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CORPORATE INCOME TAX REFORM IN THE EU[1]

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Abstract

Using CORTAX, a computable general equilibrium (CGE) model designed to assess the economic impact of corporate taxation, we examine the possible economic impacts of uncoordinated and coordinated changes in national corporate tax rates among a group of economies (the EU) that are tightly associated through international trade and investment. The aim is to contribute to the ongoing debate about the desirability, modality and likely impact of alternative policy solutions to the challenges posed by tax competition and aggressive tax planning. Corporate income tax rates can generate substantial responses within the implementing country as well as beyond its own borders. Harmonisation of CIT rates would likely involve winners and losers, and as such, may be best pursued gradually and as part of a broader package of corporate tax reform.

1. Introduction

There are increasing calls for corporate tax reforms across the EU. These are motivated by evidence that the current system is unfair and inefficient. Uncoordinated national tax regimes can feature tax loopholes and inconsistencies in the treatment of corporate profits across borders that give rise to strategic tax planning by multinational corporations. There is growing recognition of these issues and a renewed impetus to address them. The European Commission has put forward an ambitious Action Plan on Corporate Taxation (EC, 2015) and attempts are being made to improve international coordination of national corporate tax policies through the OECD Base Erosion and Profit Shifting (BEPS) Project.

In this paper, we evaluate the effects of hypothetical changes in corporate income tax (CIT) rate on EU economies using CORTAX, a computable general equilibrium (CGE) model. The model captures the key features of the corporate tax regimes including investment decisions, loss compensation, multinational profit shifting and the debt-equity choice of firms. CORTAX is a multi-regional model including all 28 EU member states, the USA and Japan. It encapsulates the behaviour of all economic agents, reflecting both the direct and indirect effects of policy changes on macroeconomic variables, such as GDP, investment and employment. The CORTAX model was originally built by the Centraal

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Planbureau (CPB) in the Netherlands (Bettendorf and van der Horst, 2006 and Bettendorf et al., 2009), based on the OECDTAX model (Sorensen, 2001). Using CORTAX we show some of the first-order effects of hypothetical changes in tax rates in a group of economies (the EU) that are tightly associated through international trade and investment. The aim is to contribute to the ongoing debate about the desirability and likely impact of alternative policy solutions to the challenges posed by aggressive tax planning.

We simulate the impact of removing differences in corporate tax rates across EU countries and their effect on tax competition considering both uncoordinated and coordinated changes. For each of the three simulations, revenue neutrality is maintained by adjusting labour taxes to compensate for any revenue increase or shortfall caused. In addition, sensitivity analysis is performed, ensuring budget neutrality through adjusting transfer to pensioners or government expenditure. We first consider simulations where one country raises or lowers its rate in isolation. We simulate an upward adjustment in a low CIT tax economy, namely Ireland, up to the level of a higher tax economy, namely Germany. These two countries represent to polar examples since Ireland has the lowest statutory CIT rate in the EU and in Germany, which is the largest country in the Union, the CIT rate is among the highest. Second, we simulate the reverse case, where Germany reduces its rate to the Irish level. In each case, we observe the impact on the country affected as well as the international spillover effects. The third simulation supposes that all EU member states choose to harmonise their CIT rates at the EU average level.

The first two simulations reveal that a tax shift from labour tax to corporate tax (Ireland) has a negative impact on GDP, whilst a tax shift from corporate tax to labour tax (Germany) has a positive impact on GDP. On the other hand, the impact on (after-tax) wages moves in the opposite direction. As anticipated, the German CIT rate simulation causes larger spillover effects, with all other countries' GDP being negatively affected to some degree. Nevertheless, the benefits to Germany are sufficient to slightly raise EU GDP by 0.19 percent.

The third simulation, where CIT rates are harmonised across the EU, tends to suggest that a tax shift from corporate tax to labour tax raises GDP, whilst the opposite tax shift lowers GDP; this holds true for 22 out of 28 EU countries. The aggregate impact is a small fall in EU GDP of 0.13 percent. This result broadly holds for the alternative budget-neutral closures. A benefit of CIT rate harmonisation is that it removes much of the incentive to engage in profit shifting.

We conclude that corporate income tax rates can generate substantial responses within the implementing country as well as beyond its own borders. Harmonisation of CIT rates would likely involve winners and losers, and as such, may be best pursued gradually and as part of a broader package of corporate tax reform.

2. Properties of CORTAX

In this section, it is described the structure of CORTAX and its calibration, describing the data sources used and its preparation as well as the European tax systems.

2.1 Structure of CORTAX

The CORTAX model has been designed to simulate the economic impact of national and international tax policy reforms, as well as the international harmonisation of national tax policies. CORTAX allows simulations of the effects of corporate tax changes within a framework that takes into account the transactions between firms (including MNEs), households and governments. In the model, each country is assumed to have the same structure in terms of consumption, savings, production and public finances (though the data i country-specific, see below). Countries are linked to each other via international trade in goods markets, international goods markets and investment by MNEs. Firms are divided into three categories: MNE´s headquarter, their subsidiaries located abroad and domestic firms that only produce in their country of residence. Multinationals and domestic firms differ to the extent that the former optimise profits globally and are engaged in profit shifting activities across borders. Domestic firms pay their corporate taxes in their country of residence according to the revenues generated in this country only. The effects of reforms can be expressed as changes in GDP, household consumption, business investment and fiscal revenue.

The model is elaborated using data from different data sources. In the present exercise, the model has been constructed with a database for the year 2012. The structural descriptions offered here, as well as aspects of the calibration, borrow heavily from Bettendorf et al. (2009).

The data sources used are Eurostat, the OECD, UN, ZEW-Mannheim (for tax codes, including asset-specific corporate tax credit and allowances) and company-level information on investment by asset type and source of financing from the Bureau van Dijk Orbis database (explained in section 2.3.1). Company behaviour in the model with respect to e.g. profit shifting closely corresponds to insights offered by empirical literature. Likewise, the model incorporates empirical insights on tax compliance costs, which are set to be at 4% of corporate tax revenue for all firms.

The model captures the economic behaviour of all the agents in the economy: Households, Firms (domestic, multinationals headquarters and subsidiaries), the Government and the Foreign sector (see, Bettendorf et al., Oct 2009, Section 2.1). The following addresses the main elements of each of these in turn.

Households. There are two types of households: old and young. Their lifetime is 40-year periods each and their behaviour remains the same during the whole period. Households maximise their intra-temporal utility function $U(t)$ with v^y being the utility of young generation and v^0 the utility of old generation:

$$U(t) = \frac{1}{1 - {}^{1}/_{\sigma_u}} \left[\sum_{\tau=0}^{T-1} \frac{v^y (t+\tau)^{1-{}^{1}/_{\sigma_u}}}{\rho_u^\tau} + \frac{\rho_0}{\rho_u^\tau} \sum_{\tau=0}^{T-1} \frac{v^0 (t+T+\tau)^{1-{}^{1}/_{\sigma_u}}}{\rho_u^\tau} \right]$$

$$= \frac{1}{1-1/\sigma_u}\left[v^y(t)^{1-1/\sigma_u} + \frac{\rho_0}{\rho_u^\tau} v^0(t+T)^{1-1/\sigma_u}\right] \sum_{\tau=0}^{T-1} \left(\frac{1+g_a}{\rho_u}\right)^\tau \quad (1)$$

where ρ_u^τ is the rate of time preference and σ_u the intertemporal substitution elasticity. g_a is the productivity growth rate.

