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Progressive tax reforms in flat tax countries

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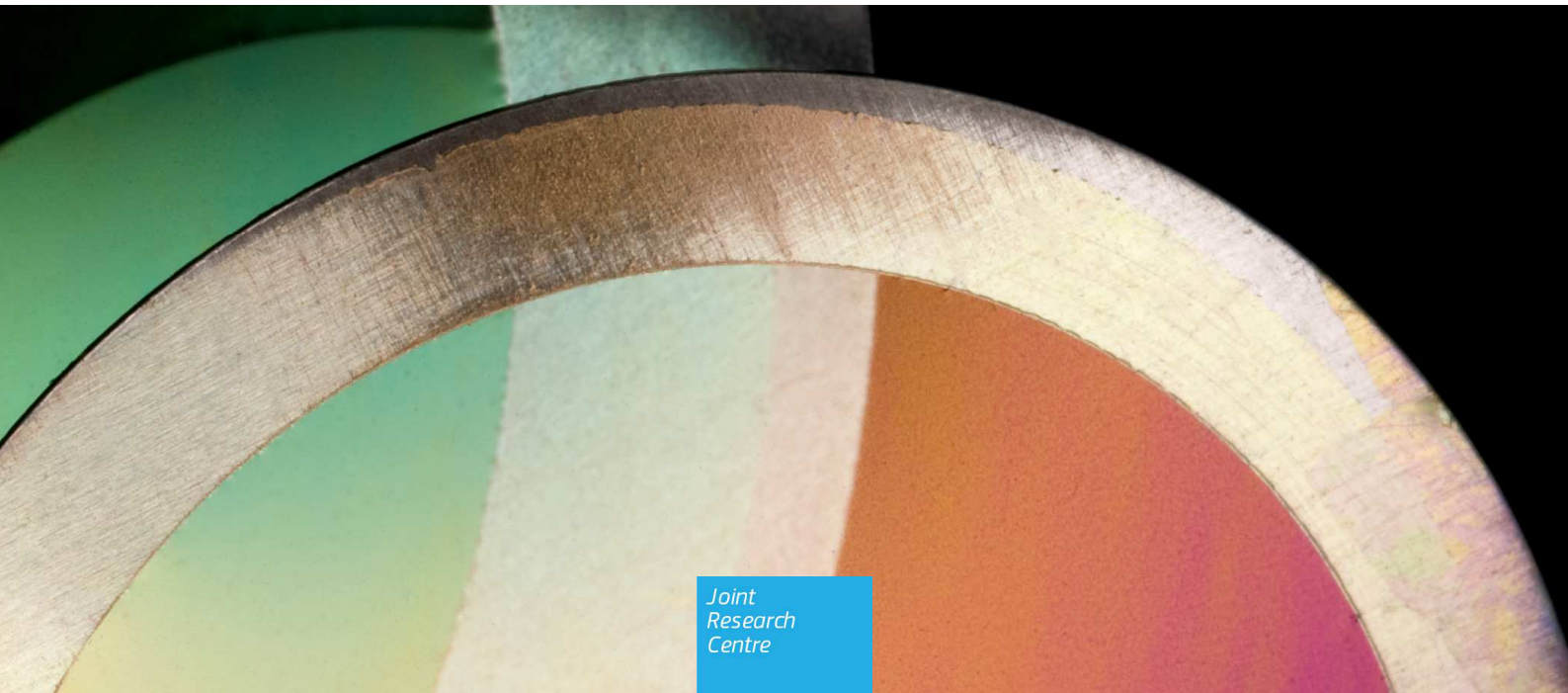

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Table of contents

Abstract 1

1 Introduction 2

2 Current tax systems (2017) 5

3 Progressive tax reforms scenarios 9

3.1 Scenario (I): Introducing a progressive personal income tax rate schedule 10

3.2 Scenario (II): Progressive personal income tax with a refundable earned income tax credit 12

3.3 Scenario (III): Introduction of a tapered basic tax-free allowance and increase in the flat PIT rate 14

4 Macroeconomic analysis of the budget-neutral scenarios 17

5 Conclusions 22

References 24

Abstract

Much of the literature on flat tax reforms has highlighted the benefits of introducing flat personal income tax systems in transition economies. The advocated benefits of flat tax systems range from their simplicity, higher compliance and lower distortionary effects on growth and employment. These arguments have often been cited to support policy recommendations favouring the adoption of flat tax systems in Central and Eastern European (CEE) countries in the 1990s and the 2000s. However since income inequality is notoriously high in these countries, the question of introducing some progressivity in the tax system has come to the fore in both policy and academic circles. In this paper, we analyse the fiscal, redistributive and macroeconomic impact of (re-) introducing progressivity in a number of CEE countries with flat tax systems. Combining microsimulation and macro models, we find that a significant reduction in income inequality can be achieved by moving from a flat to a progressive tax system with positive, albeit negligible, macroeconomic and employment impact. The magnitude of these effects depends on country-specificities and tax system characteristics, due in particular to the existence of tax allowances and tax credits.

Keywords: Flat tax, microsimulation model, DSGE model, inequality progressivity, employment, growth

1 Introduction

Many developing and transition economies have moved away from complex, progressive tax systems to simpler tax schedules, with fewer tax brackets and lower top statutory marginal tax rates (Sabirianova Peter et al., 2010). Keen et al. (2008) show that Central and Eastern European (CEE) countries have been especially active in this respect. They identify two waves of flat taxes adopted in recent years: the first wave, including the Baltic countries (Estonia, Latvia and Lithuania), is characterized by tax rates set at moderately high levels (or close to the highest marginal tax prior to the reform), while the second wave started in Russia, followed by Romania and Hungary, and is marked by tax rates that are instead closer to the lowest of the pre-reform rates. In most transition economies, the flat tax was introduced with the purpose of simplifying the tax system, reducing tax evasion and improving economic efficiency through lower tax distortions. Nevertheless, this implementation has produced diverse results. For example, in Russia, the replacement of a progressive tax system by a flat one, in 2001, was followed by a significant growth in tax revenue, due to higher compliance and reporting, see Gorodnichenko et al. (2009). Ivanova et al. (2005) argue, however, that it is unclear whether this was due to the parametric reforms or to accompanying changes in enforcement. Slovakia also introduced a flat tax reform in 2004 and Remeta et al. (2015) find a number of weaknesses which became apparent over time, noting in particular lower levels of tax revenues and tax compliance, as a result of a weak tax administration and high social security contribution rates. In a recent study covering a larger set of transition countries, Filer et al. (2018) find no significant effect of flat tax reforms on income underreporting. They contend that this may be due to a parallel deterioration in attitudes towards the public sector in these countries. Recently, Saavedra et al (2017) analysed the impact of flat tax reforms in Central and Eastern European countries on tax revenues, tax structures and tax compliance. While they found no influence on tax revenues collected, they do however find that flat tax reforms lead to a shifting of the tax system towards indirect taxes (including consumption taxes). They also find some evidence of a positive impact on tax compliance although only in the cases where the personal and corporate income flat tax rates were aligned.

Most CEE countries introduced or increased tax allowances and tax credit in parallel to the adoption of flat personal income tax (PIT) systems. Country-specific studies simulating the impact of flat tax reforms in European countries find that rather small efficiency gains were achieved, while coming at the price of an increase in inequality, see in particular Decoster and Orsini (2007), González-Torrabadella and Pijoan-Mas (2006) and Caminada and Goudswaard (2001). Nonetheless, the impact of moving from a progressive to a flat tax system on income inequalities remains unclear. For instance, Duncan and Sabirianova Peter (2016) find that progressivity reduces inequality in observed

income, but has a significantly smaller impact on actual inequality approximated by consumption-based Gini indices. Furthermore, this differential effect is found to be much larger in countries with weaker institutions. In a recent paper, Horvath et al. (2018) also investigate the consequences of hypothetical reforms of the personal income tax system towards a progressive tax system in Slovakia. The authors find that the overall economic and fiscal impact of such reforms would be moderate. They contend that only radical reforms would generate significant output and employment losses. Keen et al. (2006) raise questions on the sustainability of flat tax systems, given also the increasing pressures stemming from the difficulty of taxing internationally mobile capital. The global trend toward increased income inequalities within countries has also been especially pronounced in the CEE countries (most notably the Baltics, Bulgaria and Romania) due to the transition to market economies, see Lakner and Milanovic (2016). This raises concerns on the role played by flat tax systems in reducing inequalities or cushioning against economic shocks through automatic stabilisation, see Fuest et al. (2008), Tóth (2013) and European Commission (2017).

The relative merits of flat vs. progressive tax systems have long been debated at theoretical level too, see in particular Stokey and Rebelo (1993), Mendoza et al. (1996) and Altig et al. (2001). Overall these analyses show that assumptions regarding discount rates, preferences and labour supply responses play an important role in determining growth outcomes. More recently, the theoretical research has focused on the distortive nature of progressive tax systems towards labour supply in particular, which play a key role to understand their welfare impact, see in particular Benabou (2002), Diamond and Saez (2011) and Heathcote et al. (2017). This more recent literature suggests that, while welfare gains can be obtained from progressive tax reforms, such gains are conditional on very specific conditions. In particular, Diamond and Saez (2011) stress that such reforms, should be socially acceptable, and not too complex in terms of tax administration and potential behavioural impact. Another important recommendation advocated by Diamond and Saez (2011) is that low-income earners should be subsidized through working tax credit in order to reduce the potential disincentive effects of introducing progressivity in flat tax systems.

In this paper we aim at providing novel cross-country evidence on these questions considering hypothetical reforms introducing progressivity in countries featuring flat tax systems. We analyse the fiscal, redistributive and macroeconomic impact of such reforms in Bulgaria, Estonia, Latvia, Lithuania, Hungary and Romania.[1] Our approach is resolutely empirical and starts from the actual tax structures of the aforementioned countries. In order to do so we use EUROMOD, the European microsimulation model for the EU, exploiting two important features of this model. First, EUROMOD

[1] Since January 1st 2018 Latvia adopted a progressive tax system. However this does not affect our analysis as we focus on the 2017 tax systems.

models countries´ tax and social benefit systems in a consistent way, in particular in reference to the definition of gross income. This brings a clear advantage for analysing the redistributive impact of tax reforms in comparable manner across countries, see Sutherland and Figari (2013). Second, EUROMOD embeds tax allowances and tax credits in the determination of the final disposable income. This is especially relevant when assessing actual tax systems which, like in the cases considered here, often feature such special tax provisions and exceptions.

We also combine EUROMOD with the macroeconomic model QUEST in order to provide a joint analysis of the redistributive and growth impact of progressive tax reforms in flat tax countries. We follow in particular the approach developed by Barrios et al. (2018) whereby both these models are combined by calibrating the QUEST model with parameters derived from EUROMOD for what concerns personal income and tax structures, participation rates and labour supply elasticities. Following this approach, the precise design of policy reforms are first simulated in EUROMOD and then incorporated into QUEST in order to obtain the macroeconomic second round effects (including on employment, GDP and prices) The second-round effects (in particular regarding price, wage and employment effects) are then incorporated in the microsimulation model in order to assess the medium-term projections in personal income tax (PIT) revenues.

Our contribution to the existing literature is threefold. First, our analysis is, to the best of our knowledge, the first study to consider such hypothetical reform scenarios in a consistent way across different countries, allowing us to draw more general conclusions about the potential economic impact of progressive tax reforms. Our results are therefore informative from both a policy and theoretical perspectives, illustrating how hypothetical (or theoretical) reforms would impact countries taking into account their specific (pre-reform) tax structures. Second, we are able to assess the potential equity impact of progressive tax reforms based on the use of a microsimulation model and household-level data together with their fiscal and macroeconomic effects, including on growth and employment. The assessment of employment effects is particularly relevant given the potential distortionary impact of tax reforms on labour supply highlighted in the recent theoretical literature. Third, our analysis considers actual tax benefits systems, including wherever relevant existing tax expenditures, i.e. tax allowances and tax credits. These tax expenditures can significantly influence the redistributive impact of flat tax systems, introducing de facto a certain level of progressivity. This allows us to qualify our results depending on country-specific characteristics and in particular to account for the fact that some degree of progressivity might actually exist in flat tax countries.

We simulate three policy reform scenarios which are themselves motivated by the main lessons drawn from the theoretical and empirical literatures. The results of these simulations are then compared with the 2017 policy baseline. In a first scenario, we consider the introduction of a

progressive personal income tax rate schedule. We then analyse the introduction of a refundable in-work tax credit in order to neutralise the budgetary effects of the first scenario and to tackle the potential disincentive effects on labour supply. Finally, we analyse an alternative reform introducing a basic tax-free allowance (or increasing an existing allowance wherever relevant) with a gradual phasing out, compensated by an increase in the flat personal income tax rate, which would also result in being budget neutral. The first scenario provides a first assessment of the fiscal and equity implications of the progressive tax reforms without compensating measures. The second and third scenarios implement, in addition, alternative budget neutral reforms which are further considered into a macro-model, in order to gauge their impact on GDP and employment.

Our results suggest that introducing progressive tax reforms would have positive effects on redistribution and equity in all countries considered although to a varying extent depending on country-specific tax systems. The role played by existing tax expenditures is found to be particularly relevant in this respect. In the medium-term, the macroeconomic impact of the budget-neutral reforms appears to be positive for all countries. The results show that cutting taxes for low (medium) income individuals increases their incentives for being employed, while raising taxes on high income earners lowers their employment rate. These counteracting forces lead to a relatively modest impact on employment and GDP. Embedding the second-round effects in the microsimulation model slightly decreases the medium-term projections on personal income tax revenues, mainly due to a negative wage effect for low (medium) income workers which counterbalances the hike in employment for these categories. The rest of the paper is organised as follows. In Section 2, we describe the current tax system of the countries considered in our analysis. In Section 3, we define the policy reform scenarios designed to introduce progressivity in the tax schedule. In Section 4, we analyse the macroeconomic impact of the budget neutral scenarios. Section 5 concludes.

2 Current tax systems (2017)

Currently in the EU, the Baltic countries, Romania, Bulgaria and Hungary have a flat personal income tax (PIT) rate.[2] The Baltic countries were the first to introduce flat tax systems among the countries considered in this paper: Estonia and Lithuania introduced such a system in 1994 followed by Latvia in 1996 (Table 1). These countries initially set their single PIT rate at rather high level, close to the top tax rates of their previous progressive systems: 26% for Estonia, 33% for Lithuania and 25% for Latvia. These countries were then followed by Romania (2005), Bulgaria (2008) and Hungary (2011).

[2] The Czech Republic also has a flat tax system at the time of witting this paper. However we chose not to consider this country in our analysis in absence of reliable estimates for labour supply elasticities needed to calibrate the QUEST model used to derive the macroeconomic impact of progressive tax reforms.

However, by contrast with the Baltic countries, the single PIT rates in this second group of countries were set equal to the minimum marginal tax rate of the progressive tax system previously in place, as in the case of Bulgaria, or even below that level, as in the case of Romania (16% vs. 18%) and Hungary (16% vs. 17%). Interestingly so, the Baltic countries decided more recently to further reduce their tax rate: from 33% to 15% for Lithuania, from 23% to 25% in Latvia and from 26% to 20% in Estonia.

Table 1: Personal income tax rates, before and after the introduction of the flat tax

	LT	LV	EE	RO	BG	HU
Currency	*EUR*	*EUR*	*EUR*	*RON*	*BGN*	*HUF*
Year	1994	1997	1994	2005	2008	2011
Before Introduction	18% - 33%	10% - 25%	16% - 35%	18% - 40%	10% - 24%	17% - 32%
After Introduction	33%	25%	26%	16%	10%	16%
2017	15%	23%	20%	16%	10%	16%
Additional PIT rate	-	-	-	-	-	-

Source: EUROMOD country reports, available at https://www.euromod.ac.uk/using-euromod/country-reports

However, despite having adopted seemingly similar tax systems, the six countries have rather different PIT structures if one accounts for the different definitions of the tax bases and the existence of tax allowances and tax credits which were in many instances introduced to compensate for the negative redistributive impact of flat tax systems, introducing de facto a certain degree of progressivity. Table 2 provides a snapshot of the definition of the tax base and existing tax allowances and tax credits simulated in EUROMOD and affecting PIT in place in 2017. This table shows that, despite having adopted flat tax systems, the countries considered here have all implemented tax allowances and tax credits. Tax allowances can in some instances be universal (as in Lithuania or Estonia) or be related to employment income (as in Romania) or to the number of dependent children (as in Bulgaria and Hungary). In some instances these allowances might be differentiated with respect to the level of income (Latvia). As for tax credits, all countries implement such schemes with a varying degree of universality and with conditions tied to specific households´ expenditures.

