WORK-RELATED TAX EXPENDITURES IN THE EU: IMPLICATIONS FOR TAX REVENUE

Salvador Barrios,[*] Serena Fatica,[**] Diego Martínez López[***] and Gilles Mourre[****]

We examine the impact on tax revenue (and the associated welfare cost) of a reduction in work-related tax reliefs in five European countries. We combine results from a EU-wide micro-simulation model with a theoretical model of labour supply to obtain a measure of the behavioural impacts of the reforms. We find that accounting for behavioural reactions both at the extensive (participation) and at the intensive margin (hours worked) has significant impacts on the revenue gain from the simulated reforms. In particular, our results suggest that at least one-fourth of the extra tax revenues collected through a reduction in work-related tax incentives is washed away after factoring in labour supply responses, especially through lower participation by individuals most at risk of exclusion. For policies strongly targeted at the bottom of the earnings distribution, the reform might even bring about a net revenue loss, depending upon the calibration of the labour supply elasticities to reflect heterogeneity across types of workers. The welfare gain of maintaining these tax reliefs could be far from negligible.

1 Introduction and motivation

The design of national tax systems has increasingly come to the fore of economic policy discussions due to its impacts on both economic efficiency and the sustainability of public finances, particularly in times of lukewarm economic growth and large budgetary consolidation needs. Reforms aimed at broadening the tax bases are a frequent policy recommendation, since they would not only enhance tax collection capacity but also minimise the economic distortions brought about by taxation. Reducing loopholes that facilitate tax avoidance and, more in general, streamlining tax expenditure have been identified as efficient ways to achieve that objective (OECD, 2010). Recurring examples of tax benefits include exemptions, allowances and credits, preferential tax rates for specific groups of taxpayers (e.g., low-income households, pensioners, etc.) or activities (e.g., purchase of cultural goods) or tax deferrals. Overall, the size of tax expenditures in the personal income tax system is significant in the EU (European Commission, 2013).

However, in principle, tax expenditures might also prove efficient from a fiscal standpoint if the immediate adverse impact on tax revenue is more than compensated by the stimulus to economic activity. Ultimately, this would translate into increased revenue in the medium to long run. One particular type of tax expenditure likely to have these features is work-related (or so-called make-work-pay, MWP) policies.[1] Following the example of the Earned Income Tax Credit (EITC) in the US, these schemes have been implemented in a growing number of EU countries over the past two decades in the form of in-work tax benefit, notably tax credit or

[*] European Commission, Joint Research Centre, IPTS. E-mail: salvador.barrios@ec.europa.eu

[**] European Commission, Directorate General for Economic and Financial Affairs. E-mail: serena.fatica@ec.europa.eu

[***] Universidad Pablo de Olavide, Department of Economics, Sevilla (Spain). E-mail: dmarlop1@upo.es

[****] European Commission, Directorate General for Economic and Financial Affairs. E-mail: gilles.mourre@ec.europa.eu

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[1] In the paper, we use the terms work-related and make-work-pay (MWP) interchangeably.

allowances, granted under the personal income tax system. The primary objective of such types of relief is to stimulate labour market participation by poor individuals or by those most at risk of exclusion. They do so by counteracting the disincentive effect exerted by the reduction/withdrawal of social benefits and, consequently, high marginal tax rates on labour income facing low-wage earners moving into employment. The effectiveness of MWP policies to reduce inequality and to enhance employment depends on several elements that go beyond the mere design of the tax relief, however. Most relevant appear social and economic factors such as the distribution of income, the functioning of the labour market, including its regulatory aspects (e.g., the existence of a minimum wage), the business cycle. In this respect, assessment based on the scheme (and experience) of a single country cannot be easily generalised to other contexts. All in all, a comprehensive cost/benefit analysis of such MWP policies should encompass both the cost per job created and the impact on income distribution (and in-work poverty in particular) as well as on reduced unemployment benefits and increase in work-related tax revenues collected (Immervoll and Pearson, 2009).

In this paper we aim at quantifying the fiscal impacts of reforms to MWP policies taking account also of the effects on the labour market equilibrium via adjustments on the supply side. We show that short-run budgetary gains from reducing those tax reliefs have indeed an economic and fiscal cost in the medium to long run when labour supply has reacted to the new policy environment. Further, we compute the marginal cost of public funds as a synthetic measure of the relative welfare effects of the simulated reforms. Our analysis rests on three building blocks: a theoretical framework for labour supply, derived from Saez *et al.* (2002), Kleven and Kreiner (2006) and Immervoll, Kleven, Kreiner and Saez (henceforth, IKKS, 2007); empirical estimates of participation and hours-of-work elasticities; simulation results obtained from a EU-wide micro-simulation model (EUROMOD). Combined together, those three ingredients allow us to model the effects that behavioural reactions along the extensive and the intensive margin have on tax revenue through changes in labour market outcomes. Consistent with the theoretical framework, we explicitly allow for heterogeneous individual responses by appropriately calibrating the labour supply elasticities across countries and types of workers. We perform our exercise on five European economies, namely France, Spain, the United Kingdom, Hungary and Slovakia, since the work-related policy is well identified for these countries. Moreover, the country sample gives rise to a very diverse set of policy configurations, not only in terms of type (credit vs. allowance) and design (e.g., conditionality on family characteristics) of the work-related tax relief, but also when it comes to the distinctive features of the whole tax-benefit system. In this respect, the use of a EU-wide micro-simulation model is essential, as the model can capture the full range of institutional features of tax and benefit systems with regards to personal income tax (PIT) and social security contribution (SSC), including pensions and other social benefits.

We believe our approach has a number of merits. First, by considering a marginal reduction in existing tax expenditures, instead of ad hoc reforms like the introduction of hypothetical harmonised policies, we make our exercise concretely based on real-life institutions, which have likely been shaped by national preferences. Moreover the choice of a marginal reform follows the political economy result that even radical tax reforms are likely to be introduced gradually. The flipside is that the marginal shocks we work with are not fully comparable across countries, since they depend on the size of the existing tax expenditures, as well as on the design of the broader tax-benefit systems they are embedded in. Secondly, by considering work-related tax reliefs as the relevant policy instrument we strengthen the case for including behavioural reactions of labour supply into the analysis. This is consistent with the empirical evidence for the US reported for instance by Eissa and Hoynes (2006), who document a strong reaction of labour supply to reforms to the EITC. When it comes to the choice of the policy instrument, our approach finds support also in the burgeoning literature on tax salience, and particularly in the experimental evidence on the EITC provided by Chetty and Saez (2009). In this respect, a simple salience argument would indeed point to the fact that individuals adjust their labour supply more promptly in response to changes in specific and well identifiable instruments (like work-related tax benefits) than to general reforms to the personal income tax schedule, which ultimate impact on the take-home pay might be more opaque to figure out *ex ante*. Third, the theoretical framework underlying our analysis allows us to highlight the significant role played by labour supply responses along the extensive margin. It is a stylised fact that low annual or weekly hours of work occur with very low frequency in the data (Eissa *et al.*, 2008). Therefore, entry is also likely to take place at non-infinitesimal hours of work (that is, at part-time or full-time hours). Hence, policies affecting participation decisions entail first-order effects on government revenue via behavioural reactions affecting discrete choices.

The paper is organised as follows. Section 2 frames our analysis by illustrating relevant dimensions of worked-related tax expenditures, including their fiscal impact. Section 3 sets out the theoretical framework, while its empirical complement – the micro-simulation model results and the calibration of labour elasticities – is put forward in Section 4. Section 5 presents the results, including sensitivity analyses. Concluding remarks and policy implications are offered in Section 6.

2 Work-related tax expenditures: rationale, design and fiscal cost

Work-related tax reliefs are increasingly being used in Europe as an instrument to foster employment. Although their specific design differs across countries, reflecting also significant differences in the broader tax-benefit systems at the national level, they tend to have common features that go beyond the pure employment-conditionality. To frame our analysis, we briefly discuss these by focusing on the specific policies implemented in the countries we consider in our analysis, leaving a more detailed description of the different instruments, as they stood in 2010, to Appendix 2.

A work-related tax relief is normally granted as a direct reduction of the individual tax liability derived from earned income, that is, as a tax credit. Specifically, for France, the instrument is designed as a tax credit for the working poor (so-called *Prime pour l´emploi, PPE*), while the corresponding policy in the UK is the working tax credit (WTC). In both cases, the tax credit, income-tested and refundable, is granted conditional on a number of personal and family characteristics other than earned income levels.[2] Similarly, in Hungary and in Slovakia the tax relief takes the form of a proportional reduction of the tax liability, gradually phased out at higher income levels. As opposed to the previous cases, though, the amount of the relief does not depend on characteristics other than the level of individual earnings. Lastly, in Spain the tax benefit is designed as an allowance (*Deducciones por renta del trabajo*), *i.e.*, a reduction in the relevant tax base (employment income), varying in amount depending on the level of individual earnings, on the tax unit (single taxpayer or household), and on other characteristics such as the place of employment.

Detailed quantitative information on the tax relief, both at the aggregate level and along the income distribution, has been retrieved through the micro-simulation model.[3] The summary statics,

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2 "Refundable" means that all qualifying taxpayers receive the full credit amount to which they are entitled, regardless of their tax liabilities. Otherwise said, if the credit is not fully exhausted by the tax liability, the exceeding amount is still granted to the taxpayer as a transfer.

3 The joint consideration of taxes and benefits entitlements is all the more necessary in the simulation of the policy reforms in order to analyse the potential changes in disposable income and incentives to take-up a job as a result of changes in tax policies. These interactions can be a defining feature of MWP policies. For instance, in the UK working tax credits are determined jointly with family benefits. Also, for the other countries considered here the interaction between taxes and tax credits (or allowances) and social benefits also play a very important role, albeit in a more indirect way. We follow Avram *et al.* (2012) who propose a simple approach to capture the interactions between taxes and benefit entitlement modelled in EUROMOD. In a first step the gross taxes are simulated before allowances and credit. In a second step the tax allowances are set to zero and the gross tax rate is calculated

(continues)

reported in Table 1, shed light on the differences in the design of the tax policy instruments considered by quantifying their impacts across income deciles. For consistency with the theoretical framework employed in our main analysis, we exclude workers not employed for the year, who might thus be in transition between jobs. Likewise, public sector employees and self-employed are not included. As a consequence, the figures presented are for full-year employees in the private sector. A first remarkable result is that the scope of the policies varies considerably across countries. While the tax expenditures in Spain and Hungary benefit around 95 per cent of the working population, the tax credit schemes in the remaining countries appear targeted at the lower end of the income distribution. The French PPE affects around 20 per cent of the working population, and, expectedly, its coverage is monotonically decreasing with income. While two out of three workers in the first income decile are entitled to the tax relief, only 5 per cent of those in the seventh decile receive it. The WTC in the UK affects roughly 14 per cent of the total working population, mostly concentrated in the lower half of the income distribution. Targeting is even more specific in Slovakia, where the tax credit de facto benefits almost all and only workers in the first income decile, roughly 9 per cent of the total working population. Substantial heterogeneity emerges also when looking at the money amounts involved. Averaged across recipients, the monthly tax credit ranges from around € 9 in Slovakia to € 177 in the UK. In Spain, the tax allowance translates into a decrease of the average individual tax liability of nearly € 42 per month.[4] Those differences naturally carry over to the aggregate value of the tax relief. The tax credits cost the budget foregone revenues ranging from roughly € 19 million in Slovakia to € 1.822 billion in the UK. To put those numbers in perspective, they equal, respectively, 5 per cent and nearly 18 per cent of the aggregate tax liability from PIT and SSC in the sample.[5]