This maximisation is subject to an intra-temporal budget constraint where net savings from young workers (wages, current transfers and negative consumption), in the left side of equation (1), are equal to negative value of net savings from all households. Young households receive income from labour $\bar{w}(t)l$ and other transfers while old households do not work and only receive income from transfers $\left(tr^0(t)\right)$ and the fixed factor $\left(\pi^0(t)\right)$ as described by Equation (2):

$$\bar{w}(t)l + tr^y(t) - (1+\tau_c)c^y(t) = -\left(\frac{1+g_a}{\rho_s}\right)^\tau \left[\pi^0(t) + tr^0(t) - (1+\tau_c)c^0(t)\right] \quad (2)$$

The intra-temporal utility function is composed by consumption (c^y) and leisure $\left(\hat{l}\right)$ included in equation:

$$v^y(\tau) = \begin{cases} \left[c^y(\tau)^{\frac{\sigma_l-1}{\sigma_l}} + \alpha_l \left(A_l(\tau)\hat{l}(\tau)\right)^{\frac{\sigma_l-1}{\sigma_l}}\right]^{\frac{\sigma_l}{\sigma_l-1}} & \sigma_l \neq 1 \\ c^y(\tau)^{\frac{1}{1+\alpha_l}} \left(A_l(\tau)\hat{l}(\tau)\right)^{\frac{\alpha_l}{1+\alpha_l}} & \sigma_l = 1 \end{cases} \quad (3)$$

In this equation α_l is the weight of leisure in utility and σ_l is a intra-temporal substitution elasticity.

The optimal consumption path and labour supply can be obtained from the first order conditions (FOC). In accordance with the empirical literature, the model assumes that substitution effects dominate and the uncompensated elasticity of labour supply is positive. Households´ savings are allocated to bonds and stocks, which are imperfect substitutes and have different rates of return. Total bonds and stock holdings are derived from the maximisation of total assets CES combination of bonds (b) and equities (e)subject to their total value:

$$A = \left[\alpha^{\frac{-1}{\sigma_s}} b^{\frac{\sigma_s+1}{\sigma_s}} + \alpha^{\frac{-1}{\sigma_s}} e^{\frac{\sigma_s+1}{\sigma_s}}\right]^{\frac{\sigma_s}{\sigma_s+1}} \quad (4)$$

such that $\rho_s A = \rho_b b + \rho_e e$

A is total assets and σ_s the substitution elasticity bonds/equities and ρ_s is the gross revenue from assets.

The returns to assets are determined on world markets and are assumed to be the same irrespective of the residence of their owner.

The effects on welfare are calculated using the compensating variation. This is calculated as the difference in transfers received by young households required to compensate the change in utility. It is presented as a percentage of GDP.

Firms. In CORTAX there are two types of firms, domestic and multinationals, with the latter disaggregated into headquarters and subsidiaries. Each country has one representative domestic firm, one multinational headquarter and several subsidiaries, which are owned by headquarters in other

countries.[2] Firms maximise their value $V_t^n(j)$, subject to the possibilities of the production function and accumulation constraints on physical capital and fiscal depreciation:

$$V_t^n(j) = \sum_{s=t}^{\infty} \Lambda(j) Div_s^n(j) R_s(j) \quad (5)$$

with n=domestic, multinational headquarters or subsidiary and R_s representing the overall effect of discounting:

$$R_s(j) \equiv \frac{1}{\left(1+\bar{r}_e(j)\right)^{s-t+1}}$$

$$\bar{r}_e(j) \equiv \frac{r_e(jj)}{\left(1-\tau_g(j)\right)}$$

$$\Lambda(j) \equiv \frac{\left(1-\tau_d(j)\right)}{\left(1-\tau_g(j)\right)}$$

Where Div_s^n are the dividends, $\bar{r}_e(j)$ represents the discount rate relevant for firms in making decisions and r_e is net return on equities. $\tau_g(j)$ is the tax rate on capital gains and $\tau_d(j)$ is the tax rate on dividends.

The production function is a Cobb Douglas combination of the fixed factor $(\omega^m N^y)$ and the value added, (VA^{mx}), which is a CES aggregate of labor $(L^m)$and capital (K^m). The only difference between domestic and multinational headquarters and the subsidiaries is the role of intermediate inputs.

The production maximization problem for domestic firms and multinational can be defined as:

$$Y^{mx} = A^{mx}(VA^{mx})^{\alpha_v^m} \quad (6)$$

With:

$$A^{mx} = (A_{0x}\omega^m N^y)^{1-\alpha_v^m}$$

$$VA^{mx} = A_{0x}\left[\alpha_{vl}^m (L^m)^{\frac{\alpha_v^m-1}{\alpha_v^m}} + \alpha_{vk}^m (K^m)^{\frac{\alpha_v^m-1}{\alpha_v^m}}\right]^{\frac{\sigma_v^m}{\alpha_v^m-1}}$$

With m equal to domestic and headquarters. While for subsidiaries it is:

$$Y^{fx}(j) = A^{fx}(j) A_0^{\alpha_q} Q(j)^{\alpha_q} \left(VA^{fx}\right)^{\alpha_v^f} \text{ with } 0 < \alpha_q + \alpha_v^f < 1 \quad (7)$$

And with :

$$A^{fx} = \left(A_{0x}\omega^f N^y\right)^{1-\alpha_v^f-\alpha_q}$$

$$VA^{fx}(j) = A_{0x}\left[\alpha_{vl}^f \left(L^f\right)^{\frac{\alpha_v^f-1}{\alpha_v^f}} + \alpha_{vk}^f \left(K^f\right)^{\frac{\alpha_v^f-1}{\alpha_v^f}}\right]^{\frac{\sigma_v^f}{\alpha_v^f-1}}$$

[2] Note that the number of firms is not modelled in CORTAX. This simplification still allows the interpretation of the results of the policy simulations by comparing MNEs with domestic firms´ situation.

Where Y^{fx} is total output, A^{fx} the output contribution of the fixed factor and Q intermediate inputs. σ_v^f is the substitution elasticity between productive factors.

Multinationals aim at maximising the sum of the value of headquarters and all their subsidiaries. In addition to labour and capital, the production function also includes a fixed, location-specific production factor (which can be considered as representing land). While labour and the land are immobile factors, capital and capital revenues are perfectly mobile across countries. The return to capital (after source taxes) is fixed by world capital markets. The supply of the location-specific production factor (i.e. land) is inelastic and revenues generated are accounted as economic rents. Additionally, multinationals are wholly owned by households in the home country, which implies that countries can partly export the tax burden to foreign households by taxing subsidiaries. Therefore the efficiency loss of tax shifting activities also affects households´ disposable income.

The aggregate production is calculated as the sum of production in all industries net of intermediate inputs in foreign subsidiaries:

$$Y(i) = q\left[Y^{dg}(i) + Y^{mg}(i) + \sum_{j\neq i} Y^{fg}(i,j)\right] + (1-q)\left[Y^{db}(i) + Y^{mb}(i) + \sum_{j\neq i} Y^{fb}(i,j)\right] - \sum_{j\neq i} p_q(j,i)Q(j,i)$$

Where (q) is the probability of a good event (shock) and $(1-q)$ the probability of a bad event. $Y^{dg}(i)$ represents domestic production, $Y^{mg}(i)$ the production of parent companies and $\sum_{j\neq i} Y^{fg}(i,j)$ the production of subsidiaries.

The model allows the parent company to charge a transfer price for intra-firm deliveries that deviates from the equivalent price that would be charged if it had been an inter-firm transaction (the 'arms-length' price). Specifically, there is an incentive in place to set an artificial price in order to shift profits from high- to low-tax countries. In order to ensure an interior solution, a convex cost function is specified to describe the costs associated with the manipulation of transfer prices. In this way, profit shifting to countries with very low corporate tax rates becomes increasingly costly at the margin.

On the other hand, bilateral foreign direct investment (FDI) stocks determine the initial size of subsidiaries. FDI is defined as the equity-financed part of foreign capital

$$FDI(i,j) = \left(1 - d_b^f(i,j)\right) K^f(i,j)$$

With d_b^f being the debt ratio.

