

## IV. Second-round effects of income tax reforms

---

*Fiscal policy measures have complex economic effects. Businesses and consumers may respond by changing their behaviour and these responses can themselves have further economic effects by changing the supply, demand and prices of goods and services. Quantitative assessments of these second-round budgetary effects are those with the highest degree of uncertainty and therefore often at the centre of political and public debates. Conventional budget analysis relying on static scoring assumes that GDP remains the same when the government changes taxes or spending. Although this assumption is simple and transparent, economic theory and empirical research confirm that fiscal policy influences the path of the economy. For example, if a tax cut stimulates growth, the revenue loss will be less than its estimate, assuming unaffected GDP. The macroeconomic feedback effect may not be large enough to make tax cuts pay for themselves, but it can make tax cuts partially self-financing.*

*This section builds on a recent paper, Barrios et al. (2017), in which the authors develop a dynamic scoring framework for analysing tax and benefit reforms in European countries.<sup>(186)</sup> The framework combines EUROMOD, a static microsimulation model, with QUEST, the European Commission's dynamic general equilibrium model. While the microsimulation model allows for the precise translation of actual tax reform proposals into policy shocks, it cannot account for the economy-wide effects of the reforms. On the other hand, dynamic general equilibrium models can consistently capture the macroeconomic feedback effects. This section shows that accounting for the macroeconomic feedback effects is important for the comprehensive evaluation of tax reforms, including their distributional impact. <sup>(187)</sup>*

Quantifying the impact of tax-cuts on the fiscal balance is a difficult task because tax-cuts can affect the tax base over time. For example, cutting capital income taxes reduces the tax revenue on impact but it can also increase the tax base over time if the tax cut stimulates the economy through higher investment. Accounting for the second-round feedback effects of tax reforms on the tax base is important from a fiscal sustainability point of view because these effects can make the tax-cut partially self-financing. Dynamic scoring methods can estimate the revenue effects of tax reforms using dynamic macroeconomic models. The literature suggests that the second-round effects can be sizable, e.g., in case of capital taxes, more than 70 percent of the tax cut can be self-financing.<sup>(188)</sup>

This section elaborates on Barrios et al. (2017) which develops a dynamic scoring framework for analysing tax and benefit reforms in European countries. The framework combines EUROMOD,

the static microsimulation model for all European Union Member States, with QUEST, the European Commission's dynamic general equilibrium model used for the analysis of fiscal and structural reforms.

EUROMOD on its own can only be used to calculate the direct, 'overnight' effect of reforms on the taxes paid and benefits received by households, assuming that their pre-tax income and employment status remain unaffected after the policy shock. The combined use of EUROMOD and QUEST has three main advantages.

- First, the microsimulation model allows for a precise translation of actual tax reform measures into policy shocks that is not possible using macroeconomic models alone.
- Second, the policy shocks can be fed into the macroeconomic model in order to capture the macroeconomic feedback effects. Static microsimulation models ignore how tax reforms endogenously affect wages, employment, prices and other monetary and fiscal variables in the economy that can lead to non-negligible feedback effects on tax-revenues. These effects can be consistently modelled in dynamic general equilibrium models.
- Third, in addition to the analysis of the macroeconomic and fiscal effects, the results

---

<sup>(186)</sup> Barrios, S, Dolls, M., Maftci, A., Peichl, A., Riscado, S., Varga, J., and C. Wittneben (2017), 'Dynamic Scoring of Tax Reforms in the European Union.' ZEW Discussion Paper No. 17-017. This study was developed in collaboration with the Joint Research Centre in the context of the ECFIN-JRC Administrative Agreement to provide support to fiscal and tax policy recommendations with the EUROMOD model.

<sup>(187)</sup> This section was prepared by Janos Varga. The author wishes to thank Savina Princen, Eric Meyermans, Valeska Gronert, Werner Roeger and Jan in 't Veld for useful comments.

<sup>(188)</sup> Trabandt, M. and H. Uhlig (2011), 'The Laffer curve revisited.' *Journal of Monetary Economics*, Vol. 58, pp. 305-327.

---

can be fed back into the microsimulation model to analyse the distributional effects of the reforms. This is the novel approach taken in the current dynamic scoring practice.

The results of this exercise indicate that accounting for the macroeconomic feedback effects is important for a comprehensive evaluation of tax reforms, including their distributional impact. This section gives a short introduction to this framework.

### Why to use EUROMOD and QUEST for the dynamic scoring of tax-revenue estimates?

Similar to other microsimulation models, EUROMOD is a static tax and benefit calculator that makes use of the representative microdata from the Statistics on Income and Living Conditions (national and EU-SILC). As a microsimulation model, it allows for the translation of actual tax and benefit reform measures into policy shocks, something which is not possible using macroeconomic models alone. <sup>(189)</sup> The extensive micro database in EUROMOD includes information on personal and household characteristics (e.g. education), 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. <sup>(190)</sup> Since EUROMOD covers only households/individuals without connecting them to the rest of the economy, it cannot account for the impact of tax reforms on wages, employment, and other variables in the economy that can lead to non-negligible feedback effects on tax-revenues.

Therefore, EUROMOD can only be used to calculate the direct, ‘overnight’ effect of reforms on the taxes paid and benefits received by households, assuming that their pre-tax income and employment status remain unaffected after the policy shock. On the other hand, micro-founded dynamic general equilibrium models, like the

QUEST model, can consistently capture the missing feedback effects. <sup>(191)</sup> These general equilibrium models can simulate the behavioural response of firms, households, fiscal and monetary authorities to policy shocks.

The idea of combining micro- and macroeconomic simulation models is not new but the approaches and techniques are still under development (see Peichl, 2016). <sup>(192)</sup> By linking these two model types, fiscal policy analysts benefit from the complementary advantages of the models. Researchers have been using linked microsimulation and computable general equilibrium (CGE) models to examine the distributional effect of policy shocks. Although these layered CGE-microsimulation models can account for some of the macroeconomic feedback effects, a serious drawback of this approach is the lack of explicit dynamic structure in the CGE model parts. <sup>(193)</sup> Static CGE models can provide the long-run, steady state feedback effects but they are silent on the short- to medium-run transition path of the simulated policy shocks. Fully dynamic macroeconomic models can provide complete impulse responses from the short run to the new, long-run steady state. Moreover, tax and benefit reforms can also affect growth; e.g. through influencing saving and investment, incentives for innovating or adopting new technologies. As opposed to traditional CGE models, these impacts

---

<sup>(189)</sup> See Sutherland (2001) and Sutherland and Figari (2013) for a description of the EUROMOD microsimulation model. Sutherland, H. (2001). EUROMOD: An integrated European benefit-tax model (No. EM9/01). EUROMOD Working Paper Series. Sutherland, H., & Figari, F. (2013). EUROMOD: The European Union tax-benefit microsimulation model (No. EM8/13). EUROMOD Working Paper.

