Progressive Tax Reforms in Flat Tax Countries

Barrios, Salvador; Ivaškaitė-Tamošiūnė, Viginta; Maftei, Anamaria; Narazani, Edlira; Varga, Janos

Veröffentlichungsversion / Published Version
Zeitschriftenartikel / journal article

Empfohlene Zitierung / Suggested Citation:
Barrios, S., Ivaškaitė-Tamošiūnė, V., Maftei, A., Narazani, E., & Varga, J. (2020). Progressive Tax Reforms in Flat Tax Countries. *Eastern European Economics*, *58*(2), 83-107. https://doi.org/10.1080/00128775.2019.1671201

EASTERN EUROPEAN ECONOMICS
2020, VOL. 58, NO. 2, 83–107
https://doi.org/10.1080/00128775.2019.1671201

Routledge
Taylor & Francis Group

Progressive Tax Reforms in Flat Tax Countries

Salvador Barrios[a], Viginta Ivaškaitė-Tamošiūnė[a], Anamaria Maftei[a], Edlira Narazani[a], and Janos Varga[b]

[a]Joint Research Centre, European Commission, Seville, Spain; [b]DG Economic and Financial Affairs, European Commission, Brussels, Belgium

ABSTRACT

The adoption of flat tax systems in Central and Eastern European countries have often been supported by arguments of simplicity, higher compliance and lower distortionary effects. However, since income inequality is high in these countries, the question of introducing some progressivity has come to the fore in both policy and academic circles. In this paper, we combine microsimulation and macro models to analyze the effects of moving from a flat to a progressive tax system and we find that a reduction in income inequality can be achieved with positive, albeit negligible, employment and growth impact.

KEYWORDS

Flat tax; microsimulation model; DSGE model; inequality; growth

JEL CLASSIFICATION

D04; D31; D63; E62; H24

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, Buttrick, and Duncan 2010). Keen, Kim, and Varsano (2008) show that Central and Eastern European (CEE) countries have been especially active in this respect. They identify two waves of adopted flat taxschemes: the first wave (in the 1990s), 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 (in the 2000s) 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. It should be noted, however, that progressivity is only one dimension of complexity in the tax system. The existence of numerous tax deductions, including allowances and credits, tend to be more important in this regards as they make the effective tax burden less transparent and add both to the cost of tax compliance and to the administrative burden for tax authorities, see Kalyva et al. (2014).

The implementation of flat tax rates 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, Martinez-Vazquez, and Sabirianova Peter 2009). Ivanova, Keen, and Klemm (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.

CONTACT Anamaria Maftei Anamaria.MAFTEI@ec.europa.eu Joint Research Centre, European Commission, Seville 41092, Spain

Supplemental data for this article can be accessed here.

(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 (SSC) rates. In a recent study covering a larger set of transition countries, Filer et al. (2019) find no significant effect of flat tax reforms on income underreporting. They contend that this may be due to a parallel deterioration in attitudes toward the public sector in these countries. Recently, Saavedra, Marcincin, and Valachy (2007) analyzed 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 toward 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, Caminada and Goudswaard 2001; Decoster and Orsini 2007; González-Torrabadella and Pijoan-Mas 2006). 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. (2015) also investigate the consequences of hypothetical reforms of the personal income tax system toward 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. (2008) 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 stabilization (see Fuest, Peichl, and Schaefer 2008; Tóth 2013).

In this paper we analyze the impact of hypothetical progressive tax reforms from three main angles considering their redistributive, fiscal, employment and growth impacts. The optimal tax literature provides the theoretical background for analyzing the relative virtues of flat vs. progressive tax systems from an equity/efficiency perspective (see, in particular, Mirrlees and Adam 2010). This theory posits that the optimal design of tax systems should maximize social welfare subject to the government budget constraint, while taking into account behavioral responses affecting labor, saving or consumption decisions. Accordingly, a given tax system may promote greater equity through income redistribution (e.g. through progressive tax rates), but distorts agents´ behavior, therefore increasing the deadweight cost (or efficiency cost) of policy interventions. The most recent contributions have focused on the distortive nature of progressive tax systems toward labor supply, (see Benabou 2002; Diamond and Saez 2011; Kalíšková 2014; Heathcote, Storesletten, and Violante 2017).[1] An important recommendation in this respect is that policies should correct the combined negative effects of

high marginal tax rates and generous social benefits (present in most developed economies) on labor supply, see Diamond and Saez (2011) for a review.[2] The existing evidence suggests indeed that the deadweight cost of high marginal tax rates on low-income/low skill individuals is especially high and dominated by the distortion exerted by the tax-benefit system on the decision to work, i.e. the so-called extensive margin of labor supply, see for instance Blundell (2012) for a discussion.[3] Following this line of arguments, it can be socially desirable to subsidize low income/low skilled individuals through working tax credits, see for instance Immervoll et al. (2007) for a specific analysis in the European case. Barrios et al. (2018) showed in addition that working tax credits might also prove efficient from a fiscal perspective in presence of progressive tax systems given that the fiscal cost (through public expenditures or tax revenue losses) entailed by these policies might be offset by the additional tax revenues gains generated from the increase in employment.