Table 2: Tax base definition and tax allowances and tax credits (2017)

	Taxable income	Tax allowances and tax credits
(1) Lithuania	The tax base is derived from gross income by deducting the following components: non- taxable income (all state social assistance and some social insurance benefits, etc.), income received from activities conducted under a business certificate, allowable deductions related to income from individual activities, the acquisition price of property and expenses related to it, basic and additional tax allowances (for families with children, disabled, farmers, etc.), particular expenses incurred by a resident (when calculating taxable income of fiscal year)	- Basic tax allowance is €310 and has a phase out of 0.5. - Additional allowances for parents raising children, and disabled people. - Deductible expenses includes life insurance payments, voluntary pension contributions, payments for studies, interest paid on loans taken for housing before 2009.
(2) Latvia	Employment income, sickness benefits, self-employment income, income from property, income from capital, different public pensions, and other income receive by children under 16. Since 2016 a Latvia has also a solidarity tax introduced in 2016. The tax is applied to incomes above €48,600 per year. Effectively, the solidarity tax substitutes the social insurance contributions on high incomes.	- Tax allowance differentiated with respect to the level of income. The maximum basic allowance is €118 and the minimum €60. - Other tax allowances include allowance for pensioners, allowance for a dependent (child, spouse or parent), for the disabled people, for politically repressed person, employee and for self-employed contributions and solidarity tax payments. - Deductible expenses include: expenses on education, health services, contributions to private pensions funds, life insurance premiums and etc.
(3) Estonia	Employment income, sickness benefit, different public and private pensions, maternity, paternity, unemployment insurance benefits, royalties, income from rent and income from self-employed.	- Universal basic tax allowance of €180 per month. - Allowances for kids, pension allowance, and allowance for self-employment income from agriculture. - Tax deductions for housing loan interest payments, study loans, contributions to the third pillar pension.
(4) Romania	Employment and self-employment income, income from investment and property, public and private pensions, contributory sickness and unemployment benefits and severance payments.	- Employee tax allowance amounts to a maximum of RON800 per month and has a phase-out slope of 0.5. - Tax allowance for pensioners up to RON2,000 per month. - Deductible expenses include private voluntary pension contributions, trade union fees and savings in collective systems for dwelling expenses. - An amount up to 2% of the personal income tax paid on employee and self-employed income can be donated to non-profit organizations or for private scholarships.
(5) Bulgaria	Employment and self-employment income and property.	- A standard child allowance amounting to BGN200 per year for one child, BGN400 for two and BGN600 for three or more children. - Tax deductions are provided for permanently disabled persons, voluntary social, unemployment, health and life insurances. - Deductible expenses include private pension contributions, income from rent and from freelance activities. - Deductions of bequests are applied for sponsoring cultural events, NGOs and the National Fund "Children's Health".
(6) Hungary	The taxable income includes all sources of income excluding pensions, child and family benefits as well as EVA (Simplified Entrepreneurial Tax) payers self-employment income (which is used only for calculating social insurance contributions but not for calculating taxes).	- No basic allowance in Hungary. There is only a Family tax allowance (since 2012) that depends on the number of kids. - Tax credit for serious disability for people with a disability level of at least 67%.

Sources: EUROMOD Country reports, available at: https://www.euromod.ac.uk/using-euromod/country-reports

Country notes: (1) In the simulations, we distinguish the withholding income tax liability (used for simulating social assistance) from the final tax liability (which has a broader taxable base, including income from self-employment, income received by farmers, from property sale, dividends, gambling, deductible expenses and unused tax allowances). (2) From January 1st, 2018 a progressive tax system was introduced in Latvia. (6) For Hungary many other tax credits cannot be simulated in EUROMOD due to insufficient information. Calculation of EVA (Egyszerűsített Vállalkozói Adó – Simplified Business Tax) is based on the amount of total revenues including VAT. The tax rate is 37% from 2012. Those paying EVA are exempted from paying the VAT, they do not have to pay entrepreneurial personal income tax and if they have no other revenues, they do not have to file a personal income tax return.

Two recent papers have analysed more specifically the redistributive and fiscal impact of tax expenditures in EU countries making use of the EUROMOD model. Barrios et al. (2016) makes use EUROMOD to assess these effects for selected tax expenditures related to households´ spending. This paper shows that housing, health and education related tax expenditures in the countries considered here tend to favour higher income deciles, although this effect is relatively small compared to what is observed in other EU countries in both fiscal and equity terms. Avram (2018) also makes use of EUROMOD to analyse the fiscal and redistributive impact of tax expenditures, distinguishing between tax allowances and tax credits. She finds that the redistributive effect of tax expenditures tend to be small. She also shows that other features of the tax system, such as the tax rate schedule and the definition of tax units, tend to have significantly larger redistributive impact.

More generally speaking, the existing evidence suggests that countries with flat tax systems tend to redistribute income significantly less than countries with progressive tax systems. For instance, the evidence provided by Astarita et al. (2018) suggests that EU countries with flat tax structures tend to redistribute more through social benefits. This is particularly the case for Hungary and Slovakia. A clear advantage of using EUROMOD in this respect is that social benefits are considered together with PIT and tax expenditures for the determination of households´ disposable income. However, EU flat tax countries tend to redistribute less than other EU countries when one considers tax and social benefits altogether. This is evidenced by results reported in Table 3 showing the difference between the Gini index using gross income and the Gini index calculating using disposable income (i.e. after tax and social benefits). Only Hungary appears to display a level of redistribution comparable to the EU average. All other countries appear to be ranked among the countries with the lower redistributive systems in the EU.

Table 3: Gini index and redistributive effect of tax and social benefits, 2017

	Disposable income (DPI)	Original Income	redistributive effect	Ranking in EU28
Hungary	0.289	0.499	0.210	14
Slovakia	0.217	0.399	0.181	20
Romania	0.365	0.543	0.179	21
Lithuania	0.371	0.539	0.168	24
Estonia	0.330	0.494	0.164	25
Latvia	0.350	0.498	0.148	27
Bulgaria	0.359	0.502	0.144	28
EU-28	*0.295*	*0.505*	*0.210*	-

Sources: EUROMOD, https://www.euromod.ac.uk/using-euromod/statistics and authors´ calculations. Pensions are considered as part of social benefits

Hence, while a certain level of progressivity exists through tax expenditures and social benefits in the countries considered here, the degree of progressivity of flat tax countries remains significantly below the one of other EU countries featuring a progressive tax system. This is an important consideration in particular when progressive tax reforms are complemented with tax credits, e.g. working tax credits, in order to reduce the disincentive effect on labour supply. We will consider this aspect more specifically in the following section.

3 Progressive tax reforms scenarios

As shown previously, CEE countries tend to have higher inequalities in disposable income and a lower redistributive impact of their tax and social benefit systems. In this section, we consider whether progressive tax reforms can possibly reduce inequalities, in particular accounting for the existence of tax allowances and tax credits in the actual systems. There is a wide range of possible scenarios that one could consider, not least because countries have different institutional features which might make them more inclined to consider specific policy options rather than others. In order to be able to compare results across countries, we study relatively standard policy reform options introducing progressivity in the tax schedule. In a first instance, we analyse the impact of a progressive tax reform without compensating measures. We then consider a first compensating measure introducing a working tax credit in order to reduce the potential disincentive effects of the progressive tax reform on labour supply. This second reform scenario is budget neutral, by contrast with the first one. Finally, as an alternative to the progressive tax reform, we also consider an increase in the basic tax allowance while keeping the flat tax system. We believe the reform scenarios considered below are general enough in order to accommodate countries´ specific circumstances and institutional features reported in Table 2. The three scenarios considered are defined as follows:

- Scenario (I): we keep the existing PIT flat rate as the second rate of the progressive PIT system. For the first rate, we reduce it by 5 pp and for the top rate we increase it by 7 pp. The first income threshold is set to 33% of the average net taxable income, while the second is equal to the average net taxable income.
- Scenario (II): the extra PIT revenues are used to lower the tax burden of the low wage earners, by introducing a refundable in-work tax credit for employees and self-employed. The tax credit is phased-in up to 10% of the average gross earnings. Between 10% and 20% of gross earnings, an eligible worker can benefit of the maximum amount (6.5% of average gross earnings). Above this income threshold, the tax credit is gradually withdrawn.

– Scenario (III): we simulate an increase in the basic tax allowance, compensated by an increase in the flat PIT rate. A tapering-off in the allowance is introduced in Estonia, and a general tax allowance with a phasing-out design is applied in Bulgaria and Hungary. The amount of the basic tax allowance is set to equal the minimum gross wage (except Estonia, where an actual proposal is used).

Budget neutrality is ensured in scenarios (II) and (III). All simulations are conducted using the EUROMOD microsimulation model for the year 2017 and data from EU-SILC survey of 2015 (using as income reference 2014). The data is updated using relevant price and wages indices. Annex A provides more details on the EUROMOD model and the EU-SILC data. Annex B to C provide more specific details on the way policy reform scenarios are implemented, including for the design of the working tax credit and the tax allowance implemented in Scenario (II) and (III) respectively.

3.1 Scenario (I): Introducing a progressive personal income tax rate schedule

The reference values for the tax brackets are calculated based on the distribution of net taxable bases observed in the EU-SILC sample used in EUROMOD.[3] Using the taxable income net of allowances ensures that we are calculating the progressive PIT liabilities on the same base as in the actual flat tax system. The tax brackets are therefore defined in a consistent way across countries, allowing for a better comparability of the results. The first income bracket is set to 33% of the average net taxable income, while the second is equal to the average net taxable income. The progressive PIT design (PIT rates and brackets) are provided in Table 4.

Table 4: Simulated progressive PIT rates and income brackets, Scenario (I).

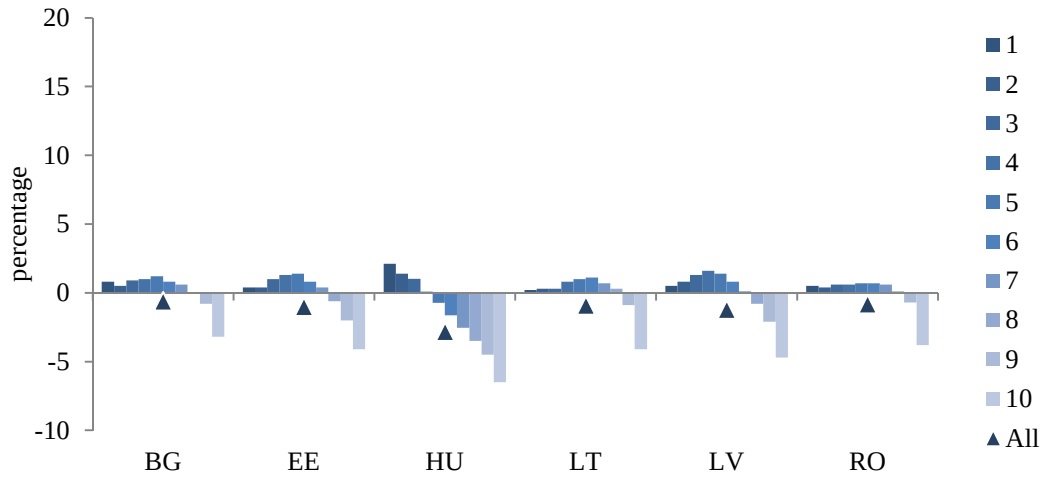
	LT	LV	EE	RO	BG	HU
Currency	*EUR*	*EUR*	*EUR*	*RON*	*BGN*	*HUF*
Average net taxable income*	763	560	848	1,355	716	97,182
33% of average net taxable income*	254	187	283	452	239	32,070
1st PIT rate	10%	18%	15%	11%	5%	11%
2nd PIT rate (existing)	15%	23%	20%	16%	10%	16%
3rd PIT rate	22%	30%	27%	23%	17%	23%
Additional PIT rate	-	-	-	-	-	-

* EUROMOD estimate

[3] We chose to use the EU-SILC sample for the calculation of the reference values of average earnings the tax brackets since the gross earnings reported in the official statistics would hide huge variability in taxable bases due to the impact of the existing tax allowances on the calculation of the PIT tax liabilities.

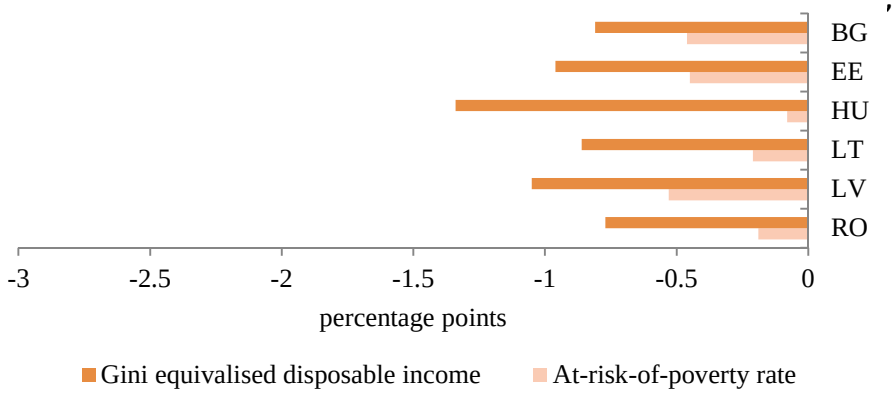
Figures 1, 2 and Annex B summarize the results of these simulations as a percentage change from the 2017 baseline scenario. In this scenario, a progressive PIT schedule increases total tax revenues. It reduces the average disposable income of the richest households. The impact on PIT revenues is positive in all countries, with increases ranging from 6.2% in Latvia to 13.8% in Hungary. All countries experience a fall in the Gini Index ranging from a low -0.77 pp in Romania to a high -1.34 pp in Hungary. Poverty is also reduced from -0.08 pp in Hungary to -0.53pp in Latvia. In all countries, these reforms result in increased implicit tax rates on labour on average (see Annex B). However, for low income deciles, the impact of these reforms on the implicit tax rate on labour is negative. Disposable income by decile also increase for most income deciles in all countries, especially for the middle income deciles. However, the mean disposable income decreases because of the fall in income of the richest households. The share of winners and losers is clearly skewed in all countries in favour of the former, with the top income deciles bearing the bulk of the increased tax burden, excepting in Hungary where the shares of winners and losers is broadly balanced (see Annex B).

Figure 1: Introducing a progressive personal income tax rate schedule: mean annual equivalised disposable income by decile (difference as % of 2017 baseline), Scenario (I)



Source: Authors´ simulations based on the EUROMOD model.

, **Scenario (I)**



Gini equivalised disposable income At-risk-of-poverty rate

Source: Authors´ simulations based on the EUROMOD model.

3.2 Scenario (II): Progressive personal income tax with a refundable earned income tax credit

In this scenario the extra PIT revenues obtained in Scenario (I) are used to lower the tax burden of the low wage earners. A refundable in-work tax credit is introduced only for employees and self-employed. The in-work tax credit is designed as follows: up to 10% of the average gross earnings from employment and self-employment, the phase-in slope is set to 0.65 (in other words, for every euro earned, an individual receives 65 cents of tax credit). Between 10% and 20% of the average gross earnings, an eligible worker can benefit of the maximum amount of the tax credit Above this income threshold, the tax credit is gradually withdrawn at a different rate for each country. The maximum amount of the tax credit is fixed to 6.5% of average gross earnings (0.65 phase-in slope x 0.1 first income threshold), while the phasing-out slope is determined automatically by imposing budget-neutrality conditions. For the countries with both withholding and final income tax liabilities (Estonia and Lithuania [4]), the in-work tax credit is designed to be part only of the final income tax liability.

