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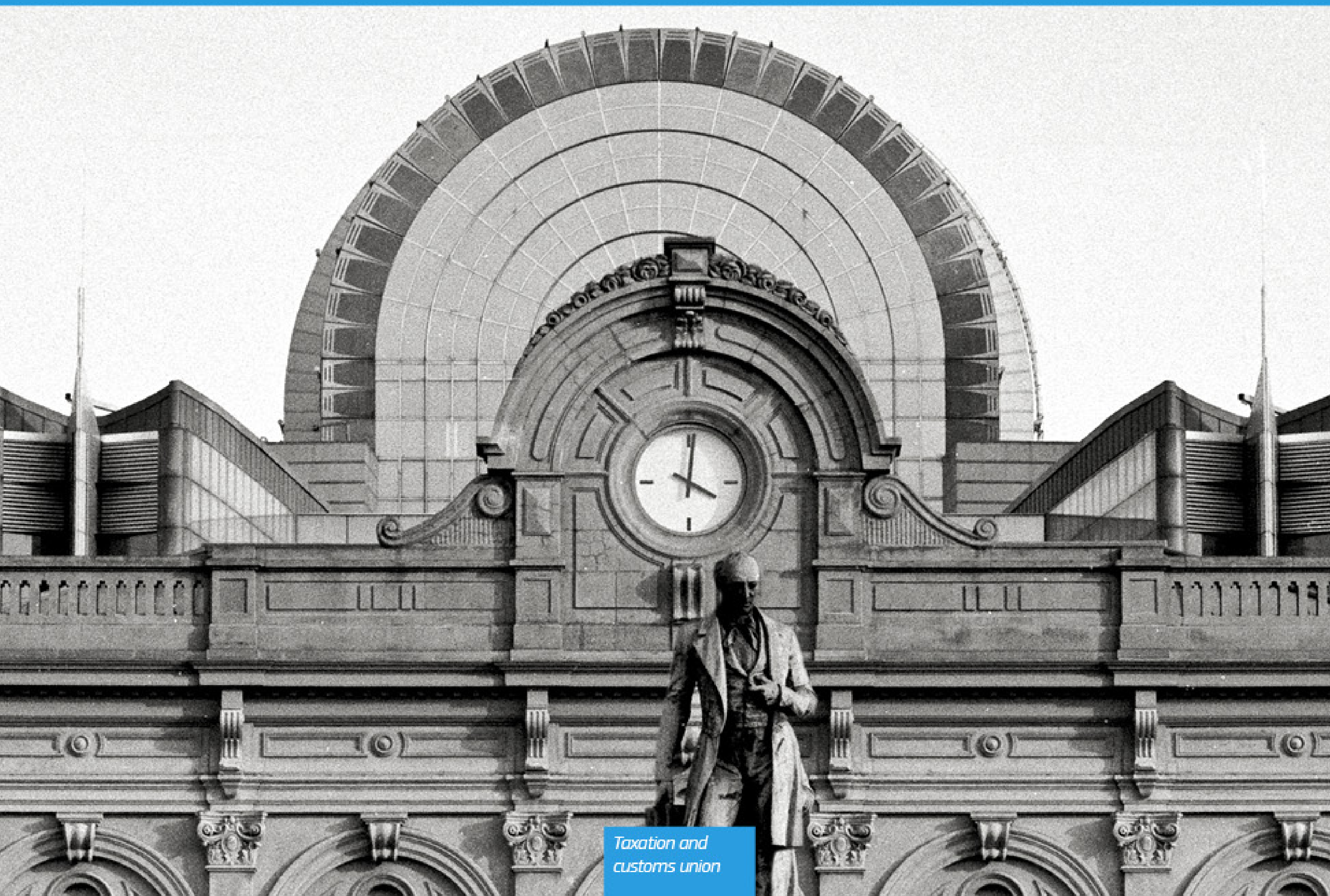

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The marginal cost of public funds in the EU: the case of labour versus green taxes*

Salvador Barrios, Jonathan Pycroft and Bert Saveyn

Abstract

One key objective of tax-based fiscal consolidations which is too often disregarded in public debate is to minimise economic distortions. This paper uses a computable general equilibrium model to gauge these potential distortions by calculating the marginal cost of public funds (MCF) for EU member states. We consider two specific tax categories which are often proposed as good candidates for efficiency-enhancing tax shifting policies: labour and green taxes. Our analysis suggests that the economic distortions provoked by labour taxes are significantly larger than for green taxes. This result suggests that a green-taxes oriented fiscal consolidation would be preferred to a labour-tax oriented one (assuming that both tax increases would yield the same tax revenues). This holds for all EU member states modelled and despite the fact that potential welfare enhancement through pollution abatement are cancelled-out. Nevertheless, this result is slightly less strong when one considers the spillover effects between countries, which are more pronounced (in relative terms) for green taxes. This suggests that the use of green taxes for fiscal consolidation would be more effective were there to be close coordination across EU countries. In addition the efficiency losses associated with labour taxes are also likely to be greater when labour markets are less flexible (from an efficiency-wage perspective), a result also found to a small extent for green taxes. This raises the possibility that undertaking structural reforms (especially in the labour market) would help to minimize the efficiency losses entailed by tax-driven fiscal consolidations.

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Introduction

The need to restore sound fiscal balance represents a key objective of EU economic policy making in the aftermath of the financial crisis. Whenever tax increases are contemplated, the challenge for policy makers is to strike a balance between short-term recovery and long-term growth, the latter requiring supply and economic efficiency-enhancing policy measures. The need to lower the efficiency loss of tax increases is also aimed at optimising the level of extra-tax revenues obtained from it given that inappropriate tax hikes could lead to lower than expected tax revenue and would eventually require successive tax increases in order to meet fiscal policy objectives. To date, much of the policy debate has been informed by (neo) Keynesian types of models assessing the size of fiscal multipliers and potential effects of fiscal consolidation in a context of zero-bound monetary policy and impaired financial sector, see in particular Corsetti et al. (2010), IMF (2012) and Coenen et al. (2012) for recent, model-based discussions. Some additional guidance on these important issues, albeit too often disregarded in the policy debate, could be drawn from the optimal tax policy literature analysis of the potential distortionary effect of tax increases, see in particular Feldstein (1997). Accordingly, the objective for policy makers should be to minimise the distortionary effect of taxation and related adverse effects on the economic recovery since existing evidence suggests that the least distortionary a tax system is, the less detrimental its impact on growth, see in particular Arnold et al. (2011). The efficiency loss associated with tax increases crucially depends on the behavioural responses of economic agents which affect the tax bases and the supply side of the economy. An appropriate metric to gauge the losses related to (and potential growth-detrimental effect of) tax increases should compare the relationship between the deadweight loss and the extra-revenue associated with a given tax increase.

In this paper we calculate more specifically the marginal cost of public funds (MCF) which proves especially useful for this purpose. This indicator is widely used in the public economics literature for the evaluation of tax reforms and public spending program requiring the transfer of resources from the private to the public sector, see in particular Dahlby (2008). Based on this measure, existing evidence suggests that the efficiency loss of tax increases vary widely across tax categories and countries and increases with the level of taxation burden in the economy, see in particular Devarajan and Robinson (2002) and Dahlby and Ferede (2011). The MCF metric is used here to gauge the cost of tax increases in the EU. To do so we make use of the computable general equilibrium model GEM-E3. One important feature of this model version is that it is calibrated using social accounting matrices derived from national account data of EuroStat. The resulting tax rates used in the simulations therefore reflect actual effective tax rates. Our analysis is carried out for all of the 24 EU member states that are specified in the model (all except for Croatia, Cyprus, Malta and Luxembourg).

We consider two specific tax categories: labour and energy taxes. Our choice of tax categories is motivated by a number of questions of special relevance in the EU context. First, we chose labour taxation because of its relatively high level in most EU countries and because it is well known to have wide-ranging effects spilling well beyond fiscal outcomes. More than any other tax category, labour taxation are directly embedded into country-specific economic and social institutions thus reflecting underlying economic structures, see Blundell and MaCurdy (1999). Second, green taxation links this analysis with the 'double dividend' literature as it is often advocated for as potential instrument for shifting the tax systems in the current EU context in order to make taxation both more employment- and environment-friendly, see Saveyn et al. (2011). Because green taxes enter the indirect tax category and is in most EU countries relatively low, resorting to it is also likely to have lower detrimental effects on economic efficiency although it may have non-negligible effects onto the low-income households.[1] Green taxation may also have direct effect on energy efficiency by changing the cost of consuming energy products and thus help minimize the corresponding efficiency losses to be expected from an increase in tax rates. Third we also chose these two tax categories because they could prove instrumental to implement EU-wide coordinated tax reforms despite the fact that they are generally not invoked as candidates for coordination across EU counties according to the optimal tax theory literature. According to this literature and the so-called destination/residence principles, the coordination of direct tax measure should concern primarily (cross-country) mobile production factors while indirect taxation should be collected at the country of destination (see Andersen and Sorensen, 2012, for a review). In practice in the EU however, the high

[1] See Speck (1999) for a discussion. In this paper we do not deal with inequality issues.

degree of openness and economic integration together with the high starting level of public expenditure and tax burden suggest that individual country tax policies might have non-negligible impact on EU partners, potentially influencing the outcome of fiscal consolidation strategies.