While there is a general consensus on the desirability of working tax credits or, more broadly speaking make work pay policies, their effectiveness depend on their design and the institutional environment in which they are implemented. For instance, Bargain and Orsini (2006) show that such policies fit better their purpose when considering family conditions, rather than strictly individual factors, and when they are effectively targeted to those categories most at risk of exclusion.[4] Immervoll and Pearson (2009) stress also that the effectiveness of make work pay policies can be conditioned by the existence of minimum wages and wage subsidies.[5] Finally, these authors note that these policies need to be financed, which in the end might imply additional taxes, including for low-income/low skilled workers.

The relative merits of flat vs. progressive tax systems with regards to growth have been debated theoretically using dynamic models, see in particular Stokey and Rebelo (1995), Mendoza, Milesi-Ferretti, and Asea (1997) and Altig et al. (2001). Overall these analyses show that assumptions regarding discount rates, preferences and labor supply responses play an important role in determining growth outcomes. The empirical evidence remains mixed on the impact of progressivity on economic growth, however, with earlier studies such as Li and Sarte (2004) and Padovano and Galli (2002) finding a negative correlation between the two variables, while more recent empirical analysis have suggested that progressivity in tax systems might only have negligible impact, see Gerber et al. (2018).

In this paper we aim at providing novel cross-country evidence on these questions considering hypothetical reforms introducing/increasing progressivity in countries featuring flat tax systems. We analyze the fiscal, redistributive and macroeconomic impact of such reforms in Bulgaria, Estonia, Latvia, Lithuania, Hungary and Romania.[6] 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 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 analyzing 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. (2019) 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 labor 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 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 labor supply highlighted in the recent theoretical literature. Third, our analysis considers actual tax benefits systems, including wherever relevant existing tax allowances and tax credits. These tax components 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.

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 analyze the introduction of a refundable in-work tax credit in order to neutralize the budgetary effects of the first scenario and to tackle the potential disincentive effects on labor supply. Finally, we analyze 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 allowances and tax credits 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 organized 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/increase progressivity in the tax schedule. In Section 4, we analyze the macroeconomic impact of the budget neutral scenarios. Section 5 concludes.

2. Personal Income Tax Systems in 2017

In 2017 Estonia, Latvia, Lithuania, Romania, Bulgaria and Hungary had a flat PIT rate.[7] 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 1997 (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). 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 later to further reduce their tax rate: from 33% to 15% for Lithuania, from 25% to 23% in Latvia and from 26% to 20% in Estonia.

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 an overview of the definition of the tax base and existing tax allowances and tax credits simulated in EUROMOD and affecting the PIT in place in 2017. Basic tax allowances can in some instances be universal (as in Estonia, Bulgaria or Hungary) or differentiated by employment income (as in Romania, Lithuania and Latvia). Bulgaria and Hungary had no basic tax allowance in 2017.[8]

Two recent papers have analyzed more specifically the redistributive and fiscal impact of tax expenditures[9] 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

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

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

Source: EUROMOD country reports.

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

	Taxable income	Tax allowances and tax credits
BG	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".
EE	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 allowance for spouse (up to €2160 per year), which is conditional on the level of joint taxable income of the married couple. - Tax deductions for housing loan interest payments, study loans, contributions to the third pillar pension.
HU	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%.
LT	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.
LV	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, Latvia has also a solidarity tax 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.
RO	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 nonprofit organizations or for private scholarships.

Sources: EUROMOD Country reports.

Country notes: (LT) and (EE) 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).

expenditures in the countries considered here tend to favor 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 analyze the fiscal and redistributive impact of tax allowances and tax credits. She finds that the redistributive effect of these tax components 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.

The redistributive properties CEE countries tax systems should be gauged considering social security contributions too. As a matter of fact, the PIT accounts for less than a third of the implicit tax rate on labor for most countries (Figure 1). Employee and employer social security contributions, which constitute a much higher share of labor taxes, are often proportional and can be capped in some countries, making them slightly regressive. A clear advantage of using EUROMOD in this respect is that social benefits are considered together with PIT (including tax allowances and credits), and employee and employer social security contributions in order to determine households´ disposable income.

Table 3 provides a snapshot of effective tax rates, inequality and redistribution through the tax systems in CEE countries compared to the rest of the EU. The evidence provided therein suggests that EU flat tax countries tend to have lower average and marginal tax rates compared to the rest of the EU. At the same time, these countries tend to redistribute less than other EU countries when one considers tax, social security contributions and social benefits altogether. Bulgaria and Estonia display both the lowest average and marginal tax rates and are significantly below the EU average. On the opposite side, Hungary has a higher average tax rate and a lower marginal tax rate compared to the EU average. Table 3 displays also the redistributive effect of the tax and benefit systems measured through the Reynolds-Smolensky index, i.e. the difference between the Gini indices of original income and disposable income. Only Hungary displays 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.