The main parameters of the simulated refundable in-work tax credit are summarised in the table below.

[4] The taxable base for the final tax is broader than the one for the withholding tax. The tax base for the final tax liability includes also incomes from self-employment, rent, property sale and royalties, deductible expenses and some additional or unused tax allowances. Gross incomes net of withholding tax are used for simulation of the social assistance and other means-tested benefits.

Table 5: Income brackets of the refundable income tax credit (monthly values)

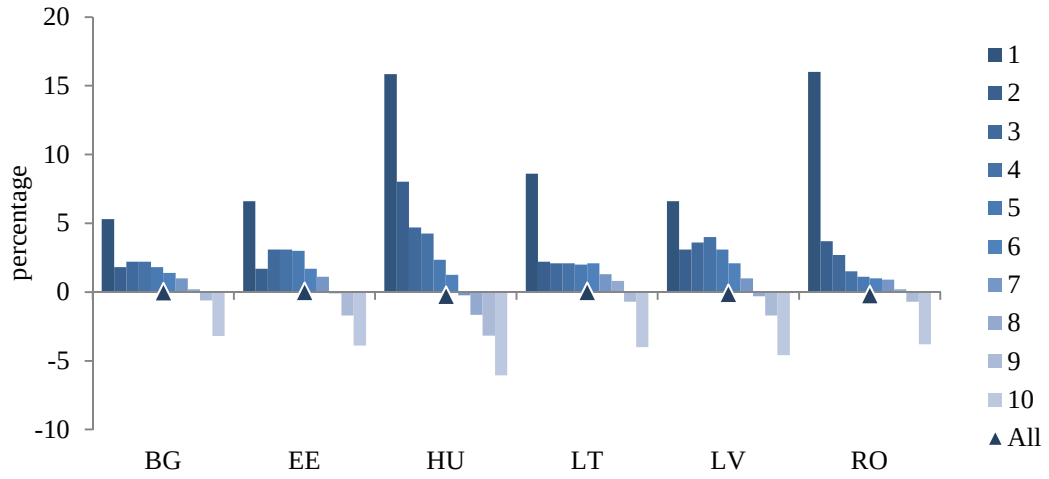
	LT	LV	EE	RO	BG	HU
Currency	*EUR*	*EUR*	*EUR*	*RON*	*BGN*	*HUF*
Average gross earnings*	767	812	1,084	1,703	894	179,742
10% of average gross earnings	77	81	108	170	89	17,974
20% of average gross earnings	153	162	217	341	179	35,948
Maximum amount of tax credit (fixed)	50.05	52.65	70.2	111	58	11,683
Phase-in slope (fixed)	0.65	0.65	0.65	0.65	0.65	0.65
Phase-out slope	0.33	0.18	0.27	0.20	0.75	0.05

* EUROMOD estimate

Figures 3, 4 and Annex C summarize the results of this simulation as a percentage change from the 2017 baseline scenario and depict the design of the tax credit for each country. In this scenario, the additional introduction of a refundable in-work tax credit – that makes the overall reform budget-neutral – redistributes further from the higher to the lower income deciles, by decreasing the tax burden of the low-wage earners.

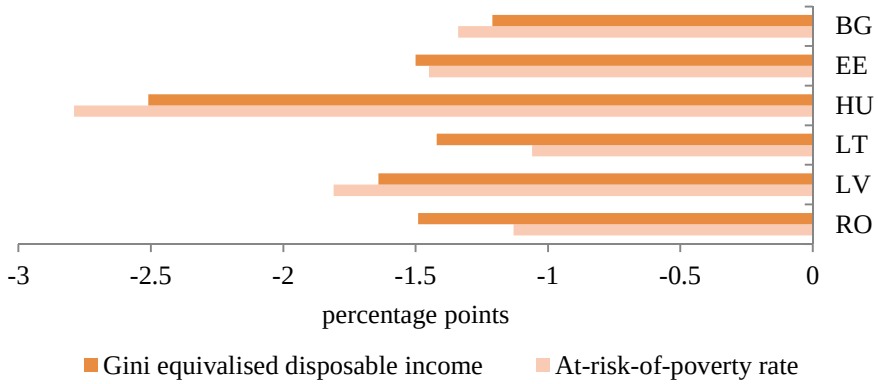
All countries experience a larger fall in the Gini Index compared to Scenario 1 from a low -1.21pp in Bulgaria to a high -2.51pp in Hungary. The reduction in poverty is also more pronounced, from -1.06pp in Lithuania to -2.79pp in Hungary compared to the baseline. The implicit tax rates on labour falls on average in Lithuania and Estonia but increases for all other countries. For low income deciles, the impact of these reforms on the implicit tax rate on labour is clearly reduced due to the stronger progressive nature of the reform. The extra PIT revenues are used to lower the tax burden of the low-wage earners, boosting the disposable income of the bottom decile. As expected, the overall net budgetary effect is neutralised compared to Scenario (I) given the counteracting effect of the tax credit.

Figure 3: Mean annual equivalised disposable income by decile (difference as % of 2017 baseline), Scenario (II)



Source: Joint Research Centre, calculations based on the EUROMOD model.

Figure 4: Inequality and at-risk-of-poverty rate, Scenario (II)



Source: Joint Research Centre, calculations based on the EUROMOD model.

3.3 Scenario (III): Introduction of a tapered basic tax-free allowance and increase in the flat PIT rate

In this scenario we simulate an increase in the basic tax allowance which is compensated by an increase in the flat PIT rate in order to ensure budget neutrality. In case of an existing phasing-out design, we do not apply any changes (as this is the case for Latvia, Lithuania and Romania), while introducing it in the countries where a tapering off does not exist (Estonia). In countries that do not have any basic allowance (Bulgaria), a basic tax allowance with a phasing out is introduced for employees[5]. The increased basic tax-free allowance is set to equal the minimum gross wage (except

[5] The self-employed in Hungary are subject to a different tax scheme, while in Bulgaria they already benefit of a basic tax allowance.

in Estonia, where an actual proposal discussed in 2017 and entered into force in 2018 is used). In countries where pensions are included in the taxable base and have a separate tax allowance which is higher than the basic allowance (as in Latvia and Romania), the allowance for pensioners is increased only if it is lower than the new basic tax allowance (as this is the case for Latvia). Other specific allowances (e.g. for children, disabled, other dependants, self-employed etc.) and tax credits remain unchanged. A more detailed description of the existing and reformed basic tax allowances is provided in Tables 6,7 and Annex F.

Table 6: Summary of existing basic tax allowances (BTA) and proposed simulations, 2017

	LT	LV	EE	RO	BG	HU
Currency	EUR	*EUR*	*EUR*	*RON*	*BGN*	*HUF*
BTA is in place	Y	Y	Y	Y	N	N
Phase-out is in place	Y	Y	N	Y	N	N
Amount of existing BTA	310	115	180	800	N	N
New BTA*	380*	380	500*	1,450	460	127,500
Gross minimum wage	380	380	470	1,450	460	127,500
TA for pensioners**	N	Y	Y	N	N	N
Amount of TA for pensioners	N	235	255	2,000	N	N
New amount of TA for pensioners	N	500	N***	2,000	N	N

Note: * an increase is based on legislation which came into force since 2018.

** A "N" indicates that tax allowance for pensioners does not exist as pension incomes are not taxed.

*** The additional allowance for pensioners was abolished under 2018 legislation. Pensioners are entitled to the BTA.

Table 7: Change in PIT flat rate (percentage points)

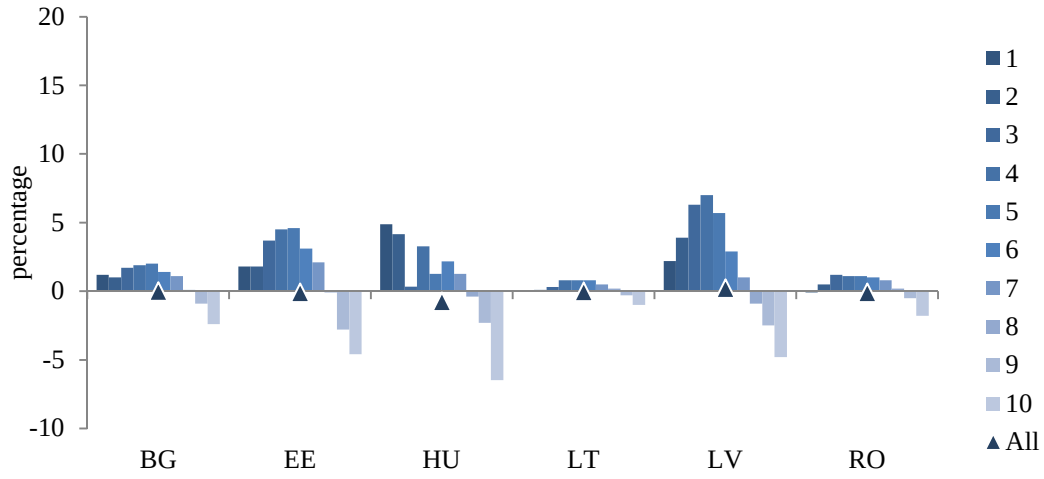
	LT	LV	EE	RO	BG	HU
Existing PIT rate (%)	15	23	20	16	10	16
New PIT rate (%)	16	28.4	23.6	18	13.3	23
Difference (pp.)	*1*	*5.4*	*3.6*	*2*	*3.3*	7

Figures 5, 6 and Annex D summarize the results of this simulation as a percentage change from the 2017 baseline scenario. In this scenario, country specific features play an even larger role than in previous scenarios. This is due to the heterogeneity of the basic tax-free allowance across countries. The tapered allowance has the largest impact both in terms of disposable income and inequality in

the countries that do not apply this feature (as in Bulgaria and Hungary) or in those where the allowance was increased substantially (as in Latvia and Estonia).

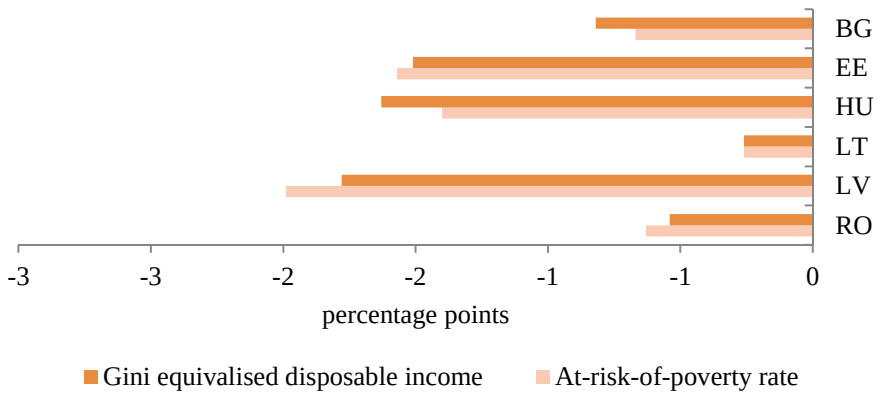
All countries experience a fall in the Gini Index although less pronounced than in Scenario (I) for Lithuania (-0.26pp) and Romania (-0.54pp) which already applied tapered allowances. Poverty is also reduced in all countries by less than in Scenarios (I) or (II). In Latvia, there is also a significant decrease in the at-risk-of-poverty rate, due to the pensioners' allowance which almost doubles. The implicit tax rate on labour increases on average in Estonia and Latvia (0.1% and 0.59% respectively) and falls in Bulgaria (-0.02%), Lithuania (-0.08%), Romania (-0.22%), and Hungary (-2.04%). The fall in implicit tax rate is concentrated on low to mid-income deciles, excepting for Latvia where all income deciles experience a fall. Disposable income increases for most income deciles (especially so for the first deciles) although on average only for Latvia as the highest income deciles experience a fall in disposable income.

Figure 5: Mean annual equivalised disposable income by decile (difference as % of 2017 baseline)



Source: Joint Research Centre, calculations based on the EUROMOD model.

Figure 6: Inequality and at-risk-of-poverty rate, Scenario (III)



Source: Joint Research Centre, calculations based on the EUROMOD model.

4 Macroeconomic analysis of the budget-neutral scenarios

We used a three-region QUEST model with tradable/non-tradable sectors and three types of labour skills (low, medium and high) to simulate the macroeconomic effect of introducing/increasing progressivity in the PIT systems in a budgetary neutral way for scenarios (II) and (III). For each country, we implement two scenarios based on the inputs we received from the preceding microsimulation analysis using EUROMOD. In order to combine EUROMOD and QUEST, we follow the approach developed by Barrios et al. (2018). We harmonize the QUEST and EUROMOD calibration in the baseline by using the labour supply elasticities, the main labour supply statistics (employment, unemployment and inactivity rates), employee and employer paid taxes and skill-premiums from EUROMOD in the QUEST model. The labour supply elasticities have been estimated following the approach developed by Bargain et al. (2014). The non-participation rates have been computed using the EU-SILC data. Both statistics are shown in Table 8 by country and skill level. The rest of the QUEST model is calibrated using national accounts statistics (EUROSTAT), parameters taken from the literature and from the estimated version of the model (Annex A provides further details on the QUEST model).

Table 8. Calibration of labour supply elasticity and non-participation rates in QUEST (by skill level)

Countries	Labour supply elasticities			Non-participation rates		
	High	*Medium*	*Low*	*High*	*Medium*	*Low*
Bulgaria	0.186	0.220	0.398	0.060	0.093	0.143
Estonia	0.152	0.198	0.221	0.044	0.048	0.053
Hungary	0.099	0.149	0.198	0.097	0.099	0.159
Latvia	0.201	0.164	0.182	0.052	0.084	0.072
Lithuania	0.158	0.220	0.297	0.048	0.091	0.094
Romania	0.211	0.270	0.368	0.115	0.198	0.248

The changes in the implicit tax rates on the employee side, which are used to obtain the policy shocks in the QUEST model, are presented in Table 9.