<sup>(190)</sup> EUROMOD integrates taxes, social contributions and benefits based on a common framework code of the policy systems for the EU-28, see <https://www.euromod.ac.uk>.

---

<sup>(191)</sup> QUEST is a fully dynamic structural macro-model with microeconomic foundations derived from intertemporal utility and profit optimisation. The different model variants have been extensively used for macroeconomic policy analysis and research, e.g. analysing the impact of fiscal and structural reforms and assessing the impact of Cohesion Policies. See Ratto, M., Roeger, W., & in 't Veld, J. (2009). QUEST III: An estimated open-economy DSGE model of the euro area with fiscal and monetary policy. *Economic Modelling*, 26(1), 222-233., Varga, J., Roeger W. and in 't Veld, J. “Growth effects of structural reforms in Southern Europe: the case of Greece, Italy, Spain and Portugal” *Empirica*, 2014, vol. 41, issue 2, 323-363.

<sup>(192)</sup> Peichl (2016) distinguishes two main strategies for linking the models: a.) completely integrate both models, and b.) combine two separated models via interfaces (so-called layered approach). The second approach can be differentiated into top-down and bottom-up approaches. The top-down approach computes the macroeconomic variables as inputs for the micro model to adjust its exogenous macro aggregates. The bottom-up approach works in the opposite order: variables from the micro model help to calibrate aggregates in the macro model (See Peichl, A. (2016), ‘Linking Microsimulation and CGE models’, *International Journal of Microsimulation*, Vol. 9(1), pp. 164-176.) Barrios et al. (2017) combines the bottom-up and top-down approaches.

<sup>(193)</sup> See Davies, J. (2004), ‘Microsimulation, CGE and Macro Modelling for Transition and Developing Economies’, Mimeo, University of Western Ontario.

can be analysed with forward-looking growth models like the QUEST model. <sup>(194)</sup>

#### IV.1. Revenue estimates of tax reforms: dynamic scoring vs. static scoring

Dynamic scoring is an American term referring to a budgetary analysis which accounts for the full macroeconomic effects of policies when estimating their budgetary effects (Mankiw and Weinzierl, 2006).<sup>(195)</sup> Traditional revenue estimation, called static scoring, on the other hand, assumes no behavioural feedback effects at the macro level when producing the budgetary estimate of policies. Dynamic scoring is a well-established exercise for budgetary estimations in the U.S., where the Joint Committee on Taxation (JCT) is legally required to provide a macroeconomic impact analysis for bills that are expected to have large fiscal effects.<sup>(196)</sup> Barrios et al. (2017) develop a dynamic scoring framework for modelling and analysing tax and benefit reforms for all EU countries.

Advocates of dynamic scoring argue that traditional scoring techniques undermine the case for tax cuts because the feedback effects of tax cuts, with reinforced incentives, are not taken into account. Laffer-curves can easily illustrate this argument. The stylised Laffer-curves of Graph IV.1 show the collected revenues from two different types of taxes (A and B). The dashed lines represent the static scoring exercise that would correspond to a standard microsimulation estimate. In this case, by cutting the tax-rates from their starting levels (TA,0 and TB,0), the corresponding tax revenues decrease proportionally if one does not take into account the macroeconomic feedback effects (from R0 to R-stat). Dynamic scoring estimates, which account for these feedback effects, would produce higher revenue estimates (R-dyn). The difference between the static and

dynamic scoring estimates captures the so-called revenue feedback effect (R-dyn – R-stat). By missing the feedback from the behavioural response of economic agents, the static scoring overestimates the revenue loss after the tax-cut and biases the analysis against the proposed policy measure.

Graph IV.1 also demonstrates that the magnitude of the revenue feedback effect depends:

- on the magnitude of the tax-change: for larger cuts one would expect stronger behaviour effects while for smaller changes the difference may be negligible;
- on the type of the tax which is captured by the shape of the corresponding Laffer-curve in our graphs. For example, cutting more ‘growth distortionary’ taxes tend to generate larger self-financing effects (Tax A vs. Tax B).

Finally, note that the Laffer-curves above correspond to the final steady states. Concerning the transition dynamics towards the new equilibrium, Mankiw and Weinzierl (2006) show that the difference between the static and dynamic scoring revenue estimates is smaller in the beginning but it is gradually increasing over time after the introduction of the tax reforms. <sup>(197)</sup>

<sup>(194)</sup> See Roeger, W., J. Varga and J. in ‘t Veld (2009), ‘Structural Reforms in the EU: A simulation-based analysis using the QUEST model with endogenous growth’, European Economy. Economic Papers 351.

<sup>(195)</sup> Mankiw, N. G., and M. Weinzierl (2006), ‘Dynamic scoring: a back-of-the-envelope guide’, *Journal of Public Economics*, Vol. 90(8), pp. 1415-1433. See also Auerbach, A. J. (2005), ‘Dynamic scoring: An introduction to the issues.’ *American Economic Review*, Vol. 95, pp. 421-425.

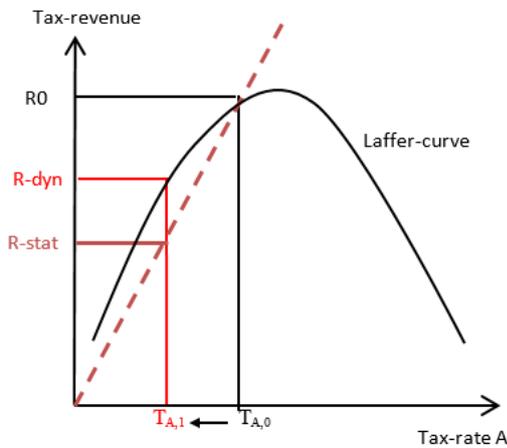
<sup>(196)</sup> The current rules require the Joint Committee on Taxation (JCT) to develop dynamic scoring estimates for any official conventional revenue score that exceeds 0.25 percent of U.S. GDP for any given year. The rules also require qualitative analysis for 20 years after the budget window. (See JCT. 2017. ‘Overview of the Joint Committee Revenue Estimating Process’,

<https://www.jct.gov/publications.html?func=startdown&id=4969>)