Corporate investment is financed by either retained earnings or by issuing bonds. CORTAX does not allow the issuing of new shares. Decisions on the source of finance are based on the difference between the after-tax cost of debt and equity. The marginal cost of debt finance increases alongside the debt share.

Among the alternative corporate tax specifications, the model incorporates the compliance costs incurred by firms for attending their corporate tax obligations. These costs are included as the amount of new workers required to carry out these tasks. Consequently there are two types of labour: workers production output and workers for tax administration. The latter are measured as a fixed share of the productive labour force. They increase in proportion to the size of the firm's payroll.

Losses and loss carry forward. At the benchmark, all firms are all equal and there are no negative extra profits, but there are random shocks affecting their revenues that can be attributed to, e.g., business cycle evolutions. These shocks may result in losses that can be carried forward in the model. Firms' decisions on inputs are made before knowing whether they will be subject to a random shock and are therefore based only on expected output values and expected marginal productivities. The probabilities of profit and loss are assumed to be independent across years because shocks are not correlated over time. CORTAX allows for losses to be carried forward for one year. While this underestimates the actual opportunities for loss compensation over more than one year, at the same time the assumption of independent shocks tends to overestimate losses that can be offset. Appendix A in Bettendorf et al. (2009) discusses this issue in further detail.

Public Sector. Government is an intermediate agent in CORTAX. There is a balanced budget where consumption and public debt are a fixed proportion of GDP and lump-sum transfers are also fixed. In this case, the issue of new debt due to economic growth covers the increase of public deficit. On the other hand, tax revenues include indirect taxes on consumption and direct taxes of income from corporate and labour, dividends, capital gains and interest. Government consumption and government debt as a share of GDP are maintained constant after a reform.

Equilibrium. In the model, all markets are in equilibrium in the base year. There is only one representative homogeneous good, which is traded in a perfect competitive world market. Therefore countries cannot exert market power and their terms of trade are fixed. The price of this good is the "numeraire" in the model. With respect to asset markets, bonds (and equities) of different origins are perfect substitutes and are freely traded on world markets. The return to these assets is therefore fixed for every country. At the same time, debt and equity are not perfect substitutes. Regarding the foreign sector, the current account equals the change in the net foreign asset position for each country so that the balance of payments is equal to zero.

2.2 Calibration of CORTAX

2.2.1 Data sources and preparation

For the sake of continuity we generally used the same data sources as in the original calibration undertaken by the CPB, see Bettendorf and van der Horst (2006). The year 2012 data was chosen as reference year for the calibration, as it represented a good compromise between timeliness and completeness. Following the initial calibration (Bettendorf and van der Horst, 2006) the countries covered include the EU's 28 member states, the United States and Japan. In a small number of cases

alternative data sources were used, or reference year, or missing values imputed. These differences are all documented below and in Annex A (macroeconomic indicators).

Tax information

CIT receipts as a percentage of GDP are from European Commission (2014, Table 18). Additional tax revenue statistics, expressed in national currency and as a percentage of GDP, are from the OECD (Dataset: Revenue Statistics - Comparative tables). Implicit tax rates on consumption are from Eurostat (2014, p.255). Statutory Corporate Income Tax (CIT) rates are from ZEW (2012, p.2) Tax rates on dividends, interest and capital gains upon disposal of shares are from ZEW (2012, pp. A24-A26). Implicit tax rate on labour income have been estimated using the EUROMOD microsimulation model.

Firm-level data from the Orbis database

Information on balance sheets and ownership structure from the Orbis database provided by Bureau Van Dijk was used. Although Orbis is a firm-level database, for the purposes of the calibration it is only used to produce national-level estimates of debt shares and of corporate investment shares (by type of asset) so as to calculate relevant corporate tax parameters such as the cost of capital (financed via equity or debt).

In keeping with an earlier calibration of CORTAX (Bettendorf et al, 2009) the sample was narrowed down to firms reporting total assets larger than two million US dollars and to firms who had complete information on investment on tangibles and intangibles. This leaves 1,005,188 companies based in the EU28, the United States and Japan. Many of these companies are subsidiaries belonging to multinational groups. Unconsolidated accounts are used as these best describe the actual investment behaviour of multinational enterprise subsidiaries across EU member states. If necessary (e.g. to test specific hypotheses) the companies accounts can be consolidated at the level of multinational groups making use of information on each company's Global Ultimate Owner (GUO).

For these companies we obtained data on their asset structure, including inventories (Orbis variable name "Stock"), fixed tangible assets, fixed intangible assets, total assets. While in principle Orbis contains information on corporate investments in buildings and machinery (Orbis variables "Plant and Machinery", "Transport Equipment"), in practice this information was missing for many companies. As information on the shares of investment directed into these two assets is necessary for the estimation of tax parameters, we estimate them using information on the Orbis-derived total quantity of investment on tangibles, multiplied by the sector-shares on buildings and machinery provided by Eurostat (Eurostat variable codes sbs_na_con_r2, sbs_na_dt_r2, sbs_na_ind_r2, sbs_is_inv_r2). For those countries and sectors for which this information was not available in Eurostat (principally France, Latvia and Malta) in common with established practice (Egger et al., 2008; Devereux and Loretz, 2008; Bettendorf et al. 2009) we estimate them by multiplying Orbis-derived total quantity of investment on tangibles by the sector-shares on buildings and machinery provided by McKenzie et al. (1998). Table 2.1 provides summary statistics on the Orbis data used.

Orbis was also used to approximate corporate debt shares, calculated as the ratio of the sum of current and non-current liabilities over total assets.

Table 2.1. Summary Statistics of Orbis Investment Shares, 2012

	Buildings	Machinery	Intangibles	Stocks	Land	No. of companies
Austria	31.6%	27.0%	5.1%	25.3%	11.0%	25,316
Belgium	28.2%	32.8%	5.2%	23.1%	10.6%	41,077
Bulgaria	30.7%	24.3%	2.8%	30.6%	11.6%	8,735
Cyprus	22.5%	26.9%	3.7%	40.1%	6.8%	134
Czech Republic	28.2%	32.9%	2.6%	25.7%	10.7%	15,120
Germany	23.8%	30.3%	4.0%	32.1%	9.9%	124,911
Denmark	15.6%	31.5%	5.4%	40.8%	6.6%	9,619
Spain	27.0%	23.7%	5.2%	32.3%	11.7%	98,010
Estonia	27.7%	28.4%	5.1%	30.6%	8.2%	2,222
Finland	27.1%	24.5%	9.3%	29.8%	9.2%	11,314
France	18.8%	24.8%	19.5%	30.6%	6.4%	84,491
United Kingdom	34.3%	21.0%	7.2%	23.3%	14.2%	100,189
Greece	26.6%	28.9%	5.5%	29.5%	9.6%	10,524
Croatia	34.7%	23.2%	3.5%	28.4%	10.2%	5,303
Hungary	26.1%	31.5%	4.4%	28.3%	9.6%	9,305
Ireland	35.7%	20.9%	6.0%	23.7%	13.7%	9,393
Italy	19.8%	25.3%	9.9%	37.2%	7.8%	167,922
Lithuania	28.1%	25.9%	3.2%	35.4%	7.4%	1,522
Luxembourg	33.1%	20.7%	14.5%	20.3%	11.5%	3,027
Latvia	30.7%	27.8%	2.6%	27.4%	11.5%	3,154
Malta	29.6%	25.9%	7.6%	26.2%	10.6%	749
Netherlands	24.1%	43.5%	7.4%	16.1%	8.8%	59,580
Poland	28.9%	28.3%	3.8%	31.0%	8.0%	21,741
Portugal	21.2%	27.7%	4.3%	37.9%	8.9%	19,508
Romania	28.6%	30.4%	2.1%	26.8%	12.0%	13,616
Slovak Republic	35.2%	25.7%	2.6%	23.4%	13.0%	8,178
Slovenia	25.8%	36.6%	4.1%	26.4%	7.1%	2,774
Sweden	27.3%	24.8%	8.3%	30.1%	9.6%	10,989
Japan	22.1%	38.5%	3.2%	27.4%	8.8%	105,429
USA	29.0%	14.5%	2.4%	41.9%	12.1%	31,336
EU(weighted average)	25.5%	27.1%	7.7%	29.9%	9.8%	868,423
Total	**27.4%**	**27.6%**	**5.7%**	**29.4%**	**9.9%**	**1,005,188**