3 Theoretical framework

3.1 *The revenue impact of reforming work-related tax expenditures*

To account for changes in behaviour following reforms to the in-work tax relief we need a model of labour supply with participation and in-work decisions. We derive the theoretical predictions from the framework proposed by IKKS (2007) building on Saez (2002), illustrated more in detail in Appendix 1. The economy is made of individuals endowed with exogenous productivity and heterogeneous preferences, and faced with a non-linear income tax schedule, who decide on their labour supply. In particular, individuals take decisions about whether to work or not, which reflects the presence of fixed costs related to working (*i.e.*, the extensive margin). Conditional on being in work, the number of hours worked is chosen (*i.e.*, the intensive margin). Individuals thus face a nonlinear tax schedule from zero to positive income tax rate depending on their decision to work and on the number of hours worked. Changes in the tax system – including reforms on tax expenditures – alter the net-of-tax wage rate and, consequently, the opportunity cost of not working (through the labour/leisure decision). Under the assumption that entry does not take place at an infinitesimal level of working hours, which finds empirical support in the literature,

before the tax credits are begin computed. The fiscal cost of tax allowances is then calculated as the difference between the taxes calculated in the first step and in the second step. Importantly, setting allowances to zero also modifies the benefit entitlements reflecting the interaction between tax and benefits necessary to consider the full range of the impact of tax reforms. The fiscal cost of the tax credit is then determined subsequently by calculating the difference between the gross taxes paid in the second step and the final net taxes paid (*i.e.*, net of allowances and credits).

4 The fiscal cost of the tax allowance is obtained as the difference between the gross tax liability without and with the allowance (see footnote 3). Given the nature of the relief (*i.e.*, a deduction against earned income), its value to the individual taxpayer increases with the marginal tax rate on personal income.

5 We have also cross-checked the results obtained from EUROMOD, both at the aggregate level and by income deciles, with comparable information available from national sources. We find that EUROMOD reproduces the income profiles of the tax reliefs and their aggregate value in a very precise way. The comparison tables are available upon request.

Table 1

MWP Tax Expenditures in Selected EU Countries: Summary Statistics

Decile	Fraction of Recipients	Total MWP Tax Expenditure	Average Monthly MWP Tax Expenditure	Total Taxes (*)	Total Benefits	Total Net Taxes
France						
1	65.18%	638.4	35.7	1058	620	438
2	34.6%	178.8	18.7	1782	433	1349
3	26.1%	124.8	18.3	2232	330	1902
4	18.9%	169.2	34.8	2475	296	2179
5	21.7%	178.8	36.8	2701	331	2370
6	13.0%	124.8	43.6	2865	301	2564
7	5.5%	49.8	41.5	3365	246	3119
8	1.7%	13.3	38.2	3529	251	3278
9	0.3%	3.0	48.1	4477	200	4277
10	0.2%	1.0	31.9	6120	303	5817
All deciles	20.8%	1481.9	30.6	30605	3311	27294
Spain						
1	66.8%	2806.0	211.5	308	92	216
2	96.9%	3427.2	242.0	509	38	471
3	98.4%	3227.0	218.3	694	33	661
4	99.2%	3135.1	219.6	770	19	751
5	99.9%	3239.2	221.0	907	31	876
6	100.0%	3426.3	221.6	1121	33	1088
7	100.0%	3300.2	221.7	1278	21	1257
8	100.0%	3488.3	221.3	1653	31	1622
9	100.0%	3191.0	221.5	1922	21	1901
10	100.0%	3234.1	221.4	2929	27	2902
All deciles	96.3%	32474.2	231.4	12091	345	11746

Table 1 *(continued)*

MWP Tax Expenditures in Selected EU Countries: Summary Statistics

Decile	Fraction of Recipients	Total MWP Tax Expenditure	Average Monthly MWP Tax Expenditure	Total Taxes (*)	Total Benefits	Total Net Taxes
UK						
1	23.8%	369.9	197.2	168	168	0
2	36.5%	740.7	290.9	341	104	236
3	42.5%	401.4	145.5	455	94	361
4	28.1%	216.0	115.2	559	71	488
5	15.2%	76.5	71.4	703	68	635
6	1.7%	15.0	126.1	845	62	783
7	0.4%	2.9	105.1	1048	62	987
8	0.0%	0.0	0.0	1257	63	1194
9	0.0%	0.0	0.0	1618	65	1553
10	0.0%	0.0	0.0	3346	77	3270
All deciles	13.8%	1822.5	177.4	10340	832	9508
Hungary						
1	99.9%	12.2	51.4	23	8	15
2	100.0%	12.9	55.6	26	7	19
3	99.7%	12.6	56.6	33	5	28
4	100.0%	13.0	56.9	40	5	35
5	100.0%	13.2	57.3	47	7	40
6	99.8%	13.1	57.5	55	7	49
7	100.0%	13.8	58.4	69	8	60
8	99.5%	12.8	57.6	79	7	71
9	99.3%	11.9	50.1	110	9	101
10	49.4%	2.6	11.8	211	11	200
All deciles	94.6%	118.2	51.4	693	75	617
Slovakia						
1	97.1%	18.7	8.8	30	10	20
2	0.7%	0.1	3.7	59	7	52
3	0.0%	0.0	0.0	26	3	23
4	0.0%	0.0	0.0	53	5	48
5	0.0%	0.0	0.0	60	6	54
6	0.0%	0.0	0.0	66	5	61
7	0.0%	0.0	0.0	81	6	75
8	0.0%	0.0	0.0	81	4	77
9	0.0%	0.0	0.0	104	5	99
10	0.0%	0.0	0.0	160	6	154
All deciles	9.4%	18.7	8.8	720	58	662

Notes: All figures in Mio euros, except for average monthly MWP tax expenditure (in euros). Average monthly MWP tax expenditure for recipient households. (*)Total taxes includes PIT and SSC. For France, total taxes includes PIT, SSC, CSG and CRDS.
Source: authors' calculations, based on Euromod F6.0++ simulations.

responses at the extensive margin will thus exert first-order effects on government revenue. Our aim is indeed to gauge not only the overall size of such revenue impacts, but also the relative magnitude of the behavioural vs. the mechanical effect of a given change in tax expenditures. Therefore, naturally, we depart from IKKS by not assuming revenue neutral reforms. Secondly, in line with the theoretical model we consider marginal changes in existing policies rather than the introduction of new hypothetical policies.

Following IKKS and Saez (2002), we stick to the assumption of ruling out income effects on labour supply, which simplifies considerably the theoretical analysis, and in particular welfare aggregation. In practice, after working through the model (see Appendix 1), it is possible to express in compact way the overall change in tax revenue following a generic marginal tax reform (∂z) affecting disposable income. Formally, this can be written as:

$$dR = dM + dB = \sum_{i=1}^{I}\left[\underbrace{\frac{\partial T_i}{\partial z}E_i + \frac{\partial T_0}{\partial z}(N_i - E_i)}_{\text{mechanical}} - \underbrace{\left(\underbrace{\frac{\tau_i}{1-\tau_i}\frac{\partial \tau_i}{\partial z}E_i w_i l_i \varepsilon_i}_{\text{intensive margin}} + \underbrace{\frac{a_i}{1-a_i}\frac{\partial (T_i - T_0)}{\partial z}\eta_i E_i}_{\text{extensive margin}}\right)}_{\text{behavioural}}\right]. \tag{1}$$

In equation 1, the overall revenue effects from the tax reform – obtained as an aggregation over the groups of individuals in the income decile i – can be decomposed into two separate parts, the mechanical and the behavioural components. The former gauges the impacts of the policy reform absent any behavioural reactions, whereas the latter quantifies the revenue effect brought about precisely by individuals reacting to the new policy environment. In particular, the first term of the mechanical element captures the direct change in tax revenues collected from those in employment (E_i), while the second term is the effect of the tax reform on the benefits received by non-working individuals $(N_i - E_i)$. The terms $T_i \equiv T(w_i l_i, z)$ and $T_0 \equiv T(0, z)$ are the tax liabilities for those working and for those unemployed, respectively, given the current policy z. Similarly, the behavioural component of the change in tax revenues can be further decomposed into two separate effects, corresponding to the changes to hours worked and participation decisions. In particular, the first term captures the adjustment along the intensive margin, with τ_i the marginal effective tax rate, wl labour income (w is the wage rate and l hours worked), and ε_i the intensive labour supply elasticity for individuals in group i. The second term in the behavioural component represents the adjustment along the extensive margin. As it is apparent, this depends on the change in the tax liability in the transition from unemployment into work $\partial(T_i - T_0)$ and on the extensive elasticity η_i, defined as the percentage change in the number of workers in group i following a one percent change in income net of taxes (which is equivalent to consumption) between working and not working. Importantly, the magnitude of effect along the extensive margin depends also on the participation tax rate, $a_i = [T_i(w_i l_i) - T(0)]/(w_i l_i)$.

3.2 *A measure of the welfare cost: the marginal cost of public funds*

The amount of tax revenues foregone due to the tax breaks is influenced by both the number of workers targeted by MWP policies and by the generosity of the relief. The potential cost of reforming MWP policies should thus be gauged in terms of a trade-off between equity and efficiency related to the revenue outcomes of the schemes. Isolating the behavioural component of the overall effects of a tax reform allows one to directly assess the non-monetary cost of the policy intervention. The theoretical framework sketched above naturally lends itself to the application of a synthetic measure of such cost, namely the marginal cost of public funds (MCF), which has emerged as one of the most important concepts in modern public finance. The MCF can be expressed as the ratio, taken with negative sign, between the change in welfare and the change in revenue brought about by a marginal arbitrary tax rate increase. As such, it indeed quantifies the welfare loss incurred by society in raising an extra euro of revenue to finance public spending. An analytical expression for the MCF from taxing labour income in the presence of fixed costs and endogenous labour force participation is derived by Kleven and Kreiner (2006). In particular, they show that, in this framework, the aggregate welfare effect is simply the sum of what we call the mechanical increase in the tax liabilities for each group of individuals. This is a direct consequence of the fact that in this type of model, at equilibrium, optimized hours of work are not affected by marginal tax reforms. The change in government revenue is derived in a straightforward way by factoring in the behavioural responses along the intensive and the extensive margin of labour supply. All in all, equation 1 provides already all the ingredients needed to compute the MCF, which can be expressed compactly as:

$$\mathrm{MCF} = -\frac{\mathrm{dWelfare}}{\mathrm{dRevenue}} = \frac{\mathrm{dM}}{\mathrm{dR}} = 1 + \frac{|\mathrm{dB}|}{\mathrm{dR}} \qquad (2)$$

Recalling notation from equation 1, dM indicates the mechanical change in revenue, which is equal, as explained above, to minus the welfare effect, and dR is the total, or net, revenue impact of the reform. The last term in equation 2 stems from the equivalence result linking the MCF and the marginal excess burden from taxation, *i.e.*, the excess distortion generated in raising an additional euro of tax revenue (Dahlby, 2008).[6] In our framework, the marginal excess burden can be immediately singled out through the behavioural component, and is therefore captured by the ratio |dB|/dR, where again, dB quantifies the change in revenue following labour supply adjustments.

