Fiscal harmonization in the European Union with public inputs*

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Abstract. Fiscal harmonization among the European Union member states is a goal involving major difficulties for its implementation. Each country faces a particular trade-off between fiscal revenues generated by taxation and the productive efficiency loss induced by their respective tax code. This paper provides a quantitative measure of these trade-offs for a number of taxes and the European Union member states using a dynamic general equilibrium model with public inputs. Calibration of the model for the EU-15 member states provides the following results: i) the maximum tax revenue level is not far from the current tax levels for most countries; ii) the cases of Sweden, Denmark and Finland are anomalous, as productive efficiency can be gained by lowering tax rates without affecting fiscal revenues; iii) in general, countries would obtain efficiency gains without changing fiscal revenues by reducing the capital tax and increasing the labor tax; and iv) capital tax harmonization to the average capital tax rate can be done with quite small changes in both fiscal revenues and output for most countries.

JEL Classification Numbers: E62, H20, H30.

Key words: Fiscal harmonization, applied general equilibrium, public inputs.

(*) We would like to thank J. Pérez, J. Rodríguez and participants in the VI Workshop on International Economics, Málaga, March 2007, X Jornadas de Economía Internacional, Madrid, June 2008, XXXII Simposio de Análisis Económico, Granada, December 2008 and Seminars at the European Central Bank for very useful comments and suggestions.
The authors acknowledge financial support from Instituto de Estudios Fiscales, SEJ-122 and Junta de Andalucía-Proyecto de Excelencia P07-SEJ-02479.

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1 Introduction

Fiscal harmonization among the European Union member states is a goal that involves major difficulties for its implementation. Each country faces a particular trade-off between fiscal revenues generated by taxation and the productive efficiency loss induced by the tax code. Countries for which a particular harmonized tax code requires more taxation will have to face an increased productive efficiency loss, whereas those required to decrease their taxes will have to face a loss in fiscal revenues. However, if we consider a menu of taxes, some room can be found for fiscal harmonization by changing the composition of the tax code. For example, by increasing labor income tax by a certain proportion and reducing capital tax by some other proportion, we could keep fiscal revenues constant while increasing productive efficiency. This paper provides a quantitative measure of these trade-offs for a number of taxes and the European Union member states (EU-15).\(^1\)

Fiscal harmonization is a very relevant issue in the context of the European Union, particularly with respect to harmonization of capital income taxes for which there exist important differences between EU countries. Differences in capital taxes would lead to competition to attract capital from abroad (the so-called race to the bottom), given the high capital mobility around the world. This is especially important in the context of the European Union where there is free capital mobility. The European Commission itself stressed the need to remove corporate tax obstacles in order to promote the creation of an integrated single market for doing business in Europe (European Commission, 1997). For instance, Tanzi and Bovenberg (1990) pointed out the need to harmonize capital taxes within the EU, given the existence of a unified market with free capital movements. However, it is not clear how such harmonization should be done. First, the particular tax system implemented by each country reflects different objectives with different government expenditure patterns. On the other hand, there are no clear reasons to think that a particular tax system is preferable to another, and this raises questions on the system around which to harmonize the different tax systems. Cnossen (2003) also suggests a tax reform program aimed at greater uniformity of capital income taxation within EU Member States.

As pointed out by Tanzi and Bovenberg (1990), without harmonization

\(^1\)We consider all the countries of the EU-15 except Luxembourg.
of capital income taxes, the allocation of capital across countries would be inefficient due to the fact that the capital returns would tend to be equalized after and not before taxes as well as the existence of externalities on other countries. Sørensen (2004) used a static general equilibrium model to analyze corporate tax harmonization in the European Union, where harmonization is assumed to take place at the unweighted average corporate tax rate, finding that the aggregate static efficiency gain from corporate tax harmonization would be quite small.

This paper examines the scope for fiscal harmonization in the EU countries. We consider a highly aggregated dynamic general equilibrium model to study the effects of different tax codes for each of the countries in the EU-15. The main difference between our model and others found in the literature is that we introduce a public input (public capital) into the production function, where the stock of public capital is financed with fiscal revenues. Following Feehan and Matsumoto (2002) we consider factor-augmenting public inputs, that is, such inputs are considered as intermediate goods that affect the production function and give rise to increasing returns. In the absence of a public input in the production function, the tax code trivially associated with full efficiency is zero for all taxes. Since we want to study the trade-off between productive efficiency and fiscal revenues for a collection of countries with different public capital stocks, the introduction of a public input involves the need for some country-specific tax exaction in order to have a positive production level. In this line, the paper develops an DGE model calibrated to data from the EU economies to obtain effective average tax rates, preference and technology parameters to solve a set of questions regarding fiscal policy in the EU countries.

To find the proportion by which each of the EU-15 countries should reduce or increase taxes is the quantitative question this paper attempts to answer. Thus, we have modelled the productive sector producing a single output from three productive factors, namely, private capital stock, labor, and the stock of a public input provided by the government. This specification of the aggregated production function allows us to model a public sector that operates in two dimensions: redistributing income, and providing public capital stocks for the production process through public investments. The aggregated production function provides us with a measure of the efficiency gains associated with different compositions for the income tax code.
We compute the combinations of capital and labor tax rates (taking the consumption tax rate as given) that maximize fiscal revenues, i.e., we build a bi-dimensional Laffer curve and compute its maximum in terms of these two-dimensional fiscal instruments to compare the current fiscal revenue situation in each country. Additionally, we derive the bi-dimensional iso-output functions indicating the combination of capital and labor taxes that corresponds to a certain level of aggregated output. Assuming the same level of fiscal revenues, we compute the combination of capital and labor taxes for which output is maximized. In general, optimal taxation policies imply the reduction of the capital tax rate together with an increase in the labor tax rate.

Four important facts arise from this comparison. First, the maximum fiscal revenue for each country is associated with relatively low values of the tax rates, and for most of the countries these values are very close to the observed ones. Second, the Laffer curve is very flat around the maximum. These two facts together imply that the EU-15 countries studied are not very far from the maximal fiscal revenue. Third, the rate of substitution between capital and labor taxes to keep fiscal revenues constant is very large, i.e., a large decrease in capital tax can be compensated by a small increase in the labor tax to keep revenue constant. This is a natural result due to the relative participation in fiscal revenues. Since the rate of substitution between capital and labor taxes that keeps production constant is in general low, some room is available to modify the tax code so that revenues are kept constant while increasing productive efficiency. Fourth, given the observed consumption tax, the maximum productive efficiency level is not far from a zero income tax code level for most countries. This implies that fiscal revenues obtained via the consumption tax are sufficient to maintain public capital stocks.