Source: Orbis

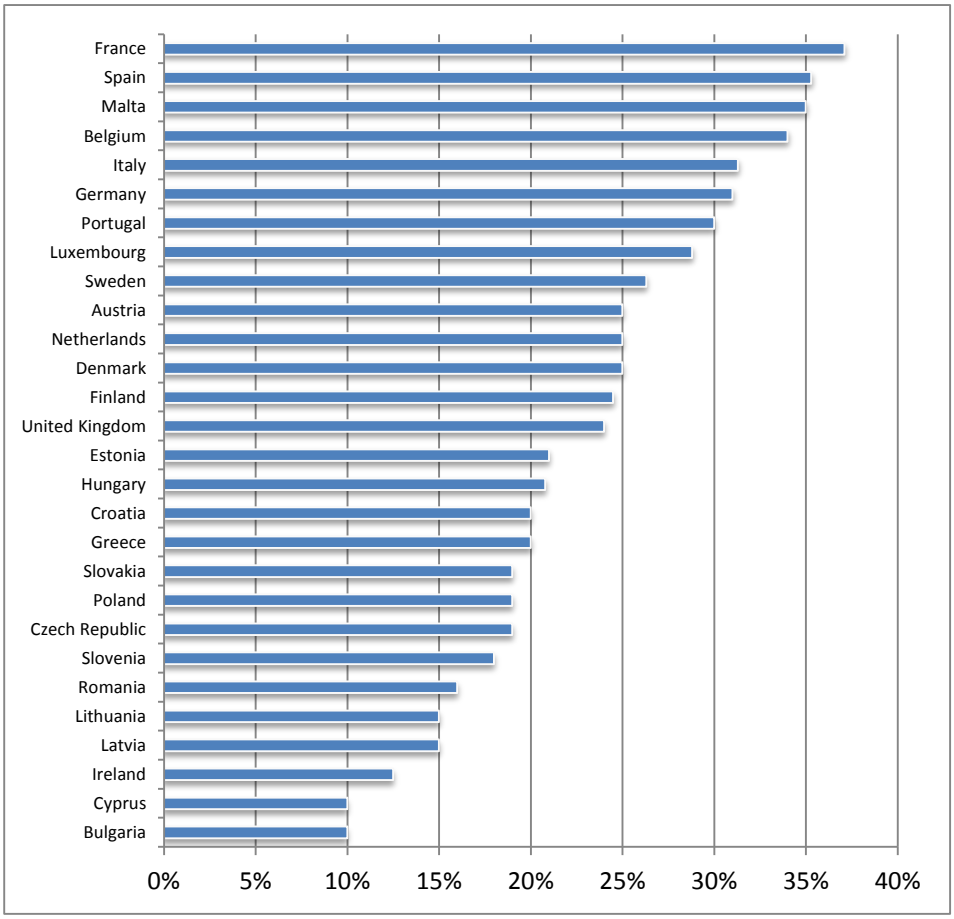
2.2.2 European Tax Systems and Model Baseline

In a model designed to appraise the impact of tax reforms, the initial structure of the tax systems concerned is extremely important. In the present calibration CORTAX is using tax data for 2012, implying that subsequent simulations of EU reforms produce outcomes *relative to tax systems as they were in 2012*. The baseline also describes economic changes induced by these reforms, as simulated by the model.

Corporate tax rates

Figure 2.1 presents prevalent corporate income tax rates across the EU. These averaged at 23% in 2012, but with considerable variation across the EU, from a high 37% in France to a low 10% in Cyprus and Bulgaria.

Figure 2.1 Corporate tax rates in EU countries, 2012



Source: ZEW (2014), "Effective Tax Levels Using Devereux/Griffith Methodology", p. 2

Fiscal depreciation

Differences in depreciation rules and inventory valuation mean that tax bases vary considerably across the EU. We have used information on tax laws of EU countries reported in ZEW (2012) to calculate relevant parameters such as the cost of capital. Table 2.2 summarises this information, presenting both rates and the rules for the calculation of annual allowances (declining balance [DB] or straight line [SL]). In 2012 most countries allowed SL depreciation for investments in buildings and intangibles

(corresponding to prevalent rules for the depreciation of a patent), whereas for machinery the rules are more varied. Estonia has no depreciation scheme applicable, due to its unique corporate taxation rules.

Table 2.2 Depreciation schemes and inventory valuation in corporate tax systems in the EU, 2012

	Buildings (number of years in brackets)	**Machinery** (number of years in brackets)	**Intangibles** (number of years in brackets)	**Inventory valuation**
Austria	SL 3% (33.33)	SL 14.29% (7)	SL 10% (10)	LIFO
Belgium	DB 10% (7) SL 5% (9.6)	DB 28.57%(2) SL 14.29% (3)	SL 20% (5)	LIFO
Bulgaria	SL 4% (25)	SL 30% (3.33)	SL 15% (6.67)	average
Croatia	SL 10% (10)	SL 50% (2)	SL 50% (2)	average
Cyprus	SL 4% (25)	SL 20% (5)	SL 20% (5)	FIFO
Czech Republic	DB 30 years	DB 6 years	SL 16.66% (6)	average
Denmark	SL 4% (25)	DB 25% (n.a.)	SL 100% (1)	FIFO
Estonia	n.a.	n.a.	n.a.	LIFO
Finland	DB 7% (n.a.)	DB 25% (n.a.)	SL 10% (10)	FIFO
France	SL 5% (20)	DB 32.14% (4) SL 7.07% (3)	SL 20% (5)	average
Germany	SL 3% (33.33)	SL 14.29% (7)	SL 20% (5)	LIFO
Greece	SL 8% (12.5)	DB 42.86% (4) SL 10.7% (1)	SL 10% (10)	LIFO
Hungary	SL 2% (50)	SL 50% (2)	SL 50% (2)	average
Ireland	SL 4% (25)	SL 12.5% (8)	SL 10% (10)	average
Italy	SL 2% (1) SL 4% (24.5)	SL 12.5% (7.5) SL 6.25% (1)	SL 33.33% (3)	LIFO
Latvia	DB 10% (n.a.)	DB 40% (n.a.)	SL 20% (5)	average
Lithuania	DB 25% (n.a.)	DB 40% (n.a.)	DB 66.66% (n.a.)	LIFO
Luxembourg	SL 4% (25)	DB 30% (4) SL 8% (3)	SL 20% (5)	LIFO
Malta	SL 12% (1) SL 2% (44)	SL 20% (5)	SL 10% (10)	FIFO
Netherlands	SL 2.5% (40)	SL 14.29% (7)	SL 20% (5)	LIFO
Poland	SL 2.5% (40)	SL 10% (10)	SL 20% (5)	LIFO
Portugal	SL 5% (20)	DB 35.71% (n.a.)	SL 10% (10)	average
Romania	SL 2.5% (40)	SL 50% (1) SL 8.33% (6)	SL 50% (1) SL 5.55% (9)	LIFO
Slovak Republic	DB 20 years	DB 6 years	SL 20% (5)	average
Slovenia	SL 3% (33.33)	SL 20% (5)	SL 10% (10)	average
Spain	SL 3% (33.33)	DB 28.57% (4) SL 8.68% (3)	DB 25% (6) SL 4.45% (4)	average
Sweden	SL 4% (25)	DB 30% (n.a.)	DB 30% (n.a.)	FIFO
United Kingdom	n.a.	DB 18% (n.a.)	SL 10% (10)	FIFO

Source: ZEW (2014), pp. A15-A21.