Table 9. Changes in implicit tax rates paid by employees in scenarios (II) and (III)

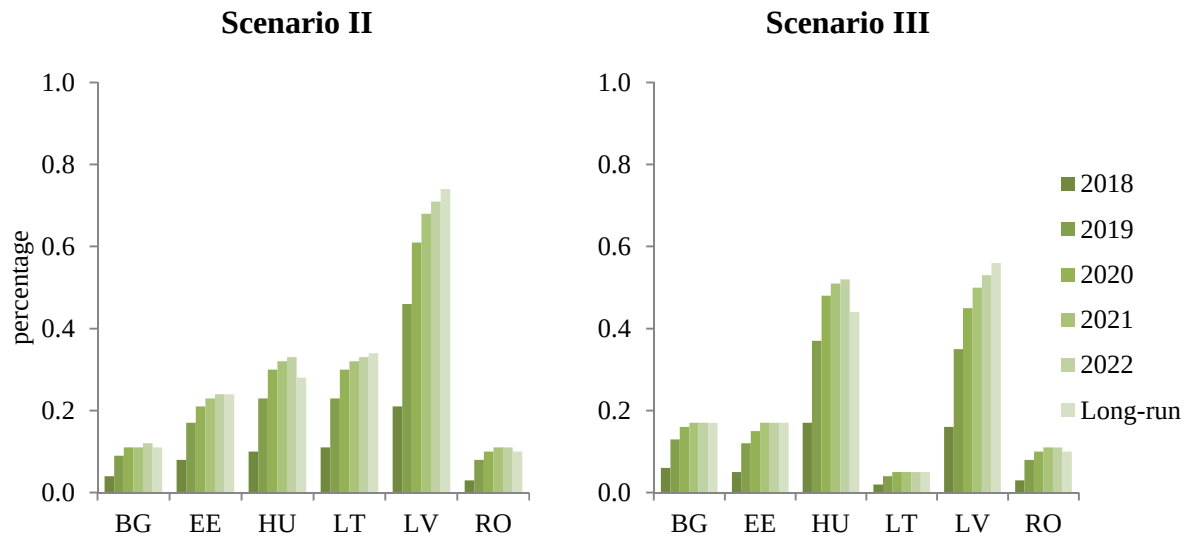
	Scenario (II)			Scenario (III)		
	High	*Medium*	*Low*	*High*	*Medium*	*Low*
Bulgaria						
Baseline (%)	16.11	16.90	14.60	16.11	16.90	14.60
Reform (%)	15.72	14.36	11.15	16.20	14.64	11.41
Change (pp)	*-0.39*	*-2.54*	*-3.45*	*0.09*	*-2.25*	*-3.19*
Estonia						
Baseline (%)	13.32	11.78	11.00	13.32	11.78	11.00
Reform (%)	12.50	8.64	6.91	12.64	9.29	8.14
Change (pp)	*-0.82*	*-3.14*	*-4.10*	*-0.68*	*-2.49*	*-2.86*
Hungary						
Baseline (%)	27.16	26.43	24.83	27.16	26.43	24.83
Reform (%)	27.92	23.15	17.34	26.88	20.04	15.54
Change (pp)	*0.76*	*-3.29*	*-7.49*	*-0.28*	*-6.39*	*-9.30*
Latvia						
Baseline (%)	21.88	20.03	17.94	21.88	20.03	17.94
Reform (%)	21.54	16.84	10.03	22.57	17.52	14.65
Change (pp)	*-0.34*	*-3.19*	*-7.91*	*0.70*	*-2.52*	*-3.29*
Lithuania						
Baseline (%)	14.91	12.28	10.43	14.91	12.28	10.43
Reform (%)	13.90	9.06	1.74	14.76	11.58	9.95
Change (pp)	*-1.01*	*-3.22*	*-8.69*	*-0.15*	*-0.70*	*-0.47*
Romania						
Baseline (%)	23.38	21.72	21.45	23.38	21.72	21.45
Reform (%)	24.00	20.85	20.38	23.73	20.38	19.96
Change (pp)	*0.63*	*-0.87*	*-1.08*	*0.36*	*-1.34*	*-1.49*

As expected, the two reforms reduce the taxes paid by employees on labour income. We also observe that low-skilled workers benefit relatively more from the tax cuts, especially in the case of the progressive PIT and refundable earned income tax credit which has a stronger progressive nature.

The corresponding results by country are presented in Figures 7, 8 below and Tables E1-E12 in Annex E. The scenarios bring slightly positive effects in terms of GDP across all scenarios due to higher overall employment. The long-run (20+ years) GDP effects are ranging from +0.01% (RO) to +0.07%

(LV) while the corresponding employment effects are between +0.10% (RO) and +0.74% (LV) relative to the baseline.

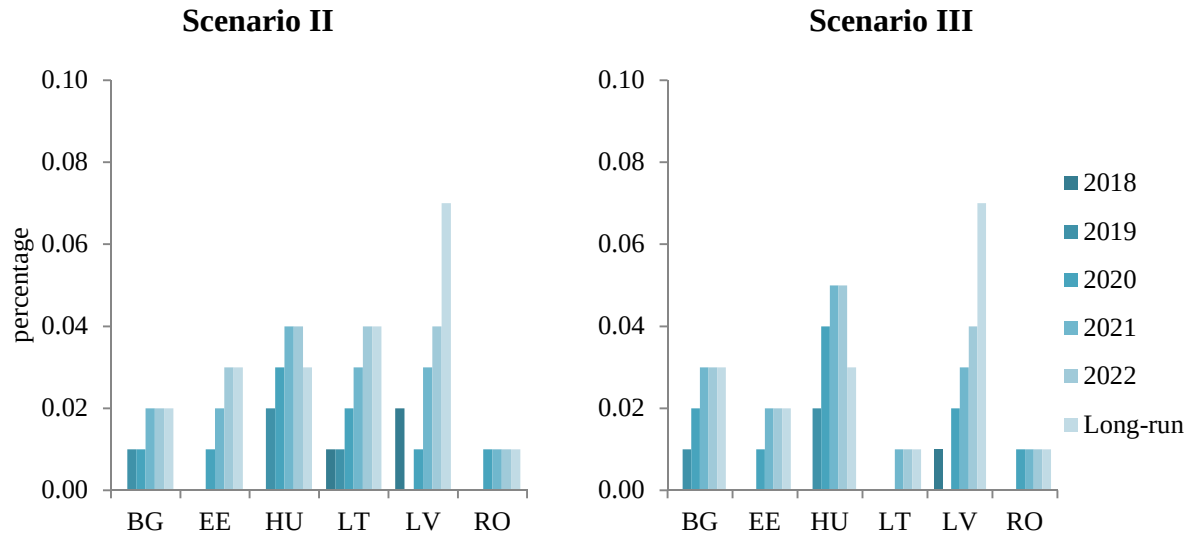
Figure 7: Medium and long-term impact on employment (% change from the baseline)



Source: Authors´ simulations based on the QUEST model.

Cutting taxes for low- (medium) skilled workers increases their incentives for being employed as their net real wage increases. On the other hand, raising taxes on the high skilled reduces their net real wage and lowers their employment rate. As low-skilled workers have lower productivity compared to medium and high-skilled workers, there is a trade-off between the higher employment rate benefiting low-skilled workers and the loss in high-skilled employment. The aggregate output and employment impact of these opposing forces depends on two main factors: the productivity differences between high-medium and low-skilled workers and their labour supply elasticities. The smaller is the difference between the productivity of high, medium and low - skilled workers and the higher (the lower) the labour supply elasticity of low (medium and high) skilled workers w.r.t net wages, the larger will be the economy wide employment effect and the more positive the GDP effect. For all the countries considered, the estimated labour supply elasticity of high-skilled workers in EUROMOD is significantly smaller compared to that of the low-skilled. This means that high-skilled workers are typically less sensitive to the cut in their net wages after a tax-hike than low-skilled workers, leading to slightly positive overall employment and GDP effect at the aggregate level.

Figure 8: Medium and long-term impact on GDP (% change from the baseline)



Source: Authors´ simulations based on the QUEST model.

It is important to note a number of caveats to the scope of this exercise. First, the positive macroeconomic effects from introducing more progressivity in the tax system depend crucially on the assumed productivity differences across skills and their labour supply elasticities[6]. Second, while a higher tax on high earnings are less detrimental for labour supply compared to that of the low-skilled, we do not take into account that progressive taxes can also decrease the potential wage-premium from investing in further training and education. Lowering the skill-(wage)-premium for higher education could lead to less investment in human capital, therefore, lower labor supply quality in the long-run. Third, a flat tax system can yield advantages in terms of efficiency of tax administration and fighting against tax evasion, in particular as it is often applied across the board to all taxes, not exclusively to income taxes. However, the recent evidence on this latter aspect has recently been questioned as discussed earlier. Furthermore this evidence has considered tax reforms moving from a progressive to a flat tax system while actually little is known for reforms going in the opposite direction. Fundamental tax reforms, as the ones considered in this paper, are usually accompanied by reforms of tax collection systems, tax enforcement rules and penalties.

In the next step of our macroeconomic analysis, we input the impulse responses for employment, gross real wages and consumer price index generated by the QUEST model back into the microsimulation model, in order to assess the medium-term projections in PIT revenues. In addition, we simulate a second scenario in which the second-round effects, i.e. the macroeconomic feedback and behavioural response to the tax change, are disregarded.

[6] We rely on the skill-specific relative earnings and employment rates to determine the skill-specific productivity differences.

We analyse both scenarios (II) and (III) over the period 2018-2022 and compare the variation in tax revenues against the baseline. More precisely, we apply the tax system of the baseline policy year 2017 to the subsequent five years and we assess the fiscal impact of the tax reforms embedding the second-round effects by amending the uprating factors and the weights in the household micro-data according to the macroeconomic feedback provided by the QUEST model for prices, employment and gross wages[7] (Annex E). This is done as follows:

a) We incorporate the macroeconomic impact of the tax reforms on employment by adapting the EUROMOD input dataset to accommodate the QUEST trajectories for the medium-term. In order to do so, we create micro-datasets for each year of analysis. For each skill group, the weights of the employed are increased/decreased according to the corresponding impulse response, while the weights of the unemployed are scaled down/up, keeping the total population constant. In this way, the employment effect estimated in QUEST is fully implemented as an extensive margin effect in the household micro-data.
b) The impulse response for the consumer price index is integrated in EUROMOD as a correction of the corresponding uprating factor.
c) For gross wagess we apply the same approach as for the CPI, with the only exception of having uprating factors for each skill category.

We subsequently run the microsimulation model to quantify the overall budgetary effects of the reform scenarios (II) and (III) under the two alternatives: one embedding and the second disregarding the behavioural response to the tax changes. The microsimulation results are presented in detail in Figures E.1 and E.2 of Annex E. Note that, since the reforms are designed to be budgetary neutral, the behavioral impact on the total PIT revenue is negligible, reaching a maximum of 1 pp. for Latvia compared to the static scenario (given the more significant effects on employment and gross wages for all skill groups). Incorporating the macro impact of the tax reforms in EUROMOD slightly decreases revenues from personal income taxes[8]. This is mainly due to the fact that the increases in employment for the largest share of employees (the middle and the low skilled) are offset by the decline in their gross wages. [9]

[7] Tables E1-E12 display the QUEST projections for net real wages, while the trajectories for gross real wages are used in this step.
[8] The trajectory of the PIT revenues in the scenarios disregarding the behavioural reactions is given by how the budget-neutrality constraint is implemented, i.e. marginally revenue-increasing or decreasing.
[9] Note, that the reform generates opposing responses in wages and employment. Decreasing (increasing) labour income taxes paid by employees will lead to higher (lower) employment of the target group, but it also exerts a downward (upward) pressure on their gross wages. As in Barrios et al. (2018), these counteracting forces mitigate the effect on the tax

5 Conclusions

Flat tax systems can theoretically bring advantages in terms of tax administration and tax compliance, employment and overall macroeconomic performance. However, such systems are also known to be less redistributive. This question has been increasingly debated in Central and Eastern European countries with flat tax systems where income inequalities are notoriously higher than in the rest of the European Union.

The existing literature brings a number of theoretical and empirical results about the advantages and drawbacks of flat vs. progressive tax systems. Yet, these general arguments have, to date, only been considered on a country by country basis, or considering specific aspects of flat tax systems on a cross-country basis such as for instance tax compliance or labour supply effects. A comparison of the relative merits of both flat vs. progressive tax systems in a comprehensive manner i.e., considering both the redistributive and macroeconomic effects, is yet missing. Such comparison is notoriously difficult, especially from an empirical perspective. One first reason is that countries differ in their institutional and economic structures. It is therefore difficult to draw general conclusions from a cross-country comparison. A second reason lies in the fact that there is actually no perfect "flat tax system", i.e., flat tax countries usually adopt basic tax allowances or tax credits benefiting low income households. In this paper we address these questions from an empirical perspective accounting for the complexities of existing flat tax systems and comparing their redistributive and macroeconomic properties against counterfactual progressive tax systems. Our analysis brings novel cross-country results. This is possible thanks in particular to the specific features of the EUROMOD microsimulation model which allows considering tax systems in a comparable way across countries (in particular with regard to the definition of the pre-tax gross income) and incorporating the effect of tax expenditures (tax allowances and tax credits) on household disposable income.

We analyse the fiscal, redistributive and macroeconomic impact of (re-)introducing progressivity in the Central and Eastern European countries with flat tax schedules, namely Bulgaria, Estonia, Latvia, Lithuania, Hungary and Romania. In order to do so, we use and combine microsimulation and macro-models. Our results suggest that enhancing progressive elements in the personal income tax system under alternative and plausible tax reform scenarios would have significant positive effects on redistribution and equity and would yield additional tax revenues. Budget neutral reforms combining progressive personal income tax systems with a working tax credit or complementing a (higher) flat

base. Barrios et al. (2018) also shows that this is not the case when employer paid taxes are cut. Decreasing employer paid taxes results in higher labor demand coupled with an upward pressure on the gross wages. As both employment and gross wages increase in this case, the tax-base is rising and the behavioral (second-round) effects on tax revenues can be substantial.

tax rate with tax allowances would yield similar results or, in some cases, would lead to further reduction in income inequality. However, there are substantial variations of results across countries depending on the existence of (pre-reform) tax expenditures. In the medium-term, the macroeconomic impact of the budget-neutral reforms appears to be positive, albeit small, for all countries.

Our paper is, to the best of our knowledge, the first to analyse within the same framework the macroeconomic and redistributive impact of progressive tax reforms in flat tax countries. A number of important related questions have not been considered and could be explored in future research using the same approach. For instance future research could potentially account for the role of tax compliance and tax administration when comparing flat vs. progressive tax systems. This would however require the availability of comparable estimates on tax evasion across income deciles and across countries together with reliable estimates on the behavioural impact of tax reforms on income underreporting. Another relevant question, not addressed in this paper, concerns the role of progressive tax systems regarding income insurance and income stabilisation. Under progressive tax systems, automatic stabilisation might be improved which, in case of adverse economic shock, can potentially help smoothing the impact of economic downturns. This property of progressive tax systems might be gauged against their potential adverse effects on labour supply which might slow down economic recovery. These questions could be addressed in future research.

References

Altig, D., Auerbach, A. J., Koltikoff, L. J., Smetters, K. A., & Walliser, J. (2001), Simulating fundamental tax reform in the United States, *American Economic Review* 91(3), 574-595.

Astarita, C., S. Barrios, F. D'Auria, A. Maftei, Ph. Mohl, M. Salto, M.L. Schmitz, A. Tumino and E. Turkisch, (2018), "Impact of fiscal policy on income distribution," Report on Public Finances in EMU, Directorate General Economic and Financial Affairs (DG ECFIN), European Commission: 71-131.

Avram, S. (2018), Who benefits from the 'hidden welfare state'? The distributional effects of personal income tax expenditure in six countries, *Journal of European Social Policy* 28(3): 271-293.

Bargain, O., Orsini, K., & Peichl, A. (2014), Comparing labour supply elasticities in Europe and the United States: new results, *Journal of Human Resources,* 49(3), 723-838.

Barrios, S., M. Dolls, A. Maftei, A. Peichl, S. Riscado, J. Varga and C. Wittneben (2018), Dynamic scoring of tax reforms in the European Union, *Journal of Policy Analysis and Management* (forthcoming).

Caminada, K. and K. Goudswaard (2001) Does a flat rate individual income tax reduce tax progressivity? A simulation for the Netherlands, *Public Finance and Management*, 1(4), 471–499.

Decoster, A. and K. Orsini (2007) Verdient een vlaktaks zichzelf terug? (Leuvense Economische Standpunten), K.U. Leuven, Centrum voor Economische Studiën.

Diamond, P. and E. Saez (2011) The Case for a Progressive Tax: From Basic Research to Policy Recommendations, *Journal of Economic Perspectives*, 25(4): 165-90.

Duncan, D. and K. Sabirianova Peter (2016) Unequal inequalities: Do progressive taxes reduce income inequality?, *International Tax and Public Finance*, 23(4), 762–783.

Fuest, C., A. Peichl and T. Schaefer (2008) Is a flat tax reform feasible in a grown-up democracy of Western Europe? A simulation study for Germany, *International Tax and Public Finance* 15(5): 620-636.

González-Torrabadella, M. and J. Pijoan-Mas (2006) Flat tax reforms: a general equilibrium evaluation for Spain, *Investigaciones Económicas*, XXX(2), 317–351.

Gorodnichenko, Y., J. Martinez-Vazquez and K. Sabirianova Peter (2009) Myth and Reality of Flat Tax Reform: Micro Estimates of Tax Evasion Response and Welfare Effects in Russia, *Journal of Political economy* 117(3), 504-554.

Heathcote, J., K. Storesletten, K., & Violante, G. L. (2017). Optimal tax progressivity: An analytical framework, *Quarterly Journal of Economics* 132(4), 1693-1754.

Horvath, M., Senaj, M., Siebertova, Z., & Svarda, N. (2015). The End of the Flat Tax Experiment in Slovakia. Economic Modelling, *forthcoming*.