These four features of the Laffer curve calculated for the EU-15 countries suggest that a reduction in capital taxation may be the proper direction toward achieving fiscal harmonization agreeable to all parties. We conduct a simulation exercise in which two possibilities are considered: i) following Sørensen (2004), harmonization is assumed to take place at the unweighted average capital tax rate (0.264); and ii) harmonization is assumed to take place at the minimum capital tax rate, which corresponds to Ireland (0.136).
When capital tax harmonization is assumed to take place at the average rate, fiscal revenues suffer only small changes in most countries. However, output shows significant changes. When harmonization is assumed to take place at the Irish capital rate, fiscal revenues are significantly reduced for most countries but with large increases in output. On the other hand, our approach of finding the optimal tax code for each country (pairs of capital and labor tax that keep revenues at the observed level with increases in productive efficiency) could result in a “convergence” of the tax codes. If this is the case we would have found the natural way to harmonize the European tax system to some extent. The measures we obtain from this simulated European tax system give us an idea of the limits to fiscal harmonization where gains are expected for all countries.

The paper is structured as follows. In Section 2 we describe the model. Section 3 presents the data used and the calibration procedure. Section 4 shows the figures of the bi-dimensional Laffer curves. Section 5 studies the optimal tax code for each country. The effects of capital tax harmonization are described in Section 6. Finally, Section 7 presents some conclusions.

2 The public inputs model

We consider a production function that relates output to three inputs: labor, private capital and public capital. Our choice of the production function assumes that a positive level of public capital is necessary for production, which implies that there must be a minimum level of fiscal revenues for the output to be positive. The government taxes private consumption goods, capital income and labor income to finance an exogenous sequence of lump-sum transfers, \( \{T_t\}_{t=0}^\infty \), and a sequence of public investment, \( \{I_{g,t}\}_{t=0}^\infty \).

2.1 Households

Consider a model economy where the decisions made by consumers are represented by a stand-in consumer, whose preferences are represented by the following instantaneous utility function:

\[
U(C_t, N_tH - L_t) = \gamma \log C_t + (1 - \gamma) \log(N_tH - L_t),
\]  

For an analysis of the fiscal policy implications from general equilibrium models with public capital see for instance, Baxter and King (1993) and Greiner and Hanusch (1998).

\footnote{For an analysis of the fiscal policy implications from general equilibrium models with public capital see for instance, Baxter and King (1993) and Greiner and Hanusch (1998).}
Private consumption is denoted by $C_t$. Leisure is $N_t \bar{H} - L_t$, and is calculated as the number of effective hours in the week times the number of weeks in a year $\bar{H}$, times the population at the age of taking labor-leisure decisions, $N_t$, minus the aggregated number of hours worked in a year $L_t$. The parameter $\gamma$ ($0 < \gamma < 1$) is the proportion of private consumption to total private income. The budget constraint faced by the stand-in consumer is:

$$(1 + \tau_t^c)C_t + K_t - K_{t-1} = (1 - \tau_t^l)W_t^e L_t + (1 - \tau_t^k)(R_t^c - \delta_K)K_{t-1} + T_t, \quad (2)$$

where $T_t$ is the transfer received by consumers from the government, $K_t$ is the private capital stock, $W_t^e$ is the compensation to employees, $R_t^c$ is the rental rate, $\delta_K$ is the capital depreciation rate which is modelled as tax deductible, and $\tau_t^c$, $\tau_t^l$, $\tau_t^k$, are the private consumption tax, the labor income tax, and the capital income tax, respectively\(^4\). The budget constraints indicate that consumption and investment cannot exceed the sum of labor and capital rental income net of taxes and lump sum transfers.

The problem faced by the stand-in consumer is to maximize the value of her lifetime utility given by:

$$Max_{(C_t, L_t)\mathbb{R}^\infty} \sum_{t=0}^{\infty} \beta^t \left[ \gamma \log C_t + (1 - \gamma) \log(N_t \bar{H} - L_t) \right]$$

subject to the budget constraints (2) given $\tau_t^c$, $\tau_t^l$, $\tau_t^k$ and $K_0$ and where $\beta \in (0, 1)$, is the consumer’s discount factor.

### 2.2 Firms

The problem of the firm is to find optimal values for the utilization of labor and capital given the presence of public inputs. The stand-in firm is represented by a nested C.E.S. with a standard Cobb-Douglas production function. The production of final output, $Y$, requires labor services, $L$, and two types of capital: private capital, $K$, and public capital (public infrastructures), $G$. Goods and factors markets are assumed to be perfectly competitive.

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\(^4\) Tax rates are constants and can be interpreted as average marginal tax rates. Jonsson and Klein (1996) use an isoelastic specification of the tax schedule rather than a linear one in order to capture the progressivity of income taxation.
firm rents capital and hires labor to maximize period profits, taking public inputs and factor prices as given. The technology exhibits a constant return to private factors and thus the profits are zero in equilibrium. However, the firms earn an economic profit equal to the difference between the value of output and the payments made to the private inputs. We assume that these profits are distributed between the private inputs in an amount proportional to the private input share of output.\textsuperscript{5} The technology is given by:

\[ Y_t = A_t \left[ \sigma G^p_{t-1} + (1 - \sigma) \left( K_t^{1-\alpha} L_t^\alpha \right)^{\rho} \right]^{1/\rho} \]  

(3)

where \( A_t \) is a measure of total-factor productivity, \( \alpha \) is the private capital share of output, \( \sigma \) measures the weight on public capital relative to private factors and \( 1/(1 - \rho) \) is a measure of the elasticity of substitution between public inputs and private inputs.

### 2.3 Government

Finally, we consider the dual role of the government: as a tax-levying entity and as supplier of public inputs. The government uses tax revenues to finance spending in public investment (infrastructures) which raises total factor productivity and lump-sum transfers paid out to the consumers. We assume that the government balances its budget period-by-period by returning revenues from distortionary taxes to the agents via lump-sum transfers, \( T_t \).

The government obtains resources from the economy by taxing consumption and income from labor and capital, whose effective average taxes are \( \tau^c_t \), \( \tau^l_t \), \( \tau^k_t \), respectively. The government budget in each period is given by,

\[ \tau^c_t C_t + \tau^l_t W^e_t L_t + \tau^k_t (R^e_t - \delta_K) K_{t-1} = T_t + I_{g,t}. \]  

(4)

where \( I_{g,t} \), is public investment. This expenditure plus the transfers to consumers are the counterpart of fiscal income. The government keeps a fiscal balance in each period. This assumption is made to highlight the distortionary effects of taxes, mainly on capital accumulation.\textsuperscript{6} Public investments

\textsuperscript{5} Guo and Lansing (1997), using a similar technology, assume that each household owns a single firm and that all households receive equal amounts of total profits.