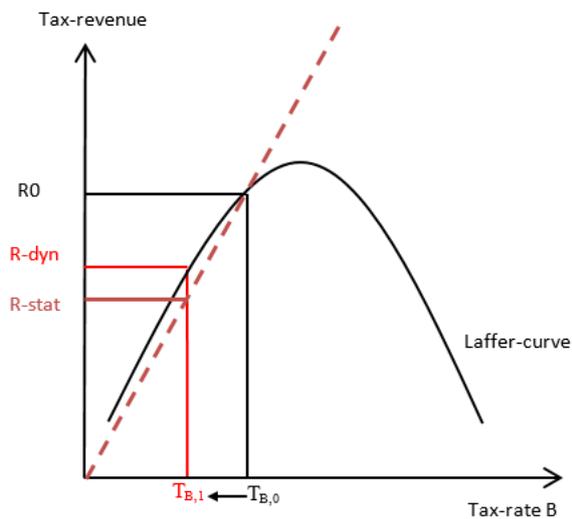
<sup>(197)</sup> Exploring the shape and the revenue maximising tax-rate of the Laffer curve has been the subject of intense academic research. For a comprehensive U.S. and EU wide analysis, see Trabandt and Uhlig (2012). Vogel (2012) uses a QUEST model variant with home production to map the Laffer curves in an economy with informal sector. Trabandt M. and H. Uhlig, 2012. ‘How Do Laffer Curves Differ across Countries?’, NBER Chapters, in: Fiscal Policy after the Financial Crisis, pages 211-249 National Bureau of Economic Research, Inc., Vogel, L. (2012) ‘Tax avoidance and fiscal limits: Laffer curves in an economy with informal sector,’ European Economy. Economic Papers 448.

Graph IV.1: **Static vs. dynamic scoring**

**Laffer curve – Tax A**



**Laffer curve – Tax B**

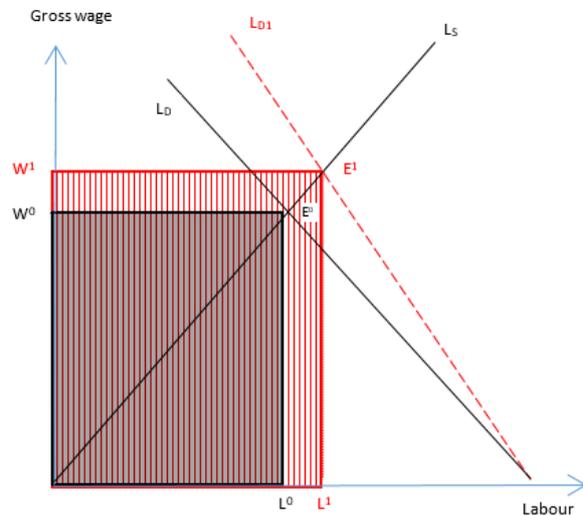


(1)  $R_0$ =pre-reform tax revenue,  $R_{-dyn}$ =tax-revenue estimate with dynamic scoring,  $R_{-stat}$ = tax-revenue estimate with static scoring

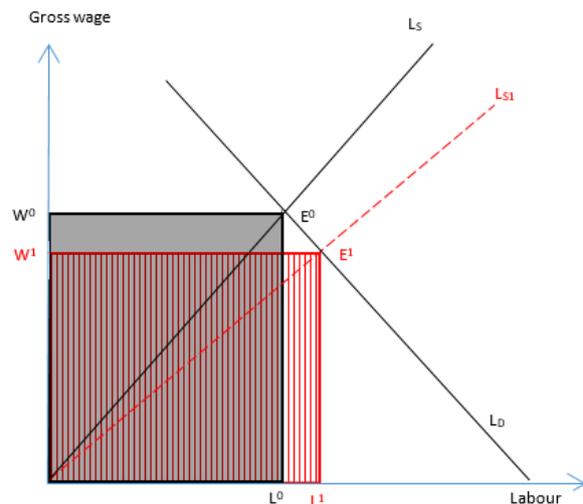
**Source:** Illustration based on Adam and Bozio (2009) Dynamic scoring, OECD Journal on Budgeting, Vol. 9(2), 107.

Graph IV.2: **Short-run feedback effect of labour tax-cuts**

**Reduction of employer-paid taxes**



**Reduction of employee-paid taxes**



(1) The rectangle of  $OL^0E^0W^0$  is the pre-reform tax-base while  $OL^1E^1W^1$  is the new tax-base after the corresponding tax-cut.  $L_D$  denotes labour demand and  $L_S$  is labour supply.

**Source:** Author's illustration.

Section IV.3 gives examples for both types of taxes (A and B-type) with different feedback effects and it also confirms the increasing gap between the static and dynamic scoring estimates over time. We will show that even two types of labour tax-reforms on employee- vs. employer-paid taxes can have different short-run feedback effects. The partial equilibrium analysis of Graph IV.2. can illustrate this point:

- When employer-paid labour taxes decrease, firms are willing to hire more labour services at all levels of the gross wage and  $L_D$  rotates up to  $L_{D1}$ . In the new equilibrium, gross wages are higher and firms are willing to hire more labour at the new wage rate. As both wages and employment increase the tax-cut unambiguously increases the tax-base (from the shaded  $OL^0E^0W^0$  rectangle to the  $OL^1E^1W^1$  rectangle with stripes). Notice, that a static scoring framework with exogenous, constant wages and employment would completely miss

this effect: this is an example of type-A tax from Graph IV.1.

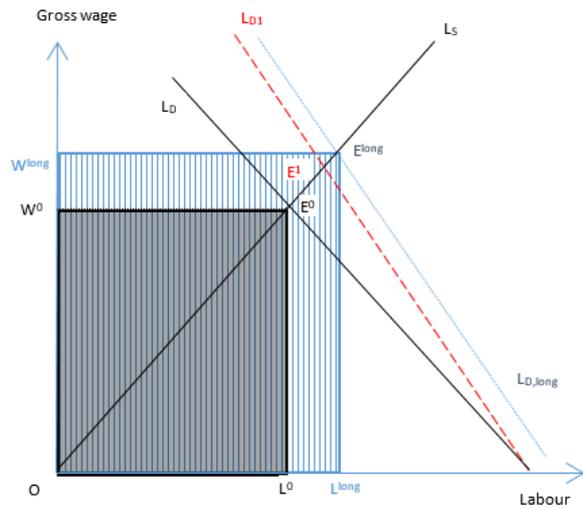
- When employee-paid labour taxes decrease, workers are willing to offer more labour services at all levels of the gross wage, and LS rotates down to the right to LS1. In this case, the tax-cut has two opposing effects on the tax-base: in the new equilibrium, gross wages are lower and firms are willing to hire more labour. The tax-base transforms from the shaded  $OL^0E^0W^0$  rectangle to the  $OL^1E^1W^1$  rectangle with stripes. Due to the two opposing effects, the tax-base may not even change significantly in the short-run. Scoring exercises with or without endogenous wage and labour response might give similar results: this is an example of type-B tax in Graph IV.1.

In the long-run, the capital stock will gradually increase to its new steady-state level, which will lead to higher labour demand (LD, long on Graph IV.3), increased wages, and larger tax-base. Consequently, along the transition path, the difference between the static and dynamic scoring revenue estimates will increase.