Ivanova, A., M. Keen and A. Klemm (2005) The Russian Flat Tax Reform, *IMF Working Paper* No. 16.

Keen, M., Y. Kim and R. Varsano (2008) The 'flat tax(es)': Principles and experience, *International Tax and Public Finance* 15:6 712–751.

Lakner, Ch. and B. Milanovic (2016) Global Income Distribution: From the Fall of the Berlin Wall to the Great Recession, *World Bank Economic Review* 30(2): 203-232.

Mendoza, E.G., G. M. Milesi-Ferretti, and P. Asea (1997). On the ineffectiveness of tax policy in altering long-run growth: Harberger's superneutrality conjecture. *Journal of Public Economics*, 66(1), 99-126.

OECD (2008) Growing Unequal? Income Distribution and Poverty in OECD countries, Paris: OECD.

OECD (2011) Divided we stand. Why inequality keeps rising, Paris: OECD.

Ratto, M., W. Roeger and J. in't Veld (2009) QUEST III: An estimated open-economy DSGE model of the euro area with fiscal and monetary policy, *Economic Modelling*, 26(1), 222-233.

Remeta, J., S. Perret, M. Jareš, and B. Brys (2015) Moving Beyond the Flat Tax – Tax Policy Reform in the Slovak Republic, *OECD Taxation Working Papers*, No. 22.

Saavedra, P., Marcincin, A., & Valachy, J. (2007). Flat income tax reforms. 2007), Fiscal Policy and Economic Growth: Lessons for Eastern Europe and Central Asia, The World Bank Publication.

Stokey, N. L., and S. Rebelo (1995). Growth effects of flat-rate taxes. *Journal of political Economy* 103(3), 519-550.

Sabirianova Peter, K., S. Buttrick and D. Duncan (2010) Global reform of personal income taxation, 1981–2005: Evidence from 189 countries, *National Tax Journal*, 63(3), 447–478.

Sutherland, H. and F.Figari (2013). EUROMOD: the European Union tax-benefit microsimulation model. *International Journal of Microsimulation*, 6(1), 4-26.

Tóth, I.G. (2013) Time series and cross country variation of income inequalities in Europe on the medium run: are inequality structures converging in the past three decades?, GINI Policy Paper 3.

in 't Veld, J. (2013) Fiscal consolidations and spillovers in the Euro area periphery and core, *European Economy Economic Papers*, No. 506.

Varga, J. and J. in 't Veld (2014) The potential growth impact of structural reforms in the EU. A benchmarking exercise, *European Economy Economic Papers*, No. 541.

Vogel L. (2012) Tax avoidance and fiscal limits: Laffer curves in an economy with informal sector, *European Economy Economic Papers*, No. 448.

Annex A. Description of the models

A.1 The microsimulation model EUROMOD and EU-SILC data

EUROMOD is a tax-benefit microsimulation model covering all 28 member states of the European Union. The model is a static tax and benefit calculator that makes use of representative microdata from the EU Statistics on Income and Living Conditions (EU-SILC) survey to simulate individual tax liabilities and social benefit entitlements according to the rules in place in each member state.[10] Starting from gross incomes contained in the micro data, EUROMOD simulates most of the (direct) tax liabilities and (non-contributory) benefit entitlements, and calculates household disposable incomes.[11] The model is unique in its area as it integrates taxes, social contributions and benefits in a consistent framework, thus accounting for interactions between the tax and benefits systems which - in the European case - can have a non-negligible impact in terms of tax revenues, disposable income distribution and also in terms of work incentives. However, EUROMOD is "static" and only delivers the first-round effects of the simulations. It does not take into account the behavioural response of individuals to a given policy change. Long-term policy effects are also not addressed with this model.

EUROMOD uses the latest available EU-SILC data. EU-SILC collects information on socio-demographic characteristics, income sources, employment status, and gross income for all members of the private households selected into the sample as well as information on household composition. The income reference period in EU-SILC is the year preceding the survey. The EU-SILC data include information on personal and household characteristics, several types of income (e.g., market income, pensions or social transfers), certain expenditures (e.g., housing costs or life insurance payments), and other variables related to living conditions. The validity of the simulated aggregates is ensured by comparison with the corresponding macroeconomic estimates provided by national tax authorities or by statistical institutes. Validation tables are offered in the EUROMOD country reports for the EU-28 Member States, which can be found at https://www.euromod.ac.uk/using-euromod/country-reports.

In order to align monetary values with the policy year of interest 2017, indices such as the consumer price index and statutory adjustment rules (e.g., for pensions and social benefits) are applied to update income components to the policy year of interest. These index variables are called uprating factors and are usually taken from Eurostat (the European statistics agency) or national statistical offices.[12] In the context of this paper, uprating factors are also used for including general equilibrium effects in EUROMOD. This way skill-specific indices are taken from the QUEST model (e.g. after a policy chocks) and included back into EUROMOD in order to obtain the final impact of reforms on tax revenues.

A more detailed description of the EUROMOD model can be found in Sutherland and Figari (2013).

[10] We use the latest available version "H.034+" of EUROMOD together with the datasets based on the 2015 version of EU-SILC. For the simulation of the tax reforms, we choose 2017 tax-benefit rules as the baseline. This is the most recent policy year that can be simulated with EUROMOD at the time of writing this paper.

[11] Note that some contributory benefits (e.g., pensions as well as unemployment or disability benefits) are not simulated but taken directly from the EU-SILC data, given the lack of individual contribution histories that would be needed to simulate them.

[12] Examples of uprating factors are consumer price indices and evolution of earnings and statutory adjustment rules for certain benefits.

A.2 Labour supply model and the macroeconomic DSGE model QUEST III

The labour supply micro-econometric model, from which labour supply elasticities and number of non-participants are estimated, follows closely Bargain et al (2014). This is a discrete choice labour supply model where individuals face a set of alternatives in terms of working hours, including the possibility of supplying zero hours in the labour market. Probabilities of supplying each of those alternatives are then estimated in order to maximize a utility function, depending on consumption, leisure and individual/household characteristics. Using this model we obtain the labour supply elasticities reported in Table 6.

The macroeconomic model used in this analysis is an extension of the European Commission's New-Keynesian model, QUEST (to be precise: version QUEST III, see Ratto et al. 2009), to include different skilled workers. The QUEST model is the standard model used by the European Commission to analyse the impact of fiscal scenarios and structural reforms in the EU Member States (see for instance Vogel 2012, in 't Veld 2013, Varga and in 't Veld 2014). As a fully forward-looking DSGE model, QUEST can capture the behavioural responses of major macroeconomic variables in an open economy context, going beyond the direct, static impact of specific tax reforms measured by EUROMOD. The labour market modelled in QUEST is strongly based on microeconomic theory and sufficiently general to adapt to the different labour market institutions of the EU countries.

More specifically, the model-version used for this exercise is a three-region open-economy model, calibrated for the country of interest, the (rest of) euro area and the rest of the world. For each region, the model economy is populated by households and final goods producing firms. There is a monetary and fiscal authority, both following rule-based stabilization policies. The domestic and foreign firms produce a continuum of differentiated goods under monopolistic competition. In order to measure the distributional consequences of policies we introduce three skill groups – high, medium and low – into the model earning different wages.[13] (See also Barrios et al. 2018)

[13] By using the ISCED education classification, we define the share of population with up to lower secondary education (ISCED 0-2) as low-skilled, with up to upper secondary, non-tertiary education (ISCED 3-4) as medium skilled and the rest of the population as high-skilled.

Annex B. Scenario (I) – Progressive personal income tax schedule

Table B.1: Impact of progressive PIT on total revenues and expenditures (difference as % of 2017 baseline)

	LT	LV	EE	RO	BG	HU
PIT	8.2	6.2	6.5	7.2	8.2	13.83
Total taxes*	8.2	6.0	6.4	6.7	7.9	13.05[14]
Total SIC	0	0	0	0	0	0.00
Pensions	0	0	0	0	0	0.00
Means tested benefits	-0.1	-0.4	-1.1	-0.5	0	-0.21
Non-means tested benefits	0	0	0	0	0	0.00
Total benefits	0	0	0	0	0	0.00
Net budgetary effect	4.2	4.3	4.01	25.1	15.3	12.23

Source: Joint Research Centre, calculations based on the EUROMOD model.

Note:*In addition to PIT, other taxes include property tax in LT, RO, BG, and HU; land tax in EE; property tax and solidarity tax for employee and self-employed in LV.

Table B.2: Mean annual net PIT liabilities by decile (difference as % of 2017 baseline)

Decile	LT	LV	EE	RO	BG	HU
1	-18.8	-16.6	-22.1	-28	-39.8	-12.21
2	-26.0	-16.8	-20.2	-22.3	-29.5	-6.93
3	-25.4	-16.1	-16.9	-17.6	-27.2	-4.34
4	-21.1	-13.0	-13.5	-13.2	-21.9	0.07
5	-18.5	-8.6	-10.0	-12	-17.4	3.77
6	-12.9	-4.6	-4.7	-8.7	-11.9	8.50
7	-3.9	-0.8	-1.6	-5.8	-8.2	12.07
8	-1.8	3.8	3.3	-1	0.8	16.53
9	5.8	8.9	10.4	5.6	10	20.38
10	24.3	17.7	19.3	22.7	36	28.08
All	8.2	6.2	6.5	7.2	8.2	13.83

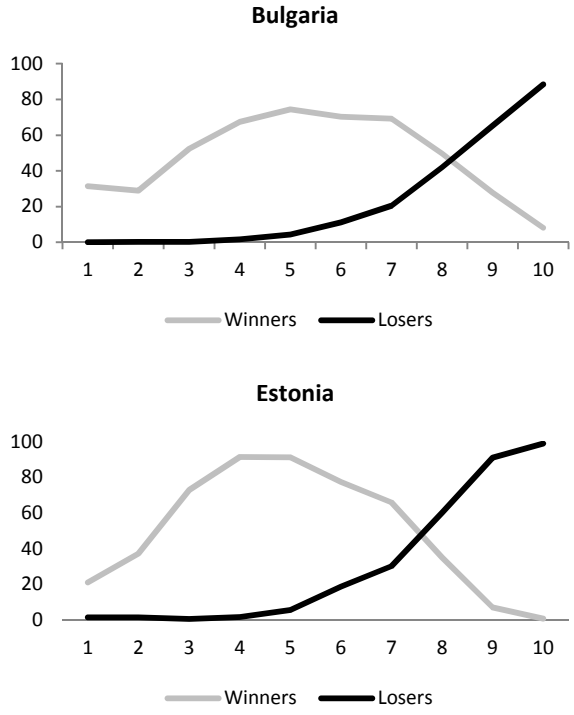
Source: Joint Research Centre, calculations based on the EUROMOD model.

[14] Following the replacement of the flat tax by a progressive one, Hungary emerges out as the country with the highest increase in total tax revenues (13.05%). This can be explained by two main features of the current tax system: 1) the implicit tax rates in Hungary are very high (exceeding 40%) compared to the other countries; 2) the share of the PIT in household income does not vary across income deciles; 3) additionally, the redistributive effect of personal income taxes is lower in Hungary than in the other analysed Member States.

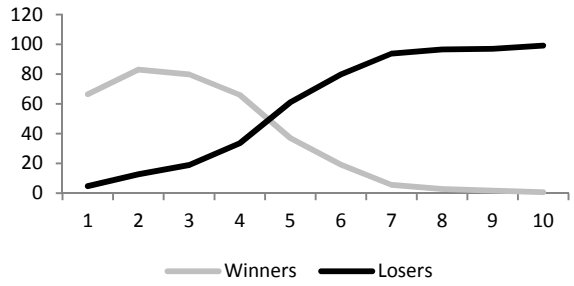
Table B.3: Implicit tax rates on labour by deciles (difference as % of 2017 baseline)

Decile	LT	LV	EE	RO	BG	HU
1	-0.15	-0.79	-1.07	-0.56	-2.36	-1.32
2	-0.40	-1.03	-1.40	-1.28	-1.71	-0.34
3	-0.50	-1.18	-1.29	-1.17	-1.55	0.10
4	-0.93	-1.09	-1.15	-1.00	-1.27	0.39
5	-1.02	-0.87	-0.93	-0.96	-1.03	0.79
6	-0.94	-0.48	-0.44	-0.79	-0.68	1.34
7	-0.58	-0.04	-0.09	-0.53	-0.45	1.74
8	-0.14	0.58	0.45	-0.11	0.24	2.25
9	0.50	1.34	1.34	0.55	0.88	2.65
10	2.49	2.75	2.54	1.85	2.84	3.63
All	0.59	0.96	0.85	0.36	0.74	2.14

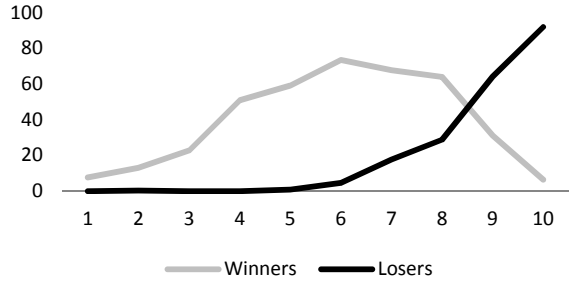
Figure B.1: Shares of affected households, winners and losers by decile (%)



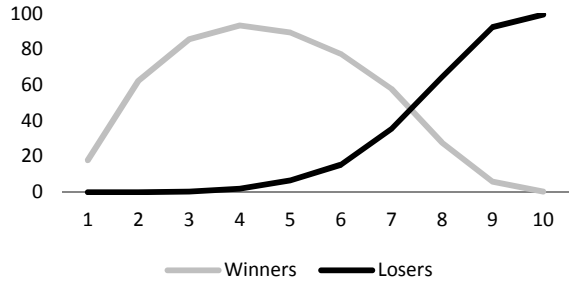
Hungary



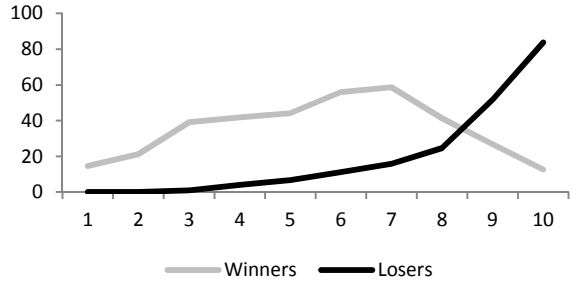
Lithuania



Latvia



Romania



Annex C. Scenario (II) – Progressive personal income tax schedule with a refundable earned income tax credit