Using information reported in Table 2.2 we calculate for each asset the net present value of the depreciation allowances as a share of the purchase price of the investment. Higher percentages denote more generous fiscal depreciation rules for that particular type of asset. Using shares of investment by different classes of assets from Orbis (as reported in Table 2.1) we then calculate a weighted average of these values for each of the one million firms considered. Finally, we calculate country-level medians to use in CORTAX. The choice of medians over means is in keeping with the previous

calibration and has the attractive feature of minimising the influence of outliers. Table 2.3 presents country-level medians of firm-specific allowances, for the first year and net present value. Net present values vary considerably, from a low 12% in the United Kingdom to just over 60% in the Netherlands, though most countries are in the 40-50% range.

Table 2.3 Summary information about the NPV of fiscal depreciation schemes in % of the purchase price

	First year tax depreciation	Net present value of allowances
Austria	3.92%	43.10%
Belgium	5.17%	57.01%
Bulgaria	6.89%	49.01%
Croatia	13.89%	62.52%
Cyprus	7.01%	44.04%
Czech Republic	4.98%	49.68%
Denmark	6.55%	45.11%
Estonia	0.00%	0.00%
Finland	7.88%	49.41%
France	5.05%	53.00%
Germany	3.95%	43.10%
Greece	6.32%	57.04%
Hungary	16.43%	39.93%
Ireland	4.24%	47.84%
Italy	2.02%	46.73%
Latvia	11.91%	55.40%
Lithuania	20.57%	59.70%
Luxembourg	3.57%	48.47%
Malta	10.07%	41.76%
Netherlands	8.51%	60.74%
Poland	3.84%	38.99%
Portugal	8.32%	49.83%
Romania	16.50%	41.43%
Slovak Republic	5.46%	54.81%
Slovenia	8.85%	52.05%
Spain	3.07%	43.45%
Sweden	6.88%	48.61%
United Kingdom	2.71%	12.42%
Europe – weighted average	4.92%	43.03%
Standard deviation	4.79%	13.10%

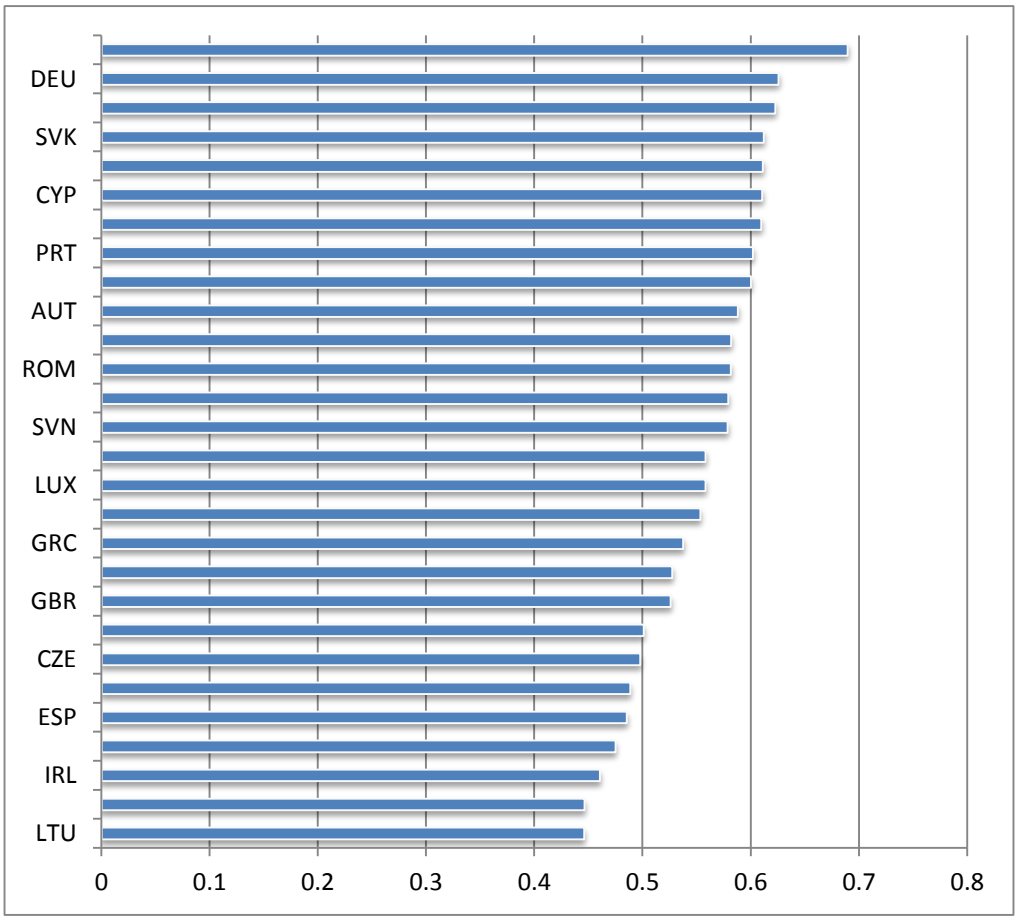
Note: To better represent contemporary conditions, we assumed inflation=1.875%, risk-free real interest rate=1.5% and return on equity=3% (i.e. 25% lower than the values assumed by CPB).

Source: National-level median values using ZEW depreciation schemes and weighted by Orbis investment shares.

Effective marginal tax rates

The relationship between corporate taxation and investment in CORTAX is determined by the cost of capital. The effective marginal tax rate (EMTR) is a measure of the cost of capital, defined as the difference in the cost of capital in the presence and in the absence of tax, as a percentage of the tax-inclusive cost of capital. The EMTR effectively summarises several parameters of the tax system, such as the statutory tax rate, depreciation allowances, treatment of inventories and depreciation of financial costs. CORTAX calculates the EMTR for both equity- and debt-financed investment. The mode of financing is very important. Unlike equity finance, nominal interest is deductible for the corporate tax base allowing for more generous EMTR for debt-financed investment. To get a handle on how investment was actually financed by firms in 2012 we use Orbis to calculate average debt-share of investment across countries (Figure 2.2). These range from a high of almost 0.7 in Italy to a low of 0.4 in Lithuania.