Kleven and Kreiner (2006) also define the broader concept of social marginal cost of public funds (SMCF), which takes distributional preferences into account in the quantification of the aggregate cost. In this case, the group-specific welfare changes are aggregated using ad hoc weights that reflect the average social marginal utility of income among the working population in each group. Although this might be a natural approach to adopt in our framework, nonetheless we prefer not to impose assumptions on the distributional preferences of the countries we analyse. Hence, we stick to an unweighted welfare aggregation. Appropriately substituting the expressions for the different components of MCF demonstrates that, even ignoring distributional concerns, observed heterogeneity in earnings, behavioural parameters, and taxes and benefits do matter for the welfare cost of raising additional government revenue. Insofar as the policies we are analysing are targeted at the low end of the earnings distribution, which is mostly the case for the countries we're looking at, the MCF formula will arguably provide us with a lower bound for the SMCF. Given the inclusion of discrete responses along the extensive margin in the underlying theoretical model, our estimates turn out to be already larger than the results commonly found in the traditional MCF literature focusing only on infinitesimal adjustments in hours worked.

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6 As pedagogically presented by Dahlby and Ferede (2011), if a government raises a tax rate by 10 per cent and the private sector responds by reducing the amount of the taxed activity by 2 per cent, the government's tax revenue will increase by 8 per cent, not 10 per cent. The efficiency loss from the reallocation of resources in the economy due to a tax is reflected in this shrinkage of the tax base. To illustrate how this phenomenon affects the calculation of the marginal cost of public funds, because the 10 per cent tax rate increase generates only an 8 per cent increase in tax revenue, the cost of raising that last, or marginal, dollar of tax revenue is 10/8=1+2/8, or 1.25. Of course, this reasoning is illustrative, since it should be considered strictly speaking only valid in marginal terms. In other words, at the existing tax rate, raising an additional euro of tax revenue costs society 1.25 euro.

4 Estimating the impact of reforming tax expenditures: implementation

Implementing the theoretical framework above requires a realistic calibration of a number of parameters. Firstly, we need to gauge the level and the changes in the tax burden on the workers under the current policy regime and the simulated scenarios. Secondly, participation and in-work labour supply elasticities must also be obtained. We discuss our methodological choices on these two issues in turn.

4.1 Simulation of the tax parameters

The baseline scenario of our exercise assumes the marginal reform as a 1 per cent decrease in the size of the tax expenditure at the individual level. As a sensitivity check, we simulate a lump-sum change in the tax expenditure equal to € 1 (per month) again at the taxpayer level. The change in the policy instrument, represented by z in equation 1, ultimately results in an increase of the tax liability, and thus of the effective tax rate, for the workers. These parameters are clearly worker-specific, and, importantly, depend on the features of the national tax and benefit systems. To account for such complex interactions, we derive them using the EUROMOD microsimulation tool.

Starting with the components of the mechanical effect, $\partial T_i / \partial z$ captures the change in the net tax liability of the workers from the actual to the reformed policy setting. In our framework, the term $(\partial T_i / \partial z) E$ exhausts the mechanical effect of a change in tax expenditure because non-working individuals are not affected by the simulated policy change. Since we do not adopt a balanced budget rule, the second term comprising the mechanical effect in equation 1 – the potential compensatory changes in the transfers received by the unemployed – will be equal to zero. The aggregate measure of the mechanical revenue impacts is obtained from the individual effects by applying employment rates (the term E_i) taken from the Labour Force Surveys.

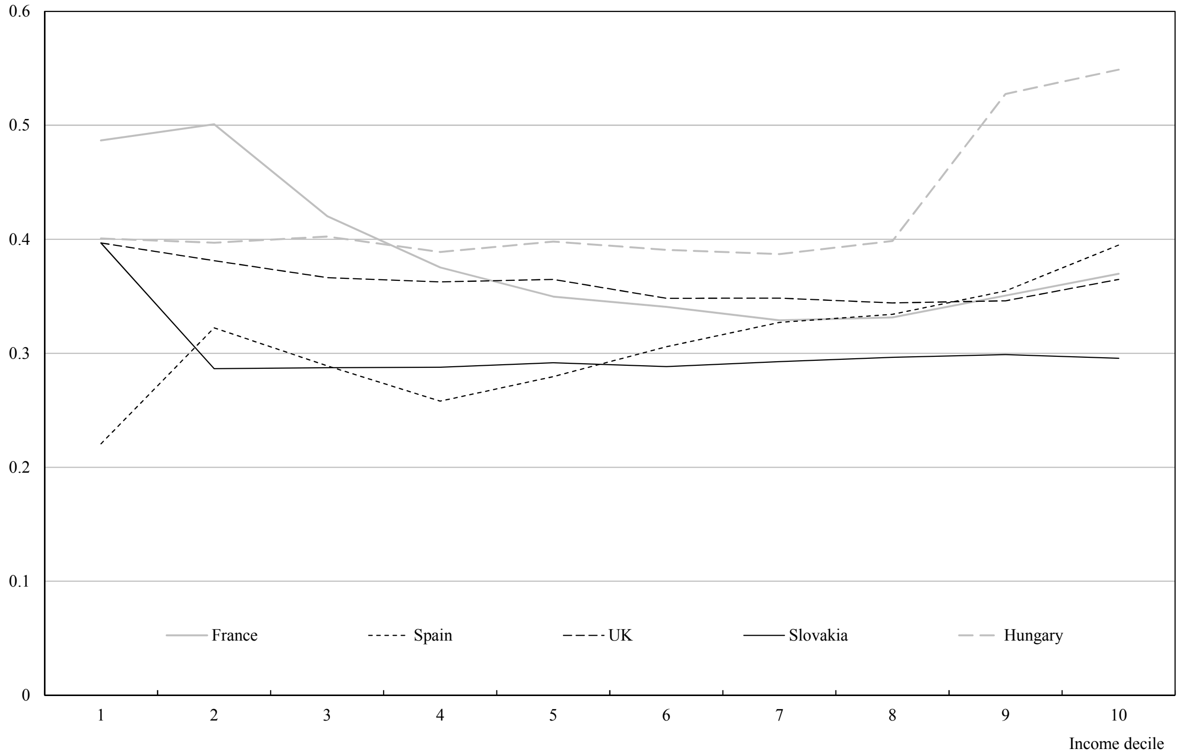
When moving to the behavioural component of the revenue effect, one needs to measure the level of the individual effective marginal tax rates (EMTR) τ_i and their marginal changes ($\partial \tau_i$) following the tax expenditure reform. In order to calculate the EMTRs we follow the approach of Jara and Tumino (2013) which explicitly accounts for all elements affecting household current cash disposable income. Thus, the EMTRs for each individual are evaluated on the basis of taxes paid by (and benefits paid to) all members of a household. Formally, individual level EMTRs are calculated as:

$$\text{EMTR} = 1 - \frac{Y_{HH}^{1} - Y_{HH}^{0}}{G_{k}^{1} - G_{k}^{0}} \tag{3}$$

where Y_{HH} is the household disposable income and G represents the earnings of the individual household member. Operationally, the household disposable income is calculated first. Then, the income of each earner in the household is increased sequentially by a given amount, while accounting for all simultaneous changes induced on the tax liability and benefit entitlement for all other household members. In computing the EMTR we have chosen to increase marginally only the largest component of the individual total income – that is, gross labour income ($w_i l_i$, using the notation in equation 1). This warrants further consistency with the underlying theoretical framework of labour supply responses. We applied a marginal increase of 3 per cent of the gross wage, which corresponds approximately to the additional earnings from a one hour increase in working hours (assuming a full-time employee working 40 hours per week).

Figure 1

Effective Marginal Tax Rates by Income Decile



Source: authors' calculations, based on Euromod F6.0++ simulations.

Figure 1 plots the simulated EMTRs across income deciles for the five countries.[7] In the cross-country comparison, low income earners tend to face relatively high marginal tax rates in France and relatively low rates in Spain. As from the fourth income decile Hungary displays the highest marginal rates, with a peak above 50 per cent at the top of the income distribution.[8] The three "old" EU Member States also show a rather similar pattern for EMTRs at the highest earnings deciles. Marginal rates do not always increase monotonously, as it appears for France and the UK. There are several reasons for this. For instance, the joint tax system in France can result in very high marginal income tax rates for low-wage spouses of high-income earners. Moreover, in general, the withdrawal of income-related benefits can increase marginal tax rates at the lower end of the income distribution. Also, discontinuities in the SSC schedules (such as earnings thresholds) can give rise to very high marginal rates (as well as participation tax rates) for some low wage earners. By contrast, at the same time, ceilings on the contribution base can result in relatively low marginal SSC rates for the highest deciles.

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7 Overall, the simulated values are in line with those in Jara and Tumino (2013). Some differences emerge for the average values. For instance, we obtain average EMTRs (non-reported) of 38.7, 30.9 and 37.1 per cent for France, Spain and the UK, respectively, while their calculations give 36.5, 25.9 and 39.4 per cent for the same countries. These discrepancies are likely caused by our sample selection rule.

8 It is worth noting that, since our simulations are based on 2010 policies, the results for Hungary reflect the progressive personal income tax schedule in place then, with a top marginal rate of 32 per cent. In addition, in 2010 a so-called "super gross-up" regime was introduced, whereby the tax base (aggregate taxable income) was grossed-up of social security contributions.

The second term in the behavioural impact in equation 1 represents the change in net tax revenues related to the extensive margin of labour supply. To compute that, we derive from EUROMOD a measure of the change in the tax liability, that is the term $\partial(T_i - T_0)$, which represents the difference between the net taxes (*i.e.*, net of social benefits) paid by the individual when working and the net taxes paid by when not working (*i.e.*, when wage income is zero). We also need to retrieve the participation tax rates (the term a_i), that is the difference between the net taxes paid by worker i when working and the net taxes paid by the same individual when not working, relative to labour income. Figure 2 plots the participation tax rates. The UK appears to have the lowest participation tax rate across all earning deciles. In all countries, except Slovakia, the participation tax rate tends to increase across income deciles. By contrast, the profile is relatively flat for Slovakia, which shows the largest participation tax rates, ranging between 73 per cent and 79 per cent.