Figure C.1: Design of the refundable in-work tax credit

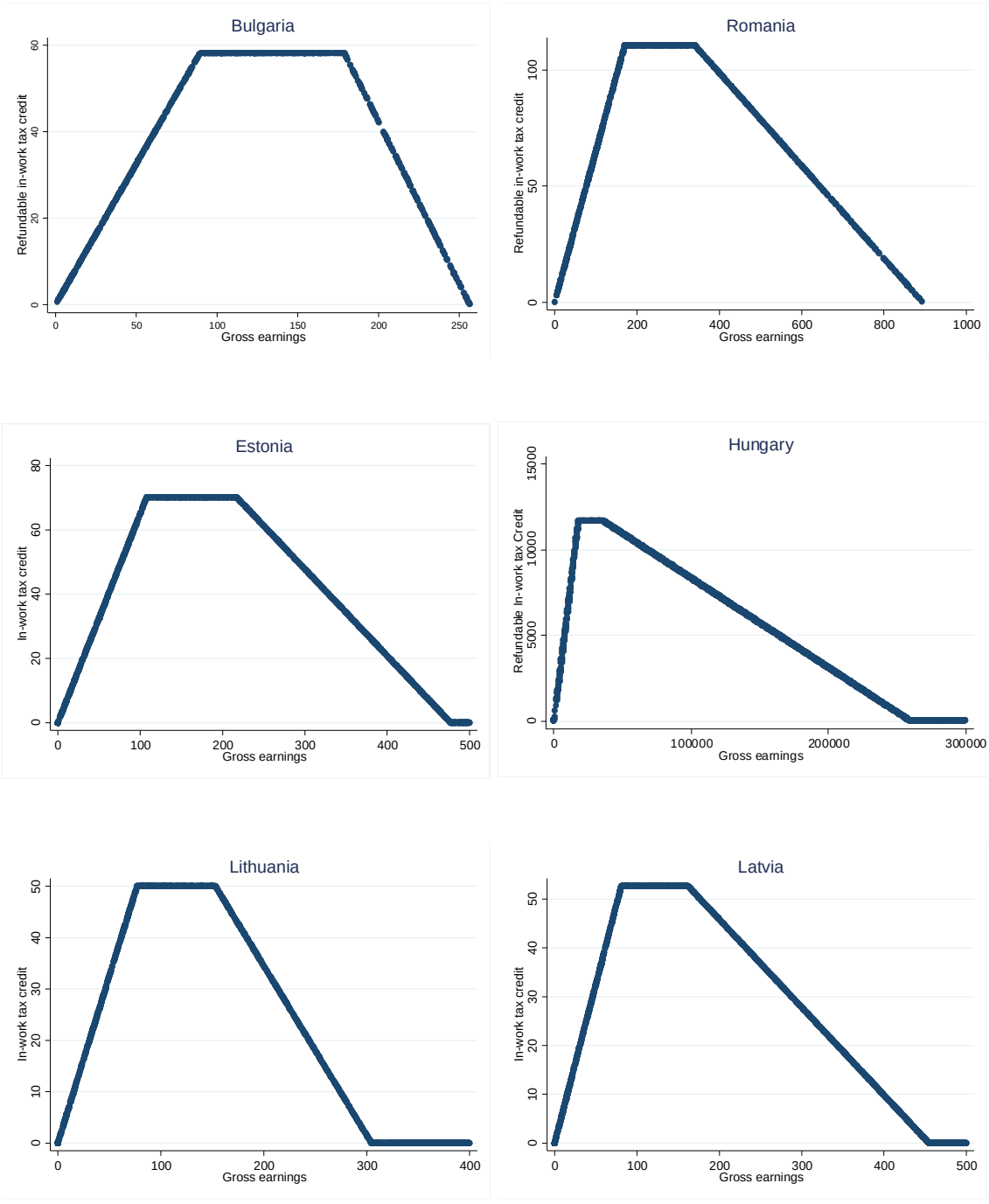


Table C.1: Impact of progressive PIT and in-work tax credit on total revenues and expenditures (difference as % of 2017 baseline)

	LT	LV	EE	RO	BG	HU
PIT	-0.1	-0.2	-0.03	1.0	-0.2	0.01
Total taxes	-0.1	-0.2	-0.03	-0.9	-0.2	0.01
Total SIC	0	0	0	0	0	0
Pensions	0	0	0	0	0	0
Means tested benefits	-0.1*	-16.2	-1.06*	-4	0	-0.85
Non-means tested benefits	0	0	0	0	0	0
Total benefits	0	-0.2	-0.03	-0.3	0	-0.02
Net budgetary effect	-0.03	0.06	0.01	-0.1	-0.4	0.04

Source: Joint Research Centre, calculations based on the EUROMOD model.

*The in-work refundable tax credit is designed to be applied only to the final income tax liability (and not to the withholding tax liability). While only the withholding tax is taken into account when assessing incomes for the means-tested benefits in LT and EE, the impact on means-tested benefits is smaller compared to the countries where there are no differences in withholding and final tax liabilities.

Table C.2: Share of taxpayers by decile (difference as % of 2017 baseline)

Decile	LT	LV	EE	RO	BG	HU
1	-8.2	-20.2	-17.7	-25.8	-23.9	-35.60
2	-8.2	-13.9	-8.3	-16	-10.1	-14.27
3	-11.4	-12.1	-13.0	-11.4	-13.4	-4.03
4	-11.7	-9.7	-10.3	-5.3	-11.6	-1.83
5	-7.9	-2.8	-5.2	-2	-6.5	-1.43
6	-6.1	-0.7	-0.1	-2.7	-2.8	-0.94
7	-2.8	-0.3	0.0	-0.9	-2.5	-0.65
8	-1.4	-0.2	0.0	-0.4	-1.9	-0.82
9	-0.5	0.0	0.0	-0.1	-1	-0.39
10	-0.4	0.0	0.0	-0.1	-0.3	-0.21
All	-6.4	-7.0	-6.4	-6.3	-7.8	-5.84

Source: Joint Research Centre, calculations based on the EUROMOD model.

Note: Taxpayers are defined as households in which the sum of all net PIT liabilities is positive.

Table C.3: Mean annual net PIT liabilities by decile (difference as % of 2017 baseline)

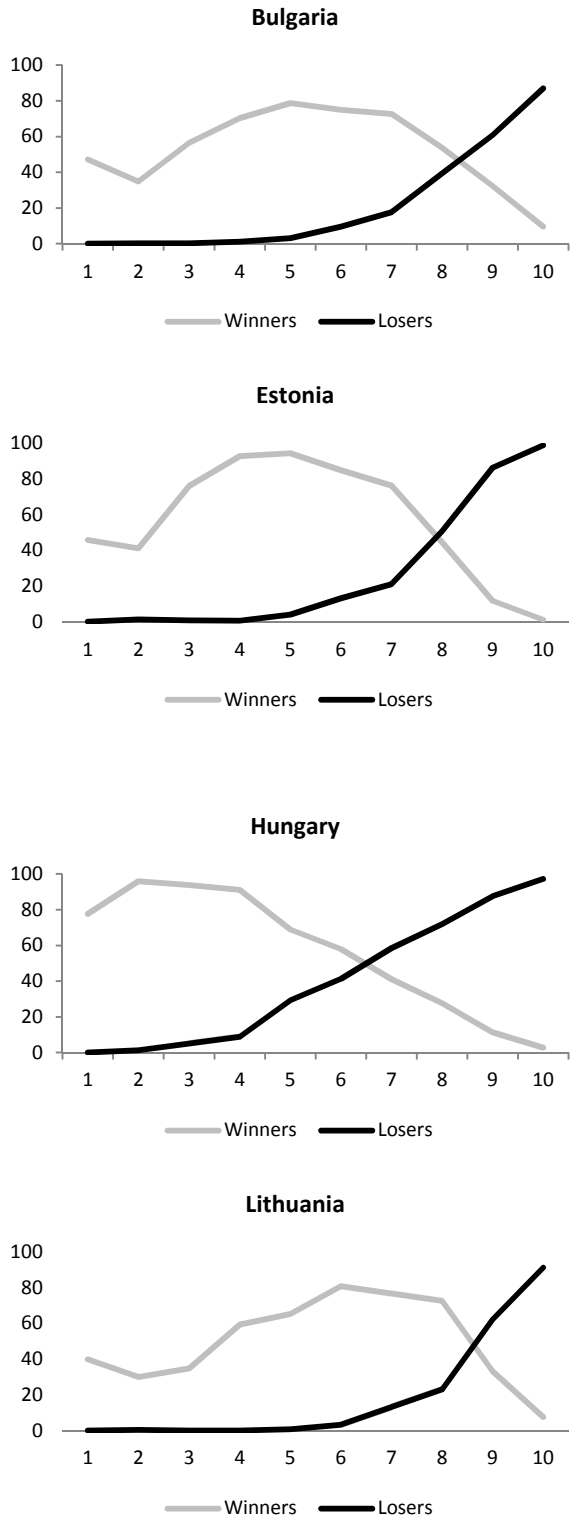
Decile	LT	LV	EE	RO	BG	HU
1	-569.1	-269.0	-283.2	-814.4	-286.5	-103.19
2	-217.6	-75.9	-77.0	-232.8	-98.5	-50.25
3	-185.2	-48.6	-54.0	-82.2	-67.6	-28.67
4	-58.9	-35.6	-33.4	-31.9	-46.1	-24.40
5	-40.5	-21.1	-22.6	-21.1	-28.2	-14.90
6	-26.4	-12.2	-11.0	-14.5	-20.5	-7.76
7	-10.5	-5.8	-6.6	-8.8	-13.4	-0.02
8	-6.6	1.0	0.3	-1.9	-2.4	7.12
9	4.4	6.9	8.4	5.2	7.5	13.74
10	23.8	17.2	18.6	22.7	35.1	25.88
All	-0.1	-0.2	-0.03	-1	-0.2	0.01

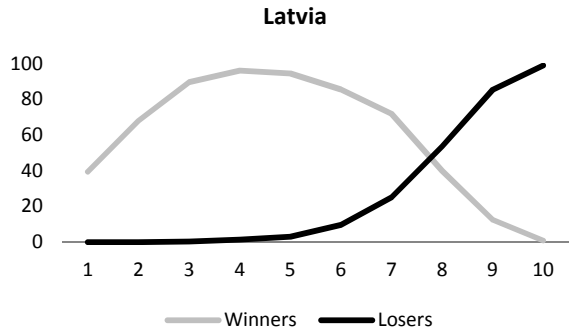
Source: Joint Research Centre, calculations based on the EUROMOD model.

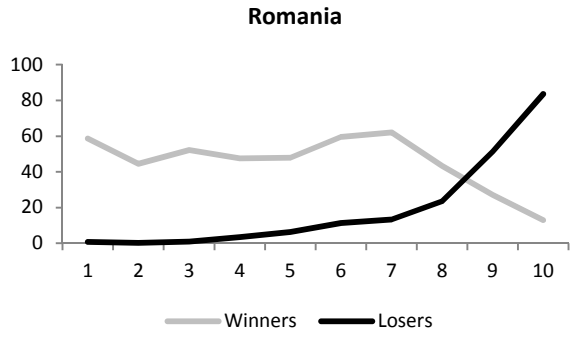
Table C.4: Implicit tax rates on labour by deciles (difference as % of 2017 baseline)

Decile	LT	LV	EE	RO	BG	HU
1	-13.96	-15.03	-4.66	-10.89	-9.42	-13.51
2	-4.47	-6.46	-6.45	-1.81	-3.26	-6.96
3	-4.26	-4.27	-6.38	-1.31	-2.21	-5.18
4	-2.60	-3.18	-6.18	-1.15	-1.79	-4.17
5	-2.07	-2.12	-5.78	-1.03	-1.23	-2.62
6	-1.85	-1.24	-4.57	-0.91	-0.83	-1.34
7	-1.11	-0.63	-3.84	-0.55	-0.54	-0.25
8	-0.54	0.23	-2.61	-0.12	0.2	0.96
9	0.37	1.07	-1.13	0.54	0.87	1.78
10	2.43	2.68	0.07	1.85	2.83	3.36
All	-0.10	0.21	-2.39	0.32	0.58	0.16

Figure C.2: Shares of affected households, winners and losers by decile (%)




Latvia
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10
Winners
Losers


Romania
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10
Winners
Losers

Annex D. Scenario (III) – Tapered basic tax-free allowance and increased flat PIT rate

Table D.1: Impact of increased PIT flat rate and general tax-free allowance on total revenues and expenditures (percentage points)

	LT	LV	EE	RO	BG	HU
PIT	0.2	-0.2	-0.1	-0.1	-0.01	-0.04
Total taxes	0.2	-0.1	-0.1	-0.1	-0.01	-0.04
Total SIC	0	0	0	0	0	0
Pensions	0	0	0	0	0	0
Means tested benefits	-0.1	-1.8	-4.4	-0.8	0	0.13
Non-means tested benefits	0	0	0	0	0	0.00
Total benefits	0	0	-0.1	0	0	0.00
Net budgetary effect	0.1	-0.1	0.04	0.4	-0.01	-0.04

Source: Joint Research Centre, calculations based on the EUROMOD model.

Table D.2: Share of taxpayers by decile (difference as % of 2017 baseline)

Decile	LT	LV	EE	RO	BG	HU
1	-0.6	-21.9	-21.9	-0.1	-20.2	-32.72
2	-2.4	-68.1	-47.2	-3.7	-10.2	-36.71
3	-10.4	-55.9	-43.9	-2.7	-13.2	-16.37
4	-6.5	-37.3	-25.1	-0.6	-9.9	-12.13
5	-4.0	-8.9	-1.7	0.0	-4.8	-6.05
6	-2.0	-2.8	0.0	-0.2	-4.6	-3.38
7	-2.8	-1.4	0.0	-0.1	-3.3	-1.44
8	-0.6	-0.1	0.0	0.0	-3.4	-0.96
9	-0.1	-0.2	-0.2	0.0	-1.5	-1.14
10	-0.1	0.0	0.0	0.0	-0.5	-0.94
All	-3.2	-23.8	-17.0	-0.8	-7.5	-11.19

Source: Joint Research Centre, calculations based on the EUROMOD model.

Note: Taxpayers are defined as households in which the sum of all net PIT liabilities is positive.

Table D.3: Mean annual net PIT liabilities by decile (difference as % of 2017 baseline)

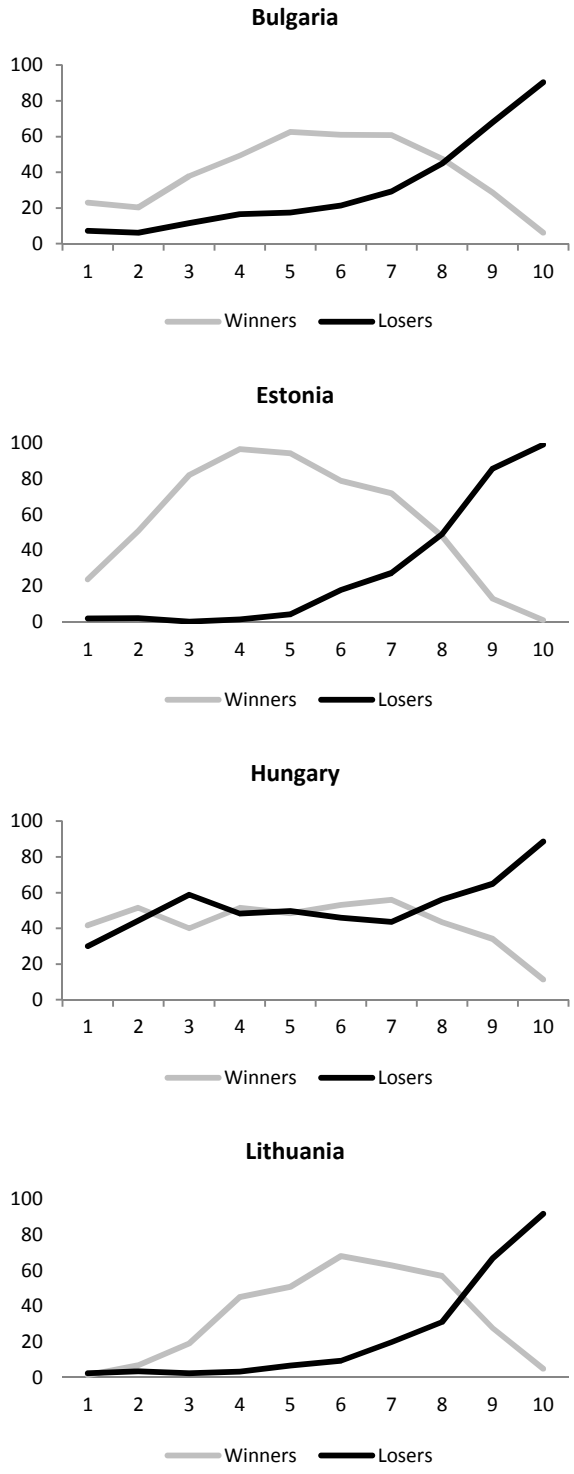
Decile	LT	LV	EE	RO	BG	HU
1	-0.6	-78.1	-89.8	7.9	-62.9	-34.46
2	-11.2	-79.0	-80.9	-31.7	-56.5	-31.04
3	-23.8	-74.0	-63.2	-35.6	-50.5	-12.02
4	-19.1	-56.8	-48.4	-26	-42.1	-23.58
5	-15.5	-35.0	-34.3	-19.7	-31.5	-14.98
6	-9.6	-15.8	-19.4	-13.6	-21.2	-15.58
7	-3.9	-4.9	-11.7	-9.3	-14.8	-10.07
8	-1.9	4.3	0.2	-2.2	-1.2	0.33
9	1.8	10.9	13.5	4	10.1	8.70
10	5.6	18.4	20.8	10.8	26.2	27.00
All	0.2	-0.2	-0.1	-0.1	0.0	-0.04

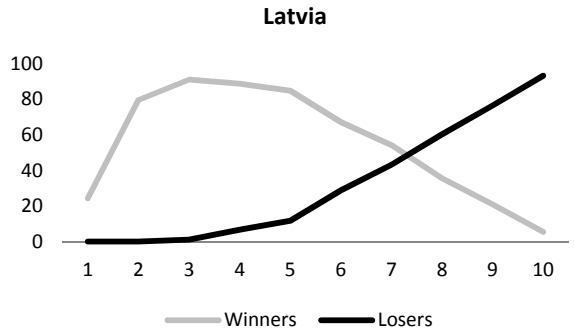
Source: Joint Research Centre, calculations based on the EUROMOD model.