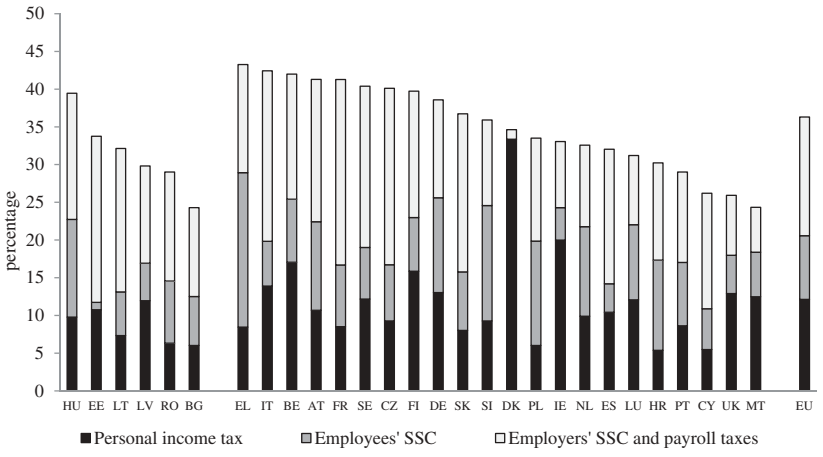

Figure 1. Composition of the implicit tax rate on labor in the EU, 2017 (%).
Source: Commission Services.

Table 3. Statistics on effective tax rates, inequality and redistributive effects of tax and benefit systems, 2017.

	Effective tax rates (%)		Gini indices		Redistributive effect	
	Average	Marginal	Disposable income	Original income	Reynolds-Smolensky index	Ranking in EU
BG	15.9	22.4	0.359	0.502	0.144	28
EE	16.4	23.0	0.330	0.494	0.164	25
HU	27.4	34.5	0.289	0.499	0.210	14
LT	17.5	25.4	0.371	0.539	0.168	24
LV	23.0	30.5	0.350	0.498	0.148	27
RO	20.4	34.6	0.365	0.543	0.179	21
EU	*22.9*	*35.1*	*0.295*	*0.505*	*0.210*	-

Source: EUROMOD web statistics and authors' calculations.
Note: Average and marginal effective tax rates are calculated considering the sum of income taxes, social contributions paid by individuals and social benefits. Pensions are considered as part of social benefits. Arithmetic averages are reported for the whole EU.

Hence, while a certain level of progressivity exists through tax allowances and tax credits 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 labor 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/increasing progressivity in the tax schedule.

In a first instance, we analyze 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 labor 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 introduction/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,[10] 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 introduction/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. Appendix A provides more details on the EUROMOD model and the EU-SILC data.

3.1. Scenario (I): Introducing a Progressive Personal Income Tax 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.[11] 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 (rates and brackets) are provided in Table 4.

Figures 2, 3 and online Appendix C 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. At-risk-of-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 labor on average. However, for low income deciles, the impact on the tax burden is negative. Disposable income increases for most income deciles in the six Member States, especially for the middle of the distribution. However, the average disposable income decreases, because the fall in income of the richest households exceeds the

Table 4. Simulated progressive PIT rates and income brackets.

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

‡ Monthly values
* EUROMOD estimate

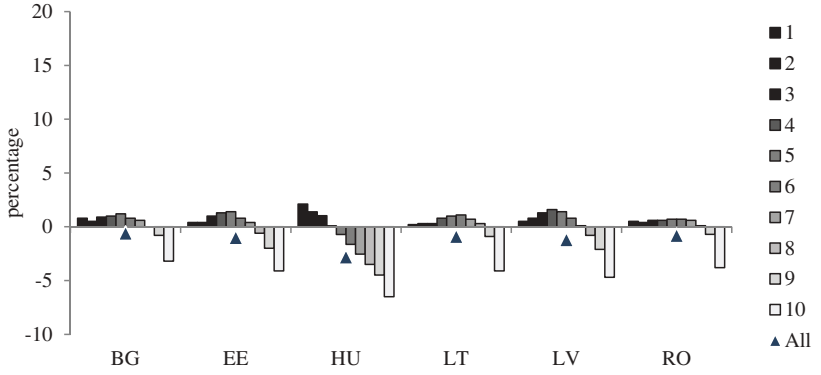

Figure 2. Impact on the mean annual equivalised disposable income by decile in Scenario (I) (difference as % of 2017 baseline).

Source: Authors´ simulations based on the EUROMOD model.

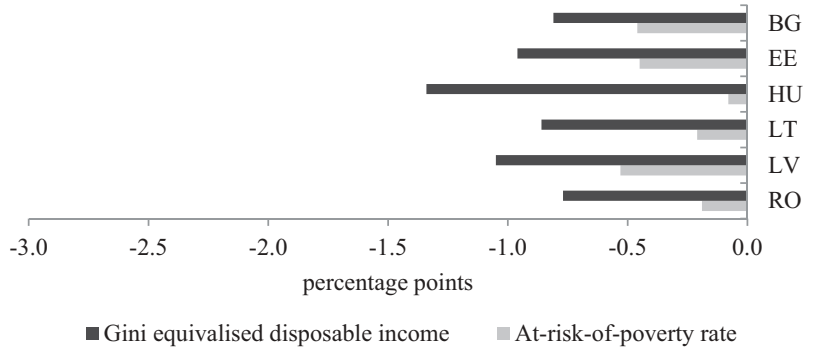

Figure 3. Impact on inequality and the at-risk-of-poverty rate in Scenario (I) (difference as pp. of 2017 baseline).