Lastly, two additional parameters are crucial to translate the static microsimulations into the dynamic effects behind the behavioural contribution to the revenue change. The term ε_i represents the (uncompensated) in-work elasticity of labour supply, *i.e.*, the variation in the number of hours worked as a result of a change in the gross labour income. Likewise, η_i represents the participation elasticity, which affects the impacts along the extensive margin. The calibration of these parameters is illustrated in the next section.

4.2 Calibration of labour supply elasticities

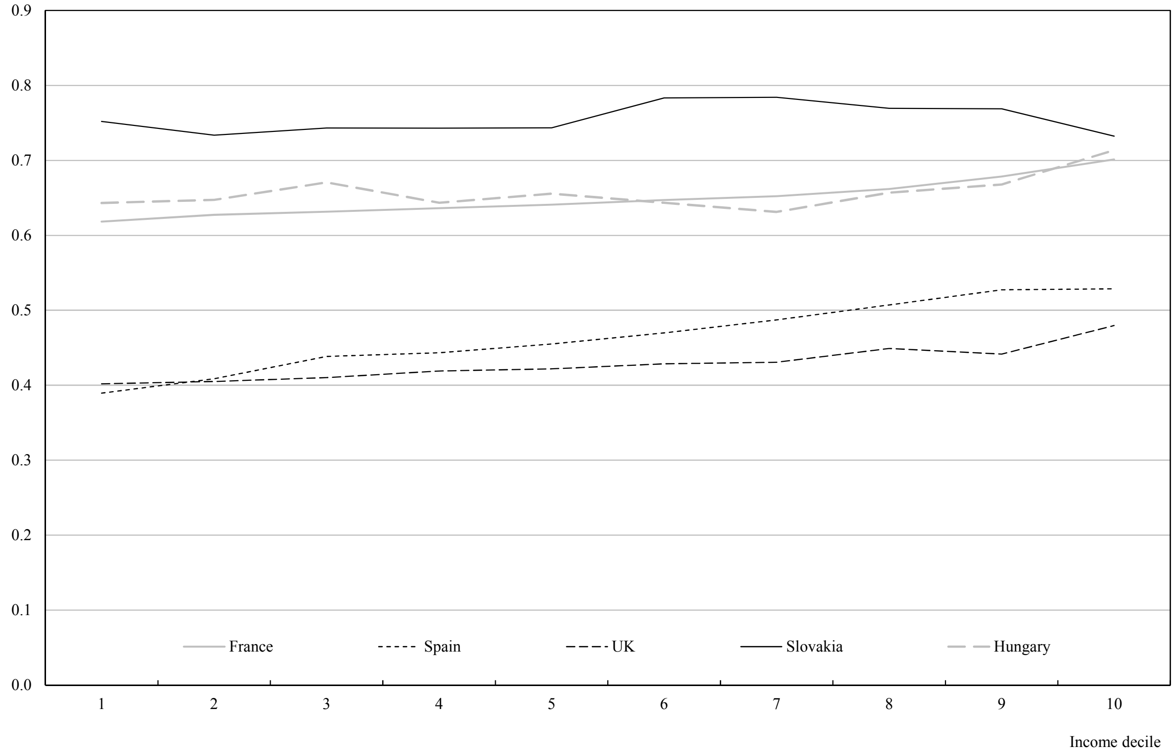
The calibration of the labour supply elasticities – both the intensive and the extensive margin – is crucial to gauge the behavioural impacts of the tax reforms. Our choices regarding these elasticities were guided by two main considerations. Firstly, the high degree of heterogeneity observed in the labour market, documented for instance in Blundell *et al.* (2011), need be accounted for. This would also allow us to have the heterogeneity uncovered by the microsimulation model reflected into the dynamic impacts. Thus, ideally the elasticities should be differentiated by type of individuals. Secondly, from a purely methodological standpoint, cross-country comparability of the elasticities is a potential source of concern. Country-specific studies have often obtained different labour supply elasticities depending on the specific period considered, the focus on specific categories of workers or the estimation method. To avoid this uncertainty, we narrow down the number of sources we rely upon to two. Thus, we take our baseline elasticities from Bargain et al. (2012) who provide both intensive (*i.e.*, number of hours worked) and extensive (*i.e.*, participation) labour supply elasticities for a range of European countries, including the five countries considered in our analysis. They are reported in Table 2. In addition, we use other estimates on the elasticities at the extensive margin, as reported in IKKS. Importantly, these are specific to type of individual and decreasing across income deciles. By doing so, we can capture, at the finest possible level of granularity, the effect of heterogeneity, which, according to recent results from empirical studies, are significant for participation decisions but relatively small adjustments in hours worked. All in all, we differentiate two baseline cases depending on the degree of heterogeneity in labour supply elasticities, as follows:

Case 1: baseline participation and hours-of-work elasticities – country-specific and aggregate value across income distribution[9] – from Bargain *et al.* (2012). For *lone parents* only, participation

[9] The elasticities by decile shown by Bargain *et al.* (2012) do not parse the extensive and the intensive margin. Moreover, they are computed over a more limited sample. Moreover, the distribution of the elasticities across income deciles is U-shaped. This result, although interesting, is not fully convincing, and deserves further investigation.

Figure 2

Participation Tax Rates by Income Decile



Source: authors' calculations, based on Euromod F6.0++ simulations.

elasticities - decreasing across deciles but not varying across countries – are taken from IKKS.[10]

Case 2: baseline participation and hours-of-work elasticities – country-specific and aggregate value across income distribution – from Bargain *et al.* (2012). For *lone parents and married women*, participation elasticities – decreasing across deciles but not varying across countries – are taken from IKKS.

The two sets of elasticities are applied to the proportional (marginal) reform (scenarios 1 and 2), whereas elasticities as in case 1 applied to the lump sum reform (scenario 1.a). Moreover, as an additional sensitivity analysis, in the latter policy intervention, we also show the result obtained by averaging the elasticities under case 1 across countries, so as to single out the effect of the different policies (combined with that of dissimilar income distributions). We label this as scenario 3.

We are aware that the current situation in the labour market would call for considering young people as one of the groups deserving a differential analysis. Although youth unemployment is an important issue, we remain sceptical about the existence of sound estimates of labour supply elasticities for the younger cohorts that could be used in our analysis.

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[10] The values of the participation elasticities for lone parents are 0.9 for deciles 1 and 2, 0.6 in deciles 3 and 4, 0.4 in deciles 5 and 6, 0.2 in deciles 7 and 8 and 0 in deciles 9 and 10.

Table 2

Labour Supply Elasticities

(simulation: 1 percent tax policy change)

	France		Spain		UK		Hungary		Slovakia	
Scenario 1	**Intensive**	**Extensive**	**Intensive**	**Extensive**	**Intensive**	**Extensive**	**Intensive**	**Extensive**	**Intensive**	**Extensive**
Married women	0.02	0.1	0.08	0.43	0.02	0.07	0.01	0.13	0.01	0.13
Married men	0.02	0.04	0.07	0.07	0	0.06	0	0.07	0	0.07
Single women	0.02	0.09	0.04	0.19	0.04	0.24	0.01	0.07	0.01	0.07
Single men	0.02	0.12	0.09	0.47	0.01	0.22	0.01	0.15	0.01	0.15
Lone parents	*as single*	*as single*	*as single*	*as single*	*as single*	*as single*	*as single*	*as single*	*as single*	*as single*
Scenario 2	**Intensive**	**Extensive**	**Intensive**	**Extensive**	**Intensive**	**Extensive**	**Intensive**	**Extensive**	**Intensive**	**Extensive**
Married women	0.02	0.1	0.08	0.43	0.02	0.07	0.01	0.13	0.01	0.13
Married men	0.02	0.04	0.07	0.07	0	0.06	0	0.07	0	0.07
Single women	0.02	0.09	0.04	0.19	0.04	0.24	0.01	0.07	0.01	0.07
Single men	0.02	0.12	0.09	0.47	0.01	0.22	0.01	0.15	0.01	0.15
Lone parents	0.02	0.1	0.08	0.43	0.02	0.07	0.01	0.13	0.01	0.13

Source: Bargain *et al.* (2012), Immervoli *et al.* (2007).

Table 2 *(continued)*

Labour Supply Elasticities
(simulation: 1 euro tax policy change)

	France		Spain		UK		Hungary		Slovakia	
Scenario 1.a	**Intensive**	**Extensive**	**Intensive**	**Extensive**	**Intensive**	**Extensive**	**Intensive**	**Extensive**	**Intensive**	**Extensive**
Married women	0.02	0.1	0.08	0.43	0.02	0.07	0.01	0.13	0.01	0.13
Married men	0.02	0.04	0.07	0.07	0	0.06	0	0.07	0	0.07
Single women	0.02	0.09	0.04	0.19	0.04	0.24	0.01	0.07	0.01	0.07
Single men	0.02	0.12	0.09	0.47	0.01	0.22	0.01	0.15	0.01	0.15
Lone parents	0.02	0.1	0.08	0.43	0.02	0.07	0.01	0.13	0.01	0.13
Scenario 3	**Intensive**	**Extensive**	**Intensive**	**Extensive**	**Intensive**	**Extensive**	**Intensive**	**Extensive**	**Intensive**	**Extensive**
Married women	0.03	0.18	0.03	0.18	0.03	0.18	0.03	0.18	0.03	0.18
Married men	0.02	0.06	0.02	0.06	0.02	0.06	0.02	0.06	0.02	0.06
Single women	0.03	0.15	0.03	0.15	0.03	0.15	0.03	0.15	0.03	0.15
Single men	0.03	0.24	0.03	0.24	0.03	0.24	0.03	0.24	0.03	0.24
Lone parents	*as single*	*as single*	*as single*	*as single*	*as single*	*as single*	*as single*	*as single*	*as single*	*as single*

Source: Bargain *et al.* (2012), Immervoli *et al.* (2007).

5 Results

This section discusses the results from a marginal reduction in work-related tax reliefs. In the baseline case, the marginal reduction is proportional, whereas the case of a lump-sum equally-sized decrease is also investigated as a sensitivity check.

5.1 Baseline: a proportional reduction in work-related tax expenditures

In all of the baseline simulations, we define our policy shock as a reduction in the taxpayer-specific amount of the considered tax expenditure by 1 percent. As such, the country-specific size of the shock is not fully comparable across countries. This lack of comparability is partly endogenous, stemming directly from the different design of the tax provisions in place in the countries considered. A way to circumvent the issue would be to assume that the same policy is introduced in all the countries. However this would be an inherently different exercise which we leave for further research. As mentioned, we believe that our approach is most useful in understanding the impacts of gradual tax reforms. The "marginal approach" used in the paper is in line with the findings of the political economy literature, suggesting that even radical tax reforms are likely to be introduced gradually.