Our results show that the efficiency losses related to tax increases (as measured by the MCF) are significantly larger for the labour tax than for green taxes, the latter being represented by households´ consumption taxes on energy products. However, the degree of cross-EU countries spillovers is also higher for green taxes despite their usually low level, thus calling for coordinated tax policies in this domain as well. Furthermore, we show that these economic costs are also likely to be reduced with a higher degree of flexibility of the labour market, especially so in the case of labour taxes but also, although to a lower extent, for energy taxes. More generally, our results tend to suggest that tax categories with a high burden over the total GDP, such as labour taxes, tend to be more distortionary than low-burden tax categories lending support to the Laffer type hypothesis. As a result, EU countries might find it appropriate to shift their taxation systems away from high burden/highly distortionary tax categories in order to favour the growth recovery without which consolidation strategies might prove difficult to sustain in the long-run. Our results prove robust to a number of robustness checks using alternative hypotheses regarding the nature of the extra-tax revenue recycling derived from a given tax hike, the degree of cross-country interdependence in import vs. domestic production substitution and the size of labour supply elasticities.

The rest of the paper is organised as follows. In section 1 we briefly review the existing literature on the marginal cost of public funds and present our modelling strategy. Our main results are presented in Section 2, while Section 3 provides robustness tests to check the sensitivity of our results to the main hypotheses of the model. Section 4 concludes.

1. Measuring the marginal cost of tax increases

1.1 Literature review

The existing literature provides a wide range of estimated MCF values, differentiated according to the methodology used, the tax categories and the country or region considered. A direct comparison of results across studies is rather complicated since definitions, the underlying theoretical framework and measurements are usually very different from one study to the other. Nevertheless, in order to give an impression of the magnitudes of previous MCF estimates we provide a succinct overview of possible estimates obtained using alternative methodologies.

The MCF metric is relatively straightforward: it simply indicates how many euros (or dollar) are lost in the economy to collect one extra euro (or dollar) tax revenues. As a result MCF usually value greater than one, e.g. MCF = 1 + α , with α measuring the efficiency loss. On the methodological side, there are various ways of measuring the MCF. In this discussion we focus on the three main approaches to estimate the MCF: econometric estimations, CGE modelling or through microsimulation.[2] Each of these methodological approaches has pros and cons. The main advantage of CGE models is to consider all potential interactions in the economy (including interactions between industrial sectors, consumers, government and the rest of the world) that determine the final welfare and tax revenue impacts of a given tax change. The drawback of this approach is that it relies on assumptions regarding the functional forms and/or elasticities of the different tax bases to the tax rate changes, however, although one must note that this limitation is not specific to the analysis of tax policy changes, however. The estimates provided by Ballard et al. (1985) concerning the US suggested that the MCF for all taxes ranged between 1.17 and 1.56 depending on the saving and labour supply elasticity used.[3] Hansson and Stuart (1985) found a MCF between 0.67 and 4.51 for the Swedish economy although suggested that varying assumptions regarding labour supply elasticity could have substantial implication in these estimates. In a more recent paper Dixon et al. (2012) estimate the MCF for recent tax increases measures taken

[2] Another strand of models concern partial equilibrium/stylised models which are also best suited to tackle specific issues in analysing the marginal cost of public funds, see Devarajan and Robinson (2002) for a review.
[3] Although formally Ballard et al. (1985) focused on the Marginal Excess Burden, the MCF can be proxied from these calculations by simply adding 1 to the estimated MEB, see Devarajan and Robinson (2002). One should note however that with such simplification it is assumed that the income elasticity for the taxed product is zero, see Dahlby (2008, ch.2).

by the Finnish government in the aftermath of the global financial crisis and estimate this cost to rise up to 1.5 in the long-run. In a recent paper Auriol and Warlters (2012) compute the MCF for African countries using a CGE models with taxes on five tax bases: domestic output, exports, imports, capital and labour in the formal sector. These authors show that taxes on domestic output generally have the lowest MCF (around 1.1) and taxes on capital in the formal sector had the highest MCFs (around 1.60).

Econometric estimations allow considering a wide range of countries and/or tax categories as the only limitation is on the data side. An important restriction however comes from the availability of reliable data on the effective tax bases to calculate their potential variation following a tax rate hike. A wide range of studies exist where estimates of the MCF can be derived from the tax base elasticities to tax rate changes thereby capturing the behavioural response of the tax base. For instance in a recent paper Dahlby and Ferede (2012) calculate the MCF for Canadian provinces using information derived from official data used for the tax base equalisation system in place in this country. Their estimates of the MCF of Canadian provinces concerned three tax categories: the corporate income tax, the personal income tax and the sales tax. These authors find a wide range of estimates for the MCF across provinces and potentially important interactions across tax categories ranging from a maximum of 30.6 in the case of corporate taxes to the a minimum of 1 for sales taxes. Dahlby and Ferede also find that the MCF is greatly reduced at the federal level and by considering the impact of the vertical equalisation grants between the federation and the provinces, a result in line with previous findings by Smart (2007).

Microsimulation models in turn have also been used to quantify the marginal cost of public funds to tackle the potential effects of tax reforms by strand of the population, allowing thereby a finer analysis of behavioural effect of tax changes. In particular Kleven and Kreiner (2006) showed that the estimated effects of tax hikes differed sensibly once the labour participation effects is isolated from the number of hours worked (where the extensive and intensive margin of labour supply are distinguished). This approach aims to reflect the fact that labour participation can display very large elasticities while hours-of-work elasticities can be close to zero. Kleven and Kreiner found indeed that once the participation effect was considered into the analysis (and thus once the heterogeneity in labour supply response across different categories of workers was allowed for), then the estimated marginal cost of public funds tended to rise sharply. Applying their analysis for five EU countries namely Denmark, France, Germany, Italy and the UK, Kleven and Kreiner (2006) found that the MCF in certain cases can be more than three times higher due to higher initial distortions of the tax system and higher sensitivity of the MCF to the inclusion of the extensive margin effect of labour participation.

1.2 Modelling approach

In this paper we use a CGE model to quantify the welfare losses related to tax increases in the EU. As noted earlier, such an approach offers the advantage of considering altogether the different interactions in the economy, including the interactions between countries, which is particularly relevant in the EU context given the high level of integration of the EU Member States. The EU-version of the GEM-E3 model (General Equilibrium Model for Energy-Economy-Environment interactions) is a computable general equilibrium (CGE) model, which explicitly models 24 EU member states and the rest of the world. The GEM-E3 models the interactions between the economy, the energy system and the environment at country and EU level. It covers all production sectors (aggregated to 18) and institutional agents of the economy. The model computes the equilibrium prices of goods, services, labour and capital that simultaneously clear all markets under the Walras law. It formulates separately the supply or demand behaviour of the economic agents which are considered to optimise individually their objective while market derived prices guarantee global equilibrium. Further details of the model are given in the GEM-E3 Manual (European Commission, 2012). [4]

As discussed earlier the use of a CGE model to calculate the MCF represents only one possible way of quantifying the welfare effect of tax increase. Such a CGE approach allows us to provide rather comprehensive approach across countries and tax categories with potentially important policy implications. Three main features of our model are especially illustrative in this respect. First, the calibration of the GEM-E3 model is based on social accounting matrices (SAMs) for 2005. As a result, the tax rates are calibrated as an effective rate, i.e. the ratio between the tax revenues and the corresponding tax base for each tax

[4] For more information see also www.GEM-E3.net.

category as reported in the SAMs, which provides a fairly reliable picture of the economy and the tax. The SAMs are calibrated to a base year data (2005) for each EU country built by combining input-output tables (as published by EUROSTAT) with national accounts data. Bilateral trade flows are also calibrated for each sector, taking into account trade margins and transport costs. Total demand (final and intermediate) in each country is optimally allocated between domestic and imported goods, which are assumed to be imperfect substitutes (the “Armington” assumption). Production is modelled through CES KLEM (capital, labour, energy and materials) production. Second, the GEM-E3 model offers a great level of detail regarding tax systems as it distinguishes between nine categories of government receipts, namely indirect taxes, environmental taxes, direct taxes, value added taxes, production subsidies, social security contributions, import duties, foreign transfers and government firms. These receipts are coming from product sales (i.e. from branches) and from sectors (i.e. agents) as described in the SAM. Unemployment benefits are part of the transfer from the government to the household sector which is a single aggregate in the SAM. We thus use observed unemployment benefit transfers to the household sector for the year 2005 which also include all other transfers related to the unemployment status (e.g. child benefit) as reported by the OECD in 2005. The latter is particular relevant to take into account the potential income loss from becoming unemployed. Third, the GEM-E3 model comprises all sectors of the economy broken down into 18 sectors while private consumption is divided among 13 durable and non-durable goods. Such level of detail allows for a consistent evaluation of the effects of tax policy changes for the different sectors of activity and economic agents. The Figure 1 sketches out the main elements of these country-specific SAMs.