Source: Authors´ simulations based on the EUROMOD model.

income gains of the rest of the population. The share of winners and losers is clearly skewed in all countries in favor 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.

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: for income up to 10% of the average gross earnings, the phase-in slope is set to 0.65 (in other words, for every euro earned, an individual receives 65 cents of tax credit). For income between 10% and 20% of the average gross earnings, an eligible worker can benefit of the maximum

amount of the tax credit. Above 20% of the average gross earnings, 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[12]), 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 summarized in Table 5.

Figures 4, 5 and online Appendix D 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 (of equivalized household disposable income) compared to Scenario 1 from a low −1.21pp in Bulgaria to a high −2.51pp in Hungary. The reduction in at-risk-of-poverty is also more pronounced, from −1.06pp in Lithuania to −2.79pp in Hungary compared to the baseline. The implicit tax rates on labor falls on average in Lithuania and Estonia but increases for all other countries. For low income

Table 5. Income brackets of the refundable in-work tax credit.

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

‡ Monthly values
* EUROMOD estimate

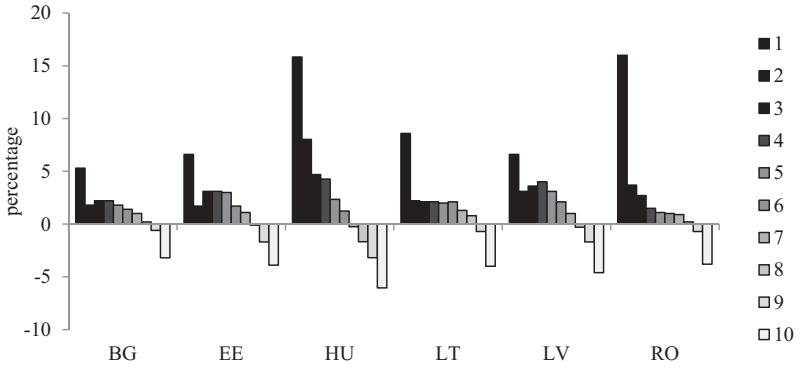

Figure 4. Impact on the mean annual equivalised disposable income by decile in Scenario (II) (difference as % of 2017 baseline).
Source: Authors´ simulations based on the EUROMOD model.

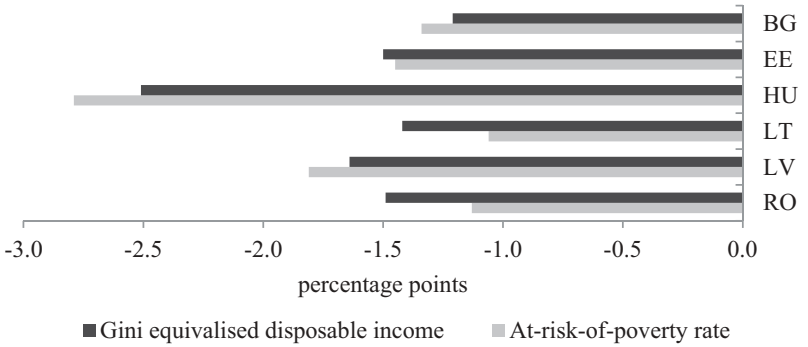

Figure 5. Impact on inequality and the at-risk-of-poverty rate in Scenario (II) (difference as pp. of 2017 baseline).

Source: Authors´ simulations based on the EUROMOD model.

deciles, the impact of these reforms on the implicit tax rate on labor 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 neutralized compared to Scenario (I) given the counteracting effect of the tax credit.

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 and Hungary), a basic tax allowance with a phasing out is introduced for employees.[13] The increased basic tax-free allowance is set to equal the minimum gross wage (except 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 dependents, 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 Appendix B.

Figure 6, 7 and online Appendix E 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 where

Table 6. Summary of existing basic tax allowances (BTA) and proposed simulations.

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

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).

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

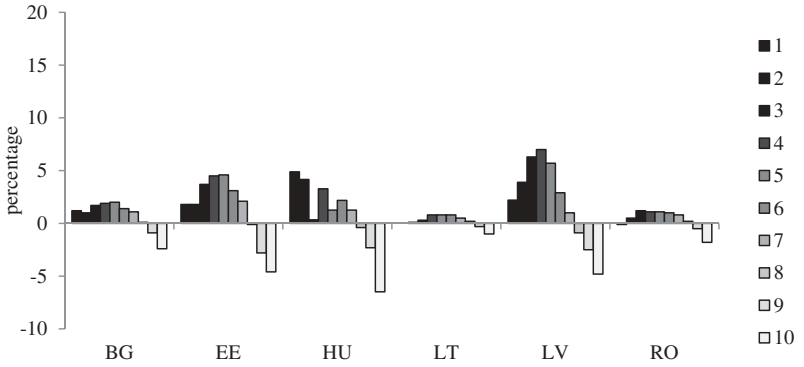

Figure 6. Impact on the mean annual equivalised disposable income by decile in Scenario (III) (difference as % of 2017 baseline).
Source: Authors´ simulations based on the EUROMOD model.