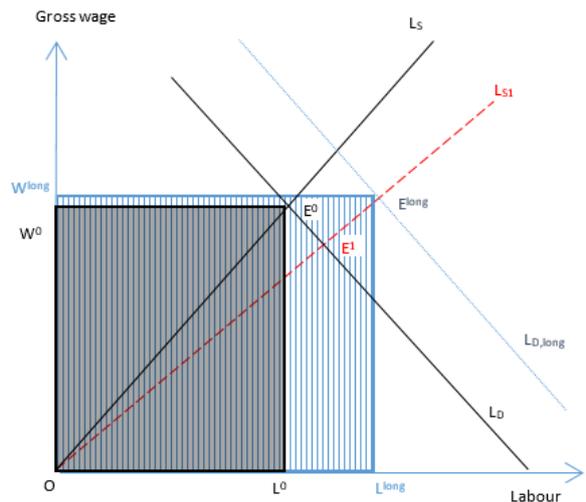
Graphs IV.2 and IV.3 can only provide a simplified, partial equilibrium insight into how labour-tax cuts affect the tax-base under the two scoring exercises. Model-based dynamic scoring exercises can capture the complex general equilibrium linkages (e.g. interaction with other fiscal revenue components), which have further impact on these estimates.

Graph IV.3: **Long-run feedback effects of labour tax-cuts**

Reduction of employer-paid taxes – long-run



Reduction of employee-paid taxes – long-run



(1) The rectangle of  $OL^0E^0W^0$  is the pre-reform tax-base while  $OL^1E^1W^1$  is the new tax-base after the corresponding tax-cut. LD denotes labour demand, LS is labour supply

**Source:** Author's illustration

---

## IV.2. Empirical estimates of the revenue feedback effects

Turning to the quantified magnitude of the feedback effects, the literature suggests that the steady state feedback effect can be surprisingly large. The seminal article of Mankiw and Weinzierl (2006) calculates the revenue feedback effect of labour and capital taxes in a standard neoclassical framework. Their model-based dynamic scoring exercise places the self-financing effect of employee-paid labour taxes between 17 percent and 38 percent. In other words, growth pays for up to 38 percent of a labour income tax cut in the steady state. The self-financing effect is even higher for the more distortionary capital taxes, between 39 percent and 74 percent, depending on the model parametrisation. Following Mankiw and Weinzierl (2006), Trabandt and Uhlig (2011) also pursue a dynamic scoring exercise in a richer neoclassical growth model.<sup>(198)</sup> The authors derive Laffer curves for the U.S., and 14 EU Member States. The paper finds that for the U.S.-calibrated model 32 percent of an employee-paid labour tax cut and 51 percent of a capital tax cut are self-financing in the steady state. In case of the EU aggregate economy, 54 percent of a labour tax cut and 79 percent of a capital tax cut are self-financing in the model. Interestingly, Trabandt and Uhlig (2011) suggests that the higher self-financing rates of several EU countries compared to the US can be explained by being closer to the revenue maximising tax-rate.

Dynamic scoring studies based on general equilibrium models can also shed light on the role of alternative financing regimes when estimating the revenue effect of tax-reforms.<sup>(199)</sup> These studies suggest that revenue losses from capital and labour income tax cuts are higher when the tax cuts are financed from decreasing productive spending or from raising more growth-distortionary taxes and lower when lump-sum taxes or transfer payment cuts are used to finance them. Openness to trade can further increase the revenue feedback effects. For example, Choi and Kim (2016) finds that the revenue feedback effect from an income

tax cut on labour or capital becomes substantially larger in a small open economy when agents can access international financial markets compared to the case of a closed economy without this possibility.<sup>(200)</sup>

Revenue scoring exercises by the Joint Committee on Taxation (JCT) in the U.S. focus on the short-to medium-run dynamic feedback effects of actual tax-reforms. The JCT relies on several models for revenue scoring. First, corporate and individual microsimulation models help to obtain the conventional, static estimate of actual tax reforms without behavioural effects.<sup>(201)</sup> In the next step, three macroeconomic models can provide estimates on the dynamic, behavioural effects of reforms – a macroeconomic growth (MEG) model, an overlapping generations (OLG) model and a dynamic stochastic general equilibrium (DSGE) model.<sup>(202)</sup> The estimated revenue feedback effects show large variation depending on the type of the tax reform and the model parametrisation. For example, in JCT (2005) the feedback effect of labour and corporate tax cuts ranges from about 3 percent to 18 percent in the first five years, and from 6 percent to 23 percent over the 10-year budget period.<sup>(203)</sup> The most recent macroeconomic analysis of the ‘Tax Cuts and Jobs Act’ estimates that the complex package of individual income tax reform would generate a substantial increase in GDP. The model-based simulations show that this output gain would finance up to 26.5 percent of the revenue loss estimated by conventional, static scoring.<sup>(204)</sup>

## IV.3. Dynamic scoring in practice

To illustrate the advantages of linking the two models, two hypothetical Belgian tax-reforms are simulated: an approximately eight percent cut in labour tax-rates paid by employees and employers

---

<sup>(198)</sup> Trabandt, M. and H. Uhlig (2011), ‘The Laffer curve revisited.’ *Journal of Monetary Economics*, Vol. 58, pp. 305-327.

<sup>(199)</sup> See Leeper, E. and S-Ch. S., Young (2008), ‘Dynamic scoring: Alternative financing schemes’, *Journal of Public Economics*, Vol. 92, pp. 159-182. and Ergete, F. (2008), ‘Dynamic Scoring in the Ramsey Growth Model,’ *The B.E. Journal of Economic Analysis & Policy*, Vol. 8(1), pp. 1-27.

<sup>(200)</sup> Choi, Y., and S. Kim (2016), ‘Dynamic scoring of tax reforms in a small open economy model’, *Economic Modelling*, Vol. 58. pp. 182-193.

<sup>(201)</sup> See JCT (2015), ‘Estimating Changes in the Federal Individual Income Tax: Description of The Individual Tax Model,’ <https://www.jct.gov/publications.html?func=startdown&id=4776>.

<sup>(202)</sup> Butz, A. (2017), ‘The Role of Revenue Estimating and Dynamic Scoring in the Tax Reform Debate.’ Daily Tax Report, 146 DTR J-1, 8/1/17. The Bureau of National Affairs

<sup>(203)</sup> JCT (2005), ‘Macroeconomic Analysis of Various Proposals to Provide \$500 Billion In Tax Relief,’ JCX-4-05.