Though this particular CGE model does have considerable detail of taxation, one should note that the ability to fully represent the complexities of tax systems is limited. For instance, labour taxation is modelled to the representative unit of labour, which cannot incorporate the details of the (progressive) labour tax policies found in member states. Furthermore we do not aim to capture potential dynamic effects of tax changes. It is important to note also that the version of the GEM-E3 model used here includes labour market imperfections including involuntary unemployment. Due to these imperfections, employees enjoy a wage premium on the top of the wage rate that would result from non-distorted labour markets.

We follow the approach of Shapiro and Stiglitz (1987) suggesting a positive correlation between wages and labour productivity (see also Blanchflower and Oswald, 1994, for empirical evidence).

The introduction of labour market imperfections has two important implications when it comes to estimating the MCF and comparing the results of labour taxes versus other tax categories. First the degree of labour market "imperfection", i.e., the gap between the efficiency wage and the wage that would result from a perfect labour market where potential supply matches labour demand is likely to influence the MCF. A large wage premium should result in a greater distortive effect of labour taxation in particular. Labour market imperfections could also magnify trade-related tax spillovers effects to the extent that wages are set in some countries by partly taking into account evolutions in the main trading-partner countries (e.g. in as Belgium).

1.3 Measuring the marginal cost of public funds with GEM-E3

The measurement of welfare is central to the analysis of MCF. The welfare measure used in GEM-E3 is derived from the utility maximisation behaviour of the representative household. Here we only provide the specification of the utility function and the budget constraint, further details on the model can be found in European Commission (2012). The households receive income from their ownership of production factors (such as working time and capital), from other institutions and transfers from the rest of the world. Household expenditure is allocated between consumption, tax payment and savings. The representative household firstly decides on the allocation of its income between present and future consumption of goods and leisure. At a 2nd stage the household allocates its total consumption expenditure between the different consumption categories available. The consumption categories are split in non-durable consumption categories (food, culture etc.) and services from durable goods (cars, heating systems and electric appliances).

The general specification of the first stage problem, with a time separable Stone-Geary utility function, can be written as follows:

$$U_{i,t} = \sum_t \left(1 + stp_{i,t}\right)^{-t} . \left(bh_{i,t} . \ln\left(HCDTOTV_{i,t} - ch_{i,t}\right) + bl_{i,t} . \ln(LJV_{i,t} - cl_{i,t})\right) \qquad (1)$$

Where $HCDTOTV_{i,t}$ represents the consumption of goods (in volume), $LJV_{i,t}$: the consumption of leisure, $stp_{i,t}$: the subjective discount rate of the households, or social time preference, $ch_{i,t}$ is the subsistence quantity of consumption, $cl_{i,t}$ the subsistence quantity of leisure, $bh_{i,t}$, $bl_{i,t}$ are the respective shares of consumption and leisure in the disposable income of the households. The maximisation is subject to the following inter-temporal budget constraint, which states that all available disposable income will be spent either now or sometime in the future:

$$\sum_{t} \left(1 + r_{i,t}\right)^{-t} .(HCDTOT_{i,t} - PCI_{i,t}.ch_{i,t} + PLJ_{i,t}.LJV_{i,t} - PL_{i,t}.cl_{it}) \qquad (2)$$

Where $r_{i,t}$ is the discount rate, $HCDTOT_{i,t}$ is the total private consumption, $PCI_{i,t}$ is the consumer price index, $PLJ_{i,t}$ is the price of leisure, $LTOT_{i,t}$ is the total available time to households. The non wage income is income such as interest payments from assets, share in firms' profits, social benefits, and remittances. Based on myopic assumptions about the future, the household decides the amount of leisure that wishes to forsake in order to acquire the desired amount of income (thus also defining labour supply behaviour).

$$Welfare_i = \frac{1}{\exp(MUI)_i} \exp\left(bh_i * \ln(HCDTOT_i - ch_i) + bl_i * \ln(LJV_i - cl_i)\right)$$

where MUI is the marginal utility of income. Note that for the purposes of this version of the model, the leisure component is fixed, and therefore the changes in welfare occur only through the changes in consumption. The estimation of the MCF can be undertaken using a general equilibrium approach encompassing all the potential market effects of a given tax increase as well as the interactions between economic agents and resulting changes in the tax bases. The MCF can be calculated using the following formula:

$$MCF_{i,k} = \frac{\Delta W_{i,k}}{\Delta TR_i} \qquad (3)$$

where $\Delta W_{i,k}$ is the welfare loss due to the increase of tax *k* in country *i* and is calculated as the change in consumer utility based on the indirect utility function in order to give it a monetary value. It could be conceptualised as the reduction in consumption relative to a benchmark case of no-policy change, where prices and incomes are fixed at their "no-policy-change" benchmark level. This technically corresponds to the "equivalent" variation.

Alternatively, using the "compensating" variation would imply using the prices and income corresponding to "policy change" scenario. See Dahlby (2008) and Schöb (1994) for a discussion. The term ΔTR_i in equation (3) represents the corresponding change in tax collection in country *i* (including all tax revenues).

The MCF provides a metric for the loss in welfare (the efficiency loss) per unit of tax revenue gain. If the MCF equals one, then the tax is equivalent to a lump-sum transfer from the households to the government with no distortion. Typically, however, the MCF is greater than one such that MCF $=1+\alpha$, with α representing the cost of the distortion. This means that for every euro that goes into the government's purse, the economy pays an efficiency cost of α euros. The higher the MCF, the larger is the cost of distortion compared with the tax revenue gains.

As mentioned above, the externality modelled in GEM-E3 stems from bilateral trade relationships. A given tax policy change will affect bilateral trade flows and, thus, economic activity (i.e. production and consumption). It will also impact on tax revenues via two channels: tax changes will affect both (i) relative prices of domestically produced versus foreign goods and services and (ii) disposable income through changes in price levels and purchasing power. Tax changes will also spill through the production chain: for instance countries importing intermediates from a country implementing a tax increase will face higher production costs if substitution possibilities (i.e. import from alternative suppliers) are limited. Tax changes also affect demand for intermediates produced abroad. A country implementing a tax increase will thus face a competitiveness loss as well as lower purchasing power. Furthermore, partner countries may benefit on the one hand from a price-competitiveness gain if their exports are close substitutes of the goods and services produced by the tax-increasing country. On the other hand, partner countries may eventually lose if their exports are complementary to those of the tax-increasing country or if the lower economic activity in the tax-increasing country reduces its imports from the partner country.[5]

[5] Andersen and Sorensen (2012) suggested recently that tax increases could also have positive side- effects on the production side since firms needed to counter-act the extra-tax burden through productivity improvement.

Alternatively one can also derive a measure of the MCF where tax-related spillovers are taken into account by considering unilateral tax increases as indicated in equation (4) below:

$$MCF_{i,k} = \frac{\Delta W_i}{\Delta R_i + \sum_{j,j \neq i} \Delta R_j} + \frac{\sum_{j,j \neq i} \Delta W_j}{\Delta R_i + \sum_{j,j \neq i} \Delta R_j} \qquad (4)$$

where *i* is the country implementing a given tax change while *j* are the other countries (not implementing any tax change). The second term of equation (4) represents the spillover effect which can be compared to the first term of equation (3) which represents the impact of a tax change for the country implementing it only. The average MCF for unilateral tax increases calculated as in (3) can then compared to the average value of the MCF for unilateral tax increases including the impact of unilateral tax increases on other countries welfare and tax revenues as calculated in (4).

The results presented here provide estimations of the MCF for a very small tax increase of 0.05 percentage points of the effective tax rate in 2005. The tax increase in the case of labour tax concerns total social total security contribution. In doing so, we aim at focusing on the labour "price" effect of taxation specifically. The green taxes considered here concerns an energy tax for households per petajoule of energy (which is the measure commonly used to express energy consumption by large customers groups such as countries). It is important to note that the effects of an energy tax increase on the utility level as a result of a better environmental quality due to lower CO2-emissions and other kinds of air pollution, is not taken into account here such that the resulting utility variation stems essentially from the traditional price and income effects of a price change of each product consumed by the representative consumer.

The small tax increment is intended to capture the marginal nature of the tax change. In practice the proceeds of a given tax increase are used to finance policy objectives such as an increase in public expenditure, a subsidy, or to repay public debt. As the impact of the allocation of tax proceeds is beyond the scope of this paper, the estimate of the MCF of a given tax increase is isolated by allocating the (small amount of) additional tax revenues to the rest of the world (i.e. outside the EU). It is important to note also that when changing the level of taxes we fix the level of leisure to a given level. This is done in particular in order to isolate specifically the effect of labour taxes on time spent in employment and in unemployment. Given the labour market setting used, this means also that unemployment is never voluntary and thus neutralises the substitution effect of hours worked with time spent in leisure.