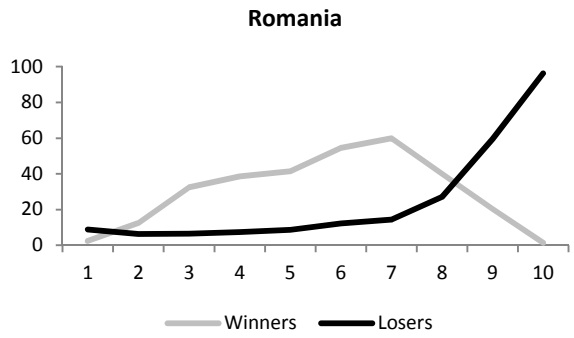
Table D.4: Implicit tax rates on labour (%) by decile (difference as % of 2017 baseline)

Decile	LT	LV	EE	RO	BG	HU
1	-0.18	-3.72	-4.35	-1.29	-5.84	-10.25
2	-0.43	-4.98	-5.66	-3.67	-4.58	-9.11
3	-0.74	-5.41	-5.09	-3.06	-4.02	-8.78
4	-1.04	-4.45	-4.45	-2.21	-3.18	-8.73
5	-1.00	-3.20	-3.52	-1.79	-2.44	-6.94
6	-0.79	-1.28	-2.09	-1.32	-1.55	-5.44
7	-0.48	-0.19	-1.28	-0.90	-1.10	-4.05
8	-0.20	0.97	0.02	-0.27	0.05	-1.57
9	0.14	1.89	1.69	0.36	0.85	-0.02
10	0.57	3.03	2.72	1.08	2.03	3.18
All	-0.08	0.59	0.10	-0.22	-0.02	-2.04

Figure D.1: Shares of affected households, winners and losers by decile (%)




Latvia
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10
Winners
Losers


Romania
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10
Winners
Losers

Annex E. Macroeconomic analysis of the budget-neutral scenarios

Table E.1. Bulgaria – Scenario (II)

	Years					
Years	2018	2019	2020	2021	2022	Long-run
GDP	0.00	0.01	0.01	0.02	0.02	0.02
Employment	0.04	0.09	0.11	0.11	0.12	0.11
- low skilled	0.22	0.47	0.57	0.61	0.63	0.63
- medium skilled	0.13	0.24	0.27	0.28	0.28	0.27
- high skilled	-0.22	-0.38	-0.42	-0.42	-0.42	-0.42
Net real wages	0.00	0.01	0.01	0.02	0.03	0.17
- low skilled	0.94	0.78	0.74	0.73	0.73	0.72
- medium skilled	0.81	0.75	0.74	0.74	0.74	0.73
- high skilled	-1.26	-1.21	-1.22	-1.23	-1.23	-1.25
Consumption	0.00	0.00	0.00	0.00	0.00	0.02
Investment	-0.02	-0.03	-0.03	-0.04	-0.04	0.00
Consumer prices, incl. VAT	-0.01	-0.02	-0.04	-0.05	-0.06	-0.14
Government balance (% GDP)	0.00	0.00	0.00	0.00	0.00	0.00
Trade balance (% GDP)	0.00	0.00	0.00	0.00	0.00	0.00

Table E.2. Bulgaria – Scenario (III)

	Years					
Years	2018	2019	2020	2021	2022	Long-run
GDP	0.00	0.01	0.02	0.03	0.03	0.03
Employment	0.06	0.13	0.16	0.17	0.17	0.17
- low skilled	0.46	0.97	1.20	1.29	1.31	1.32
- medium skilled	0.14	0.26	0.29	0.29	0.29	0.29
- high skilled	-0.27	-0.49	-0.53	-0.53	-0.53	-0.53
Net real wages	0.00	0.00	0.01	0.02	0.03	0.25
- low skilled	1.95	1.63	1.55	1.53	1.53	1.52
- medium skilled	0.88	0.81	0.80	0.80	0.80	0.78
- high skilled	-1.59	-1.51	-1.53	-1.54	-1.54	-1.57
Consumption	0.00	0.00	0.00	0.01	0.01	0.03
Investment	-0.02	-0.04	-0.05	-0.05	-0.05	-0.01
Consumer prices, incl. VAT	-0.01	-0.03	-0.06	-0.07	-0.09	-0.21
Government balance (% GDP)	0.00	0.00	0.00	0.00	0.00	0.00
Trade balance (% GDP)	-0.01	-0.01	-0.01	-0.01	0.00	0.00

Table E.3. Estonia – Scenario (II)

	Years					
Years	2018	2019	2020	2021	2022	Long-run
GDP	0.00	0.00	0.01	0.02	0.03	0.03
Employment	0.08	0.17	0.21	0.23	0.24	0.24
- low skilled	0.53	1.11	1.36	1.44	1.46	1.46
- medium skilled	0.31	0.62	0.74	0.77	0.77	0.77
- high skilled	-0.31	-0.60	-0.69	-0.70	-0.70	-0.69
Net real wages	0.00	-0.03	-0.04	-0.04	-0.04	-0.11
- low skilled	3.99	3.62	3.56	3.58	3.60	3.63
- medium skilled	2.28	2.09	2.07	2.08	2.09	2.11
- high skilled	-2.29	-2.16	-2.18	-2.19	-2.20	-2.18
Consumption	0.00	0.00	0.01	0.01	0.02	0.02
Investment	-0.02	-0.03	-0.03	-0.03	-0.02	-0.01
Consumer prices, incl. VAT	0.00	-0.01	-0.01	-0.02	-0.02	-0.03
Government balance (% GDP)	0.00	0.00	0.00	0.00	0.00	0.00
Trade balance (% GDP)	0.00	0.00	0.00	0.00	0.00	0.00

Table E.4. Estonia – Scenario (III)

	Years					
Years	2018	2019	2020	2021	2022	Long-run
GDP	0.00	0.00	0.01	0.02	0.02	0.02
Employment	0.05	0.12	0.15	0.17	0.17	0.17
- low skilled	0.33	0.69	0.85	0.91	0.92	0.92
- medium skilled	0.23	0.46	0.55	0.57	0.58	0.58
- high skilled	-0.22	-0.43	-0.49	-0.49	-0.49	-0.48
Net real wages	0.00	-0.01	-0.02	-0.02	-0.03	-0.09
- low skilled	2.48	2.26	2.22	2.22	2.24	2.26
- medium skilled	1.69	1.55	1.53	1.54	1.55	1.57
- high skilled	-1.62	-1.53	-1.54	-1.55	-1.56	-1.54
Consumption	0.00	0.00	0.00	0.01	0.01	0.02
Investment	-0.01	-0.02	-0.02	-0.02	-0.02	-0.01
Consumer prices, incl. VAT	0.00	-0.01	-0.01	-0.02	-0.02	-0.02
Government balance (% GDP)	0.00	0.00	0.00	0.00	0.00	0.00
Trade balance (% GDP)	0.00	0.00	0.00	0.00	0.00	0.00

Table E.5. Hungary – Scenario (II)

	Years					
Years	2018	2019	2020	2021	2022	Long-run
GDP	0.00	0.02	0.03	0.04	0.04	0.03
Employment	0.10	0.23	0.30	0.32	0.33	0.28
- low skilled	0.87	1.90	2.43	2.65	2.73	2.69
- medium skilled	0.16	0.30	0.33	0.34	0.33	0.28
- high skilled	-0.30	-0.52	-0.56	-0.56	-0.56	-0.61
Net real wages	0.01	0.03	0.07	0.13	0.20	1.01
- low skilled	7.62	6.89	6.66	6.61	6.60	6.41
- medium skilled	1.86	1.75	1.72	1.69	1.67	1.36
- high skilled	-3.56	-3.52	-3.58	-3.62	-3.66	-4.03
Consumption	-0.01	0.00	0.00	0.01	0.01	0.02
Investment	-0.05	-0.08	-0.11	-0.12	-0.12	-0.01
Consumer prices, incl. VAT	-0.03	-0.07	-0.11	-0.14	-0.17	-0.32
Government balance (% GDP)	-0.02	-0.03	-0.03	-0.04	-0.04	0.00
Trade balance (% GDP)	-0.02	-0.02	-0.02	-0.02	-0.02	0.00

Table E.6. Hungary – Scenario (III)

	Years					
Years	2018	2019	2020	2021	2022	Long-run
GDP	0.00	0.02	0.04	0.05	0.05	0.03
Employment	0.17	0.37	0.48	0.51	0.52	0.44
- low skilled	1.20	2.61	3.32	3.61	3.71	3.66
- medium skilled	0.35	0.66	0.74	0.75	0.75	0.67
- high skilled	-0.58	-1.03	-1.11	-1.11	-1.11	-1.20
Net real wages	0.01	0.04	0.11	0.21	0.32	1.62
- low skilled	10.57	9.55	9.24	9.17	9.15	8.88
- medium skilled	4.07	3.84	3.79	3.76	3.72	3.26
- high skilled	-6.81	-6.73	-6.83	-6.91	-6.97	-7.60
Consumption	-0.02	-0.01	0.00	0.01	0.01	0.02
Investment	-0.08	-0.14	-0.17	-0.18	-0.19	-0.02
Consumer prices, incl. VAT	-0.04	-0.11	-0.17	-0.22	-0.26	-0.50
Government balance (% GDP)	-0.03	-0.05	-0.06	-0.07	-0.07	0.00
Trade balance (% GDP)	-0.04	-0.04	-0.04	-0.03	-0.02	0.00

Table E.7. Latvia – Scenario (II)

	Years					
Years	2018	2019	2020	2021	2022	Long-run
GDP	0.02	0.00	0.01	0.03	0.04	0.07
Employment	0.21	0.46	0.61	0.68	0.71	0.74
- low skilled	1.99	4.37	5.66	6.23	6.46	6.57
- medium skilled	0.40	0.81	0.97	1.03	1.04	1.07
- high skilled	-0.73	-1.49	-1.79	-1.88	-1.89	-1.87
Net real wages	-0.03	-0.09	-0.12	-0.13	-0.12	-0.18
- low skilled	8.75	7.16	6.63	6.49	6.47	6.52
- medium skilled	1.58	1.33	1.25	1.23	1.23	1.25
- high skilled	-3.12	-2.73	-2.68	-2.69	-2.70	-2.67
Consumption	0.01	0.01	0.01	0.02	0.03	0.06
Investment	-0.03	-0.07	-0.07	-0.06	-0.05	-0.02
Consumer prices, incl. VAT	0.00	0.00	-0.02	-0.03	-0.04	-0.06
Government balance (% GDP)	0.01	-0.01	-0.01	-0.01	0.00	0.00
Trade balance (% GDP)	0.00	-0.01	0.00	0.00	0.00	0.00

Table E.8. Latvia – Scenario (III)

	Years					
Years	2018	2019	2020	2021	2022	Long-run
GDP	0.01	0.00	0.02	0.03	0.04	0.07
Employment	0.16	0.35	0.45	0.50	0.53	0.56
- low skilled	0.76	1.65	2.12	2.34	2.43	2.50
- medium skilled	0.52	1.08	1.33	1.42	1.45	1.48
- high skilled	-0.62	-1.26	-1.51	-1.58	-1.59	-1.56
Net real wages	-0.02	-0.05	-0.07	-0.07	-0.07	-0.18
- low skilled	3.21	2.63	2.42	2.36	2.34	2.37
- medium skilled	2.18	1.83	1.72	1.70	1.70	1.74
- high skilled	-2.64	-2.31	-2.27	-2.28	-2.28	-2.24
Consumption	0.01	0.01	0.01	0.02	0.03	0.06
Investment	-0.03	-0.06	-0.07	-0.06	-0.05	-0.02
Consumer prices, incl. VAT	0.00	-0.01	-0.02	-0.03	-0.04	-0.06
Government balance (% GDP)	0.00	-0.01	0.00	0.00	0.00	0.00
Trade balance (% GDP)	0.00	0.00	0.00	0.00	0.00	0.00

Table E.9. Lithuania – Scenario (II)

	Years					
Years	2018	2019	2020	2021	2022	Long-run
GDP	0.01	0.01	0.02	0.03	0.04	0.04
Employment	0.11	0.23	0.30	0.32	0.33	0.34
- low skilled	1.45	3.09	3.85	4.12	4.18	4.16
- medium skilled	0.27	0.52	0.61	0.63	0.64	0.64
- high skilled	-0.28	-0.54	-0.61	-0.61	-0.60	-0.60
Net real wages	-0.01	-0.04	-0.07	-0.07	-0.07	-0.12
- low skilled	11.16	10.04	9.87	9.93	10.00	10.06
- medium skilled	2.09	1.93	1.92	1.93	1.94	1.96
- high skilled	-2.34	-2.24	-2.27	-2.28	-2.28	-2.27
Consumption	0.00	0.00	0.01	0.02	0.02	0.03
Investment	-0.02	-0.04	-0.04	-0.03	-0.03	-0.02
Consumer prices, incl. VAT	0.00	-0.01	-0.02	-0.03	-0.04	-0.04
Government balance (% GDP)	0.00	0.00	0.00	0.00	0.00	0.00
Trade balance (% GDP)	0.00	0.00	0.00	0.00	0.00	0.00

Table E.10. Lithuania – Scenario (III)

	Years					
Years	2018	2019	2020	2021	2022	Long-run
GDP	0.00	0.00	0.00	0.01	0.01	0.01
Employment	0.02	0.04	0.05	0.05	0.05	0.05
- low skilled	0.03	0.05	0.07	0.07	0.07	0.07
- medium skilled	0.07	0.14	0.17	0.17	0.17	0.17
- high skilled	-0.05	-0.09	-0.11	-0.11	-0.10	-0.10
Net real wages	0.00	0.00	0.00	0.00	0.00	-0.02
- low skilled	0.19	0.17	0.17	0.17	0.17	0.17
- medium skilled	0.56	0.51	0.51	0.51	0.52	0.52
- high skilled	-0.42	-0.40	-0.40	-0.41	-0.41	-0.40
Consumption	0.00	0.00	0.00	0.00	0.00	0.01
Investment	0.00	-0.01	-0.01	-0.01	-0.01	0.00
Consumer prices, incl. VAT	0.00	0.00	0.00	-0.01	-0.01	-0.01
Government balance (% GDP)	0.00	0.00	0.00	0.00	0.00	0.00
Trade balance (% GDP)	0.00	0.00	0.00	0.00	0.00	0.00