\textsuperscript{6} This assumption has been used by Barro (1990), Glomm and Ravikumar (1994), Cassou and Lansing (1998), among others. They argue that this setup may represent a closer approximation to actual constraints than one which allows the government to borrow or lend large amounts.
accrue into the public structures stock. We assume the following accumulation process for the public capital:

\[ G_t = (1 - \delta_G)G_{t-1} + I_{g,t}. \]

which is analogous to the private capital accumulation process.

### 2.4 Equilibrium

Our model has three productive factors. However, the third factor, public capital, has no market price. This implies that the rent generated by the public input must be assigned to the private factors.

Based on the firm profit maximization problem, the first-order conditions are:

\[
R_t = \alpha(1 - \sigma)A_t X_t^{1/\rho - 1} \left(K_{t-1}^\alpha L_t^{1-\alpha}\right)^{\rho - 1} K_{t-1}^\alpha L_t^{1-\alpha}, \tag{5}
\]

\[
W_t = (1 - \alpha)(1 - \sigma)A_t X_t^{1/\rho - 1} \left(K_{t-1}^\alpha L_t^{1-\alpha}\right)^{\rho - 1} K_{t-1}^\alpha L_t^{1-\alpha}, \tag{6}
\]

where \( X_t = \sigma G_{t-1}^\rho + (1 - \sigma) \left(K_{t-1}^\alpha L_t^{1-\alpha}\right)^{\rho} \). On the other hand, taking the derivative of the profit function with respect to public capital, we obtain:

\[
\frac{\partial Y_t}{\partial G_{t-1}} = \sigma A_t X_t^{1/\rho - 1} G_{t-1}^{\rho - 1}. \tag{7}
\]

Notice that equation (7) is not properly a condition of the model since there is no agent to claim the income generated by the public input.

From the above equations we can obtain the following relations that will be useful for our calibration:

\[
R_t K_t = \alpha(1 - \sigma)A_t X_t^{1/\rho - 1} \left(K_{t-1}^\alpha L_t^{1-\alpha}\right)^\rho, \\
W_t L_t = (1 - \alpha)(1 - \sigma)A_t X_t^{1/\rho - 1} \left(K_{t-1}^\alpha L_t^{1-\alpha}\right)^\rho, \\
\frac{\partial Y_t}{\partial G_{t-1}} G_{t-1} = \sigma A_t X_t^{1/\rho - 1} G_{t-1}^\rho.
\]

From private factor income ratios we obtain that \( R_t K_t / W_t L_t = \alpha / (1 - \alpha) \).

The ratios of total private income to total public expenditures, and private
The relation of private factors income to the public input income is:

\[ \frac{R_t K_{t-1} + W_t L_t}{\partial Y^G / \partial G_{t-1}} = \frac{1 - \sigma}{\sigma} \left[ \frac{1}{G_{t-1}} K_{t-1}^{\alpha} L_{t-1}^{1-\alpha} \right]^\rho = \tilde{Y}_t^\rho, \]

\[ \frac{R_t K_{t-1}}{\partial Y^G / \partial G_{t-1}} = \frac{\alpha}{\sigma} \frac{1 - \sigma}{\sigma} \left[ \frac{1}{G_{t-1}} K_{t-1}^{\alpha} L_{t-1}^{1-\alpha} \right]^\rho = \alpha \tilde{Y}_t^\rho, \]

\[ \frac{W_t L_t}{\partial Y^G / \partial G_{t-1}} = (1 - \alpha) \frac{1 - \sigma}{\sigma} \left[ \frac{1}{G_{t-1}} K_{t-1}^{\alpha} L_{t-1}^{1-\alpha} \right]^\rho = (1 - \alpha) \tilde{Y}_t^\rho. \]

The l.h.s. ratio can be obtained from national accounts, whereas the r.h.s. is a transformation of the usual estimation of the output from an assumed aggregated Cobb-Douglas production function. The firm will produce extraordinary profits of the magnitude \( \frac{\partial Y^G}{\partial G_{t-1}} G_{t-1} = \sigma A_t X_t^{1/\rho - 1} G_{t-1}^\rho, \) since this amount is not charged to the owner of the factor. The government usually does not charge a price that covers the full cost of the services provided with the contribution of public inputs. Therefore a rent is generated. We assume that this rent is dissipated and absorbed by the other factors as:

\[ R_t^e K_{t-1} = \alpha (1 - \sigma) A_t X_t^{1/\rho - 1} (K_{t-1}^{\alpha} L_{t-1}^{1-\alpha})^\rho + s \sigma A_t X_t^{1/\rho - 1} G_{t-1}^\rho, \]

\[ W_t^e L_t = (1 - \alpha) (1 - \sigma) A_t X_t^{1/\rho - 1} (K_{t-1}^{\alpha} L_{t-1}^{1-\alpha})^\rho + (1 - s) \sigma A_t X_t^{1/\rho - 1} G_{t-1}^\rho. \]

The effective return to capital \( R_t^e, \) includes a share \( s \) of the payment to the public input, and the effective return to labor \( W_t^e, \) absorbs the balancing \((1 - s). \) If we assume that \( s = \alpha, \) then,

\[ R_t^e K_{t-1} = \alpha A_t X_t^{1/\rho - 1} [\sigma G_{t-1}^\rho + (1 - \sigma) (K_{t-1}^{\alpha} L_{t-1}^{1-\alpha})^\rho] = \alpha Y_t, \quad (8) \]

\[ W_t^e L_t = (1 - \alpha) A_t X_t^{1/\rho - 1} [\sigma G_{t-1}^\rho + (1 - \sigma) (K_{t-1}^{\alpha} L_{t-1}^{1-\alpha})^\rho] = (1 - \alpha) Y_t. \]

Thus, the economy satisfies the following feasibility constraint:

\[ C_t + I_t + I_{g,t} = R_t^e K_{t-1} + W_t^e L_t \quad (9) \]

The relation of private factors income to the public input income is:

\[ \frac{R_t^e K_{t-1}}{\partial Y^G / \partial G_{t-1}} = \alpha \frac{\sigma G_{t-1}^\rho + (1 - \sigma) (K_{t-1}^{\alpha} L_{t-1}^{1-\alpha})^\rho}{\sigma G_{t-1}^\rho} = \alpha \left( 1 + \frac{1 - \sigma}{\sigma} \left( \frac{K_{t-1}^{\alpha} L_{t-1}^{1-\alpha}}{G_{t-1}} \right)^\rho \right) \]

\[ \frac{W_t^e L_t}{\partial Y^G / \partial G_{t-1}} = (1 - \alpha) \frac{\sigma G_{t-1}^\rho + (1 - \sigma) (K_{t-1}^{\alpha} L_{t-1}^{1-\alpha})^\rho}{\sigma G_{t-1}^\rho} = (1 - \alpha) \left( 1 + \frac{1 - \sigma}{\sigma} \left( \frac{K_{t-1}^{\alpha} L_{t-1}^{1-\alpha}}{G_{t-1}} \right)^\rho \right) \]
2.5 Solution of the model

To compute the solution of the model, we assign the Lagrange multiplier $\lambda_t$, to the budget constraint at dates $t$. The first-order conditions for the consumer are:

$$\frac{1}{C_t} - \lambda_t(1 + \tau^e_t) = 0,$$  \hfill (10)

$$-(1 - \gamma)\frac{1}{N_t - L_t} + \lambda_t(1 - \gamma^t)W^e_t = 0,$$  \hfill (11)

$$\beta^t [\lambda_{t+1} (1 + (1 - \tau^k_t)(R^e_{t+1} - \delta K))] - \lambda_t \beta^{t-1} = 0.$$  \hfill (12)

Together with the first-order conditions of the firm once the public capital rent is reassigned, the budget constraint of the government (4), and the feasibility constraint of the economy, (9), characterize a competitive equilibrium for the economy.