Table 3 shows the results for France. The mechanical effect – by construction unchanged in both scenarios, as it is independent from the behavioural reactions – is around € 0.73 million. The modest size of the impacts reflects the design features of the policy, in terms both of the number of recipients and the magnitude of individual entitlements, as documented in our descriptive analysis and underpinned by other studies (Immervol and Pearson, 2009). In scenario 1, the total behavioural impact is € –0.34 million. The results suggest that almost one half of aggregate extra-tax revenues raised through the decrease in the tax expenditure is lost once the labour supply reaction is factored in. The total behavioural effect is driven by the changes in participation which appear concentrated in the fourth decile. By contrast, reactions along the intensive margin take place at the very bottom of the income distribution, perhaps not surprisingly given the design of the PPE, targeted at low wage earners. Scenario 2 replicates the exercise differentiating the participation elasticities for lone parents and married women as well. At € –0.68 million, the overall behavioural effect is twice as large as the corresponding value in scenario 1. In other words, more than 90 per cent of the mechanical revenue gain is taken away as a consequence of the reduced labour supply, mainly stemming from adjustment along the extensive margin. Overall, this ultimately eats away the static revenue gain from the tax reform, which amounts to only € 0.05 million.

Table 4 provides simulation results for Spain. In the Spanish case the estimated mechanical effect of a decrease in the tax allowance for employment income – unchanged, by construction, across all simulated scenarios – is estimated at around € 50 million per month. The order of magnitude clearly shows the broad range of application of this tax relief – potentially all employment income earners, with disadvantaged categories receiving a more generous allowance. In contrast with the French case, the reduction in tax expenditure in the Spanish case affects the tax revenues only indirectly since the 1 percent reduction is in fact affecting the tax base in the first place. The differences in magnitude carry over when it comes to the overall impact of the behavioural effect. In scenario 1, roughly one third of the mechanical revenue effect is compensated by the reduced revenue due to lower labour supply, with a negligible contribution from the adjustment on the intensive margin. Overall, the net impact on the budget is an increase in revenue of around € 35 million. Given the nature of the policy instrument, and the assumed constant elasticities in scenario 1, the profile of the behavioural component appears relatively flat along the income deciles, as expected, with the exception of a spike in decile 2. Changing the

Table 3

France: Decomposition of the Impact of a 1 Percent Decrease in MWP Tax Credit on Labour Tax Revenue
(scenario 1: participation elasticities for lone parents decreasing across income deciles)
(million euros)

decile	total	mechanical	behavioural_total	behavioural_extensive	behavioural_intensive
1	0.07	0.15	–0.09	–0.02	–0.06
2	0.19	0.23	–0.04	–0.04	0.01
3	0.05	0.06	–0.01	–0.01	0.00
4	0.02	0.16	–0.14	–0.15	0.01
5	0.03	0.07	–0.04	–0.04	0.00
6	0.02	0.05	–0.03	–0.03	0.00
7	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00
total	***0.39***	***0.73***	***–0.34***	***–0.29***	***–0.05***

Source: authors' calculations, based on Euromod F6.0++ simulations.

Table 3 *(continued)*

France: Decomposition of the Impact of a 1 Percent Decrease in MWP Tax Credit on Labour Tax Revenue
(scenario 2: participation elasticities for lone parents and married women decreasing across income deciles)
(million euros)

decile	total	mechanical	behavioural_total	behavioural_extensive	behavioural_intensive
1	–0.10	0.15	–0.25	–0.19	–0.06
2	0.07	0.23	–0.15	–0.16	0.01
3	0.02	0.06	–0.05	–0.05	0.00
4	0.00	0.16	–0.16	–0.16	0.01
5	0.02	0.07	–0.05	–0.04	0.00
6	0.02	0.05	–0.03	–0.03	0.00
7	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00
total	***0.05***	***0.73***	***–0.68***	***–0.63***	***–0.05***

Source: authors' calculations, based on Euromod F6.0++ simulations.

Table 4

Spain: Decomposition of the Impact of a 1 Percent Decrease in MWP Tax Allowance on Labour Tax Revenue
(scenario 1: participation elasticities for lone parents decreasing across income deciles)
(million euros)

decile	total	mechanical	behavioural_total	behavioural_extensive	behavioural_intensive
1	0.45	0.82	–0.38	–0.25	–0.12
2	3.11	5.41	–2.30	–2.01	–0.29
3	4.02	5.39	–1.38	–1.71	0.33
4	2.80	4.04	–1.24	–1.21	–0.02
5	3.04	4.27	–1.23	–1.19	–0.03
6	3.54	5.23	–1.70	–1.48	–0.22
7	3.93	5.27	–1.34	–1.31	–0.02
8	4.08	5.41	–1.33	–1.33	0.00
9	4.02	5.65	–1.63	–1.28	–0.35
10	5.75	7.16	–1.40	–1.35	–0.05
total	***34.73***	***48.65***	***–13.92***	***–13.14***	***–0.78***

Source: authors' calculations, based on Euromod F6.0++ simulations.

Table 4 *(continued)*

Spain: Decomposition of the Impact of a 1 Percent Decrease in MWP Tax Allowance on Labour Tax Revenue
(scenario 1: participation elasticities for lone parents decreasing across income deciles)
(million euros)

decile	total	mechanical	behavioural_total	behavioural_extensive	behavioural_intensive
1	0.38	0.82	–0.45	–0.32	–0.12
2	2.63	5.41	–2.78	–2.49	–0.29
3	3.85	5.39	–1.55	–1.88	0.33
4	2.67	4.04	–1.37	–1.35	–0.02
5	3.06	4.27	–1.20	–1.17	–0.03
6	3.57	5.23	–1.66	–1.44	–0.22
7	4.14	5.27	–1.13	–1.11	–0.02
8	4.33	5.41	–1.08	–1.08	0.00
9	4.64	5.65	–1.01	–0.66	–0.35
10	6.40	7.16	–0.76	–0.71	–0.05
total	***35.67***	***48.65***	***–12.99***	***–12.20***	***–0.78***

Source: authors' calculations, based on Euromod F6.0++ simulations.

Table 5

UK: Decomposition of the Impact of a 1 Percent Decrease in MWP Tax Credit on Labour Tax Revenue
(scenario 1: participation elasticities for lone parents decreasing across income deciles)
(million euros)

decile	total	mechanical	behavioural_total	behavioural_extensive	behavioural_intensive
1	4.14	5.12	–0.99	–0.97	–0.02
2	1.69	2.28	–0.58	–0.57	–0.01
3	0.86	1.14	–0.28	–0.27	–0.01
4	0.17	0.28	–0.10	–0.10	0.00
5	0.15	0.21	–0.06	–0.06	0.00
6	0.02	0.02	0.00	0.00	0.00
7	0.08	0.09	–0.01	–0.01	0.00
8	0.01	0.01	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00
total	***7.12***	***9.14***	***–2.02***	***–1.98***	***–0.04***

Source: authors' calculations, based on Euromod F6.0++ simulations.

Table 5 *(continued)*

UK: Decomposition of the Impact of a 1 Percent Decrease in MWP Tax Credit on Labour Tax Revenue

(scenario 2: participation elasticities for lone parents and married women decreasing across income deciles)

(million euros)

decile	total	mechanical	behavioural_total	behavioural_extensive	behavioural_intensive
1	3.65	5.12	–1.48	–1.46	–0.02
2	1.49	2.28	–0.78	–0.77	–0.01
3	0.78	1.14	–0.37	–0.36	–0.01
4	0.17	0.28	–0.11	–0.11	0.00
5	0.15	0.21	–0.06	–0.06	0.00
6	0.02	0.02	–0.01	–0.01	0.00
7	0.08	0.09	–0.01	–0.01	0.00
8	0.01	0.01	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00
total	***6.33***	***9.14***	***–2.81***	***–2.77***	***–0.04***

Source: authors' calculations, based on Euromod F6.0++ simulations.

Table 6

Hungary: Decomposition of the Impact of a 1 Percent Decrease in MWP Tax Credit on Labour Tax Revenue
(scenario 1: participation elasticities for lone parents decreasing across income deciles)
(million euros)

decile	total	mechanical	behavioural_total	behavioural_extensive	behavioural_intensive
1	0.51	0.85	–0.35	–0.35	0.00
2	0.43	0.78	–0.35	–0.35	0.00
3	0.68	1.00	–0.32	–0.32	0.00
4	0.78	1.01	–0.24	–0.24	0.00
5	0.75	1.02	–0.27	–0.27	0.00
6	0.71	0.96	–0.24	–0.24	0.00
7	0.90	1.12	–0.22	–0.22	0.00
8	0.84	1.04	–0.20	–0.20	0.00
9	0.82	0.96	–0.14	–0.16	0.02
10	0.16	0.18	–0.02	–0.02	0.00
total	***6.59***	***8.93***	***–2.34***	***–2.36***	***0.02***

Source: authors' calculations, based on Euromod F6.0++ simulations.

Table 6 *(continued)*

Hungary: Decomposition of the Impact of a 1 Percent Decrease in MWP Tax Credit on Labour Tax Revenue
(scenario 2: participation elasticities for lone parents and married women decreasing across income deciles)
(million euros)

decile	total	mechanical	behavioural_total	behavioural_extensive	behavioural_intensive
1	0.17	0.85	–0.68	–0.68	0.00
2	–0.04	0.78	–0.82	–0.82	0.00
3	0.39	1.00	–0.61	–0.61	0.00
4	0.50	1.01	–0.51	–0.51	0.00
5	0.59	1.02	–0.43	–0.43	0.00
6	0.58	0.96	–0.38	–0.38	0.00
7	0.87	1.12	–0.26	–0.26	0.00
8	0.80	1.04	–0.24	–0.24	0.00
9	0.87	0.96	–0.09	–0.11	0.02
10	0.17	0.18	–0.02	–0.02	0.00
total	***4.89***	***8.93***	***–4.04***	***–4.06***	***0.02***

Source: authors' calculations, based on Euromod F6.0++ simulations.

Table 7

Slovakia: Decomposition of the Impact of a 1 Percent Decrease in MWP Tax Credit on Labour Tax Revenue
(scenario 1: participation elasticities for lone parents decreasing across income deciles)
(million euros)

decile	total	mechanical	behavioural_total	behavioural_extensive	behavioural_intensive
1	0.05	0.13	–0.08	–0.09	0.00
2	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00
total	***0.05***	***0.13***	***–0.08***	***–0.09***	***0.00***

Source: authors' calculations, based on Euromod F6.0++ simulations.

Table 7 *(continued)*

Slovakia: Decomposition of the Impact of a 1 Percent Decrease in MWP Tax Credit on Labour Tax Revenue
(scenario 2: participation elasticities for lone parents and married women decreasing across income deciles)
(million euros)

decile	total	mechanical	behavioural_total	behavioural_extensive	behavioural_intensive
1	–0.13	0.13	–0.26	–0.26	0.00
2	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00
total	***–0.13***	***0.13***	***–0.26***	***–0.26***	***0.00***

Source: authors' calculations, based on Euromod F6.0++ simulations.

participation elasticities for married women – as in scenario 2 – results in a marginal change in the overall behavioural revenue effect (€ –13 million) and slightly differentiated impacts along the various deciles of the income distribution. In particular, a larger revenue impact (in absolute value) is apparent in deciles 1-4 as opposed to a smaller contribution from deciles 5-10. Thus, the revenue loss from the lowest deciles is larger in scenario 2 than in scenario 1.