Figure 2.2 Average debt-asset ratio of firms in EU countries, 2012

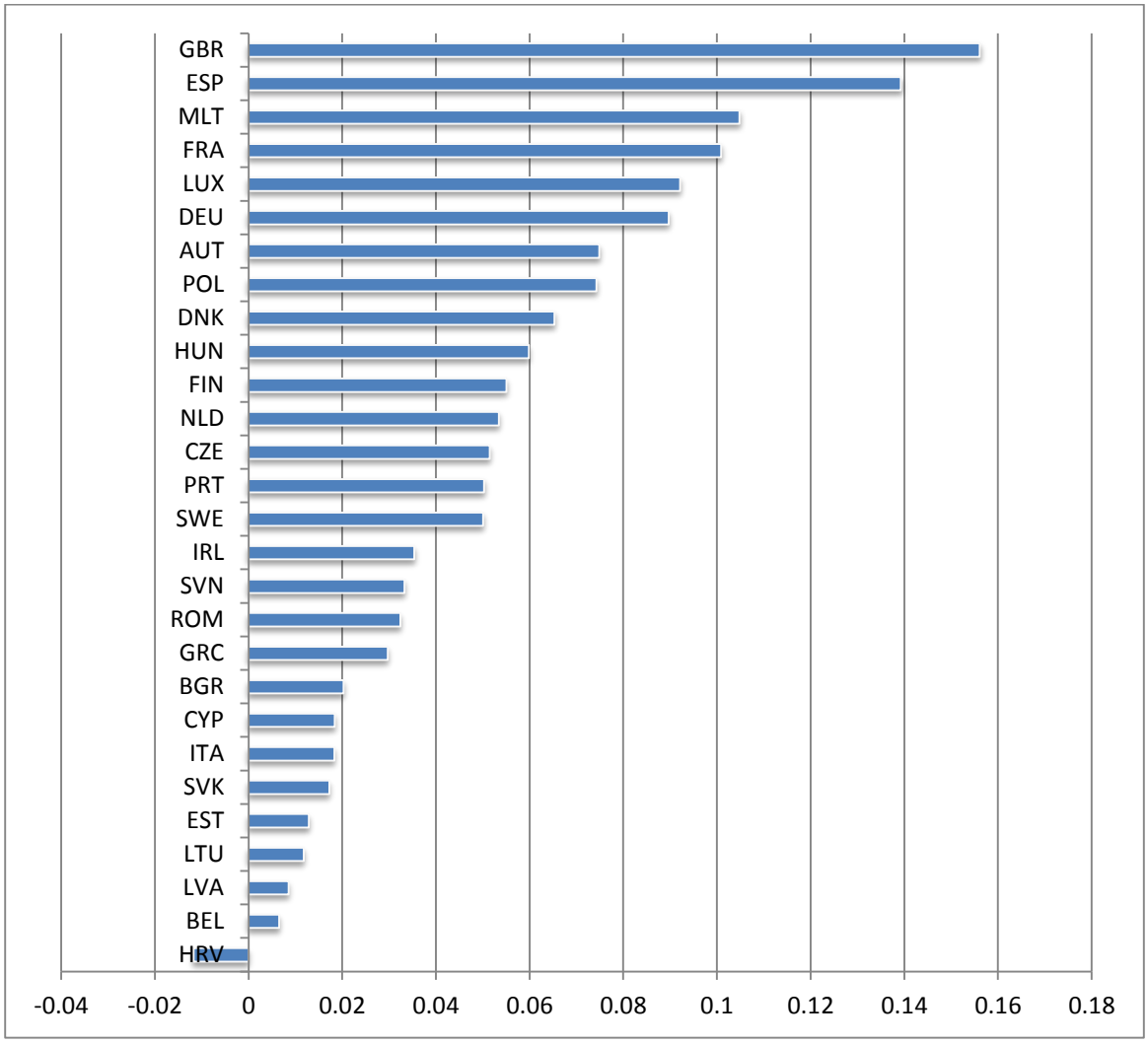


Source: National-level averages from Orbis

Using information on the debt-share of each country, CORTAX calculates a weighted average of EMTRs for debt and equity finance (Figure 2.3). This can be interpreted as a summary indicator of how distortionary the corporate tax system is for marginal investment decisions. On one end, the

United Kingdom and Spain have the highest average EMTR whereas on the other end, Croatia has a negative EMTR.

Figure 2.3 Average EMTR in EU countries, 2012

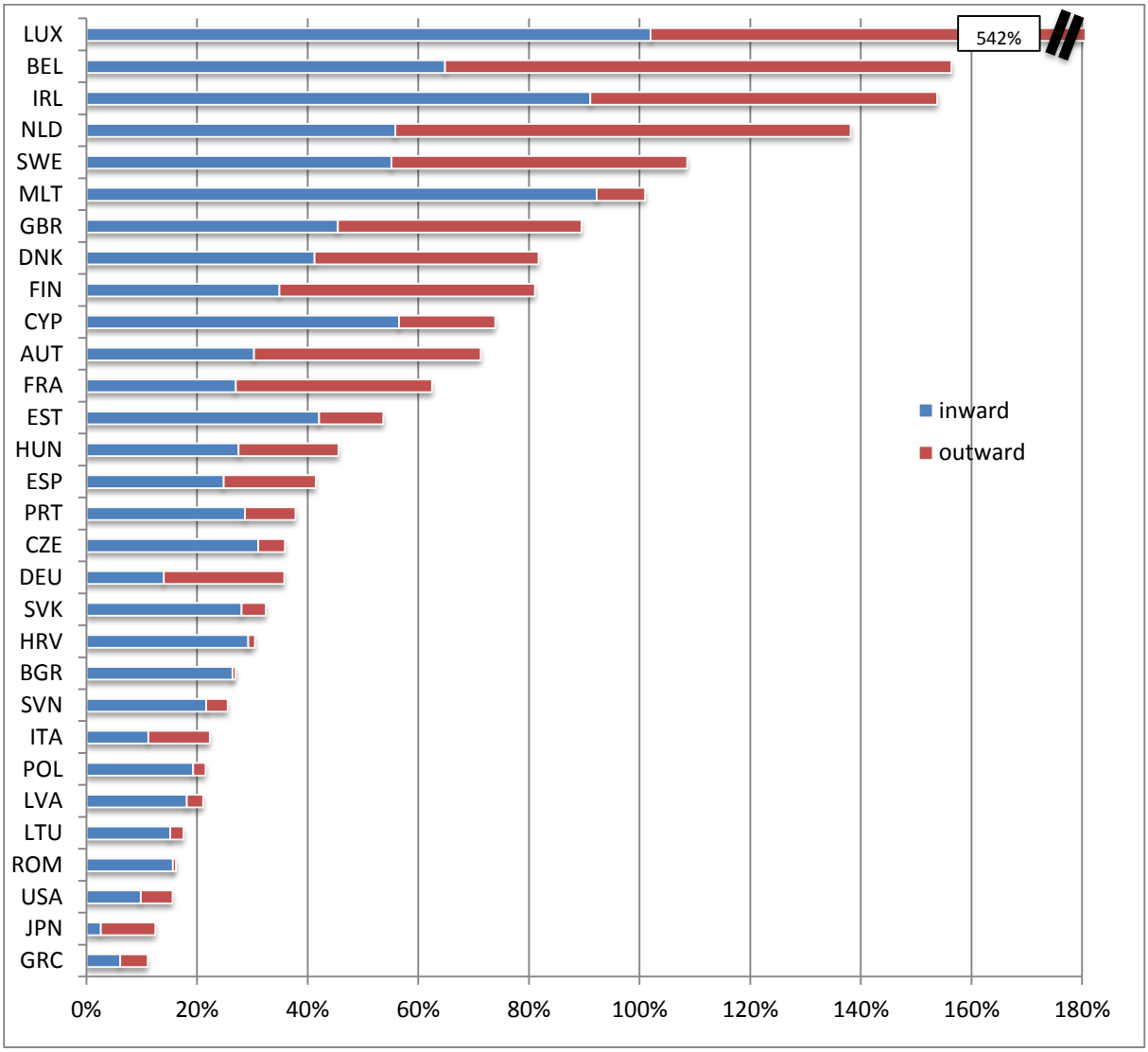


Source: CORTAX

Corporate tax revenue

The CORTAX baseline simulates corporate tax revenues in each country. To determine the corporate tax base we use national accounts data on gross value added minus total labour income, thereby correcting for the income from the self-employed. The share of economic rents is set at 2.5% of value added. To calculate deductible costs we use capital shares from national accounts, fiscal depreciation rates from Table 2.3, a nominal interest rate of 4.5% and debt shares from Figure 2.2.