<sup>(204)</sup> JCT (2017), Macroeconomic Analysis of the Conference Agreement for HR. 1. The “Tax Cuts and Jobs Act.” JCX-69-17. <https://www.jct.gov/publications.html?func=startdown&id=5055>

respectively. In the first step, the QUEST model is calibrated to mirror EUROMOD and EU-SILC in terms of labour supply and labour taxation statistics at the aggregate, macro-level. <sup>(205)</sup> This step makes sure that both models start from the same baseline. Being a macro model, the QUEST model cannot integrate all the underlying micro level data of EUROMOD. In order to bring the granularity of the labour force in the QUEST model closer to EUROMOD, the labour force is disaggregated into three-skill groups: low-, medium-, and high-skilled based on the standard ISCED classification. <sup>(206)</sup> Participation, employment and unemployment rates, wages and labour supply elasticities in the QUEST model are calibrated to match the EUROMOD counterparts for the three skill groups. At this stage, labour supply elasticities by skill-groups are estimated with the help of a satellite labour supply discrete choice model. <sup>(207)</sup> These estimates serve to calibrate the skill-specific Frisch elasticity of labour supply in the QUEST model.

After aligning the labour supply and labour taxation parameters between the two models, the tax shocks are introduced into the EUROMOD microsimulation model in order to calculate the corresponding ‘overnight’ change in the effective labour tax rates (note, that these changes do not include any behavioural responses from the side of employees or employers). The aggregated changes in the effective labour taxes by skill-groups serve as the relevant policy shocks for the QUEST model simulations. In order to account for the ‘clean’ macroeconomic feedback effects of the shock on tax revenues, the debt-stabilisation rule remains idle for the first 15 years. By doing so, one can account for the direct budgetary effect of the shocks in the short- to medium-run. <sup>(208)</sup>

<sup>(205)</sup> Barrios et al. (2017) used the “G3.0+” version of EUROMOD together with the latest available datasets in EU-SILC. For the simulation of the tax reforms, they chose the 2013 tax-benefit rules as the baseline.

<sup>(206)</sup> The share of population with up to lower secondary education (ISCED 0-2) are low-skilled, with up to upper secondary, non-tertiary education (ISCED 3-4) are medium skilled and the rest of the population is considered high-skilled.

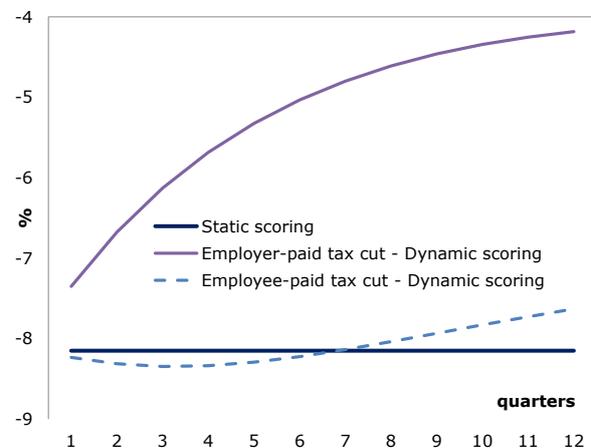
<sup>(207)</sup> A labour supply discrete choice model was set up to estimate the skill-specific labour supply elasticities following the standard methodology in Bargain et al. (2014). Bargain, O., Orsini, K., and A. Peichl, (2014), ‘Comparing labor supply elasticities in Europe and the United States, new results’ *Journal of Human Resources*, Vol. 49(3), pp. 723-838. For more details, see the Appendix B of Barrios et al. (2017).

<sup>(208)</sup> In the long-run, personal income taxes ensure budgetary neutrality. As previous research shows (e.g. Leeper and Young

Graph IV.4 compares the percent change in total labour tax revenues from the static estimates and the dynamic scoring revenue estimates simulated by the QUEST model. We can make the following observations from these results:

- Without wage and employment feedbacks, a static scoring exercise would give the same percent decline in revenues for both cases (solid dark blue line) because the tax rates fall by the same magnitude while the tax-base does not change.
- In line with Graph IV.2, cutting employee-paid taxes has two opposing effects on the tax base: employment increases and wages decline. As the tax base may not change at all, the static and dynamic scoring estimates could be very close to each other, especially in the short run. Notice, however, that the gap between the two scoring estimates starts increasing overtime. This result is also in line with Mankiw and Weinzierl (2006).

Graph IV.4: **Static and dynamic revenue estimates of labour tax cuts**



(1) Percent deviations from baseline. QUEST simulations.

Source: Barrios et al. (2017)

- As explained in the previous section, cutting employer-paid taxes will give much larger difference between the dynamic and static scoring results. The behavioural responses increase the tax-base with higher wages and

(2008), there are various alternative ways to tackle the government deficit generated by the reforms. The different financing may have very different second-round effects on the tax-revenues. Choi and Kim (2016) show examples when the tax-cut can be completely self-financing.

employment (see Graph IV.2) and the tax-cut becomes partly self-financing. The transition dynamics is again in line with Mankiw and Wenzierl (2006), as the revenue feedback effect is gradually increasing. After three years, the dynamic scoring estimate is almost half of the static scoring results.

Graph IV.4 only shows the difference between static and dynamic scoring with respect to labour tax revenues. Self-financing effects reported in the literature typically correspond to total tax revenues, not only to the labour tax burden. The panels in Table IV.1 also show how the main tax revenue components change under dynamic scoring compared to static scoring after five years. The table also reports the revenue feedback or self-financing effect. The feedback effect is the percentage difference of the revenue effect produced by the macroeconomic model relative to the static revenue estimate. This index allows us to quantify the extent to which the reforms are self-financing through economic growth.

**Table IV.1: Revenue scores and self-financing**

	Static scoring	Dynamic scoring	Self-financing rate
<b>Employer tax cut:</b>			
effect on tax revenues			
- labour tax	-8.2	-4.1	50.2
- consumption tax	0.0	0.9	n/a
- corporate tax	7.5	0.8	n/a
- total tax-revenues	-2.5	-1.7	32.1
<b>Employee tax cut:</b>			
effect on tax revenues			
- labour tax	-8.2	-7.1	13.3
- consumption tax	0.0	1.9	n/a
- corporate tax	0.0	1.8	n/a
- total tax-revenues	-3.7	-2.8	25.2

(1) Static and dynamic scoring revenue effects are in percent deviations from baseline. n/a - not applicable.

**Source:** QUEST simulations.

Focusing on the first column of the table, we can see that under static scoring, labour tax revenue decreases in both reform scenarios, while consumption tax revenue stays unchanged. Notice that corporate tax revenues remain unaffected when cutting employee-paid taxes but they significantly increase when employer paid taxes are cut due to the widening of the tax base (income from sales, less employee compensation).

The second column shows that under dynamic scoring all three tax revenue components change. Since employment, wages, consumption and

output all react to the tax reform, static scoring can under or overestimate the expected tax revenues.