Table 5 shows the simulation results for the UK, where the work-related tax relief is provided via an income-tested refundable tax credit. Overall, the marginal change in the tax expenditure – independent from the labour supply assumptions – results in a mechanical revenue gain of around € 9 million per month. Similarly to the French case, the mechanical revenue gain is concentrated on the low-wage earners, in particular those in deciles 1 to 3. In scenario 1, the overall behavioural impact takes away roughly one-fourth of the mechanical effect, with the adjustment along the extensive margin accounting for almost the full decrease in revenue. Inspection of the results by deciles clearly shows that the contribution to the revenue erosion is decreasing monotonically with income, and is concentrated in the lower half of the distribution. Assuming participation elasticities decreasing across deciles also for married women (as in scenario 2) increases the total behavioural revenue loss by 40 per cent, to slightly less than € 3 million. The total net impact on revenue would then be in the order of € 6 million per month.

Results for Hungary are shown in Table 6. A marginal reduction in the tax credit yields around € 9 million of extra-revenue, without accounting for labour supply responses. Once those are factored in, revenues increase by slightly less than € 7 million (scenario 1) or € 5 million (scenario 2). While, following the assumptions on the elasticities, the behavioural impacts on the extensive margin decrease monotonically along the entire income distribution, the mechanical effects have roughly the same order of magnitude across deciles (except for the top decile). Strikingly, adjustments in hours worked are practically null in both scenarios.

The results for Slovakia are reported in Table 7. As is apparent, the policy (change) affects only workers in the bottom decile of the income distribution. The purely mechanical effect is around € 0.13 million per month, whereas the behavioural impacts (only due to adjustments in participation) range from € 0.08 million (scenario 1) to € 0.26 million (scenario 2), in absolute value. As a result, when one allows for heterogeneous labour supply responses from married women, the reduction in the work-related tax credit turns out worsening the public balance.

5.2 Sensitivity analysis: a lump-sum reduction in work-related tax expenditures

The results in the previous section show a large degree of heterogeneity across countries, in terms both of the magnitude of the aggregate impacts and of their distributional effects. The discrepancies stem from the differences in the national tax-benefit systems, and in particular in the design of the tax reliefs considered. Although, as such, they are largely unavoidable, it is nonetheless interesting to check whether the results are robust to different working assumptions. We run sensitivity analyses based as before on a marginal shock. However, in this case, it is assumed to take the form of a lump-sum reduction in the work-related tax expenditure at the taxpayer's level equal to € 1 per month. We simulate the policy change applying the set of elasticities that allows for a differentiated participation response only for lone parents (scenario 1.a, directly comparable to the baseline scenario 1). In addition, to "clean" the results from the effects of different labour supply responses across countries we re-calculate the behavioural impacts using average elasticities (scenario 3). In this way, the cross-country differences in the results should capture the pure effects of the national tax (and benefit) policies, and of the underlying income distributions, rather than differences in labour market and other institutions which might be behind the labour supply elasticities.

Table 8 shows the results for France. The mechanical impact of the lump sum reform is almost € 6 million per month, around 8 times as large as the one form the proportional policy change, indicating that the individual monetary gain from the PPE might indeed be tiny for a significant share of recipients.[11] The overall behavioural impact is roughly € 3.3 million, around 60 per cent of the mechanical impact. In the scenario with equal elasticities across countries the cost of the reform in terms of revenue loss increases to € 4 million per month.

In the case of Spain, the lump sum policy change halves the size of the mechanical effects (now around € 23 million per month) compared to the case of a proportional change in the tax allowance (Table 9). The total behavioural impact is reduced by the same proportion when country-specific elasticities are used, whereas averaging the elasticities across countries would imply a much smaller revenue loss (around € 3.8 million).

Also for the UK, the lump sum shock implies a reduced mechanical revenue gain compared to the proportional change in the tax credit (Table 10). The aggregate value is around € 4.7 million. Like in the baseline case, roughly one-fourth of the gain is eroded by the behavioural reactions, slightly more pronounced when average elasticities are considered.

Both for Hungary and Slovakia (Tables 11 and 12) the lump sum shock translates into larger mechanical revenue effects compared to the proportional policy change. In Hungary, the revenue gain absent behavioural reactions reaches almost € 16 million per month. The reduction due to the labour supply responses hovers at around one-third, and is dampened in the case with average elasticities. For Slovakia, a lump sum reduction in the tax credit would increase the revenue impacts tenfold compared to the proportional policy shock under scenario 1.a, implying an overall revenue loss of roughly € 1.5 million a month. The sign of the net effect on revenues is reversed in the case of average elasticities, with a positive contribution to the budget equal to € 0.3 million.

5.3 *Quantifying the marginal cost of public funds*

Equipped with the full set of results illustrated in the previous sections, we can straightforwardly derive the MCF of the different simulated reforms by applying equation 2. In Table 13 we report the values for the aggregate MCF obtained by first aggregating the relevant variables, *i.e.*, the welfare and the revenue changes, across deciles, and then taking the ratio between the two. As a sensitivity check, we also calculated decile-specific MCF and then averaged these measures across the deciles affected by the policy (change). The relative magnitude of the measures is mostly unchanged. The aggregate values in Table 14 are clearly above 1, the benchmark level for the MCF for a proportional tax reform in the absence of extensive labour supply responses (Ballard and Fullerton, 1992).[12] In some cases, the deviation from the unit benchmark is substantial.

Scenario 1, which simulates the proportional reform in tax expenditure with a minimum level of differentiation in labour supply elasticities, leads to relatively modest aggregate welfare losses for all countries except France and Slovakia, where the tax credits are more targeted to low income earners, and the resulting MCF is slightly below 2 and 3, respectively. The distortions are minimal in the UK case by contrast, which is likely to be due to the compensating effect of extra child benefit provided since a loss in disposable income due to the reduction in tax credit is automatically compensated by an increase in the child benefit.

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[11] In this respect, the policy change should be intended as equal to € 1 at most, as for some taxpayers the individual tax credit before the policy change is lower than that amount.

[12] The uncompensated hours-of-work elasticity is assumed equal to zero.

Table 8

France: Decomposition of the Impact of a Lump-sum Decrease in MWP Tax Credit on Labour Tax Revenue
(scenario 1.a: participation elasticities for lone parents decreasing across income deciles)
(million euros)

decile	total	mechanical	behavioural_total	behavioural_extensive	behavioural_intensive
1	0.38	0.40	–0.02	–0.06	0.04
2	0.49	1.45	–0.97	–0.25	–0.72
3	0.80	1.03	–0.23	–0.23	0.00
4	0.11	0.64	–0.53	–0.49	–0.04
5	0.36	0.98	–0.63	–0.59	–0.04
6	0.49	1.41	–0.91	–0.92	0.00
7	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00
total	***2.63***	***5.92***	***–3.29***	***–2.54***	***–0.75***

Source: authors' calculations, based on Euromod F6.0++ simulations.

Table 8 *(continued)*

France: Decomposition of the Impact of a Lump-sum Decrease in MWP Tax Credit on Labour Tax Revenue
(scenario 3: elasticities as in scenario 1, but averaged across countries)
(million euros)

decile	total	mechanical	behavioural_total	behavioural_extensive	behavioural_intensive
1	0.36	0.40	–0.05	–0.11	0.06
2	–0.07	1.45	–1.52	–0.45	–1.07
3	0.68	1.03	–0.35	–0.35	0.00
4	0.07	0.64	–0.57	–0.51	–0.06
5	0.32	0.98	–0.66	–0.61	–0.06
6	0.49	1.41	–0.92	–0.93	0.01
7	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00
total	***1.84***	***5.92***	***–4.08***	***–2.96***	***–1.12***

Source: authors' calculations, based on Euromod F6.0++ simulations.

Table 9

Spain: Decomposition of the Impact of a Lump-sum Decrease in MWP Tax Allowance on Labour Tax Revenue

(scenario 1.a: participation elasticities for lone parents decreasing across income deciles)

(million euros)

decile	total	mechanical	behavioural_total	behavioural_extensive	behavioural_intensive
1	0.60	1.23	–0.62	–0.46	–0.17
2	1.93	2.71	–0.78	–0.96	0.18
3	1.35	1.98	–0.63	–0.62	–0.01
4	1.49	2.15	–0.66	–0.66	–0.01
5	1.25	1.84	–0.59	–0.52	–0.07
6	1.69	2.38	–0.69	–0.65	–0.03
7	1.77	2.34	–0.57	–0.56	–0.01
8	1.83	2.44	–0.61	–0.60	–0.01
9	1.84	2.59	–0.75	–0.59	–0.16
10	2.53	3.18	–0.65	–0.63	–0.03
total	***16.28***	***22.84***	***–6.56***	***–6.25***	***–0.31***

Source: authors' calculations, based on Euromod F6.0++ simulations.

Table 9 *(continued)*

Spain: Decomposition of the Impact of a Lump–sum Decrease in MWP Tax Allowance on Labour Tax Revenue
(scenario 3: elasticities as in scenario 1, but averaged across countries)
(million euros)

decile	total	mechanical	behavioural_total	behavioural_extensive	behavioural_intensive
1	0.83	1.23	–0.40	–0.32	–0.07
2	2.14	2.71	–0.57	–0.64	0.08
3	1.58	1.98	–0.40	–0.40	0.00
4	1.77	2.15	–0.38	–0.37	0.00
5	1.52	1.84	–0.32	–0.29	–0.03
6	2.00	2.38	–0.38	–0.37	–0.01
7	2.02	2.34	–0.31	–0.31	0.00
8	2.10	2.44	–0.33	–0.33	0.00
9	2.22	2.59	–0.37	–0.31	–0.06
10	2.83	3.18	–0.35	–0.34	–0.01
total	***19.03***	***22.84***	***–3.80***	***–3.68***	***–0.12***

Source: authors' calculations, based on Euromod F6.0++ simulations.

Table 10

UK: Decomposition of the Impact of Lump–sum Decrease in MWP Tax Credit on Labour Tax Revenue

(scenario 1.a: participation elasticities for lone parents decreasing across income deciles)

(million euros)

decile	total	mechanical	behavioural_total	behavioural_extensive	behavioural_intensive
1	1.49	1.81	–0.32	–0.33	0.00
2	1.09	1.35	–0.26	–0.26	0.00
3	0.87	1.04	–0.17	–0.17	0.00
4	0.29	0.34	–0.05	–0.05	0.00
5	0.06	0.07	–0.01	–0.01	0.00
6	0.02	0.02	0.00	0.00	0.00
7	0.04	0.04	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00
total	***3.86***	***4.68***	***–0.83***	***–0.82***	***0.00***

Source: authors' calculations, based on Euromod F6.0++ simulations.