**Definition.** A competitive equilibrium for this economy is a sequence of consumption, leisure, and private investment $\{C_t, N_t - L_t, I_t\}_{t=0}^\infty$ for the consumers, a sequence of capital and labor utilization for the firm $\{K_t, L_t\}_{t=0}^\infty$, and a sequence of government transfers $\{T_t\}_{t=0}^\infty$, such that, given a sequence of prices, $\{W^c_t, R^c_t\}_{t=0}^\infty$, taxes, $\{\tau^c_t, \tau^k_t, \tau^l_t\}_{t=0}^\infty$ and a sequence of public investments $\{I_{gt}\}_{t=0}^\infty$:

i) The optimization problem of the consumer is satisfied.

ii) Given prices for capital and labor, and given a sequence for public inputs, the first-order conditions of the firm are satisfied with respect to capital and labor.

iii) Given a sequence of taxes, and government investment, the sequence of transfers and current spending are such that the government constraint is satisfied.

iv) The feasibility constraint of the economy is satisfied.

Notice that according to the definition of equilibrium for our model economy, the government enters completely parameterized, and fiscal policy is made consistent to the model and the data. In other words, in our model the private sector reacts optimally to policy changes, and these policy changes are given exogenously.
3 Data and Calibration

Before simulating the model, values must be assigned to the parameters. The parameters of the model are:

\[(\alpha, \beta, \gamma, \delta, \sigma, \rho, \tau_c, \tau_l, \tau_k)\]

In calibrating the model presented in the previous section we need three different sets of information: tax rates \((\tau_c, \tau_l, \tau_k)\), technological parameters, \((\alpha, \delta, \sigma, \rho)\) and preference parameters, \((\beta, \gamma, \cdot)\). Following Kydland and Prescott (1982), we set as many parameters as possible in advance based upon \textit{a priori} information.

3.1 Tax rates

Computational macroeconomic models of fiscal policy crucially depend on realistic measures of tax rates. Agents’ decisions depend on marginal tax and therefore effective marginal taxes should be used in the calibration. However, estimating marginal tax rates is a difficult task and, as pointed out by Mendoza, Razin and Tesar (1994), is often impractical at an international level given the limitations due to data availability and difficulties in dealing with the complexity of tax systems. Mendoza \textit{et al.} (1994) proposed a method to estimate effective average taxes and show that these are within the range of marginal tax rates estimated in previous works and display very similar trends. On the other hand, these authors argue that their definition of effective average tax rates can be interpreted as an estimation of specific tax rates that a representative agent, in a general equilibrium context, takes into account. Sørensen (2004) also uses empirical estimates of average effective tax rates in calibrating a static GE model of fiscal policy.

We use effective average tax rates, borrowed from Boscá \textit{et al.} (2005), who used the methodology proposed by Mendoza \textit{et al.} (1994) to estimate these\footnote{Calonge and Conesa (2003) estimated marginal tax rates, following Gouveia and Strauss (1994). They found that the aggregate marginal tax rate is 1.8 times greater than the aggregate average tax rate. However, inspection of the figures from estimated average tax rates reveals this proportion to be very large.}. Table 1 shows the estimated average tax rates reported by Boscá \textit{et al.} (2005) for the year 2001 for the selected countries, including consumption...
tax rates, labor tax rates and capital tax rates. However, the use of average effective tax rates involves the use of conservative values (smaller implied behavioral responses).

<table>
<thead>
<tr>
<th>Country</th>
<th>$\tau^c$</th>
<th>$\tau^l$</th>
<th>$\tau^k$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>0.141</td>
<td>0.474</td>
<td>0.245</td>
</tr>
<tr>
<td>Belgium</td>
<td>0.123</td>
<td>0.452</td>
<td>0.288</td>
</tr>
<tr>
<td>Denmark</td>
<td><strong>0.201</strong></td>
<td>0.439</td>
<td><strong>0.388</strong></td>
</tr>
<tr>
<td>Finland</td>
<td>0.178</td>
<td>0.473</td>
<td>0.288</td>
</tr>
<tr>
<td>France</td>
<td>0.132</td>
<td>0.433</td>
<td>0.350</td>
</tr>
<tr>
<td>Germany</td>
<td>0.124</td>
<td>0.381</td>
<td>0.181</td>
</tr>
<tr>
<td>Greece</td>
<td>0.148</td>
<td>0.410</td>
<td>0.164</td>
</tr>
<tr>
<td>Ireland</td>
<td>0.173</td>
<td>0.316</td>
<td><strong>0.136</strong></td>
</tr>
<tr>
<td>Italy</td>
<td>0.107</td>
<td>0.417</td>
<td>0.262</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.148</td>
<td>0.363</td>
<td>0.232</td>
</tr>
<tr>
<td>Portugal</td>
<td>0.150</td>
<td>0.303</td>
<td>0.245</td>
</tr>
<tr>
<td>Spain</td>
<td>0.113</td>
<td>0.341</td>
<td>0.219</td>
</tr>
<tr>
<td>Sweden</td>
<td>0.133</td>
<td><strong>0.555</strong></td>
<td>0.361</td>
</tr>
<tr>
<td>UK</td>
<td>0.123</td>
<td><strong>0.254</strong></td>
<td>0.343</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>0.142</td>
<td>0.400</td>
<td>0.264</td>
</tr>
<tr>
<td><strong>Std. Dev.</strong></td>
<td>0.026</td>
<td>0.079</td>
<td>0.076</td>
</tr>
</tbody>
</table>

Table 1 shows important differences between EU countries. In the case of consumption tax, the maximum value corresponds to Denmark (0.201) whereas the lowest value corresponds to Italy (0.107). Therefore, despite VAT harmonization treaties in the EU, which lead to consumption tax convergence, there are important differences between EU countries. However, the standard deviation of consumption tax is significantly lower than the standard deviation of both labor and capital taxes. The labor tax rate ranges from a minimum of 0.254 for the UK to a maximum of 0.555 for Sweden. Finally, capital tax rates range from the very low rate of Ireland (0.136) to 0.388 in Denmark, with a variability similar to that of labor tax.
3.2 Preference parameters