Table 1 provides descriptive statistics on the share of total labour taxes and energy taxes by country for the year 2005 which is used for the calibration of the model. The main source for the data is EuroStat. As one would expect, the labour taxes are substantially larger in EU countries (the simple average for labour taxes is 20.7% of GDP vs. 1.4% for energy taxes) although the relative dispersion of energy taxes is greater across countries (the coefficient of variation in 32.7% for energy taxes vs. 25.9% for labour taxes). Overall these figures also reflect the relatively large share of labour taxes in the richer EU countries.

2. Results.

The results presented here focus firstly on the comparison of the MCF for labour and green taxes both across the EU and for individual countries, as well as the notion of tax shifting from labour to green taxes. Secondly, the impacts of each country changing their tax rates on the rest of the EU – the spillover effects – are considered. Thirdly, the investigation into the importance of labour market flexibility is reported. Lastly, a robustness check on the values of the labour supply elasticity, Armington elasticities, and revenue-recycling strategies are carried out.

2.1 The Marginal Cost of Public Funds for Labour versus green Taxes: Individual country and EU-wide results

The MCF is calculated for each EU country introducing each tax unilaterally. The key results are reported in Table 2, which compares the GDP-weighted value for the within country MCF (corresponding to equation 1 above) for labour and energy taxes. These results show that the efficiency losses from green taxes are far smaller than for labour taxes. Considering EU-wide figures, the value for labour taxes of 1.90 implies that to raise an additional 1 euro of revenue, the average efficiency loss would be 0.90 euros. In contrast, raising an additional 1 euro of revenue from energy taxes, leads to an average efficiency loss of only 8 cents. Note that these values obtained for the MCF are broadly in line with the existing literature commented in Section 1. The result is also consistent with economic theory, which suggests that taxing goods with a relatively inelastic demand, such as energy, will result in only small distortions. This is not the case for labour *if* one is faced with a labour supply curve that is at least somewhat elastic. Furthermore, increased unemployment also requires additional social security payments from the government, which is also incorporated in the model. The detailed country results also bring results in line with prior expectations whereby countries with high starting level of taxation have also the highest values of the MCF. An important point to note regarding the energy taxes is that it is possible for MCF values to fall below one in some countries. This reflects the situation where a good is, in effect, under-taxed from an efficiency perspective, and raising the tax improves the overall efficiency of the economy. Tax efficiency, in this sense, is similar to the notion first put forward by Ramsey (1927), which proposed that consumption taxes for a particular good should be proportional to the inverse of the price elasticity of demand. The relative inelasticity of demand for energy taxes tends to make them good candidates for efficient taxation.

Regarding the MCF of labour taxes, there is a fair range across different countries from only 1.30 in Estonia to 2.41 in France. For the MCF of green taxes, the range is from 0.62 in Bulgaria to 1.42 in France. An important point to notice is that in every country, the MCF for labour taxes is higher than for green taxes, suggesting that all countries would see an efficiency gain from switching from labour to green taxes. These country values are compared with the total tax share of GDP in each country in Figure 2. For example, the highest potential losses from tax hikes are found for France, which has a MCF of 2.41 for labour taxes and a tax share of GDP of 44.6%. Focusing firstly on labour taxes (the triangles), there is a tendency for those countries with a higher tax share of GDP to also have a higher MCF. This is consistent with the notion of the Laffer Curve, which suggests that as overall taxes rise, further taxation at the margin becomes progressively less efficient. Interestingly, this notion does not hold for green taxes where there is no clear relationship between the overall tax burden and the MCF, suggesting that (on average) green taxes are especially efficient in comparison to labour taxes for countries that have a high overall tax share. It is also interesting to note that the effect of green tax appears to be more heterogeneous across countries than labour taxes which could be explained by the original diverse taxation of energy-intensive products in EU Member States contrary to rather homogeneous factor labour. This point is illustrated by considering separately the values of the MCF against the initial tax burden of labour and energy tax separately in the country-specific results reported in Figure 2.

Raising tax rates in a single country primarily affects welfare in that country, but there are also spillover effects to other EU countries. Comparing the individual country results for MCF with the EU-wide results shows the extent of these spillover effects. The EU-wide MCF is calculated according to Equation 2 above. Table 3 compares the individual country MCF with the EU-wide MCF for labour taxes. The spillover effect reported here refers to the percentage of the total EU-wide MCF that is *not* accounted for in the individual country MCF. For example, for Germany the EU-wide MCF is 2.04, of which 1.96 is the individual country effect. Therefore, in percentage terms the spillover effect is 3.6% of the total effect.[6] As can be seen, the spillover effects are typically modest for labour taxes. The countries with the highest percentage spillover effects (Belgium, Denmark and the Netherlands) are relatively small countries, with high trade to GDP shares. Table 4 reports the individual country and EU-wide MCFs for energy taxes and calculates the spillover effects. One difference in comparison to the comparable values for labour taxation in Table 3 is that the spillover effects, on average, represent a much higher percentage of the total EU-wide MCF. This reflects that energy-intensive goods tend to be more intensively traded than the average of the economy.

Finally one should note that the results reported in Table 1 do not allow us to say anything about the importance of each country on the magnitude of a welfare change given that the MCF measure is the ratio between this variable and the tax revenue variation. In order to check this we have calculate the share of each country in the welfare variation and the tax revenue variation of the spillover component of equation (4). These calculations indicated that some countries have a more prominent role because of their size (Germany, France and the UK are the salient cases) or because of their degree of openness to the rest of EU economies (which is the case for Belgium or the Netherlands). We also looked at the role of each separate country on the EU-wide spillovers considering separately positive and negative effects on welfare and tax revenues. As in the case of labour taxes, we again

[6] The calculation is (2.04 – 1.96) / 2.04 = 3.6%.

observed that the large EU countries generate most of the spillovers although here some relatively small albeit open countries tend to play a bigger role (e.g. Belgium and the Netherlands in particular). The sign of the spillover effect was predominantly negative, thus suggesting that *ceteris paribus*, a tax increase in a given country deteriorates the overall EU economic efficiency.

More generally, our results suggest overwhelmingly that should tax increases be considered in EU countries, energy taxes represent a better candidate than labour taxes. One possible reason for this could be that labour taxes have a bearing on labour supply and production levels. Green taxes in turn only impact on consumption and only indirectly on labour supply (through the level of post-tax increases level of income). In a second best world, a new distortion balances other distortions and the equalisation of the MCF across tax categories suggests that energy is relatively under-taxed compared to labour taxes, at least in the EU countries considered here. This result is not necessarily surprising given that the MCF is known to increase linearly with the level of taxation, see Dahlby (2008) such that it is generally a better option to increase low- burden tax rates rather than increasing tax rates which are already at a high level. Our investigation of the cross-country spillovers on energy taxes provides more nuanced results, however. Adopting the view of a benevolent EU-tax policy maker would certainly advocate for increasing the green rather than the labour tax, although the advantage of the former over the latter becomes less important once cross-country spillovers are considered. Indeed our analysis shows that these spillovers are potentially more important for energy rather than for labour taxes. This result in a way illustrates the theoretical finding by Bovenberg and De Moij (1994) who showed that the optimal level of environmental taxes lied below the Pigouvian level once tax interactions were considered. Our results show similarly that when countries´ interactions are considered the advantage of raising green versus labour taxes is reduced although green taxes increases remain a better option than labour tax increases thus suggesting that potential tax shifting between labour and energy taxes would yield significant benefits in terms of economic efficiency.