Table 10 *(continued)*

UK: Decomposition of the Impact of Lump–sum Decrease in MWP Tax Credit on Labour Tax Revenue

(scenario 3: elasticities as in scenario 1, but averaged across countries)

(million euros)

decile	total	mechanical	behavioural_total	behavioural_extensive	behavioural_intensive
1	1.42	1.81	–0.39	–0.28	–0.12
2	1.19	1.35	–0.16	–0.23	0.07
3	0.87	1.04	–0.17	–0.15	–0.02
4	0.16	0.34	–0.18	–0.05	–0.14
5	0.01	0.07	–0.06	–0.01	–0.04
6	0.00	0.02	–0.02	0.00	–0.01
7	0.04	0.04	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00
total	***3.70***	***4.68***	***–0.98***	***–0.72***	***–0.26***

Source: authors' calculations, based on Euromod F6.0++ simulations.

Table 11

Hungary: Decomposition of the Impact of Lump–sum Decrease in MWP Tax Credit on Labour Tax Revenue
(scenario 1.a: participation elasticities for lone parents decreasing across income deciles)
(million euros)

decile	total	mechanical	behavioural_total	behavioural_extensive	behavioural_intensive
1	0.57	1.71	–1.14	–1.13	–0.01
2	0.42	1.33	–0.91	–0.95	0.04
3	0.83	1.62	–0.79	–0.78	–0.01
4	0.97	1.69	–0.72	–0.71	–0.01
5	1.08	1.69	–0.60	–0.59	–0.01
6	1.09	1.63	–0.54	–0.54	0.00
7	1.44	1.80	–0.36	–0.36	0.00
8	1.36	1.69	–0.33	–0.33	0.00
9	1.62	1.80	–0.18	–0.18	0.00
10	0.72	0.81	–0.09	–0.09	0.00
total	***10.10***	***15.75***	***–5.66***	***–5.66***	***0.00***

Source: authors' calculations, based on Euromod F6.0++ simulations.

Table 11 *(continued)*

Hungary: Decomposition of the Impact of Lump–sum Decrease in MWP Tax Credit on Labour Tax Revenue

(scenario 3: elasticities as in scenario 1, but averaged across countries)

(million euros)

decile	total	mechanical	behavioural_total	behavioural_extensive	behavioural_intensive
1	0.96	1.71	–0.75	–0.72	–0.03
2	1.08	1.33	–0.25	–0.39	0.13
3	1.08	1.62	–0.54	–0.51	–0.03
4	1.20	1.69	–0.49	–0.46	–0.02
5	1.14	1.69	–0.55	–0.49	–0.06
6	1.15	1.63	–0.47	–0.46	–0.01
7	1.39	1.80	–0.41	–0.42	0.01
8	1.30	1.69	–0.39	–0.39	0.00
9	1.44	1.80	–0.36	–0.36	0.00
10	0.66	0.81	–0.14	–0.14	0.00
total	***11.41***	***15.75***	***–4.34***	***–4.33***	***–0.01***

Source: authors' calculations, based on Euromod F6.0++ simulations.

Table 12

Slovakia: Decomposition of the Impact of Lump–sum Decrease in MWP Tax Credit on Labour Tax Revenue

(scenario 1.a: participation elasticities for lone parents decreasing across income deciles)

(million euros)

decile	total	mechanical	behavioural_total	behavioural_extensive	behavioural_intensive
1	–1.42	1.39	–2.81	–2.83	0.02
2	–0.02	0.01	–0.03	–0.03	0.00
3	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00
total	***–1.44***	***1.40***	***–2.84***	***–2.86***	***0.02***

Source: authors' calculations, based on Euromod F6.0++ simulations.

Table 12 *(continued)*

Slovakia: Decomposition of the Impact of Lump–sum Decrease in MWP Tax Credit on Labour Tax Revenue
(scenario 3: elasticities as in scenario 1, but averaged across countries)
(million euros)

decile	total	mechanical	behavioural_total	behavioural_extensive	behavioural_intensive
1	0.31	1.39	–1.08	–1.16	0.08
2	0.00	0.01	–0.01	–0.01	0.00
3	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00
total	***0.31***	***1.40***	***–1.09***	***–1.17***	***0.08***

Source: authors' calculations, based on Euromod F6.0++ simulations.

Table 13

The Marginal Cost of Public Funds for a Reduction in MWP Tax Expenditure

	Simulated Scenarios				***Cross–scenario st. dev.***
Country	**S1**	**S2**	**S1.a**	**S3**	
France	1.87	15.37	2.25	3.22	*5.62*
Spain	1.40	1.36	1.40	1.20	*0.08*
UK	1.28	1.44	1.21	1.26	*0.09*
Hungary	1.36	1.83	1.56	1.38	*0.19*
Slovakia	2.85	–	–	4.47	*0.81*
Cross–country st. dev.	*0.59*	*5.99*	*0.39*	*1.32*	

Source: authors' calculations, based on Euromod F6.0++ simulations.

Allowing for differentiated elasticities for lone parents increases the cost of reforming the tax reliefs granted through a direct reduction of the tax liability (for France, the UK and Hungary), whereas leaves the welfare cost of reducing the allowance (as it is the case for Spain) virtually unaffected. The welfare cost jumps to 15 for France, showing the sensitivity of the MCF to the participation elasticities for more vulnerable groups. Although this might seem a rather high value, particularly against the standard setup where the MCF is derived, it is still well in the range of estimates which can be obtained in the context of labour tax reforms accounting for responses along the extensive margin. In fact, the result is driven by the very low value of the denominator, because net revenue raised for France approach zero under the assumption of heterogeneous labour supply responses, as in scenario 2. Importantly, averaging the decile-specific MCF across the affected deciles would result in an overall MCF of 9.

The variability in the estimates of the MCF is to a large extent explained by the assumptions used regarding the elasticity of labour supply at the extensive margin. The cross-country variability in results (measured by the standard deviation of the MCFs) is indeed nearly tenfold when moving from Scenario 1 to Scenario 2 in the last row of Table 14. France and Slovakia are the countries for which the assumptions regarding the labour supply elasticities have the biggest impact. When using a homogenous definition of the tax policy change (€ 1) as in Scenario 1.a the cross-country differences in results becomes much smaller (with a standard deviation of 0.4), thus pointing to an important role played by the country-specific tax policy rules in places and possibly also due to the differences in income distributions. Interestingly, when moving from Scenario 1.a to Scenario 3 where elasticities are assumed to be identical across countries, the cross-country differences in MCF are more than tripled, thus pointing to the strong country-specific component of our results. Overall, the results obtained on the MCF point to large efficiency losses tied to reduction in the tax reliefs offered to low-wage workers.

6 Conclusion and discussion

The paper examines the impact on tax revenue of a marginal reduction in actual work-related tax expenditures in five European countries, France, Spain, the United Kingdom, Hungary and

Slovakia. The marginal approach used in the paper is in line with the findings of the political economy literature, suggesting that even radical tax reforms are likely to be introduced gradually. Moreover, assuming reforms to existing policies makes the exercise concretely based on real-life institutions, and allows for a significant degree of heterogeneity given the differences in the national tax-benefits systems considered. We combine static results from the micro-simulation model EUROMOD with a relatively new theoretical framework to obtain a measure of the behavioural impacts induced by the adjustment of the labour supply both at the extensive (labour market participation) and at the intensive margin (hours worked).

The results suggest that the behavioural effects wash away at least one-fourth of the mechanical impact of the reform, and in most instances between one-third and two-thirds of it. Participation decisions play a pivotal role in determining the size of the behavioural impacts. This would be the combined effect of both the behavioural reactions (particularly the calibration of the labour supply elasticities to allow for heterogeneity across groups) and the individuals targeted by the work-related tax benefits being concentrated at the bottom of the earnings distribution.

Differences across countries are remarkable, and mostly driven by the design of the tax relief. In particular, the revenue gain erosion might become significant the more the tax instrument is targeted at the low end of the income distribution. In extreme cases, the reduction of the tax expenditure might even ultimately translate into a revenue loss. As suggested by the use of different scenarios, the results are affected by the calibration of the labour supply elasticities across agents, with the extensive margin playing a much larger role than the intensive margin, as expected. Moreover, allowing for more heterogeneity in the behavioural responses across groups of individuals, and particularly singling out married women and lone parents, leads to larger revenue losses.

Since participation responses are mostly concentrated at the bottom of the earnings distribution, the revenue effects are more pronounced in countries where such low income levels are supported (e.g., via minimum wage or work-tested benefits). At the same time, the purely mechanical effect on revenue is largest at the lower end of the distribution for the policies clearly targeted at the low income workers, like it is the case for the tax credits in place in Slovakia, France and, to a lesser extent, the UK. The implications for the costs of the reforms are substantial. The revenue erosion from a proportional shock is at least 50 per cent in the case of France and Slovakia, and might grow even larger than the static mechanical impact in the case with more heterogeneous elasticities. As in our framework there is a direct correspondence between the mechanical impacts and the change in welfare, the size of the behavioural component determines also the welfare cost of the reform. Normalising that in terms of revenue raised, as indicated by the MCF, shows that aggregate welfare loss per unit of revenue raised is unambiguously above one, and in some of the simulated scenarios significantly larger than that.

Some limitations of our analysis should be borne in mind when drawing policy conclusions. In particular, arguably, the assumption of competitive labour markets with voluntary unemployment underlying the theoretical model might severely limit the applicability of our framework to the current juncture. Nonetheless, as pointed out by Kleven and Kreiner (2006), theories of imperfect labour markets would still predict higher unemployment following tax rate increases, while differing from the perfect labour market model only in the transmission mechanism (wages instead of individuals' voluntary participation decisions). Since unemployment would still have a revenue impact, our reasoning on the risk of revenue erosion would still apply to the new scenario.

A second factor which might play an important role in adverse business cycle conditions is the presence of the underground economy. Although its level should not affect our results, given that they depend only on observed revenue, however dropping out of the official labour market following a tax increase might be a somewhat appealing option for low income earners. Nonetheless, in this respect, we are confident that the size of the labour supply elasticities used in our computations account for those factors, and therefore consider our result sufficiently robust to this other caveat.

All in all, although the budget consolidation needs currently faced by many European countries call for increasing government revenue, particularly by reviewing and reducing tax exemptions and relief, our results suggest some caution with respect to which tax expenditures might more efficiently be reduced. In particular, reducing work-related tax relief appear particularly costly, both in terms of the revenue erosion and in terms of the welfare costs to society following behavioural responses in labour supply. Put in a more positive way, the budgetary cost of tax expenditures in MWP policies turns out to be much lower when taking into account the behavioural effects, while they generate significant gains in terms of both economic activity – induced by a stronger labour supply – and welfare – caused by higher consumption.

APPENDIX 1
THEORETICAL FRAMEWORK

Following Immervoll *et al.* (2007) and Saez *et al.* (2012) we set up a theoretical framework where heterogeneous taxpayers take decisions on labour and pay taxes. Individuals take decisions about whether to work or not, which reflects the presence of fixed costs related to working (*i.e.*, the extensive margin). Conditional on this decision, the number of hours worked is chosen (*i.e.*, the intensive margin). Individuals thus face a nonlinear tax schedule from zero to positive income tax rate depending on their decision to work and on the number of hours worked. Changes in the tax system alter both the net-of-tax wage rate and, consequently, the opportunity cost of working (through the labour/leisure decision). Building on this simple framework we derive analytical expressions in which the changes in government tax revenues reflects the potential changes in labour supply and thus allows to gauge the relative strength on the behavioural vs. mechanical effect of a given change in tax expenditure and corresponding change in effective taxation.