the allowance was absent (as in Bulgaria and Hungary) or in those where the allowance was increased substantially (as in Latvia and Estonia).[14]

All countries experience a fall in the Gini index although with less pronounced in Lithuania (−0.26 pp) and Romania (−0.54 pp) which already applied tapered allowances. At-risk-of-poverty is also reduced in all countries, but less than in Scenarios (I) or (II). In Latvia, there is also a significant decrease in the at-risk-of-poverty rate (−2 pp), due to the pensioners' allowance which almost doubles. The implicit tax rate on labor increases on average in Estonia and Latvia and falls in Bulgaria, Lithuania, Romania, and Hungary. The decline in the tax burden is concentrated in the bottom and middle deciles, raising their disposable income. Conversely, the top deciles experience a higher implicit tax rate, which reduces their disposable income increases for most income deciles (especially so for the first deciles)

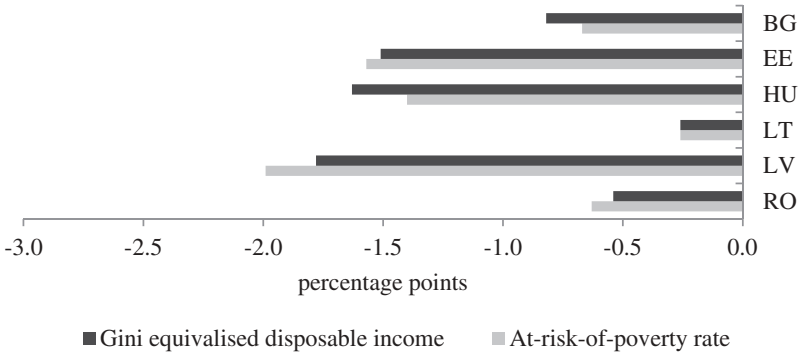

Figure 7. Impact on inequality and the at-risk-of-poverty rate in Scenario (III) (difference as pp. of 2017 baseline).

Source: Authors´ simulations based on the EUROMOD model.

although on average only for Latvia as the highest income deciles experience a fall in disposable income.

4. Macroeconomic Analysis of the Budget-neutral Scenarios

We used a three-region QUEST model with tradable/non-tradable sectors and three types of labor 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 the two models, we follow the approach developed by Barrios et al. (2019). We harmonize the QUEST and EUROMOD calibration in the baseline by using the labor supply elasticities, the main labor supply statistics (employment, unemployment and inactivity rates), employee and employer paid taxes and skill-premiums from the microsimulation model. The labor supply elasticities and the non-participation rates have been estimated using EUROMOD and the labor supply model described in Appendix A.2. 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 (Appendix A provides further details on the QUEST model).

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. As expected, the two reforms

Table 8. Calibration of labor supply elasticity and nonparticipation rates in QUEST (by skill level).

	Labor supply elasticities			Nonparticipation rates		
Countries	*High*	*Medium*	*Low*	*High*	*Medium*	*Low*
BG	0.186	0.220	0.398	0.060	0.093	0.143
EE	0.152	0.198	0.221	0.044	0.048	0.053
HU	0.099	0.149	0.198	0.097	0.099	0.159
LT	0.158	0.220	0.297	0.048	0.091	0.094
LV	0.201	0.164	0.182	0.052	0.084	0.072
RO	0.211	0.270	0.368	0.115	0.198	0.248

Table 9. Changes in implicit tax rates paid by employees.

	Scenario (II)			Scenario (III)		
	High	*Medium*	*Low*	*High*	*Medium*	*Low*
BG						
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*
EE						
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*
HU						
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*
LT						
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*
LV						
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*
RO						
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*

reduce the taxes paid by employees on labor 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 8, 9 below and Tables F.1 to F.12 in online Appendix F. 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.

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 labor supply elasticities. The smaller is the difference between the productivity of high, medium and low – skilled workers and the higher (the lower) the labor 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 labor 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.

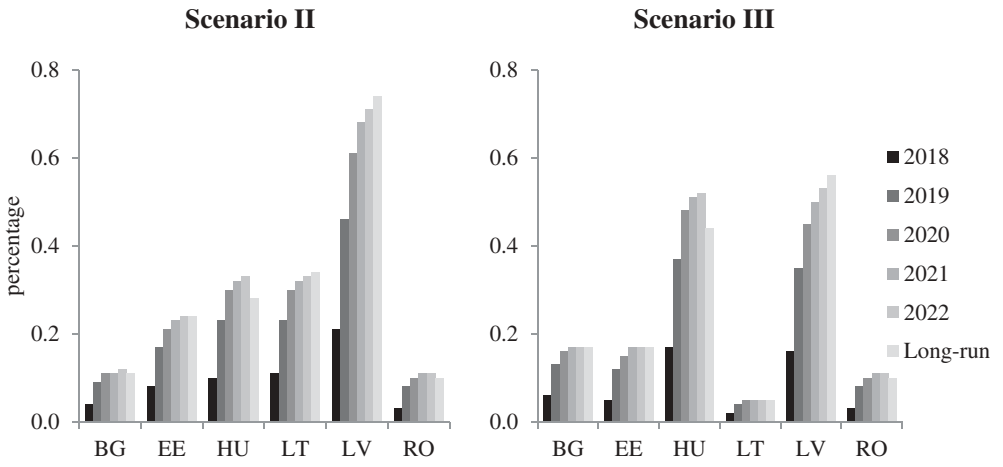

Figure 8. Medium and long-term impact on employment (difference as % of 2017 baseline).
Source: Authors´ simulations based on the QUEST model.