Second, preference parameters are calibrated using data observations for the years 2000-2001, taken from the National Accounts OECD Database. From the first-order conditions we can obtain the following value of $\beta$ and $\gamma$ as a function of data observations:

$$\beta = \frac{1}{1 + (1 - \tau_{t+1}^k)(R_{t+1} - \delta)/(1 + \tau_{t}^c)C_t}$$  \tag{13}$$

$$\gamma = \frac{C_t}{(1-\tau_{t}^c)W(N_tH - L_t) + C_t}$$  \tag{14}$$

The value of $\beta$ goes from 0.937 for Ireland to 0.981 for Denmark. Most countries have values in the interval 0.96-0.97. The parameter $\gamma$ ranges from 0.376 for Denmark and the Netherlands to 0.525 for Greece.

3.3 Technological parameters

Finally, we use data from the national income and product accounts for the 14 countries to calibrate the technological parameters. Data are taken from the National Accounts OECD database. First, to determine the value of the total disposable effective time endowment of individuals, $N_tH$, that is, non-sleeping hours of the working-age population, we assume that each adult has a time endowment of 96 hours per week ($H = 96$). Data on the population aged from 15 to 64 years and the average hours worked per year were obtained from the Corporate Data Environment OECD Database.

Next, we compute the values for all the technological parameters in the model. Following Conesa and Kehoe (2003), the aggregate labor income share, $(1 - \alpha)$, is computed as unambiguous labor income divided the sum of unambiguous labor income and unambiguous capital income:

$$1 - \alpha = \frac{CE}{GDP - NWI - TS}$$

where $CE$ is the compensation of employees, $GDP$ is the Gross Domestic Product, $NW\overline{I}$ is non-wage income of the households defined as the net operating surplus plus the net mixed income of the household sector of the economy, and $TS$ is taxes less subsidies. The results obtained are consistent
with the ones reported by the European Commission (1995). Aggregate capital income shares $\alpha$ range from 0.281 for Portugal to 0.387 for Finland. The values are in the interval 0.30-0.34 in most countries.

The depreciation rate of private capital, $\delta_K$, was chosen to match the depreciation-output ratio obtained from the data. The capital stock was generated using a perpetual inventory method under the assumption of a geometric depreciation rate:

$$K_t = (1 - \delta_K)K_{t-1} + I_t$$

Capital series were generated for the period 1970-2001. The initial capital stock was chosen iteratively to match the average capital-output ratio over the period 1970-1979. In constructing the public capital stock we assume that the depreciation rate is equal to the depreciation rate of the private capital stock. Total public capital stock have been derived using series for government consumption of fixed capital, given the computed depreciation rate. Values for the depreciation rate go from 0.040 of Austria to 0.064 of Denmark.

The weight of public capital relative to private factors have been calculated from the National Accounts OECD database. The parameter $\sigma$ is calibrated to match the ratio of public capital to GDP. Values range from 0.027 for Austria to 0.12 for Ireland.\(^8\)

Finally, the parameter $\rho$ is set equal to zero, that is, we assume that the elasticity of substitution between public and private inputs is unity. Note that this assumption implies that the production function given by (3) is transformed into a Cobb-Douglas:

$$Y_t = A_tG_{t-1}^{\alpha(1-\sigma)} K_{t-1}^{\alpha(1-\sigma)(1-\sigma)} L_t^{(1-\alpha)(1-\sigma)}$$

Table 2 summarizes the calibrated parameter values for the EU countries used in the computations.

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\(^8\)A large variety of papers estimating this parameter for the U.S. economy appear in the literature. For instance, Cassou and Lansing (1998) introduce public capital stock using a Cobb-Douglas production function. In the calibration they consider a range of values for the public capital share of output between 0 and 0.12. Aschauer (1989) and Munnell (1990) estimate values of 0.39 and 0.34, respectively. On the other hand, Aaron (1990) and Tatom (1991) estimate values that are not statistically different from zero. Guo and Lansing (1997) obtain a value of 0.0525.
### Table 2: Calibrated parameter values

<table>
<thead>
<tr>
<th>Country</th>
<th>$\alpha$</th>
<th>$\beta$</th>
<th>$\gamma$</th>
<th>$\delta$</th>
<th>$\sigma$</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0.334</td>
<td>0.973</td>
<td>0.472</td>
<td>0.040</td>
<td>0.027</td>
</tr>
<tr>
<td>Belgium</td>
<td>0.321</td>
<td>0.970</td>
<td>0.471</td>
<td>0.048</td>
<td>0.033</td>
</tr>
<tr>
<td>Denmark</td>
<td>0.308</td>
<td>0.981</td>
<td>0.376</td>
<td>0.064</td>
<td>0.031</td>
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<tr>
<td>Finland</td>
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<td>France</td>
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<td>0.965</td>
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</tr>
<tr>
<td>Germany</td>
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<td>0.967</td>
<td>0.405</td>
<td>0.053</td>
<td>0.034</td>
</tr>
<tr>
<td>Greece</td>
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<td>0.941</td>
<td>0.525</td>
<td>0.043</td>
<td>0.041</td>
</tr>
<tr>
<td>Ireland</td>
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<td>0.937</td>
<td>0.380</td>
<td>0.063</td>
<td>0.120</td>
</tr>
<tr>
<td>Italy</td>
<td>0.328</td>
<td>0.965</td>
<td>0.500</td>
<td>0.043</td>
<td>0.059</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.337</td>
<td>0.960</td>
<td>0.376</td>
<td>0.057</td>
<td>0.074</td>
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<tr>
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<td>0.987</td>
<td>0.406</td>
<td>0.049</td>
<td>0.064</td>
</tr>
<tr>
<td>Spain</td>
<td>0.340</td>
<td>0.952</td>
<td>0.458</td>
<td>0.050</td>
<td>0.078</td>
</tr>
<tr>
<td>Sweden</td>
<td>0.292</td>
<td>0.975</td>
<td>0.472</td>
<td>0.057</td>
<td>0.059</td>
</tr>
<tr>
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<td>0.295</td>
<td>0.963</td>
<td>0.443</td>
<td>0.047</td>
<td>0.030</td>
</tr>
</tbody>
</table>

### 4 The maximum of the Laffer curve

The model calibrated in the above section can be used to answer several questions about fiscal policy in the EU countries. The first natural question in our context is related to the relationship between fiscal policy in each country and the Laffer curve. How far are the current tax levels for each country from the maximum tax revenue level? Is there any country to the right, the “dark side”, of the maximum of the Laffer curve? To answer these questions we first calibrate the model to identify the current situation for each country. This exercise allows us to compute the maximum fiscal revenue level and the maximum productive efficiency level, given the current tax code. Consumption tax rates are fixed and therefore we focus on the role of capital and labor taxes. Thus, we build a bi-dimensional Laffer curve in terms of labor and capital tax rates, as the locus of capital and labor tax rates that yield the same fiscal revenues. This bi-dimensional Laffer curve will show the level of fiscal revenues for each combination of capital and labor taxes. From these calculations we can obtain a map of iso-revenue curves, indicating all the combinations of capital and labor tax rates which generate a given fiscal revenue.