As shown on Graph IV.4, static scoring overestimates the direct revenue loss from labour tax revenues. Additional revenues from consumption taxes also stay undetected in static scoring because the method does not account for the increase in household disposable income. As households benefit more from the direct tax-cut on their wages, the feedback effect on tax revenues from increased consumption is higher for an employee-paid than for an employer-paid tax reduction (1.9 vs. 0.9 percent). Finally, static scoring predicts significantly larger corporate tax revenues from lowering employer-paid taxes compared to the dynamic scoring counterpart (7.5 percent vs. 0.8 percent). That is because in this case, the static approach only accounts for the declining tax rate without the growth in gross wages and employment. (See Graphs IV.2 and IV.3). The dynamic feedback effects reduce the fall in employee compensation, therefore, the increase in profits and corporate tax revenues becomes smaller. Furthermore, static scoring also misses the expansion of domestic demand from easing the burden of taxation on employees, which leads to an increase in firms' output and turnover. The dynamic scoring results show that around 1.8 percent rise in corporate tax revenue remains undetected in the static scoring exercise in this case.

The aggregate revenue effects from all tax components are in the range of estimates in the literature. In the case of an employer (employee) tax reduction, the total tax revenue under dynamic scoring decreases by 1.7 (2.8) percent from the baseline, compared to 2.5 (3.7) percent under static scoring. This suggests that static scoring overestimates the revenue loss from a tax cut by a significant amount: the self-financing rate is about 32 and 25 percent respectively.

It is important to stress that these results do not violate the Invariance of Incidence Proposition (IIP) in the QUEST model: a shift of taxation from employers to employees, which leaves overall labour tax revenues constant, or only changes the composition of the tax-wedge but not its size, would not affect employment and GDP in the long-run (see Box IV.1 at the end of the section).

#### IV.4. Distributional impacts of tax reforms

In addition to providing a dynamic scoring estimate of labour tax-reforms, one can also use the EUROMOD-QUEST link to explore the distributional effects of the reform scenarios.

Feeding the macrosimulation results back into the microsimulation model in order to analyse the distributional impact of policies is not a common practice in the dynamic scoring literature. Although researchers have been linking microsimulation and large-scale macroeconomic models to examine the distributional effect of policy shocks, the applied macroeconomic models were static computable general equilibrium models without proper dynamics, and therefore, inappropriate to analyse the short- to medium-run effect of policies (see Verikios and Zhang 2015, Clauss and Schubert, 2009, Labandeira et al. 2009).<sup>(209)</sup> Fully forward looking general equilibrium models, like the QUEST model, are better suited to provide the dynamic macroeconomic effects as inputs into microsimulation models for distributional analysis.

In order to assess the effect of the labour tax reforms on the disposable income of households by income deciles, the QUEST simulated macroeconomic trajectories for employment, gross real wages and the consumer price index can be fed into EUROMOD. In practice, this step first requires an increase in the weighting of employed persons in EUROMOD according to the simulation results. At the same time, the weighting of unemployed persons decreases in order to keep the total population constant for each skill groups.<sup>(210)</sup> Second, the macroeconomic feedback effects on the consumer price index and the skill-specific gross wages feed into EUROMOD by adjusting the corresponding uprating factors. Finally, the microsimulation model is used to

quantify the distributional effects of the two reforms by income deciles.<sup>(211)</sup>

One can also compare the scenarios obtained from linking the two models with the static counterparts, i.e. without accounting for the macroeconomic feedback effects. This comparison allows for the benefits of this approach for distributional analysis to be sustained.<sup>(212)</sup>

The result of this exercise (see Graphs IV.5 and IV.6 below) mirrors the previous analysis on the static and dynamic scoring profiles of Graph IV.4. Reducing the labour tax burden on employers has no direct first-order distributive effects when using EUROMOD alone because employers are not part of the microsimulation model. Without modelling the impact of employer-paid taxes on firms, EUROMOD alone cannot account for the feedback effect of this reform on household income. The reform of employer-paid taxes raises household disposable income only when behavioural responses are included. When the feedback effects obtained from the QUEST model simulations are channelled into EUROMOD, one can see that household disposable income rises across most deciles, with the exception of the first decile (Graph IV.5). The rise in disposable income is due to increased labour demand which leads to higher wages and employment (see Graph IV.2). This effect is regressive: top deciles benefit more from the reform while the first decile faces a loss in disposable income because of lower benefit payments following the wage and employment increase.

On the other hand, reducing the labour tax burden on employees has a similar effect on the total disposable income of households either with or without interacting the two models, QUEST and EUROMOD (Graph IV.6). As discussed earlier, the opposing move in wages and employment can leave the tax base almost unaffected in the short-