Let us assume that the total population N is divided into i groups according to their skill level, which in turn determines their pre-tax wage. Each group has N_j individuals that earn the same exogenous wage rate w_i. Individuals within each group may differ in the fixed cost of working such that they may also differ in their extensive responses. Preferences are represented by the following additively separable utility function:

$$u_i(c, l, q) \tag{4}$$

where c is consumption, l labour and q the fixed cost of working. The partial derivative of (4) with respect to c is positive while the partial derivatives with respect to l and q are negative, conditional on labour participation. The budget constraint is given by:

$$c = w_i l - T(w_i l, z) \tag{5}$$

where $T(w_i l, z)$ represents the net taxes paid by the individual of group i; the parameter z is just a way to denote the tax reforms considered below. When the individual does not work (l=0), the above tax function becomes $-T_0(0, z)$, that is, the welfare benefit received by those who do not work. In such case, the budget constraint is $c_0 = -T_0(0, z)$.

Plugging (5) into (4) and maximising the new expression gives the optimal labour supply

$$l_i((1-\tau_i)w_i) = l_i(W_i) \tag{6}$$

where Wi is the net-of-tax wage rate. As usual in the literature, we ignore income effects on labour supply in order to simplify the analysis and in absence of a general consensus in the literature about the size of such as income effects (see Blundell and MaCurdy, 1999, for a survey), which in many cases is simply insignificant.

A key variable in this analysis is the elasticity of labour supply with respect to the net-of-tax wage rate. In absence of income effects, the uncompensated and compensated elasticities can be considered as being identical, such that we have:

$$\varepsilon_i = \frac{\partial l_i}{\partial W_i} \frac{W_i}{l_i} \tag{7}$$

In relation to the extensive response, we first need to define the critical value of the fixed cost q that determines whether the individual enters the labour market or not. In terms of utility levels, the necessary condition to supply a strictly positive number of hours of work is given by:

$$u_i\left(w_i l - T\left(w_i l, z\right), l, q_i\right) > u_i\left(-T\left(0, z\right)\right) \tag{8}$$

which implicitly defines an upper-bound value for qi, denoted by $\bar{q}_i$. Provided that the individual cost of working qi is below $\bar{q}_i$, the labour supply will be strictly positive. Let the fixed cost qi be distributed across the individuals belonging to group i following the distribution function $F_i(q)$, with $f_i(q)$ as density function. Hence, $F_i\left(\bar{q}_i\right)$ is the proportion of individuals who choose to work because their qi is below $\bar{q}_i$. The total employment in group i is then given by $E_i \equiv N_i F_i\left(\bar{q}_i\right)$.

In line with Saez (2002), let the extensive elasticity for each individual of group i be defined as:

$$\eta_i = \frac{\partial F_i}{\partial (c_i - c_0)} \frac{(c_i - c_0)}{F_i} = \frac{f_i\left(\bar{q}_i\right)(c_i - c_0)}{F_i\left(\bar{q}_i\right)} \tag{9}$$

The variable ηi represents the percentage change in the number of workers in group i as result of a one-percentage change in the difference in consumption when working and not working are compared.

At this point, the mechanical effect of a tax reform (given by a change in the personal tax expenditures in our case) can be defined as:

$$dM = \sum_{i=1}^{I} \left[\frac{\partial T_i}{\partial z} F_i N_i + \frac{\partial T_0}{\partial z} (1 - F_i) N_i \right] \tag{10}$$

The first term refers to the change in the tax revenues by modifying personal tax expenditures in the case of employed individuals while the second term is the effect of the tax reform on the benefits received by non-working individuals.

The behavioural effect, on the other hand, takes into consideration the effect of changes in the labour supply (intensive response) and in the decision on participation in labour market (extensive response) on the tax revenues after the tax reform. Analytically this can be expressed by the following expressions:

$$dB = \sum_{i=1}^{I} \left[\tau_i d(w_i l_i) E_i + \left(T_i - T_0\right) \frac{dF_i}{dz} N_i \right]. \tag{11}$$

The first term of 11) is the behavioural effect related in the intensive response while the second term represents the behavioural effect in the extensive response. After differentiating totally the labour income and some algebraic manipulations using 7), we arrive at the following expression of the first term of (11): $\sum_{i=1}^{I}\left[-\frac{\tau_i}{1-\tau_i}d\tau_i E_i w_i l_i \varepsilon_i\right]$, where the usual assumption that there is no incidence effect of changes in labour supply on pre-tax wage rate (dw=0) has been used.

As mentioned above, the second term of (11) refers to the behavioural effect related to the extensive response. Denoting by $a_i = \frac{T(w_i l_i) - T(0)}{w_i l_i}$ the participation tax rate, a more comprehensive expression of this second term can be obtained: $\sum_{i=1}^{I}\left[-\frac{a_i}{1-a_i}\frac{\partial(T_i - T_0)}{\partial z}\eta_i E_i\right]$, where the expression 5) – and its equivalent when l=0 –, the elasticity 9), dw=0 and the envelope theorem have been used. Hence the total behavioural effect of expression 11) can be rewritten as:

$$dB = \sum_{i=1}^{I}\left[-\frac{\tau_i}{1-\tau_i}d\tau_i E_i w_i l_i \varepsilon_i - \frac{a_i}{1-a_i}\frac{\partial(T_i - T_0)}{\partial z}\eta_i E_i\right]. \tag{12}$$

Finally, adding expression (10) and (12), we obtain the total change in the personal income tax revenues:

$$dR = dM + dB = \sum_{i=1}^{I}\left[\frac{\partial T_i}{\partial z}E_i + \frac{\partial T_0}{\partial z}(N_i - E_i) - \frac{\tau_i}{1-\tau_i}d\tau_i E_i w_i l_i \varepsilon_i - \frac{a_i}{1-a_i}\frac{\partial(T_i - T_0)}{\partial z}\eta_i E_i\right], \tag{13}$$

where terms among brackets are, respectively, the intensive mechanical effect, the extensive mechanical effect, the intensive behavioural effect and the extensive behavioural effect.

APPENDIX 2
MAKE-WORK-PAY TAX EXPENDITURES IN FRANCE, SPAIN, THE UK, HUNGARY AND SLOVAKIA

The main features of the work-related tax expenditures in our sample of countries are described in this section. The reference year for the tax rules is 2010.

France

The Employment Bonus (Prime pour l'emploi – PPE) is an individual tax credit established in order to encourage the return to employment and improve earnings from working.

The amount depends on:

- The earned income (employee and self-employment)
- The tax unit income
- The number of hours worked

To be eligible for the PPE, the household *"Revenu Brut Global"*, must be under € 16,251 for a single person, or € 32,498 for couples. Each dependent child increases the basic amount by € 4,490. The PPE is also based on the individual earned income, corresponding to employment income and self-employment income. For part-time workers, this earned income is converted to full-time equivalent.[13] The credit is equal to 7.7 per cent of the annual employment or self-employment income earned when not exceeding the minimum wage (€ 12,475), increased by € 36 for each dependent person (double for the first child of a single, divorced or widowed person). If the earned income exceeds this amount, the credit is 17 per cent of the difference between the earned income and the ceiling (€ 17,451 or 26,572, for a single, divorced or widowed person with one child or more; or for a married person with a non-working spouse). The credit is assessed by the tax authorities and is aggregated at the household level. If the total tax credits exceed the household's income tax liability, the excess is refunded.

Spain

Work-related tax incentives (*Reducción por rendimientos del trabajo, prolongación de la actividad laboral y movilidad geográfica y personas con discapacidad que obtengan rendimientos del trabajo como trabajadores activos*) are granted through an income related non-refundable tax allowance for taxpayers who receive employment income. The amount of the allowance diminishes as the level of net employment income increases, and varies between € 2,652 and € 4,080.[14]

The allowance, which cannot exceed total net employment income, is doubled for employees who accept an employment in a different city or who are older than 65. Further provisions are applicable in case of disabled taxpayers. In the case of joint taxation, and even if both partners have incomes from work, the allowance is only applicable once.

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[13] The conversion coefficient is defined as: 1820/ yearly number of hours worked for employees or 365/yearly number of days worked for self-employees.

[14] Tax payers with net employment income equal or below € 9,180 may reduce the tax base by € 4,080. Taxpayers with net income over € 13,260 or non-employment income over € 6,500 may only reduce the tax base by € 2,652. Tax payers in between will reduce their tax base by € 4,080 minus the result of multiplying by 0.35 by the difference between net income and € 9,180.

United Kingdom

The working tax credit (WTC) is an income-tested refundable tax credit, calculated on the basis of the previous tax year's annual income. WTC contains a number of elements depending on family composition (basic, couple and lone parent element), health (disability and severe disability element), number of hours worked (30 hour element) and age of the claimant (50+ element).

The eligibility conditions for working adults are:

- working at least 30 hours per week and aged above 24 years old,
- working at least 16 hours per week and have a dependent child or
- working at least 16 hours per week and disabled.

Examples of the different elements are as follows:

- a basic element of £1,890 payable to everyone (in 2009/10)
- a couple and lone parent element (£1,860)
- a 30 hour [working week] element (£775)
- a disabled worker element (£2,530)
- a severely disabled worker element (£1,075)
- a 50+ return-to-work payment (discontinued after April 2012).

Hungary

The Employee Tax Credit is a refundable tax credit for low income individuals. It amounts to 17 per cent of wage income earned, subject to a monthly maximum credit of HUF 15,100 (€ 55). That implies that the tax credit can be fully exploited if the annual wage earnings are lower than HUF 3,188,000 (€ 11,572). The tax credit tapers off in the income range HUF 3,188,000-4,698,000 (€ 17,054), when the reduction is equal to 12 per cent of the income exceeding HUF 3,188,000 (€ 11,572). No tax credit is available for those earning more than HUF 4,698,000 (€17,054). Eligibility does not depend on family (e.g., number of children) characteristics. Note: the tax credit was abolished as of 2013.

Slovakia

The employee tax credit was introduced in January 2009. Entitled are employees who have worked at least 6 months during the year and have annual earnings of at least 6 minimum wages (with the minimum wage standing at € 307.7 per month in 2010). Eligibility is conditional on receiving only employment income. If annual earnings are lower than 12 minimum wages, the tax credit amounts to 19 per cent of the difference between the basic tax allowance (equal to 22.5 × the minimum subsistence level, fixed at € 185.19 per months in 2010) and the minimum wage less social insurance contributions. If annual earnings are higher than 12 minimum wages, the tax credit amounts to 19 per cent of the difference between the individual basic tax allowance and taxable income. The tax credit becomes zero when taxable income is equal to the basic tax allowance. The tax credit is refundable.

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