Figure 1(a-m) shows the iso-revenue curves for all countries. We plot
the iso-revenue curve for the current (using 2001 as the reference year) level of fiscal revenues for each country, indicating the current tax code in terms of labor and capital income taxes and the combinations of tax pairs that produce the same level of fiscal revenues. We also show the iso-revenue curves corresponding to 90%, 80% and 70% of the current fiscal revenues and the maximum level fiscal revenues tax combination. Several interesting results emerge from these figures. First, the maximum fiscal revenue level corresponds to relatively low tax rates values. This means that, given the current tax level, there is less room available to increase capital and labor tax rates in the case of countries which want to increase fiscal revenues. Second, tax levels that maximize fiscal revenues are fairly similar between countries indicating that the maximum of the Laffer curve is not very different from one country to another. This is a consequence of the fact that preferences and technological parameters are quite similar across European countries. Labor tax rates at maximum are very similar, around 49% for all countries. A little more variability is found in the case of the capital tax rates, with an average value around 37%.

Another important finding is that for all the countries, the iso-revenue curves take the form of an ellipse, although this is very vertical, representing capital tax in the vertical axis and labor tax in the horizontal axis. This implies that fiscal revenues are very sensitive to changes in the labor tax but not to changes in the capital tax. There may be several reasons that explain this result. First, labor income is more important than capital income because it represents a larger share of national income. Thus, fiscal revenues are more sensitive to changes in the labor tax than to changes in the capital tax. Second, this result implies that the distortionary effects of capital taxes are larger than those corresponding to labor taxes. For instance, an increase in the capital tax rate leads to a very small change in fiscal revenues, due to the fact that such an increase negatively affects capital accumulation to a strong degree.

The results of this exercise are summarized in Table 3. Columns 2 and 3 show tax rates that maximize fiscal revenues (the difference in relation to the current tax rates is shown in brackets), while columns 4 and 5 compute the tax rates corresponding to the maximum productive efficiency. The right-most column shows the percentage deviations in terms of fiscal revenues of the current situation for each country with respect to the maximum fiscal
We observe that there are several countries where the current tax code (2001 as the reference year) is very close to the maximal fiscal revenue tax code. Moreover, some of them are situated on the right, the “dark side”, of the maximum of the bi-dimensional Laffer curve. Austria, Belgium, Denmark, Finland, France and Sweden are countries where the current tax code is very close to the maximum tax revenue level. On the opposite side, the countries that are farther from the Laffer maximum are Portugal, the UK, Ireland, and Spain.

In particular, we observe three countries that are situated on the “dark side” of the Laffer curve, where some taxes are above the maximum fiscal revenue tax level; this is termed “the prohibitive range” by Laffer (1981). These are Denmark, Finland and Sweden⁹. In the case of Denmark we observe that the capital tax is slightly above the maximum revenue capital tax. In

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⁹Jonsson and Klein (2003), calibrating three different GE models, also found that Sweden is well to the right of the maximum of the Laffer curve for most of the tax instruments. A similar result was found by Hansson (1984) using a static model.
fact, Denmark is the EU-15 country with the largest capital tax rate. Simply stated, by reducing the capital tax rate, fiscal revenues in Denmark would increase. The other two special cases are Finland and Sweden, where the labor tax rate is above the maximum fiscal revenues labor tax, particularly in Sweden. Therefore, reducing the labor tax rate would lead to an increase in both fiscal revenue and efficiency in these two countries.

Finally, we also compute the maximum efficiency tax code for each country, that is, the tax code corresponding to the maximum output level, given the consumption tax rate. Without the existence of public capital in the production function, the maximum efficiency tax code would be trivially zero. Not surprisingly, the maximum productive efficiency shows zero capital tax rates for all countries. However, we find several examples with positive labor taxes, such as France, Ireland, Italy, the Netherlands, Portugal, Spain and Sweden. This finding shows that for these countries, fiscal revenues obtained from consumption taxes are not sufficient to support the observed level of public input provision. The largest values for the maximum efficiency labor tax rates correspond to Ireland (8%) and Spain (6%), followed by France (5%) and Italy (4%). For Austria, Belgium, Denmark, Germany, Greece and the UK, the fiscal revenues obtained from consumption tax are sufficient to support the observed level of public input provision.

This set of results shows that the macroeconomic implications of the tax system in the European countries are very similar, both in terms of fiscal revenues and efficiency. We find that capital and labor tax rates corresponding to the maximum of the Laffer bi-dimensional curve are similar between countries. Thus, a natural way to achieve fiscal harmonization in Europe would be for all the countries to move to the maximal tax revenues level. If the objective of all the countries was to maximize tax revenues, then fiscal harmonization would be almost perfect, with respect to both labor and capital tax rates. A similar result would be obtained if all the countries decided to implement a fiscal policy with the objective of achieving the maximal efficiency level. In this case, the total harmonization of the capital tax rates would be obtained if all the countries decided to use a maximal efficiency tax code.

\[10\] See, for instance, Jones, Manuelli and Rossi (1997) and Auerbach (2006) for an evaluation of the optimal capital income taxation.
5 The optimal tax code

Next, we consider the optimal tax level for each country, fixing fiscal revenues at the current (using 2001 as the reference year) observed level. That is, given the fiscal revenues level and all the combinations of capital and labor taxes that produce such a fiscal revenues level, we compute the pair \((\tau_k, \tau_l)\) that produce the maximum level of output. The question we want to answer is whether it is possible to increase productive efficiency in the different European countries by substituting one tax by the other without changing public revenues. Maximizing productive efficiency, given a certain level of fiscal revenues, involves finding an ordered pair \((\tau_k, \tau_l)\) such that the rate of substitution between capital and labor tax that keeps production constant is equal to the rate of substitution that keeps fiscal revenues constant. For most countries this would involve a substitution of capital by labor taxes, that is, the government budget balance is maintained through adjustment in the tax rate on labor income.