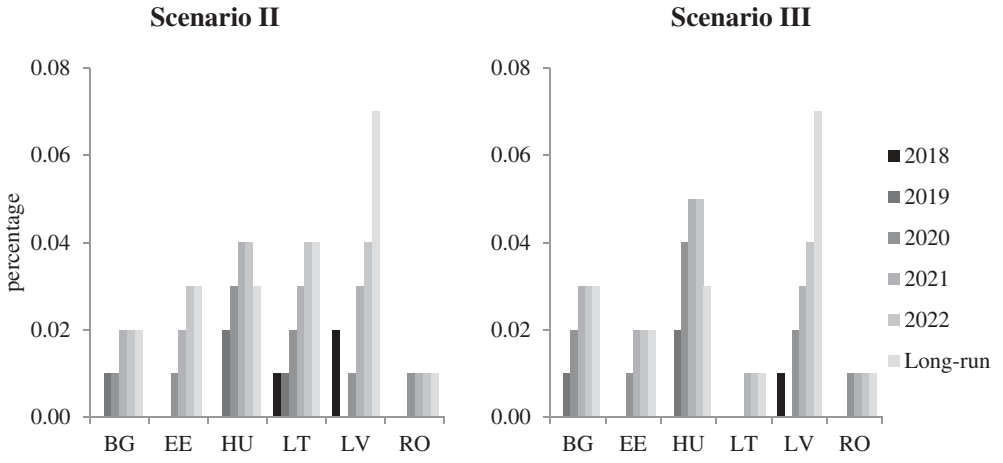

Figure 9. Medium and long-term impact on GDP (difference as % of 2017 baseline).
Source: Authors´ simulations based on the QUEST model.

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 labor supply elasticities.[15] Second, while a higher tax on high earnings is less detrimental for labor 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 behavioral response to the tax change, are disregarded.

We analyze 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[16] (online Appendix F). This is done as follows:

(1) 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.
(2) The impulse response for the consumer price index is integrated in EUROMOD as a correction of the corresponding uprating factor.
(3) For gross wages 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 behavioral response to the tax changes. The microsimulation results are presented in detail in Figures F.1 and F.2 of online Appendix F. 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[17]. 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.[18]

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 generally 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 labor 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 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 allowances and tax credits on household disposable income.

We analyze the fiscal, redistributive and macroeconomic impact of introducing/increasing 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 tax rate with tax allowances would yield similar results and 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 allowances and tax credits. 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 analyze 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 behavioral 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 stabilization. Under progressive tax systems, automatic stabilization 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 labor supply which might slow down economic recovery. These questions could be addressed in future research.

Notes

1. A joint or individual treatment between spousal earnings could in principle make an important difference in the welfare gains obtained from a progressive versus a flat tax schedule. Accordingly, under joint of family taxation, the secondary earner would pay a higher marginal tax rate under a progressive tax compared to a flat tax schedule, with potentially distortive effects on labor market participations, especially for women. By contrast, under an individual taxation system, the secondary earner would face a lower marginal tax rate under a progressive rather flat rate tax schedule. However, in practice, a flat tax system could also accommodate joint taxation, as for instance in the case of Estonia (see Table 2).
2. According to Diamond and Saez (2011), working tax credits should be phased out with high marginal tax rates in order to reduce the potential disincentive effects on labor supply. Taxes should then be lower in the middle income ranges and increase toward the top of the income distribution.
3. The extensive margin of labor supply measures the disincentive for people to take up a job. By contrast, the intensive margin measures the number of hours worked.
4. Using EUROMOD and considering the cases of Finland, France and Germany, Bargain and Orsini (2006) show in particular that the positive effects of working tax credits on single women is offset by the negative effects the policy has on the labor participation of married women.
5. Following Immervoll and Pearson (2009) the existence of minimum wage can prevent working tax credit from being "captured" by employers through lowering wages.
6. On January 1st 2018, Latvia implemented a progressive tax system and, a year later, Lithuania introduced a second PIT rate. However this does not affect our analysis as we focus on the 2017 tax systems.
7. The Czech Republic also had a flat tax schedule, but is excluded from the analysis due to the fact that it applies an additional 7% solidarity tax on gross income exceeding a certain threshold.
8. In 2018, Estonia introduced an income dependent tax allowance. In Romania, the family composition is accounted for in the basic tax allowance.
9. Tax expenditures constitute foregone government revenue through preferential tax provisions (e.g. exemptions, allowances, deductions, credits) applied to specific groups, with the aim to promote social or economic policies.
10. The net taxable income is defined as the gross taxable income minus applicable allowances.
11. We chose to use the EU-SILC sample for the calculation of the reference values of the tax brackets since the gross earnings reported in the official statistics would hide variability in taxable bases due to the impact of the existing tax allowances on the calculation of the PIT liabilities.
12. 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.
13. The self-employed in Hungary are subject to a different tax scheme, while in Bulgaria they already benefit of a basic tax allowance.
14. Inequality is measured using Gini index of equivalized disposable income. Equivalised disposable income is calculated dividing household disposable income by the modified OECD equivalence scale.
15. We rely on the skill-specific relative earnings and employment rates to determine the skill-specific productivity differences.
16. Tables F.1 to F.12 of online Appendix F display the QUEST projections for net real wages, while the trajectories for gross real wages are used in this step.
17. The trajectory of the PIT revenues in the scenarios disregarding the behavioral reactions is given by how the budget-neutrality constraint is implemented, i.e. marginally revenue-increasing or decreasing.