Figure 2.4 Inward and outward FDI in % of GDP in EU countries, 2012



Source: Eurostat, adjusted for CYP, MLT, LUX and NLD according to non-SPE figures by the OECD and UNCTAD.

3. Simulation results

This section provides the results of three CIT reforms. The economic effects of the three simulations evaluated are discussed in the following subsection. In addition, we include a sensitivity analysis on the compensating variable to keep constant the government balance. In the central case, the compensating variable is a labour tax while in the sensitivity analysis we perform the simulations assuming that transfers to old or government expenditures adjust. The main tables present the effects on GDP, employment and utility disaggregated by country.

3.1. Increase of the Statutory CIT rate in Ireland

The statutory CIT rate Ireland is among the three lowest in the EU, around 12.5 % (Figure 2.1). The difference between this CIT rate and the rates in other countries has been behind tax planning

activities at firm level and tax competition among countries. The difference among this tax rate and the CIT in Germany, which is around 31%, was 19 percentage points. The economic effects of rising in isolation corporate taxation in Ireland to the level of Germany and compensating the effects on revenues with labour tax are displayed in Table 3.1. The first column of the table list all the countries included in the model and the other columns include the percentage variation of capital, wage, employment and GDP and the variation in percentage of GDP of CIT revenues, Total tax revenues and Welfare. The last row of the table also shows the effect on these variables for the EU average.

Table 3.1. Economic effects of raising CIT in Ireland

	Capital	**Wage**	**Employm.**	**GDP**	**Rev_CIT**	**Rev_tax**	**Welfare**
	%	**%**	**%**	**%**	**% of GDP**	**% of GDP**	**% of GDP**
AUT	0	0	0	0	0	0	0
BEL	0	0	0	0	0	0	0
DNK	0	0	0	0.02	0.01	0	0.01
FIN	0.03	0	0.03	0.03	0.02	0	0.02
FRA	0.01	0	0.01	0.02	0.01	0	0.01
DEU	0	0	0	0	0	0	0
GRC	0	0	0	0	0	0	0
HRV	0	0	0	0	0	0	0
IRL	-6.73	-4.82	0.48	-3.31	2.77	-0.04	-0.47
ITA	0	0	0	0.01	0	0	0.01
LUX	0.24	-0.03	0.25	0.35	0.17	0.01	0.18
NLD	0.02	0	0.02	0.08	0.02	0	0.02
PRT	0	0	0	0.01	0	0	0
ESP	0.01	0	0.01	0.01	0.01	0	0.01
SWE	0	0	0	0.02	0.01	0	0.01
GBR	0.01	0	0.01	0.02	0.01	0	0.01
CYP	0	0	0	0	0	0	0
CZE	0	0	0	0	0	0	0
EST	0	0	0	0	0	0	0
HUN	0	0	0	0	0	0	0
LVA	0	0	0	0.01	0	0	0
LTU	0	0	0	0	0	0	0
MLT	0.01	0	0.01	0.01	0.01	0	0.01
POL	0	0	0	0	0	0	0
SVK	0	0	0	0	0	0	0
SVN	0	0	0	0	0	0	0
BGR	0	0	0	0.01	0	0	0
ROM	0	0	0	0	0	0	0
USA	0	0	0	0	0	0	0
JPN	0	0	0	0	0	0	0
EU	**-0.05**	**-0.04**	**0.01**	**-0.02**	**0.04**	**0**	**0**

In this simulation, the CIT in Ireland raises 18.5 pp and increases the cost of capital in 0.53 pp, what cuts down the demand of capital. On the other hand, the marginal productivity of labour falls and also wages do. The fall of wages slightly increases employment but the negative effect of capital is bigger and reduces GDP in Ireland in 3.31%. This is the country directly affected and the one that register the most significant effects. The spillover effects of this policy in Ireland do not have relevant effects in other countries. Only Luxembourg seems to slightly react to the shock, with an increase of capital and employment of 0.2% and a raise of GDP in 0.35%. In all other countries, the impact is negligible. The reason behind is that Luxembourg has relation with all countries through Foreign direct investment flows.

In relation to tax revenues, the increase of CIT rates raises CIT revenues as percentage of GDP in 2.77% but due to the reduction of labour taxes total tax revenues fall in -0.04% of GDP. Welfare in Ireland falls 0.47% of GDP in favour of Luxembourg. In average, there is no change in welfare in the EU. GDP falls -0.02 and CIT revenues increase in 0.04

3.2. Reduction of the Statutory CIT rate in Germany

In this simulation, the effects on the affected country and the rest of the EU are bigger than in previous simulation. The reduction of the statutory CIT rate in Germany to the level of Ireland reduces the cost of capital and boost investment and capital in 5.95%. The raise of capital spurs increases the marginal productivity of labor and raises wages. The increase of the tax on labour to compensate the reduction of CIT increases the cost of labour and reduces employment in 0.88%. The effects of capital are translated to production and GDP increases in 1.63 in Germany. This result is according to expected since corporate taxation is more distortionary than taxes on labour.

This independent decision of Germany also has effects on these variables for other countries, 20 countries of the 30 registered in Table 3.2 are affected by this tax reform. Germany is the biggest economy in the EU and it has connections with all countries. Thus, the impact of tax reforms on the EU-weighted average is bigger than for Ireland. Regarding employment, the only country positively affected is Malta, where employment raises in 0.03 %. In all other countries the effect is negative and rather small. GDP only increases in Germany and it is negative in all other countries. Nevertheless, the effect on average is positive, 0.19%.

The impact of this reform on welfare is negative. In Germany, welfare falls as a consequence of the decrease in employment. All other countries have slightly negative variations and the EU average falls in in 0.04 % of GDP.

Table 3.2. Economic effects of reducing CIT in Germany

	Capital	Wage	Employm.	GDP	Rev_CIT	Rev_tax	Welfare
	%	%	%	%	% of GDP	% of GDP	% of GDP
AUT	-0.12	0.01	-0.14	-0.31	-0.09	0	-0.11
BEL	-0.03	0.01	-0.04	-0.08	-0.04	0	-0.04
DNK	-0.04	0.01	-0.04	-0.12	-0.04	0	-0.04
FIN	-0.04	0	-0.05	-0.09	-0.03	0	-0.03
FRA	-0.05	0.03	-0.09	-0.18	-0.1	0	-0.11
DEU	5.95	3.75	-0.88	1.63	-2.59	0.02	-0.01
GRC	-0.01	0	0	-0.02	0	0	-0.01
HRV	-0.01	0	-0.01	-0.07	-0.01	0	-0.02
IRL	-0.04	-0.01	-0.03	-0.12	-0.01	0	-0.02
ITA	-0.03	0	-0.03	-0.05	-0.03	0	-0.03
LUX	-0.57	0.04	-0.6	-0.66	-0.31	-0.01	-0.24
NLD	-0.06	0.01	-0.08	-0.25	-0.07	0	-0.07
PRT	-0.01	0	-0.01	-0.04	-0.02	0	-0.01
ESP	-0.01	0.01	-0.03	-0.07	-0.04	0	-0.03
SWE	-0.04	0.01	-0.05	-0.14	-0.06	0	-0.06
GBR	-0.02	0	-0.03	-0.12	-0.04	0	-0.03
CYP	0	0	0	-0.03	0	0	0
CZE	-0.02	0	-0.01	-0.1	-0.02	0	-0.02
EST	0	0	0	-0.02	0	0	0
HUN	-0.04	0	-0.04	-0.2	-0.03	0	-0.06
LVA	-0.01	0	0	-0.02	0	0	0
LTU	-0.01	0	0	-0.03	0	0	0
MLT	0.21	0.22	0.03	-0.68	-0.33	-0.01	-0.27
POL	-0.01	0	-0.01	-0.06	-0.01	0	-0.01
SVK	-0.01	0	-0.01	-0.07	-0.01	0	-0.01
SVN	-0.01	0	-0.01	-0.04	-0.01	0	-0.01
BGR	-0.01	0	0	-0.03	0	0	0
ROM	-0.01	0	-0.01	-0.04	-0.01	0	-0.01
USA	0.01	0.01	-0.01	-0.02	-0.02	0	-0.01
JPN	0	0	-0.01	-0.01	-0.01	0	-0.01
EU	**0.97**	**0.64**	**-0.18**	**0.19**	**-0.55**	**0**	**-0.04**