Table 4 shows the optimal tax code for each country together with the percentage change in output, capital and labor that should be verified in order to attain the optimal tax schedule. Additionally, Figure 2(a-m) combines the iso-revenue curves together with the iso-output curves, representing combinations of capital and labor tax rates that produce the same level of output. We plot the iso-revenue curve corresponding to the current level of fiscal revenues together with the iso-output curves, normalized to 100 at the point of the current tax code. For each level of fiscal revenues, there is only one pair of tax rates that maximizes output, determined by the tangency point closest to the origin between the iso-revenue and the iso-output curves. As we can see, the iso-output curves are concave and, as shown in the previous section, the maximum efficiency level corresponds to a non-zero tax rate for some countries\(^\text{11}\).

For most countries, optimal tax rates imply a reduction in capital tax rates and an increase in labor tax rates. As a consequence, such a change will increase capital stock and reduce labor. This result is found in all the countries except Finland and Sweden, that is, the two countries where the

\(^{11}\text{Laffer (1981), assumes that the iso-output curves between capital and labor taxes are convex, reflecting the implicit assumption of a diminishing marginal rate of substitution between factor tax rates. However, calibration of our model suggests the existence of an increasing marginal rate of substitution between factor tax rates.}
labor tax rate is above the maximum revenue labor tax.

Table 4: Optimal tax code

<table>
<thead>
<tr>
<th></th>
<th>(\tau^l)</th>
<th>(\tau^k)</th>
<th>Change in GDP (%)</th>
<th>Change in K (%)</th>
<th>Change in L (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>0.47</td>
<td>0.25</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Belgium</td>
<td>0.47</td>
<td>0.20</td>
<td>0.66</td>
<td>6.27</td>
<td>-1.85</td>
</tr>
<tr>
<td>Denmark</td>
<td>0.45</td>
<td>0.31</td>
<td>1.07</td>
<td>5.07</td>
<td>-0.61</td>
</tr>
<tr>
<td>Finland</td>
<td>0.46</td>
<td>0.30</td>
<td>0.68</td>
<td>-0.09</td>
<td>1.26</td>
</tr>
<tr>
<td>France</td>
<td>0.46</td>
<td>0.26</td>
<td>0.61</td>
<td>5.69</td>
<td>-3.20</td>
</tr>
<tr>
<td>Germany</td>
<td>0.42</td>
<td>0.00</td>
<td>0.85</td>
<td>8.72</td>
<td>-3.57</td>
</tr>
<tr>
<td>Greece</td>
<td>0.43</td>
<td>0.09</td>
<td>0.11</td>
<td>6.40</td>
<td>-1.87</td>
</tr>
<tr>
<td>Ireland</td>
<td>0.35</td>
<td>0.00</td>
<td>0.64</td>
<td>8.62</td>
<td>-3.36</td>
</tr>
<tr>
<td>Italy</td>
<td>0.46</td>
<td>0.10</td>
<td>1.52</td>
<td>10.68</td>
<td>-2.52</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.40</td>
<td>0.07</td>
<td>0.86</td>
<td>10.12</td>
<td>-3.44</td>
</tr>
<tr>
<td>Portugal</td>
<td>0.32</td>
<td>0.00</td>
<td>1.92</td>
<td>9.02</td>
<td>-0.74</td>
</tr>
<tr>
<td>Spain</td>
<td>0.40</td>
<td>0.00</td>
<td>1.68</td>
<td>17.07</td>
<td>-3.81</td>
</tr>
<tr>
<td>Sweden</td>
<td>0.49</td>
<td>0.28</td>
<td>11.19</td>
<td>16.50</td>
<td>10.22</td>
</tr>
<tr>
<td>UK</td>
<td>0.31</td>
<td>0.00</td>
<td>4.32</td>
<td>28.46</td>
<td>-4.26</td>
</tr>
<tr>
<td>Average</td>
<td>0.420</td>
<td>0.133</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>0.058</td>
<td>0.127</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The tax code is optimal for Austria, i.e., given the current level of fiscal revenues, and given the consumption tax rate in Austria, the combination of capital and labor tax rates in this country corresponds to the maximum output level. Greece is another country where the current tax code is very close to the optimal and so small gains can be generated by changing the current tax code. In fact, changing the current tax rates would increase output by only 0.11%. However, the reduction in the capital tax rate and the increase in the labor tax rate would generate an increase of 6.4% in the stock of capital and a reduction of 1.87% in labor. On the other hand, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, and the Netherlands are countries where the optimal tax code does not cause a significant change in GDP, but involves important variations in the utilization of capital and labor. For Germany, Ireland, the Netherlands, Portugal, Spain and the UK, capital tax goes to zero. Razin and Yuen (1999) show that under both tax competition and tax coordination, the optimal long-run tax rate on
capital incomes will be zero, resulting in the so-called “race to the bottom” in capital income taxation. Note that the countries for which the optimal capital tax is zero are the countries where the current level of fiscal revenues is far from the maximum of the Laffer curve.

The most inefficient case is that of Sweden, located at the right of the maximum of the Laffer curve. By reducing both capital and labor taxes, productive efficiency would increase, whereas tax revenues remain constant. In fact, by changing the combination of taxes and moving to the optimal ones, output would increase by 11.2%. Moreover, the utilization of capital and labor factors would increase.

The results obtained from the above exercise give us some idea regarding the question of whether the optimal tax code for each country, given the current level of fiscal revenues, favors fiscal harmonization or not. The answer is positive in the case of labor tax rates, whereas it is negative in the case of capital tax rates. Optimal labor tax rates display a standard deviation of 0.058, whereas the standard deviation is 0.079 in the current situation. Thus, variability of labor tax rates between countries would be reduced if these countries change the current level of labor tax rates to the optimal ones. However, we observe how capital tax rates variability increases in the optimal tax code.

6 Capital tax harmonization

Finally, we conduct a simulation exercise on the effects of capital tax harmonization on fiscal revenues and output in the EU countries. We consider two capital harmonization possibilities: first, harmonization is assumed to take place at the unweighted average capital tax rate, similar to the analysis in Sørensen (2004); and second, harmonization is assumed to take place at the minimum capital tax rate, corresponding to Ireland. The average capital tax rate is 0.264, whereas the capital tax rate in Ireland is 0.136.

Table 5 summarizes the results of the simulation in terms of fiscal revenues and output changes (steady state values). First, considering the case of capital tax harmonization based on the average capital tax, we observe that the fiscal revenues do not change significantly for most countries, except in the case of Ireland. This result is due to the fact that Ireland has a very low capital tax rate compared to other countries. On the other hand,
Belgium, Denmark, Finland, France and the UK are countries where fiscal revenues decrease, whereas fiscal revenues increase in any other country. The most favored country is Sweden, where fiscal revenues remain almost constant, whereas output increases by 2.8%. In terms of output, this harmonization process would negatively affect Germany, Greece and Ireland for which output would decrease between 2% and 4%, and, to a lesser extent, in Spain (1.5%) and the Netherlands (-1%). On the other hand, output would increases by around 3% in Denmark, France, Sweden and in the UK. In general, we find that the response of fiscal revenues to changes in capital taxes is far smaller than the response of output. This result indicates that the distortions generated by capital taxes are significant.