2.2 The role of labour market flexibility

The degree of labour market flexibility reflects the extent to which a change in wages resulting from a tax increase affects the supply of labour. By altering the degree of labour market flexibility, we address the question of whether the real wage reflects the marginal product of labour or whether wage rigidity, linked to labour market imperfection, hinders such an adjustment (see in particular Boeters and Savard, 2011, for a review of the literature, and Hutton and Ruocco, 1999, for an example of analysis of the impact of tax changes with efficiency wage in a CGE model). In the labour market setting adopted here, the tax change will not be fully reflected in the real wage because of the existence of a wage premium of certain categories of workers. In such a setting the interaction between the tax system and the labour market setting can be non-negligible, especially, though not exclusively, when considering labour tax changes.[7] The version of GEM-E3 used in this paper includes a labour market setting consistent with the efficiency wage theory of Shapiro and Stiglitz (1987). This theory posits, firstly, that the productivity of labour has a positive correlation with wages leading firms to offer a wage premium, and secondly, that this wage premium increases with lower employment. In periods of high unemployment firms have less need to offer high wages to attract more productive workers or to increase productivity of existing workers. The wage setting in such model is given by the following expression:

$$w\frac{PCI}{\overline{\overline{PCI}}} = \overline{wr} + e + \frac{e}{q}\left[\left(\frac{b}{u}\right)^{eg} + r\right] \tag{3}$$

where PCI is the consumer price index and *eg* an adjustment parameter to reflect the different labour market flexibility conditions that prevail in each country, *b* is the quit from job rate, *u* is the actual unemployment rate, *r* is the interest rate, *w* is the wage rate, *e* is the disutility from working (for the "shirker" e=0) and *q* measures the efficiency of the workforce, see European Commission (2012) for more details on the derivation of equation (3). In this equation, the degree of labour market flexibility in the model is captured in the parameter *eg*, which can be adjusted. A higher *eg* indicates a higher degree of labour

[7] Note that in our model there is only one representative individual and only one tax rate for each tax category based on the calibration using the data contained in the SAMs. For the labour market in particular we thus consider only one country average effective tax rate for each tax category. Therefore the progressivity of tax systems is not accounted for. Studies tend to show that the labour tax progressivity can have non-trivial effects on labour supply and therefore on the MCF (see in particular Lockwood and Manning, 1993).

market flexibility, i.e. according to equation (3) the higher the transmission of the quit rate and the lower the impact of unemployment changes on the real wage level.[8] Re-running the model with different values of *eg* allow an investigation into the impact of labour market flexibility on the MCF. [9] Our high flexibility scenario involved doubling *eg*, whereas our low flexibility scenario involved halving *eg*. These are large hypothetical changes in order to allow us to explore the responsive of the MCF values without being intended to reflect possible policy changes affecting the labour market. Table 5 show the results for the high and low labour market flexibility cases for the labour tax MCF and green tax MCF respectively for the EU as a whole. These results clearly shows a large impact on the MCF for labour taxes, with a less flexible labour market raising the EU average MCF (GDP-weighted) by 33.6% to 2.54 and a more flexible labour market reducing it by 13.6% to 1.64. These results should not come as a surprise given that labour market flexibility affects directly the way the change in wage costs is transmitted to the employment level, such as from a marginal rise in labour taxes. Nevertheless, the results do demonstrate the importance of labour market flexibility for the MCF of labour taxes. By contrast, the effect on the MCF of energy taxes is much less pronounced. On average, the MCF rises by less than 5% under less flexible labour market conditions and is reduced by just over 3% under more flexible conditions. The country-specific results are shown in Appendix tables A.1 and A.2. These show some interesting features, however given that in some cases the efficiency wage assumption does not fully capture the degree and nature of the rigidity of each specific labour market, we feel that the country-specific results should be interpreted with care. For example, Spain barely experiences a change in its MCF while this country is known to have especially distorted labour market, whereas other large countries, especially France and Germany, show large fluctuations in the MCF for labour taxes.

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[8] There is arguably no specific reason for choosing a specific value of the *eg* value against another one as the highly stylised representation of the labour market used in the version of GEM-E3 allow us to say little about whether this convenient or not. One could argue for instance that since the *eg* parameter should represent as closely as possible the degree of flexibility of the labour market then country-specific values should be set in accordance to "estimated", e.g., by the labour market literature. In fact, this is only partly true in the labour market setting outlines in Appendix 2 given that, while the parameter eg is set at an ad-hoc value, the level of unemployment used is taken from observed data. Instead of trying to stick to some ad-hoc country-specific measure of labour market flexibility we chose instead to keep the same value of this parameter across countries and rather to check whether the MCF estimates change when the degree of flexibility is higher or lower than in our benchmark cases without inferring too much about whether this degree of flexibility reflects the reality of EU countries labour markets. In adopting this approach we are therefore more interested in the change in the

3. Robustness Checks

We provide a number of additional results to the analysis carried out above in order to verify their robustness to alternative assumptions regarding the values of the labour supply elasticities, which may ultimately affect the number of hours worked in our model where time worked is chosen against leisure or unemployment. In addition, given that we consider EU economies, which are closely linked together through international trade, we also provide alternative estimates of the MCF depending on the degree of substitution between domestic production and imported goods. This is done by specifying alternative assumption regarding the Armington elasticities. Finally we also consider alternative hypotheses regarding the recycling of the extra-tax revenues yielded from the marginal tax increases in order to check whether our central benchmark case (i.e. through a direct income transfer to the rest of the world) does not influence our results.

In order to investigate the impact of the labour supply elasticities on the MCF values, we replaced the labour supply elasticities with values from the literature, where available, and average values otherwise. Specifically, we took the values for labour supply elasticity from Evers et al. (2008). This study reports estimates of labour supply elasticity for selected countries for men and women separately. We took these values and weighted them by gender share in the workforce to give an overall value using EuroStat data for 2005. This gave us estimates for France, Sweden, Germany, Italy and the Netherlands. Two further countries, UK and Finland, have values for women only. Using the average ratio of the elasticity of men to women, we further completed the missing estimates for the overall elasticity in these two countries. For the rest of the EU, we took an average of these values. We then recalibrated our model to have these labour supply elasticities, and re-ran the simulations to calculate the MCF for labour and energy taxes. The values of the base labour supply elasticities are compared with those used in this robustness check in Table 6.

As can be seen from Table 7, the average, GDP-weighted MCF is lower when using these elasticities – the individual country average falls from 1.90 to 1.62 and the EU-wide average

value of the MCF on average across EU countries rather than on whether the country-specific degrees of "flexibility" are correctly reflected.

[9] Note that the values for *ef* must be recalibrated in this case.

falls from 1.97 to 1.61. Note that the net spillover effects are near-zero when using the new elasticities. Nevertheless, the pattern is quite closely related to the base case with a correlation coefficient for the individual country values of 0.58. In the case of energy taxes, shown in Table 8, the GDP-weighted values for the EU also fall from 1.08 to 1.01 for individual country MCF, and from 1.17 to 1.06 for the EU-wide MCF. The values for MCF closely reflect the base values with a correlation coefficient of 0.97 for the individual country MCFs. Considering both Table 7 and 8, one notes that the relative size of the MCF for labour and energy taxes tells the same story as our base case, strongly suggested that our main result – that energy taxes are generally less distortionary than labour taxes – is robust to these new specifications.

As noted, an important feature of our CGE model, GEM-E3, is the modelling on international trade. The price sensitivity of these trade flows is determined primarily by the trade elasticities in the model. These elasticities are always somewhat uncertain, and therefore, it is good practice to test the robustness of our results against alternative values. Four extra model runs are carried out for each tax type and the MCF re-estimated. These are (i) increased then (ii) decreased import (Armington) elasticities, and then (iii) increased then (iv) decreased export elasticities. Tables 9 and 10 show the EU average results (GDP-weighted). The values reported as “base trade elasticity” are the benchmark results (as reported in Table 2). One can detect a minor tendency for higher trade elasticities to cause higher MCF estimates. However, the main observation is that the values of the trade elasticities have little impact on the MCF, and so the conclusions are robust to such changes.

As explained in Section 2, the calculation of the MCF involves implementing a marginal increase in the tax rate. Our preferred methodology for dealing with the extra revenue raised is to give it to the rest of the world, so there is no domestic benefit from additional government spending. Nevertheless, it is sensible to try an alternative closure of the model in order to assess whether this choice unduly influences our results. With this in mind, we ran the model with the additional revenues being returned to household by means of a lump sum transfer. This was run for both labour and energy taxes, with the results being reported in Tables 11 and 12. Note that in this case, the MCF values obtained are not one plus the distortion ($1 + \alpha$), but simply the distortion itself (α), as the 1 extra-tax revenues is transferred back to households already. In order for the results tables to be comparable to the earlier values, a one has been added to the MCF estimates obtained. Evidently, the different closure rule results in a smaller MCF for labour taxes, both at the individual country and the EU-wide levels. Otherwise, the variation across countries is similar to the standard values; the correlation coefficient for the individual country MCFs is 0.68. Regarding the MCF for green taxes, again the different closure rule reduces the estimates. However as for labour taxes, the variation across countries is similar with a correlation coefficient for the individual country MCFs of 0.80. From this robustness check, we can clearly see that our main result holds – that the MCF for labour is considerably higher than for green taxes. The magnitude of the MCF in this specification is lower. We choose to rely more on our standard estimates, because with this closure, the measurement of the MCF is altered as one must now take into account the benefits from additional spending.

4. Conclusions

Our research provides some useful evidence for EU countries that are considering how to approach fiscal consolidation. Firstly, the modelling work makes a strong case that the economic distortions caused by labour taxes are greater than for green taxes. This is an important consideration when seeking to promote economic recovery. Assuming that the revenue yield would be the same, relying on green taxation to raise revenues, rather than labour taxation, would be expected to be more efficient for the economy as a whole. This result holds for all EU member states modelled and despite the fact that potential welfare-enhancing effect of pollution abatement are cancelled out in our model.