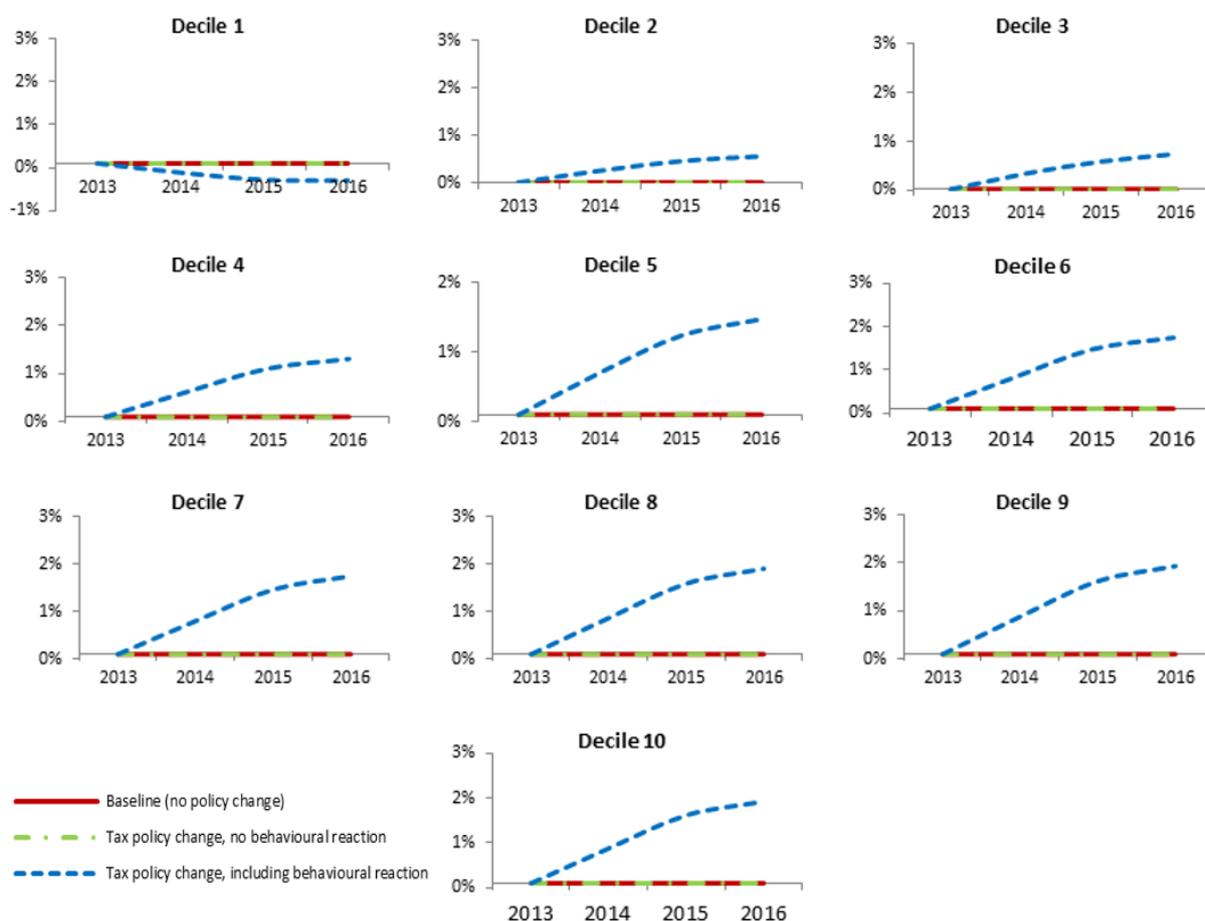
<sup>(209)</sup> Verikios, G. and X-G, Zhang (2015), 'Reform of Australian urban transport: A CGE-microsimulation analysis of the effects on income distribution,' *Economic Modelling*, Vol. 44(C), pp. 7-17. Clauss, M. and S. Schubert (2009), 'The ZEW combined microsimulation-CGE model: innovative tool for applied policy analysis,' ZEW Discussion Papers 09-062. Labandeira, X., J. M. Labeaga, and M. Rodríguez, 2009. 'An integrated economic and distributional analysis of energy policies,' *Energy Policy*, Vol. 37(12), pp. 5776-5786. For a review, see Feltenstein A., L. Lopes, J. Porras-Mendoza and S. Wallace (2014), 'Modeling tax reform in developing countries,' in: *Taxation and Development: The Weakest Link?*, Chapter 3, pp 69-102. Edward Elgar Publishing.

<sup>(210)</sup> This means that in EUROMOD the authors implement the employment effects from QUEST simulations at the extensive margin.

<sup>(211)</sup> Note, that QUEST also provides impulse responses on other components of the functional income distribution, e.g. income from profits, financial assets. These effects are not implemented yet in Barrios et al. (2017).

<sup>(212)</sup> The analysis focuses on the short-run effects of the reform and temporarily deactivates the debt-stabilisation rule. The long run, 'steady state' distributional effect of the tax-reform depends on which budgetary item will compensate for the missing tax revenues. The QUEST model offers a wide range of fiscal closure rules, which could be based on revenue or spending items in the government's budget constraint. Exploring the long-run implications of these various alternative fiscal closure rules goes beyond the scope of the analysis.

Graph IV.5: **Impact of employer-paid tax reform on disposable income by income decile**



(1) percent deviation from baseline

Source: Barrios et al. 2017

run (see Graph IV.2), therefore, the static and dynamic scoring estimates remain very close.

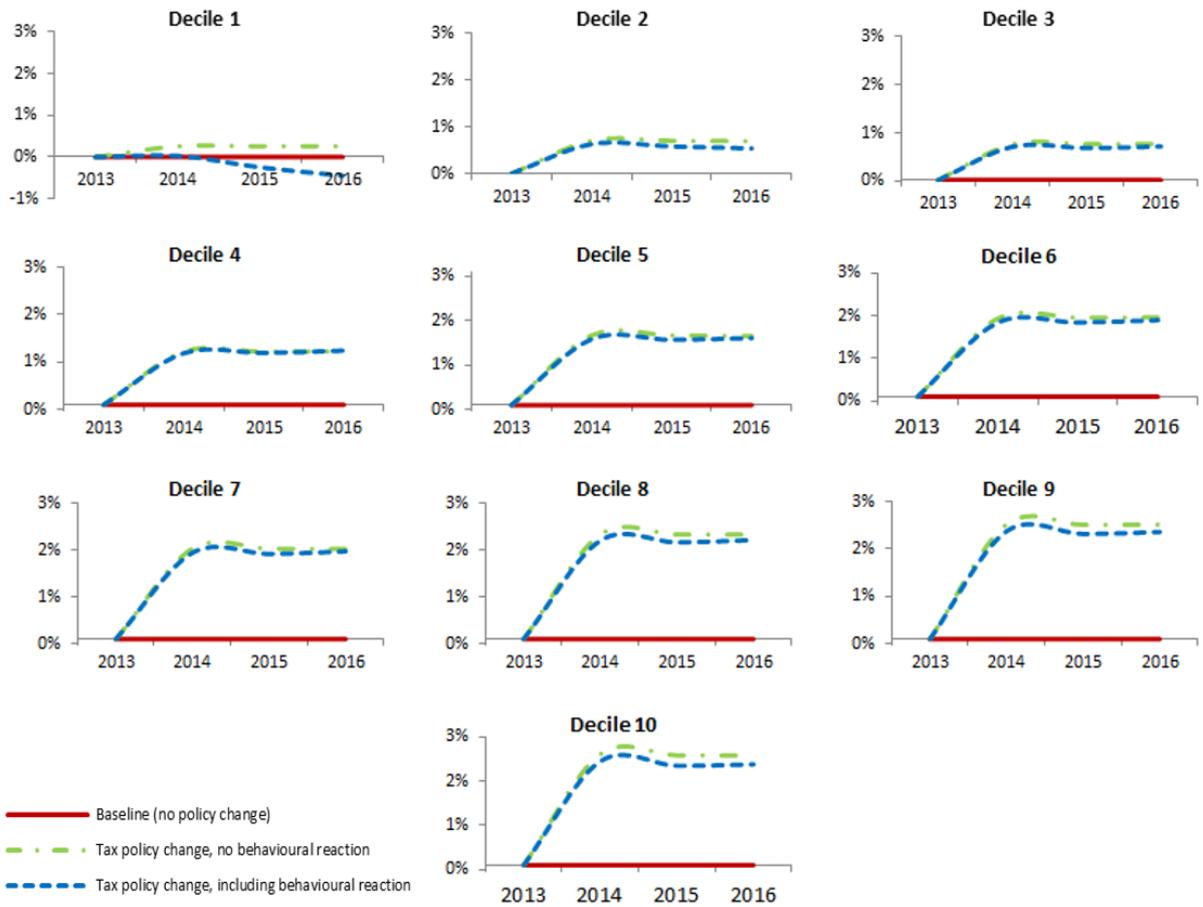
This highlights that second-round dynamic effects can also be crucial for assessing the impact of tax reforms on income inequality. Ignoring these dynamic effects could lead to wrong conclusions on the distributional impacts of tax reforms.

