

Modelling a pension system that is based on (i) average earnings of the best 25 years and (ii) the total number of contributory periods is tricky in LMM. Even early in a lifetime, there are incentives to contribute because of (i) acquiring a period of insurance and (ii) contributing to the best 25 years if for some reason earnings later in lifetime fail to increase. Therefore, we follow the following approach: (i) calculate an 'actual' pension for an individual who contributes for 40 years (at an earnings profile determined by the Mincer estimation) and (ii) calculate a 'lifetime' accrual rate that is necessary to yield the same pension benefit (see the calculation in 'Pensionsfr.xlsx').

Croatia

Currently, a vast majority of individuals opt out of the funded scheme and transfer their assets to the public scheme upon retirement. We follow the AWG group and assume that the share of new retirees who keep their assets in the funded scheme will increase to 30 percent.

Luxembourg

In Luxembourg, there is no explicit actuarial adjustment of pension benefits for early retirement. However, for the calibration of the LMM, we interpret the higher accrual rates for older individuals with longer contribution periods economically and treat them as an actuarial adjustment of pension benefits. Thus, the LMM's accrual rate is higher than the standard accrual rate (reflecting older individuals and/or longer periods) and we implement deductions for retirement before the statutory retirement age.

Hungary

Differently to almost all other Member States (but analogously to Slovenia), the calculation of the pension benefit is based on net earnings. In order to keep the equations of the model consistent with the LMM, we reduce the accrual rate 'mp' by age- and skill-specific tax and employee social security contribution rates (in the calib programme code).

Eligibility for pension benefits before the statutory retirement age was largely eliminated in previous years. However, people in the 'mixed group' receive pension benefits in the LMM if they withdraw from the labour market. In the model, we assume that actuarially adjusted pension benefits are paid for individuals who leave the labour market earlier. Given the LMM assumptions (e.g., perfect foresight, perfect capital markets), lifetime income, consumption and retirement incentives are reflected in the right way.

Malta

The pension benefit in Malta is based on pensionable income, which is determined by the average of the highest salaries of ten years (for people born in 1962 or later) or earnings of the last 10–13 years for people born before 1962. Thus, we take an approach similar to the method for France for the calculation of the accrual rate (see 'Pensionsmt.xlsx').

Netherlands

In the Netherlands, a flat-rate basic pension is available from the statutory retirement age onwards. Analogously to Ireland, we pay p00 in the Netherlands only from the age of 70 and increase the amount by a factor that reflects the longer pay-out phase.

Poland

As the funded system is increasingly phased out (significant reduction of contribution rate, explicit opting in to the system from 2014, plans to terminate the OFE), we implement the NDC system in LMM.

The government pays the contributions to the pension system during unemployment (based on the unemployment benefit). As the benefit is a flat benefit and not earnings-related, we model this contribution in the part connected to labour market participation (reflected in '*m1*' in the model) instead of the earnings-related part ('*b1*' in the model).

Romania

A major change in the Romanian public pension system was drafted in 2018 and legislated in 2019. Different to pension reforms in many other countries that go along with long transitional periods, the legislated reform has rather strong short- and medium-term impacts both for pensions already in payment as well as for labour market incentives. According to the AWG pension group, the average

impact of the recalculation of each pension benefit according to the new pension law will be a 14 percent increase. In order to balance pension expenditures and labour market incentives for the calibration period 2015–2019, we implement a part of this pension increase in the calibration of the model.

Slovenia

The PRB is calculated on the basis of net earnings. This is different to most other countries, where pensions are based on gross earnings. In order to keep the equations of the model consistent with LMM, we reduce the accrual rate '*mp*' by age- and skill-specific tax and employee social security contribution rates (in the calib programme code).

The fact that the PRB is based on the best 24 consecutive years (and not lifetime income) is modelled analogously to France: we calculate an 'actual' pension for an individual who contributes for 40 years (at an earnings profile determined by the Mincer estimation) and calculate a 'lifetime' accrual rate necessary to yield the same pension benefit (see the calculation in 'Pensionssi.xlsx').

Finland

We do not include the flat basic state pension in the model. The national pension is reduced by 50 percent with higher earnings (so that no basic pension is paid at all once the earnings-related pension exceeds around EUR 1,300) and the amount of flat pensions is changed in the LMM calibration procedure anyhow to reflect total pension benefits.

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