Nevertheless, further investigation showed that this result is somewhat less strong when one considers the spillover effects between countries, as these are more pronounced (in relative terms) for green taxes. This suggests that close coordination across EU countries would be beneficial, especially in the case of green taxation. Another key result from our research is that the flexibility of the labour market has important effects on the level of distortion: more flexible labour markets are associated with lower distortions. As one would expect, the effect is more pronounced for labour taxes, though there is also some effect for green taxes. The implication is that were EU countries to undertake structural reforms (especially in the labour market), this would help to minimise the efficiency losses from tax-driven fiscal consolidations. A final consideration, not addressed in the current paper, is the progressivity of the different tax types, which would be an interesting avenue to explore in future research.

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Tables

Table 1: Share of tax revenues in GDP: values used for the calibration of the GEM-E3 model.

Country	Total tax revenues	Labour taxes*	Green taxes **
Austria	40.8%	26.6%	1.5%
Belgium	45.2%	29.1%	1.0%
Bulgaria	33.0%	13.3%	2.8%
Czech republic	39.0%	20.9%	1.7%
Denmark	49.8%	26.6%	1.4%
Estonia	30.0%	29.0%	1.0%
Finland	42.9%	16.2%	1.3%
France	44.6%	18.1%	1.3%
Germany	40.3%	19.9%	1.8%
Greece	33.3%	26.1%	1.0%
Hungary	37.3%	26.9%	2.0%
Ireland	29.4%	19.8%	0.8%
Italy	41.6%	14.7%	2.1%
Latvia	26.3%	23.7%	1.4%
Lithuania	27.4%	15.3%	0.6%
Netherlands	39.2%	14.3%	1.4%
Poland	33.1%	21.7%	1.4%
Portugal	34.0%	16.8%	1.6%
Romania	23.3%	18.1%	1.1%
Slovakia	47.1%	13.0%	1.5%
Slovenia	38.1%	29.7%	1.9%
Spain	36.4%	20.5%	1.0%
Sweden	50.1%	16.0%	1.3%
United Kingdom	35.6%	21.0%	1.7%

** Households' social security contributions + labour income tax*
*** Energy taxes paid by households*

Table 2: The marginal cost of public funds for a labour taxes and energy taxes

	Labour taxes	green taxes
EU average (GDP Weighted)	*1.90*	*1.08*
Simple average	*1.73*	*0.90*
Austria	1.82	0.87
Belgium	1.98	0.63
Bulgaria	1.56	0.62
Czech rep.	1.49	0.81
Germany	1.96	1.14
Denmark	2.31	0.86
Estonia	1.30	0.79
Greece	1.59	0.85
Spain	1.79	0.89
Finland	1.61	0.63
France	2.41	1.42
Hungary	1.53	0.86
Ireland	1.33	0.62
Italy	1.68	1.10
Lithuania	1.45	0.84
Latvia	1.42	0.82
Netherlands	1.57	0.83
Poland	1.63	1.26
Portugal	1.82	0.93
Romania	1.43	0.89
Sweden	2.06	0.87
Slovenia	1.66	0.95
Slovakia	2.19	1.06
United Kingdom	1.81	1.13
Coefficient of variation	*17.38%*	*22.21%*

Table 3: The MCF of labour taxes: country vs EU-wide effects

	Country	EU	Spillover effect*
Austria	1.82	1.91	4.30%
Belgium	1.98	2.29	13.52%
Bulgaria	1.56	1.59	1.77%
Czech rep.	1.49	1.50	0.97%
Germany	1.96	2.04	3.63%
Denmark	2.31	2.56	9.69%
Estonia	1.30	1.36	4.20%
Greece	1.59	1.60	0.88%
Spain	1.79	1.84	2.37%
Finland	1.61	1.66	2.77%
France	2.41	2.50	3.71%
Hungary	1.53	1.58	3.71%
Ireland	1.33	1.41	5.27%
Italy	1.68	1.68	-0.19%
Lithuania	1.45	1.49	2.47%
Latvia	1.42	1.49	4.27%
Netherlands	1.57	1.69	7.00%
Poland	1.63	1.63	-0.36%
Portugal	1.82	1.93	5.34%
Romania	1.43	1.42	-0.56%
Sweden	2.06	2.15	4.37%
Slovenia	1.66	1.78	6.80%
Slovakia	2.19	2.22	1.46%
United Kingdom	1.81	1.86	2.76%
EU (GDP Weighted)	*1.90*	*1.97*	*3.49%*
Simple average	*1.73*	*1.80*	*4.04%*
Coefficient of variation	*17.38%*	*18.99%*	

* Calculated as the percentage of the second term in the right hand side of equation (2) divided by the MCPF measured for the EU. The change in the labour tax concerns total social security contribution paid by the employers and the employees. The tax increase is equal to 0.05 percentage point.

Table 4: The MCF of green taxes: country vs EU-wide effects

	Country	EU	Spillover effect* (% of total MCF)
Austria	0.87	1.07	18.3%
Belgium	0.63	0.87	27.9%
Bulgaria	0.62	0.64	4.6%
Czech rep.	0.81	0.87	6.5%
Germany	1.14	1.24	8.2%
Denmark	0.86	0.93	6.5%
Estonia	0.79	0.92	13.5%
Greece	0.85	0.90	5.5%
Spain	0.89	0.98	9.5%
Finland	0.63	0.70	10.6%
France	1.42	1.54	7.7%
Hungary	0.86	1.01	14.6%
Ireland	0.62	0.88	29.5%
Italy	1.10	1.14	3.6%
Lithuania	0.84	0.95	11.8%
Latvia	0.82	0.84	2.1%
Netherlands	0.83	0.97	14.4%
Poland	1.26	1.27	1.1%
Portugal	0.93	1.06	12.9%
Romania	0.89	0.95	6.0%
Sweden	0.87	0.95	8.0%
Slovenia	0.95	1.10	13.7%
Slovakia	1.06	1.17	9.5%
United Kingdom	1.13	1.17	3.6%
EU (GDP-weighted)	*1.08*	*1.17*	*7.8%*
Simple average	*0.90*	*1.00*	*10.2%*
Coefficient of variation	*22.21%*	*19.02%*	

* Calculated as the percentage of the second term in the right hand side of equation (2) divided by the MCPF measured for the EU. The change in the Energy tax concerns the energy consumption by households (in real terms). The tax increase is equal to 0.05 percentage point.

Table 5: The Marginal Cost of Public Funds and labour market flexibility: the case of Labour tax

	MCF, benchmark case	*Less flexible Labour market*	*More flexible Labour market*
Labour taxes *EU average (GDP-weighted)*	***1.90***	***2.54***	***1.64***
% change vs. benchmark		*+33.6%*	*-13.6%*
Green taxes *EU average (GDP-weighted)*	***1.08***	***1.13***	***1.04***
% change vs. benchmark		*+4.6%*	*-3.3%*

Table 6: The labour supply elasticities: Base vs. robustness-check values

	Base L-supply elasticity values*	New L-supply elasticity values*
Austria	0.520	0.346
Belgium	0.761	0.346
Bulgaria	0.474	0.346
Czech rep.	0.405	0.346
Germany	0.611	0.024
Denmark	0.814	0.346
Estonia	0.511	0.346
Greece	0.646	0.346
Spain	0.820	0.346
Finland	0.709	0.019
France	0.657	0.179
Hungary	0.533	0.346
Ireland	0.471	0.346
Italy	0.481	1.173
Lithuania	0.685	0.346
Latvia	0.691	0.346
Netherlands	0.521	0.554
Poland	0.577	0.346
Portugal	1.154	0.346
Romania	0.601	0.346
Sweden	0.670	0.389
Slovenia	0.778	0.346
Slovakia	0.532	0.346
United Kingdom	0.816	0.085

* Base values calculated from GEM-E3 model; new values derived from Evers et al. (2008, see text above).

Table 7: The MCF with different labour supply elasticities: Labour taxes

	Country		EU	
	Base L-supply elasticity	New L-supply elasticity	Base L-supply elasticity	New L-supply elasticity
Austria	1.82	1.69	1.91	1.72
Belgium	1.98	1.59	2.29	1.68
Bulgaria	1.56	1.60	1.59	1.62
Czech rep.	1.49	1.51	1.50	1.51
Germany	1.96	1.32	2.04	1.24
Denmark	2.31	1.66	2.56	1.72
Estonia	1.30	1.31	1.36	1.34
Greece	1.59	1.47	1.60	1.47
Spain	1.79	1.88	1.84	1.86
Finland	1.61	1.51	1.66	1.44
France	2.41	1.75	2.50	1.73
Hungary	1.53	1.48	1.58	1.50
Ireland	1.33	1.35	1.41	1.41
Italy	1.68	1.96	1.68	2.01
Lithuania	1.45	1.51	1.49	1.49
Latvia	1.42	1.42	1.49	1.44
Netherlands	1.57	1.48	1.69	1.62
Poland	1.63	1.61	1.63	1.58
Portugal	1.82	1.61	1.93	1.62
Romania	1.43	1.52	1.42	1.48
Sweden	2.06	1.82	2.15	1.86
Slovenia	1.66	1.56	1.78	1.60
Slovakia	2.19	2.29	2.22	2.27
United Kingdom	1.81	1.51	1.86	1.52
EU (GDP-weighted)	*1.90*	*1.62*	*1.97*	*1.61*
Simple average	*1.73*	*1.60*	*1.80*	*1.61*
Coefficient of variation	*17.4%*	*13.7%*	*19.0%*	*13.9%*