#### IV.5. Conclusion

The purpose of this section is to demonstrate that behavioural responses and macroeconomic feedback effects are essential for a comprehensive evaluation of tax reforms. The dynamic scoring exercise of Barrios et al. (2017) accounts for the macroeconomic effects of actual tax reforms when estimating their budgetary effects. Their approach combines the first-order fiscal and distributional effects of tax reforms using the EUROMOD microsimulation model and the second-round general equilibrium effects derived from the

QUEST macroeconomic model. The authors find that the direct self-financing effect of reducing employer-paid taxes is roughly 50 percent while the aggregate self-financing effect on total tax revenues is around 32 percent in the case of Belgium. The self-financing effect is smaller, around 13 and 25 percent, in case of a similar reduction in employee-paid taxes. Standard microsimulation methods focus only on the household-side and do not take into account the macroeconomic interaction with the rest of the economy. Accounting for the general equilibrium feedbacks from the rest of the economy, particularly from firms, fiscal and monetary authorities gives a more complete and comprehensive budgetary and income distribution estimate.

Graph IV.6: **Impact of employee-paid tax reform on disposable income by income decile**



(1) percent deviation from baseline

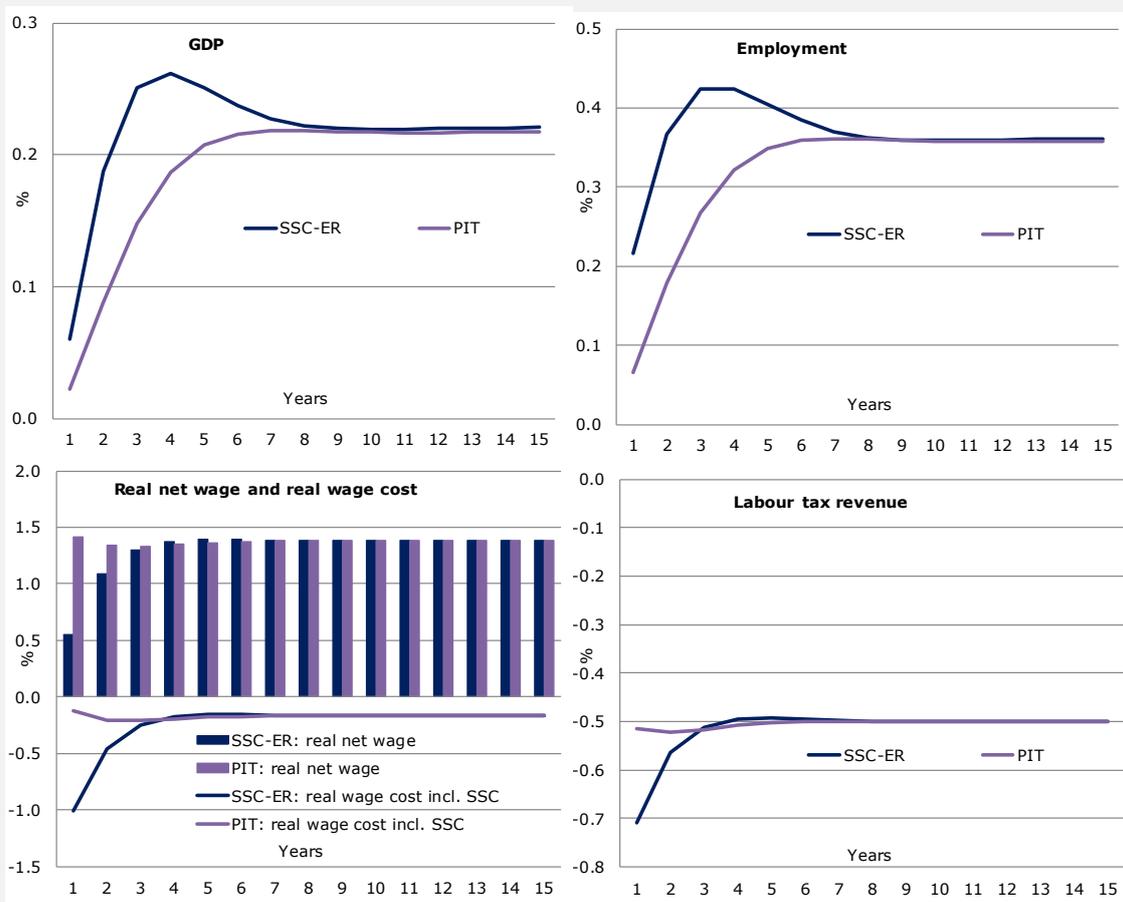
Source: Barrios et al. (2017)

### Box IV.1: Invariance of Incidence Proposition

The Invariance of Incidence Proposition (IIP) holds in the QUEST model over the medium to long-run: a shift of taxation from employers to employees, which leaves overall labour tax revenues constant, or only changes the composition of the tax-wedge but not its size, does not affect employment and GDP (see Stiglitz, 1988, OECD, 1990 and Goerke, 2002). <sup>(1)</sup> This can be illustrated by the following two simulation scenarios which show the decrease of employee paid personal income tax (PIT) and employer paid social security contributions (SSC-ER) in the order of 0.5 percent of GDP. Graph B IV.1 presents the corresponding impulse responses on GDP, employment, real wages and labour tax revenues.

Graph B IV.1: Invariance of Incidence Proposition

#### Employer vs. employee paid labour tax cuts



Note: percent deviation from baseline. The simulations show the effect of a permanent decrease in PIT and SSC respectively in a model calibrated for Belgium. In the long-run, lump-sum taxes are used to balance the government budget.

Source: QUEST simulations.

<sup>(1)</sup> Stiglitz, J. E. (1988), *Economics of the Public Sector*, 2nd ed., New York and London: W. W. Norton. Goerke, L. (2002) *Taxes and Unemployment. Collective Bargaining and Efficiency Wage Models*. Springer. OECD (1990). *Employer versus employee taxation: the impact on employment*, in OECD *Employment Outlook 1990* (pp. 153–177).

*(Continued on the next page)*

*Box (continued)*

The equivalence of labour taxes paid by employers and employees implies that our output and employment effects converge to the same percent deviations w.r.t. the baseline in the medium to long-run. Note that on the short-run, the differences between the scenarios are due to the nominal and real wage rigidities. After five years, real wage costs (including social security contributions) and net real wages converge to the same level effects, independently of whether the employers or employees' tax burden decreased. Ten years after the shock GDP and employment is up by around 0.2 percent and 0.35 percent respectively in both scenarios.