18. The reform generates opposing responses in wages and employment. Decreasing (increasing) labor 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. These counteracting forces mitigate the effect on the tax base. Barrios et al. (2019) show 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.
19. 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.
20. 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.
21. Examples of uprating factors are consumer price indices and evolution of earnings and statutory adjustment rules for certain benefits.
22. By using the ISCED education classification, we define the share of population with lower secondary education (ISCED 0–2) as low-skilled, with up to upper secondary and non-tertiary education (ISCED 3–4) as medium skilled and the rest of the population as high-skilled.
23. The tables provided include only the changes in the general allowance and abolishment of the pensioners' tax allowance.

Disclosure statement

The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They should not be attributed to the European Commission. Any mistake and all interpretations are the authors' and theirs only.

Notes on contributors

Salvador Barrios is a Senior Economist at the European Commission, Joint Research Centre (JRC), Fiscal Policy Analysis Unit.

Viginta Ivaškaitė-Tamošiūnė is an Economic Analyst at the European Commission, Joint Research Centre (JRC), Fiscal Policy Analysis Unit.

Anamaria Maftei is an Economic Analyst at the European Commission, Joint Research Centre (JRC), Fiscal Policy Analysis Unit.

Edlira Narazani is an Economic Analyst at the European Commission, Joint Research Centre (JRC), Fiscal Policy Analysis Unit.

Janos Varga is a Policy Analyst at the European Commission, Directorate General for Economic and Financial Affairs.

References

Altig, D., A. J. Auerbach, L. J. Koltikoff, K. A. Smetters, and J. Walliser. 2001. "Simulating Fundamental Tax Reform in the United States." *American Economic Review* 91 (3):574–95. doi:10.1257/aer.91.3.574

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):271–93. doi:10.1177/0958928717735061

Bargain, O., and K. Orsini. 2006. "In-Work Policies in Europe: Killing Two Birds with One Stone." *Labour Economics* 13 (6):667–693.

Bargain, O., K. Orsini, and A. Peichl. 2014. "Comparing Labor Supply Elasticities in Europe and the United States: New Results." *Journal of Human Resources* 49 (3):723–838 doi:10.1353/jhr.2014.0017

Barrios, S., F. Figari, L. Gandullia, and S. Riscado. 2016. "The Fiscal and Equity Impact of Tax Expenditures in The Eu." *JRC Working Papers on Taxation and Structural Reforms No. 1*.

Barrios, S., M. Dolls, A. Maftei, A. Peichl, S. Riscado, J. Varga, and C. Wittneben. 2019. "Dynamic Scoring of Tax Reforms in the European Union." *Journal of Policy Analysis and Management* 38 (1):239–62. doi:10.1002/pam.2019.38.issue-1

Barrios, S., S. Fatica, D. Martinez-Lopez, and G. Mourre. 2018. "The Fiscal Effects of Work-related Tax Expenditures in Europe." *Public Finance Review* 46 (5):793–820. doi:10.1177/1091142116679729

Benabou, R. 2002. "Tax and Education Policy in a Heterogeneous#agent Economy: What Levels of Redistribution Maximize Growth and Efficiency?." *Econometrica* 70 (2):481–517.

Blundell, R. 2012. "Tax Policy Reform: The Role of Empirical Evidence." *Journal of the European Economic Association* 10 (1):43–77. doi:10.1111/j.1542-4774.2011.01054.x

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):471–99.

Decoster, A., and K. Orsini. 2007. "Verdient Een Vlaktaks Zichzelf Terug?." *Leuvense Economische Standpunten* 17. 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. doi:10.1257/jep.25.4.165

Duncan, D., and K. Sabirianova Peter. 2016. "Unequal Inequalities: Do Progressive Taxes Reduce Income Inequality?" *International Tax and Public Finance* 23 (4):762–83. doi:10.1007/s10797-016-9412-5

Filer, R. K., J. Hanousek, T. Lichard, and K. Torosyan. 2019. "Flattening' Tax Evasion? Evidence from The Post#communist Natural Experiment." *Economics of Transition and Institutional Change* 27 (1):223–246.

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):620–36. doi:10.1007/s10797-008-9071-2

Gerber, C., A. Klemm, L. Liu, and V. Mylonas. 2018. "Personal Income Tax Progressivity: Trends and Implications." *IMF working paper No. 246*.