Table 8: The MCF with different labour supply elasticities: green taxes

	Country		EU	
	Base L-supply elasticity	New L-supply elasticity	Base L-supply elasticity	New L-supply elasticity
Austria	0.87	0.81	1.07	0.97
Belgium	0.63	0.59	0.87	0.78
Bulgaria	0.62	0.61	0.64	0.64
Czech rep.	0.81	0.80	0.87	0.85
Germany	1.14	0.99	1.24	1.01
Denmark	0.86	0.87	0.93	0.89
Estonia	0.79	0.81	0.92	0.98
Greece	0.85	0.84	0.90	0.87
Spain	0.89	0.91	0.98	0.99
Finland	0.63	0.68	0.70	0.71
France	1.42	1.26	1.54	1.32
Hungary	0.86	0.81	1.01	0.95
Ireland	0.62	0.57	0.88	0.81
Italy	1.10	1.11	1.14	1.17
Lithuania	0.84	0.85	0.95	0.79
Latvia	0.82	0.85	0.84	0.85
Netherlands	0.83	0.76	0.97	0.91
Poland	1.26	1.25	1.27	1.25
Portugal	0.93	0.89	1.06	0.98
Romania	0.89	0.91	0.95	0.95
Sweden	0.87	0.84	0.95	0.87
Slovenia	0.95	0.91	1.10	1.06
Slovakia	1.06	1.05	1.17	1.12
United Kingdom	1.13	1.08	1.17	1.10
EU (GDP-weighted)	*1.08*	*1.01*	*1.17*	*1.06*
Simple average	*0.90*	*0.88*	*1.00*	*0.95*
Coefficient of variation	*22.2%*	*20.5%*	*19.0%*	*17.2%*

Table 9: The MCF with different trade elasticities: Labour taxes (EU averages)

	Country			EU-wide		
	High trade elasticity	Base trade elasticity	Low trade elasticity	High trade elasticity	Base trade elasticity	Low trade elasticity
Different import elasticities	*1.91*	*1.90*	*1.88*	*1.97*	*1.97*	*1.96*
Different export elasticities	*1.90*	*1.90*	*1.89*	*1.97*	*1.97*	*1.96*

Table 10: The MCF with different trade elasticities: green taxes (EU averages)

	Country			EU-wide		
	High trade elasticity	Base trade elasticity	Low trade elasticity	High trade elasticity	Base trade elasticity	Low trade elasticity
Different import elasticities	*1.10*	*1.08*	*1.05*	*1.17*	*1.17*	*1.16*
Different export elasticities	*1.09*	*1.08*	*1.07*	*1.17*	*1.17*	*1.17*

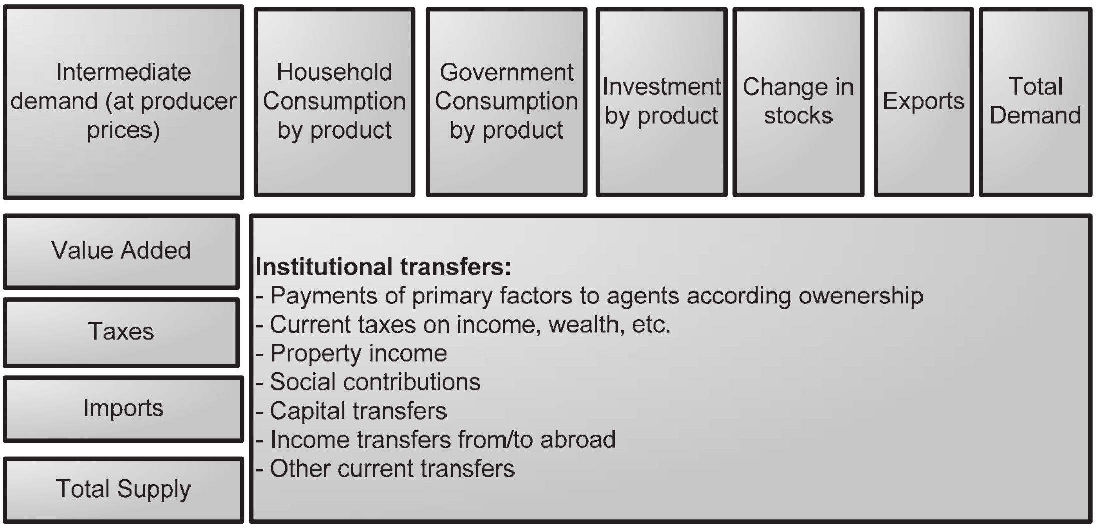
Table 11: The MCF of labour taxes: alternative tax recycling

	Country		EU	
	Standard closure rule	Alternative closure rule (with 1 added)	Standard closure rule	Alternative closure rule (with 1 added)
Austria	1.82	1.39	1.91	1.49
Belgium	1.98	1.28	2.29	1.48
Bulgaria	1.56	1.32	1.59	1.37
Czech rep.	1.49	1.29	1.50	1.38
Germany	1.96	1.64	2.04	1.75
Denmark	2.31	1.41	2.56	1.52
Estonia	1.30	1.18	1.36	1.24
Greece	1.59	1.48	1.60	1.51
Spain	1.79	1.40	1.84	1.46
Finland	1.61	1.36	1.66	1.41
France	2.41	1.78	2.50	1.87
Hungary	1.53	1.31	1.58	1.40
Ireland	1.33	1.14	1.41	1.19
Italy	1.68	1.38	1.68	1.42
Lithuania	1.45	1.21	1.49	1.29
Latvia	1.42	1.25	1.49	1.31
Netherlands	1.57	1.15	1.69	1.29
Poland	1.63	1.37	1.63	1.43
Portugal	1.82	1.45	1.93	1.56
Romania	1.43	1.37	1.42	1.42
Sweden	2.06	1.41	2.15	1.48
Slovenia	1.66	1.37	1.78	1.48
Slovakia	2.19	1.34	2.22	1.43
United Kingdom	1.81	1.37	1.86	1.41
EU (GDP-weighted)	*1.90*	*1.48*	*1.97*	*1.56*
Simple average	*1.73*	*1.36*	*1.80*	*1.44*
Coefficient of variation	*17.4%*	*10.4%*	*19.0%*	*10.2%*

Table 12: The MCF of energy taxes: alternative tax recycling

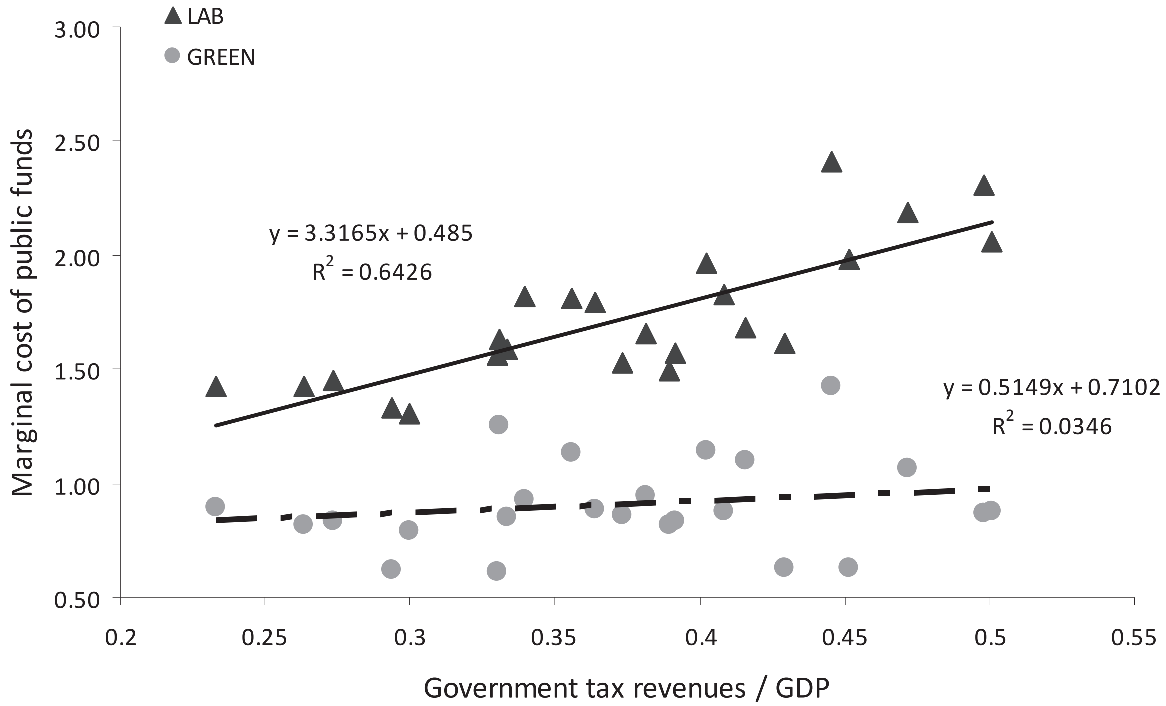
	Country		EU	
	Standard closure rule	Alternative closure rule (with 1 added)	Standard closure rule	Alternative closure rule (with 1 added)
Austria	0.87	0.70	1.07	0.85
Belgium	0.63	0.55	0.87	0.73
Bulgaria	0.62	0.58	0.64	0.66
Czech rep.	0.81	0.72	0.87	0.84
Germany	1.14	0.97	1.24	1.10
Denmark	0.86	0.86	0.93	0.90
Estonia	0.79	0.79	0.92	0.86
Greece	0.85	0.79	0.90	0.84
Spain	0.89	0.73	0.98	0.82
Finland	0.63	0.71	0.70	0.78
France	1.42	1.05	1.54	1.17
Hungary	0.86	0.75	1.01	0.88
Ireland	0.62	0.61	0.88	0.77
Italy	1.10	0.89	1.14	0.96
Lithuania	0.84	0.70	0.95	0.78
Latvia	0.82	0.74	0.84	0.74
Netherlands	0.83	0.65	0.97	0.80
Poland	1.26	1.01	1.27	1.10
Portugal	0.93	0.71	1.06	0.81
Romania	0.89	0.85	0.95	0.93
Sweden	0.87	0.77	0.95	0.82
Slovenia	0.95	0.83	1.10	0.94
Slovakia	1.06	0.58	1.17	0.68
United Kingdom	1.13	0.89	1.17	0.92
EU (GDP-weighted)	*1.08*	*0.88*	*1.17*	*0.97*
Simple average	*0.90*	*0.77*	*1.00*	*0.86*
Coefficient of variation	*22.2%*	*17.3%*	*19.0%*	*14.7%*