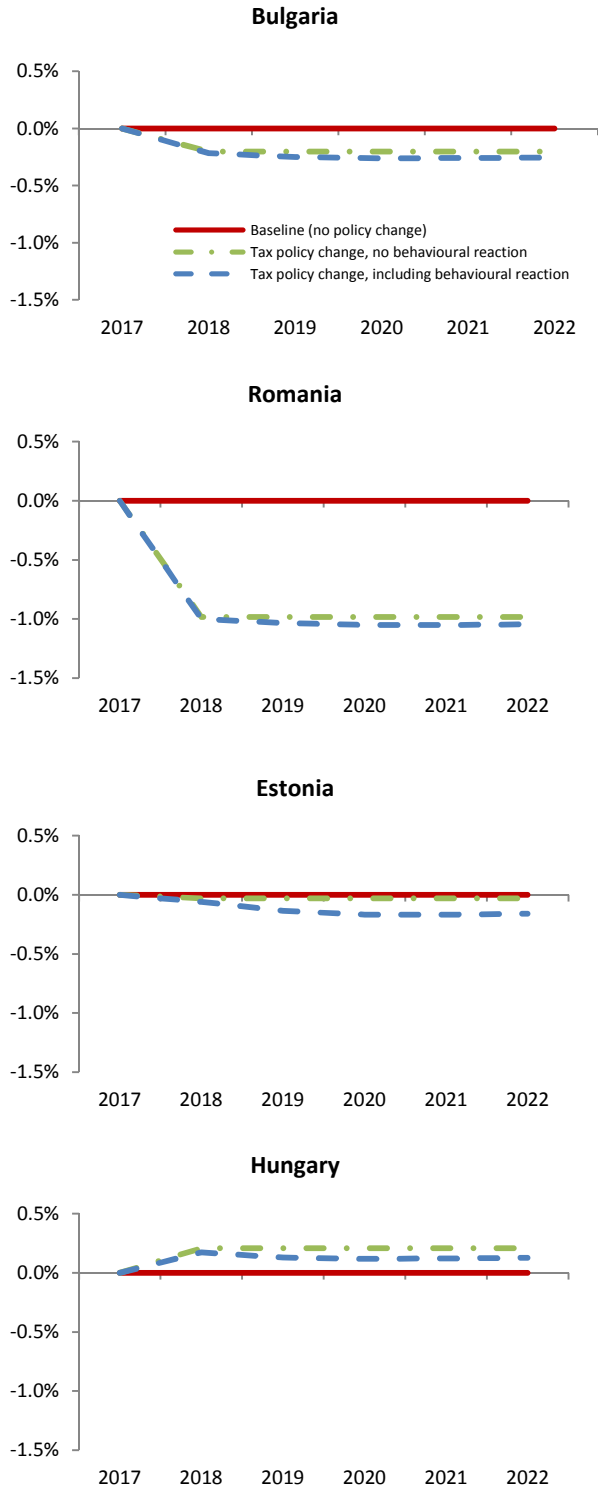
Table E.11. Romania – Scenario (II)

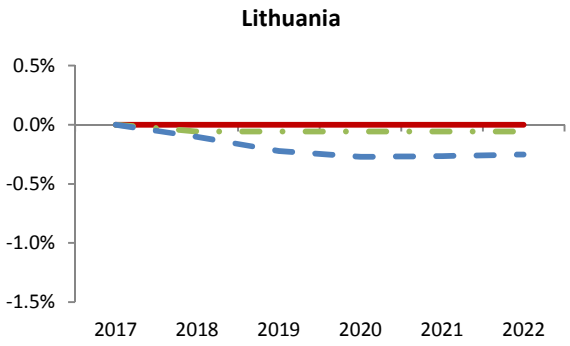
	Years					
Years	2018	2019	2020	2021	2022	Long-run
GDP	0.00	0.00	0.01	0.01	0.01	0.01
Employment	0.03	0.08	0.10	0.11	0.11	0.10
- low skilled	0.17	0.37	0.45	0.48	0.49	0.48
- medium skilled	0.11	0.23	0.27	0.28	0.29	0.27
- high skilled	-0.23	-0.45	-0.51	-0.52	-0.52	-0.53
Net real wages	0.00	0.01	0.01	0.03	0.04	0.21
- low skilled	1.09	0.97	0.93	0.93	0.92	0.89
- medium skilled	0.84	0.76	0.75	0.74	0.74	0.70
- high skilled	-1.62	-1.53	-1.54	-1.55	-1.56	-1.61
Consumption	0.00	0.00	0.00	0.00	0.01	0.01
Investment	-0.01	-0.02	-0.02	-0.02	-0.02	0.00
Consumer prices, incl. VAT	-0.01	-0.02	-0.03	-0.05	-0.06	-0.11
Government balance (% GDP)	0.00	-0.01	-0.01	-0.01	-0.01	0.00
Trade balance (% GDP)	0.00	0.00	0.00	0.00	0.00	0.00

Table E.12. Romania – Scenario (III)

	Years					
Years	2018	2019	2020	2021	2022	Long-run
GDP	0.00	0.00	0.01	0.01	0.01	0.01
Employment	0.03	0.08	0.10	0.11	0.11	0.10
- low skilled	0.17	0.35	0.43	0.46	0.47	0.45
- medium skilled	0.11	0.22	0.27	0.28	0.28	0.27
- high skilled	-0.22	-0.43	-0.49	-0.50	-0.50	-0.51
Net real wages	0.00	0.01	0.01	0.03	0.04	0.20
- low skilled	1.04	0.92	0.89	0.88	0.88	0.85
- medium skilled	0.81	0.74	0.72	0.72	0.72	0.68
- high skilled	-1.56	-1.47	-1.48	-1.50	-1.50	-1.55
Consumption	0.00	0.00	0.00	0.00	0.01	0.01
Investment	-0.01	-0.02	-0.02	-0.02	-0.02	0.00
Consumer prices, incl. VAT	-0.01	-0.02	-0.03	-0.04	-0.05	-0.11
Government balance (% GDP)	0.00	-0.01	-0.01	-0.01	-0.01	0.00
Trade balance (% GDP)	0.00	0.00	0.00	0.00	0.00	0.00

Figure E.1: PIT impact in EUROMOD incorporating macro feedback on prices, wages and employment – Scenario II




Lithuania
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0.0%
-0.5%
-1.0%
-1.5%
2017
2018
2019
2020
2021
2022

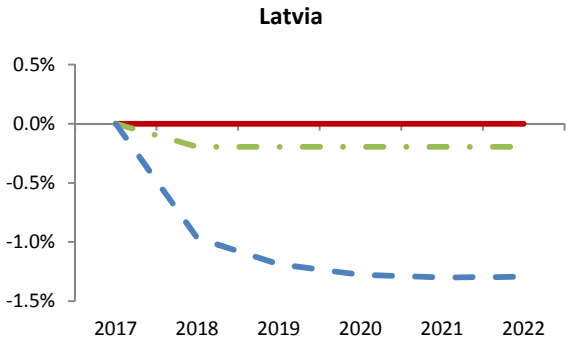
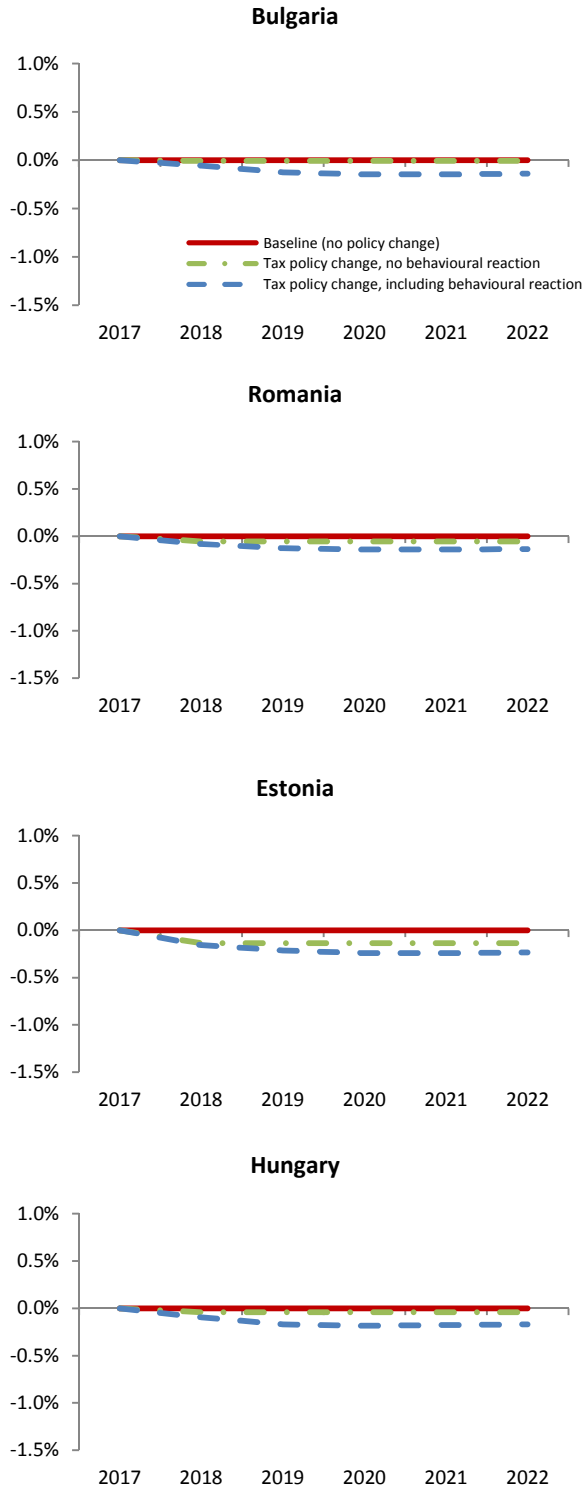
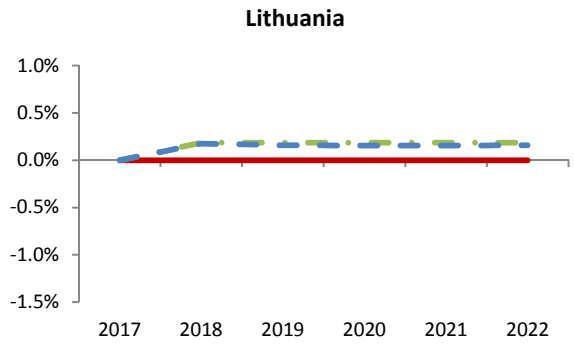
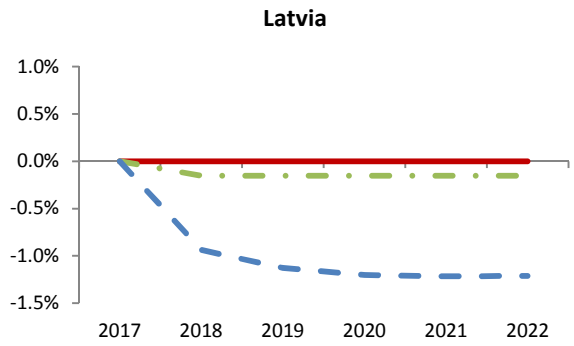

Latvia
0.5%
0.0%
-0.5%
-1.0%
-1.5%
2017
2018
2019
2020
2021
2022

Figure E.2: PIT impact in EUROMOD incorporating macro feedback on prices, wages and employment – Scenario III




Lithuania
1.0%
0.5%
0.0%
-0.5%
-1.0%
-1.5%
2017
2018
2019
2020
2021
2022


Latvia
1.0%
0.5%
0.0%
-0.5%
-1.0%
-1.5%
2017
2018
2019
2020
2021
2022

Annex F. Description of the existing and reformed tax allowances

There are no basic allowance schemes in Hungary and Bulgaria.

In Lithuania, there is the general tax allowance applied to employment-related income (salary, bonuses, sickness allowances, holiday payments, maternity, paternity allowances, etc.). The monthly general tax allowance is 310 EUR per month if tax payer's monthly gross income does not exceed 380 EUR. If income is higher, the monthly general allowance is calculated using following formula = 310 – 0.5x (monthly employment-related income – 380).

The proposal for the 2018 is to increase the main amount up to current minimum gross wage (380). The monthly general allowance will be calculated using following formula = 380 – 0.5x (monthly employment-related income – 400). This reform was implemented in our simulations.

Table E.1: Design of existing and reformed tax allowances in Lithuania

	Baseline 2017	Reform
Basic tax allowance	310 € / month (3,720€ / year) BTA = 310 – 0.5x (monthly employment-related income – 380).	380€ / month (4,560€ / year) BTA= 380 – 0,5 x (monthly employment-related income – 400).

Estonia has the basic tax allowance which equals 180 EUR per month (2160 per year) and has no phasing out. There are no income limits to receive this allowance. The simulated reform is based on the proposal for the 2018. The basic allowance is increased to 500 EUR per month (6000 per year), phase out is introduced, pensioners' additional allowance is abolished (pensioners are entitled to the general tax allowance). For budget neutrality, the PIT needs to be increased from 20 to 23.6%.

If also an additional tax allowance for married couples is introduced, this would result in an additional increase of the PIT rate up to 25.3%[15].

[15] All the tables provided below include only the changes in the general allowance and abolishment of the pensioners' tax allowance.

Table E.2: Design of existing and reformed tax allowances in Estonia

	Baseline 2017	Reform	
Basic tax allowance	180€ / month (2,160€ / year)	500€ / month (6,000€ / year)	
Introduction of phase out of the basic tax free allowance	n/a	Monthly taxable income, €	Basic tax free allowance, €
		0 – 1,200€	500€ / month
		1,200 – 2,100 €	(2,100 – x) * 0.5556
		> 2,100 €	0
Pensioners' tax allowance	236€ / month (2,832€ / year)	0€ / month	
Introduction of an additional allowance*	n/a	2160 /year if joint income<=50400 year.	

In Latvia, there is the basic non-taxable income allowance which is applied to employees or self-employed people who do not receive old-age or disability pensions. Pensioners are eligible for a higher non-taxable minimum income allowance. As of 2016, there is a phase out (please see description in the table and the formula below the table). In the reform the basic amount of the tax allowance was increased up to the gross minimum wage, while the brackets were left unchanged. Pensioners' allowance was increased by the same nominal amount as the maximum tax allowance (by 265 EUR up to 500EUR per month).

Table E.3: Design of existing and reformed tax allowances in Latvia

	Baseline 2017	Reform
Maximum amount of the basic tax allowance	*115€ / month*	*380€ / month*
Income below which the maximum allowance is applied	400€ / month	400€ / month
Minimum amount of the basic tax allowance	60€ / month	60€ / month
Income above which minimum allowance is applied	1,100€ / month	400€ / month
Pensioners' tax allowance	*235€ / month*	*500€ / month*

The phase out (withdrawal rate) is calculated according to the following formula:

$$R = \frac{TA_{max} - TA_{min} \times 12}{Y_{lim1} - Y_{lim2}}$$

where R is the withdrawal rate, TA_{max} is the maximum amount of tax allowance (EUR per year), TA_{min} is the minimum amount of tax allowance (EUR per month), Y_{lim1} is income level above which the minimum allowance is applied (EUR per year) and Y_{lim2} is income level below which the maximum allowance is applied (EUR per year).

In Romania, there is a tax allowance for oneself and allocated dependents. It is a personal deduction which is given to employees who have a monthly gross wage under or equal to 3,000 RON. The amount of the deduction is a function of the number of taxpayer's dependent persons (please see description in the table). The dependent person can be the spouse, child or other family relative up to the 2nd degree (children, parents, brothers and sisters, grandparents and grandchildren) of the taxpayer or his/her spouse's with a gross taxable and non-taxable income which does not exceed 300 RON.

Table E.4: Design of existing and reformed tax allowances in Romania

	Baseline 2017	Reform
Maximum amount of the employee tax allowance	*800 RON / month*	*1,450 RON / month*
Standard deduction on employment income	300 RON / month	550 RON / month
Deduction for dependents on employment income	100 RON / month	180 RON / month
Pensioners' tax allowance	*2,000 RON / month*	*2,000 RON / month*

If the gross wage is between 1,501 and 3,000 RON, the personal deduction is decreasing with income and its amount is established by applying the following formula:

*Personal deduction = Personal deduction (gross wage <=1,500 RON) * [1-(Gross wage – 1,500) / 1,500]*

In the reform scenario, the maximum amount of the employee tax allowance has been increased to the minimum gross wage (1,450 RON), while the brackets and the phase-out slope were left unchanged. The tax allowance for pensioners was also unaltered, as their maximum deduction continues to remain superior to the employee tax allowance.

From January 1st, 2018 the standard deduction on employment income will be increased to 510 RON per month and the deduction for dependents to 160 RON per month.

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