Next, we consider the case where capital tax harmonization takes place at the minimum capital tax rate, corresponding to Ireland (0.136). This implies a reduction in capital tax rates in all EU-15 countries and no change for the Irish economy. In this case, as expected, all countries experience a loss of fiscal revenues (except, of course, Ireland), given the significant reduction in the capital tax rate. The most important reductions in fiscal revenues correspond to the UK (around -5%), France (-2.5%) and Spain (-2.2%). However, gains in efficiency are very important, and output increases significantly in all countries. The UK is the country were fiscal revenues would decrease by a larger proportion, close to -5%, but output would increase by 7%. In the case of Spain we observe that fiscal revenues are very sensitive to the change in capital tax, but changes in output are small. In fact, the reduction in fiscal revenues are similar in Spain and France, but whereas in the former output increases only by 2.75%, in the case of France output increases by 7.7%. The largest effects on output, other than in the UK and France, occur in Finland, where output increases by more than 7%, whereas fiscal revenues decrease by 1 percent, and in Denmark where, with a very small reduction in fiscal revenues (-0.43%), output increases by 6.5%. Similarly, in Sweden, the new capital tax will reduce fiscal revenues by 0.16% but will increase output by 5.63%.

Comparing both exercises, our simulations show that the real effects of capital tax harmonization are always positive in the second case (Ireland or minimum capital tax), whereas real effects would be negative for a large number of countries in the first case (average capital tax). From this point of view, it seems that countries would prefer a harmonization process involving a
reduction in capital tax rather than a harmonization process in which some countries would have to reduce capital tax whereas other countries would have to increase it. However, this would involve an important slowdown in fiscal revenues for some of the countries.

<table>
<thead>
<tr>
<th>Table 5: Capital tax harmonization</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average capital tax</strong></td>
</tr>
<tr>
<td>Revenues (%)</td>
</tr>
<tr>
<td>Austria</td>
</tr>
<tr>
<td>Belgium</td>
</tr>
<tr>
<td>Denmark</td>
</tr>
<tr>
<td>Finland</td>
</tr>
<tr>
<td>France</td>
</tr>
<tr>
<td>Germany</td>
</tr>
<tr>
<td>Greece</td>
</tr>
<tr>
<td>Ireland</td>
</tr>
<tr>
<td>Italy</td>
</tr>
<tr>
<td>Netherlands</td>
</tr>
<tr>
<td>Portugal</td>
</tr>
<tr>
<td>Spain</td>
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<td>Sweden</td>
</tr>
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<td>UK</td>
</tr>
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</table>

7 Conclusions

Fiscal harmonization among the European Union member states is a goal involving major difficulties for its implementation. Each country faces a particular trade-off between fiscal revenues generated by taxation and the efficiency loss induced by the tax code. This fiscal harmonization process is particularly important with respect to capital taxes, given the perfect capital mobility across European countries.

This paper provides a quantitative measure of these trade-offs for a number of taxes and for all those countries of the European Union using a DGE model with public input provision. We calibrate the model for each country and use it to answer a set of important questions regarding fiscal policy and fiscal harmonization in the EU-15 context. In summary, calibration of
the model for the EU-15 member countries, except Luxembourg, yields the following results:

i) First, we calculate bi-dimensional Laffer curves for each country to compute the maximal revenue tax code for each one. We find that the maximum tax revenue level is not far from the current tax level for most countries.

ii) The case of Sweden, Denmark and Finland are anomalous, as efficiency can be gained by lowering tax rates without changing fiscal revenues. This is due to the fact that these three countries are situated on the "dark side" of the maximum of the Laffer curve for some taxes, i.e., to the right.

iii) In general, countries would obtain efficiency gains without changing fiscal revenues by reducing capital taxes and increasing labor taxes. Additionally, we find a group of countries for which the maximal efficiency capital tax rate is zero. These countries are the ones in which the current level of fiscal revenues is far from the maximum of the Laffer curve.

iv) Finally, we conduct a simulation exercise showing that capital tax harmonization to the average capital tax rate can be done with quite small changes in fiscal revenues but with important (negative and positive) changes in output. However, when capital harmonization is assumed to be done at the minimum current capital tax, the effects on output would be positive for all countries, but at the cost of a reduction in fiscal revenues. This second harmonization process option, or at least a reduction in capital taxes, would seem to be the most preferable for the European Union countries.

References


Figure 1.a: Iso-revenue curves (Austria).

Figure 1.b: Iso-revenue curves (Belgium).
### Denmark

<table>
<thead>
<tr>
<th>Labor tax rate</th>
<th>Capital tax rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>0.4</td>
<td>0.3</td>
</tr>
<tr>
<td>0.5</td>
<td>0.4</td>
</tr>
<tr>
<td>0.6</td>
<td>0.5</td>
</tr>
<tr>
<td>0.7</td>
<td>0.6</td>
</tr>
<tr>
<td>0.8</td>
<td>0.7</td>
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- [0.44, 0.30]
- [0.45, 0.36]
- 0.999

Figure 1.c: Iso-revenue curves (Denmark).

### Finland

<table>
<thead>
<tr>
<th>Labor tax rate</th>
<th>Capital tax rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>0.4</td>
<td>0.3</td>
</tr>
<tr>
<td>0.5</td>
<td>0.4</td>
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<tr>
<td>0.6</td>
<td>0.5</td>
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<tr>
<td>0.7</td>
<td>0.6</td>
</tr>
<tr>
<td>0.8</td>
<td>0.7</td>
</tr>
</tbody>
</table>

- [0.46, 0.34]
- [0.47, 0.29]
- 0.999

Figure 1.d: Iso-revenue curves (Finland).
Figure 1.e: Iso-revenue curves (France).

Figure 1.f: Iso-revenue curves (Germany).
Figure 1.g: Iso-revenue curves (Greece).

Figure 1.h: Iso-revenue curves (Ireland).
Figure 1.i: Iso-revenue curves (Italy).

Figure 1.j: Iso-revenue curves (Netherlands).
Figure 1.k: Iso-revenue curves (Portugal).

Figure 1.l: Iso-revenue curves (Spain).
Figure 1.m: Iso-revenue curves (Sweden).

Figure 1.n: Iso-revenue curves (UK).
Figure 2.a: Optimal tax code (Austria).

Figure 2.b: Optimal tax code (Belgium).
Figure 2.c: Optimal tax code (Denmark).

Figure 2.d: Optimal tax code (Finland).
Figure 2.e: Optimal tax code (France).

Figure 2.f: Optimal tax code (Germany).
Figure 2.g: Optimal tax code (Greece).

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