Figure 1: Social Accounting Matrix representation as used in GEM-E3



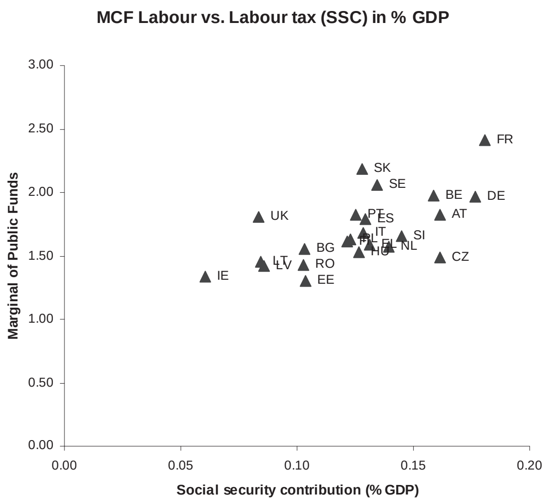
Source: European Commission (2012).

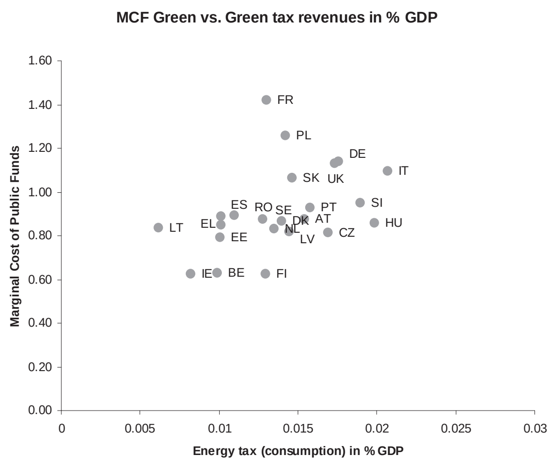
Figure 2: The marginal cost of public funds vs. total tax revenues



Source: GEM-E3 simulations

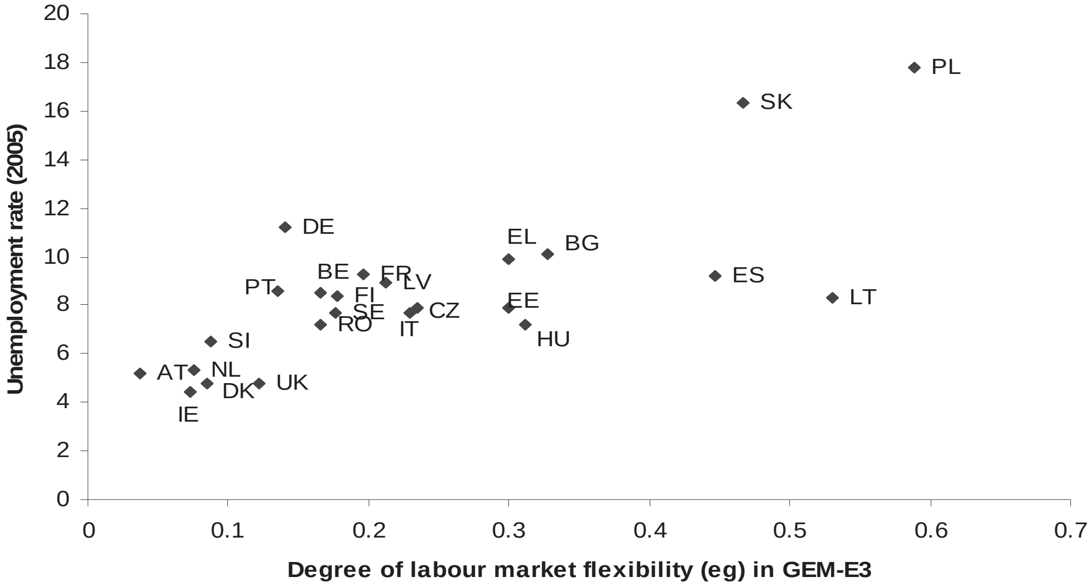
Country details for labour and energy taxes





Appendix

Figure A.2.1: Labour market flexibility in GEM-E3 and actual unemployment rates (in 2005)



Sources. GEM-E3 calibration and Ameco (European Commission, DG ECFIN)

Table A1: **The MCF and labour market flexibility: the case of Labour tax**

		EU-results	
	MCF, benchmark case	***Less flexible Labour market***	***More flexible Labour market***
EU	***1.90***	***2.54***	***1.64***
% change vs. benchmark		***+33.6%***	***-13.6%***
		Country-results	
	MCF, benchmark case	***Less flexible Labour market***	***More flexible Labour market***
Austria	1.82	2.41	1.60
Belgium	1.98	2.98	1.64
Bulgaria	1.56	1.51	1.60
Czech rep.	1.49	1.63	1.42
Germany	1.96	3.07	1.56
Denmark	2.31	4.85	1.75
Estonia	1.30	1.29	1.33
Greece	1.59	1.77	1.43
Spain	1.79	1.80	1.80
Finland	1.61	1.77	1.52
France	2.41	3.64	1.91
Hungary	1.53	1.70	1.43
Ireland	1.33	1.27	1.38
Italy	1.68	1.92	1.52
Lithuania	1.45	1.44	1.47
Latvia	1.42	1.44	1.41
Netherlands	1.57	2.43	1.31
Poland	1.63	1.78	1.53
Portugal	1.82	2.05	1.66
Romania	1.43	1.40	1.46
Sweden	2.06	2.57	1.79
Slovenia	1.66	1.84	1.55
Slovakia	2.19	2.30	2.13
United Kingdom	1.81	2.00	1.66

Table A2: **The MCF and labour market flexibility: the case of Green taxes**

	EU-results		
	MCF, benchmark case	***Less flexible Labour market***	***More flexible Labour market***
EU	***1.08***	***1.13***	***1.04***
% change vs. benchmark		***+4.6%***	***-3.3%***
	Country-results		
	MCF, benchmark case	***Less flexible Labour market***	***More flexible Labour market***
Austria	0.87	0.88	0.87
Belgium	0.63	0.61	0.65
Bulgaria	0.62	0.61	0.64
Czech rep.	0.81	0.82	0.82
Germany	1.14	1.24	1.07
Denmark	0.86	0.87	0.88
Estonia	0.79	0.81	0.93
Greece	0.85	0.87	0.84
Spain	0.89	0.86	0.92
Finland	0.63	0.61	0.65
France	1.42	1.55	1.33
Hungary	0.86	0.87	0.85
Ireland	0.62	0.59	0.65
Italy	1.10	1.13	1.07
Lithuania	0.84	0.87	0.88
Latvia	0.82	0.83	1.02
Netherlands	0.83	0.85	0.82
Poland	1.26	1.29	1.23
Portugal	0.93	0.93	0.91
Romania	0.89	0.86	0.91
Sweden	0.87	0.88	0.84
Slovenia	0.95	0.96	0.94
Slovakia	1.06	1.06	1.06
United Kingdom	1.13	1.16	1.11

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