González-Torrabadella, M., and J. Pijoan-Mas. 2006. "Flat Tax Reforms: A General Equilibrium Evaluation for Spain." *Investigaciones Económicas* 30 (2):317–51.

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):504–54. doi:10.1086/599760

Heathcote, J., K. Storesletten, and G. L. Violante. 2017. "Optimal Tax Progressivity: An Analytical Framework." *Quarterly Journal of Economics* 132 (4):1693–754. doi:10.1093/qje/qjx018

Horvath, M., M. Senaj, Z. Siebertova, and N. Svarda. 2015. "The End of the Flat Tax Experiment in Slovakia." *Council for Budget Responsibility Working Paper No. 4*.

Immervoll, H., H.J. Kleven, C.T. Kreiner, and E. Saez. 2007. "Welfare Reform in European Countries: A Microsimulation Analysis." *The Economic Journal* 117 (516):1–44. doi:10.1111/j.1468-0297.2007.02000.x

Immervoll, H., and M. Pearson. 2009. "A Good Time for Making Work Pay? Taking Stock of In-Work Benefits and Related Measures across the OECD." *OECD Social, Employment and Migration Working Paper No. 81*.

In 't Veld, J. 2013. "Fiscal Consolidations and Spillovers in the Euro Area Periphery and Core." *European Economy Economic Papers No. 506*.

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

Kalíšková, K. 2014. "Labor Supply Consequences of Family Taxation: Evidence from the Czech Republic." *Labour Economics* 30:234–44. doi: 10.1016/j.labeco.2014.04.010.

Kalyva, A., C. Astarita, L. Bauger, S. Fatica, G. Mourre, and F. Wöhlbier. 2014. "Tax Expenditures in Direct Taxation in EU Member States." *European Economy Occasional Papers No. 207*.

Keen, M., Y. Kim, and R. Varsano. 2008. "The 'Flat Tax(Es)': Principles and Experience." *International Tax and Public Finance* 15 (6):712–51. doi:10.1007/s10797-007-9050-z

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):203–32. doi:10.1093/wber/lhv039

Li, W., and P. Sarte. 2004. "Progressive Taxation and Long- Run Growth." *American Economic Review* 94 (5):1705–1716.

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. doi:10.1016/S0047-2727(97)00011-X

Mirrlees, J. A., and S. Adam. 2010. *Dimensions of Tax Design: The Mirrlees Review*. Oxford: Oxford University Press.

Padovano, F., and E. Galli. 2002. "Comparing the Growth Effects of Marginal vs. Average Tax Rates and Progressivity." *European Journal of Political Economy* 18 (3):529–44. doi:10.1016/S0176-2680(02)00104-0

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):222–33. doi:10.1016/j.econmod.2008.06.014

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., A. Marcincin, and J. Valachy. 2007. "Flat Income Tax Reforms." In *A Fiscal Policy and Economic Growth. Lessons for Eastern Europe and Central Asia*, edited by C. Grey, T. Lane, and A. Varoudakis, 253–80. Washington DC: World Bank.

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):447–78. doi:10.17310/ntj.2010.3.00

Stokey, N. L., and S. Rebelo. 1995. "Growth Effects of Flat-Rate Taxes." *Journal of Political Economy* 103 (3):519–50. doi:10.1086/261993

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*.

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.

Appendices

Appendix 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.[19] Starting from gross incomes contained in the micro data, EUROMOD simulates most of the (direct) tax liabilities and (noncontributory) benefit entitlements, and calculates household disposable incomes.[20] 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 behavioral 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. A more detailed description of the EUROMOD model can be found in Sutherland and Figari (2013).

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.[21] 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.2 The labor supply model and the macroeconomic DSGE model QUEST III

The labor supply micro-econometric model, from which labor supply elasticities and number of non-participants are estimated, follows closely Bargain, Orsini, and Peichl (2014). This is a discrete choice labor supply model where individuals face a set of alternatives in terms of working hours, including the possibility of supplying zero hours in the labor 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 labor supply elasticities reported in Table 8.

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, Roeger, and In't Veld 2009), to include different skilled workers. The QUEST model is the standard model used by the European Commission to analyze 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 behavioral responses of major macroeconomic variables in an open economy context, going beyond the direct, static impact of specific tax reforms measured by EUROMOD. The labor market modeled in QUEST is strongly based on microeconomic theory and sufficiently general to adapt to the different labor 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.[22]

Appendix B. 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 (see Table B1). If income is higher, the monthly general allowance is calculated using following formula = 310–0.5x (monthly employment-related income – 380).

Table B1. 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).

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.

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%.[23]

Table B2. 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)	
		Monthly taxable income, €	Basic tax free allowance, €
Introduction of phase out of the basic tax free allowance	n/a	0 – 1,200€ 1,200–2,100 € > 2,100 €	500€/month (2,100 – x) * 0.5556 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 (see Table B3 and the formula below the table). In the reform the basic amount of the tax allowance was increased up to the gross

Table B3. 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*

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).

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 (see Table B4). 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.

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:

Table B4. 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*

*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.