3.3. Homogenization of the Statutory CIT rates in the EU

In this case, we simulate that all Statutory CIT rates are equal to the EU average rate, 27.7%. Table 3.3 includes two additional columns that show the variation of the CIT rates and the Cost of Capital in percentage points (pp). The higher increases in the tax rates are observed in Bulgaria and Cyprus, which increase in 17.7 pp, followed by Ireland, 15.2 pp., Latvia and Lithuania, 12.7 pp. On the other hand, the highest reductions are registered in France, Spain and Malta, around 9-7 pp. In these three countries, the fall of CIT rates reduces the cost of capital and it raises capital. The wage increases and

since labour tax rise, employment falls. However, the positive effect on capital prevails and raises GDP in 0.96% in France and around 1.4% in Spain and Malta. The opposite case happens when CIT rates increase and raise the cost of capital. In Ireland, the increase of the cost of capital reduces investment and capital. Despite the increase of employment, the negative effects are bigger and they cut down GDP and welfare. Although there are some mixed effects that cannot be easily explained, the results are in line with the values observed in the previous simulations where shocks were perform by individual countries in isolation.

Table 3.3. Economic effects of homogenizing CIT in the EU

	CIT_rate	CoC	Capital	Wage	Employm.	GDP	Rev_CIT	Rev_tax	Welfare
	pp	pp	%	%	%	%	% of GDP	% of GDP	% of GDP
AUT	2.7	0.09	-1.01	-0.65	0.13	-0.4	0.41	-0.01	-0.05
BEL	-6.3	-0.01	-0.08	0.22	-0.27	-0.12	-0.2	0	0
DNK	2.7	0.08	-0.84	-0.44	0.07	-0.29	0.31	0	-0.04
FIN	3.2	0.08	-0.78	-0.47	0.13	-0.21	0.35	0	-0.01
FRA	-9.4	-0.35	3.19	1.61	-0.27	0.96	-1.04	0.01	0.23
DEU	-3.3	-0.11	1.24	0.76	-0.13	0.34	-0.49	0	0.04
GRC	7.7	0.12	-1.26	-1.11	0.44	-0.26	0.82	0	0.06
HRV	7.7	-0.04	0.75	0.17	0.17	0.16	0.04	0	0.08
IRL	15.2	0.42	-5.4	-3.88	0.42	-2.71	2.28	-0.03	-0.31
ITA	-3.6	-0.02	0.08	0.25	-0.22	-0.11	-0.25	0	-0.09
LUX	-1.1	-0.04	0.08	0.34	-0.44	-0.19	-0.36	0	-0.06
NLD	2.7	0.08	-0.72	-0.42	0	-0.5	0.19	-0.01	-0.14
PRT	-2.3	-0.04	0.46	0.29	-0.08	0.07	-0.25	0	-0.03
ESP	-7.6	-0.35	4.07	2.53	-0.29	1.29	-1.48	0.02	0.28
SWE	1.4	0.03	-0.33	-0.18	0.04	-0.08	0.15	0	0.02
GBR	3.7	0.28	-2.91	-1.23	0.02	-1	0.74	-0.01	-0.24
CYP	17.7	0.29	-4.08	-2.89	0.48	-1.79	2.02	-0.02	0.08
CZE	8.7	0.26	-3.12	-2.15	0.28	-1.21	1.35	-0.02	-0.09
EST	6.7	0.04	0.06	-0.34	0.31	0.03	0.36	0	0.04
HUN	6.9	0.22	-2.56	-1.78	0.31	-0.93	1.11	-0.01	-0.05
LVA	12.7	0.06	-0.39	-0.77	0.65	0.1	0.77	0	0.22
LTU	12.7	0.09	-0.69	-0.93	0.56	-0.04	0.88	0	0.14
MLT	-7.3	-0.26	3.21	2.01	-0.1	1.59	-1.07	0.02	0.23
POL	8.7	0.37	-4.56	-3.06	0.33	-1.68	1.81	-0.03	-0.2
SVK	8.7	0.07	-0.81	-0.82	0.38	-0.25	0.67	0	0.1
SVN	9.7	0.2	-1.98	-1.16	0.32	-0.55	0.95	-0.01	0.05
BGR	17.7	0.33	-4.36	-3.2	0.65	-1.52	2.25	-0.03	0.05
ROM	11.7	0.24	-2.9	-2.22	0.58	-0.89	1.53	-0.02	0.08
USA	0	0	0	0	0	0	0	0	0
JPN	0	0	0	0	0	0	0	0	0
EU	**0**	**0**	**-0.15**	**-0.11**	**-0.01**	**-0.13**	**-0.05**	**0**	**0**

Looking at the effects on EU average, the positive effects observed in those countries that reduce the CIT are not enough to compensate the negative impact of raising this tax rate in other countries as Ireland, Cyprus, Czech Republic and Poland, the countries that suffer the biggest variations in GDP. In average, the EU GDP falls in 0.13 pp while EU Welfare is not affected. The impact in total revenues is almost negligible.

3.4 Sensitivity analysis

In previous simulations, we assumed there is government balance neutrality using taxes on labour as compensating variable for changes in CIT rates. The effects of the same simulations have been evaluated assuming two other scenarios. First, reducing the transfers to old (Tables B3.1-B3.3) and second, reducing government expenditure (Tables B3.4-B3.6). Tables are displayed in the Annex.

In Table B3.1, where the CIT for Ireland rises, the sensitivity analysis shows very similar results to the central case for most of the variables. There are differences only in welfare due to the close rule. The reduction of transfers to households has a direct effect on utility and welfare. The impact on GDP and welfare is quite different depending on the scenario when we simulate a reduction of CIT in Germany. If the compensating variable is transfers to old, there are higher increases in these variables both for Germany and the EU. The positive effects on capital and employment raise GDP and compensate for the negative direct effect of transfers to households. However, these positive effects for the EU average does not hold when the CIT rates are homogenize in all countries and compensated with transfers to old. Table B3.3 present the negative values for capital, wages, employment and GDP and almost negligible positive effects in welfare. Although countries like Belgium, France and Germany reduce their CIT rates, the positive effects on their macro variables are not enough to compensate the negative results in other countries.

The results of the simulations in Table B3.4 and Table B3.5 show figures very similar to those of the central case. It is the reduction of CIT for Germany compensated with government expenditures, Table B3.5, what differs more from the central case. The reason is that reducing government expenditures does not have a negative effect on employment and does not directly affect welfare. Consequently, the positive effects on capital and employment raise GDP and Welfare. Given the weight of Germany in the EU, these positive results are transferred to the EU average.

4. Conclusions

This paper evaluates the effects that changing the corporate income tax (CIT) rate may have on EU countries. It considers the case of uncoordinated tax changes, by simulating an upward adjustment in Ireland, a low CIT tax economy, and a downward adjustment in Germany, one of the three countries with highest CIT rates and the largest economy in the EU. These two simulations represent two opposing cases of rather drastic policy changes, which although not realistic, serve to uncover an interesting set of not always intuitive impacts. Additionally, the third simulation considers

a coordinated policy change, whereby all EU member states choose to harmonise their CIT rates at the EU average level. These simulations have been evaluated in different scenarios, using as compensating variable tax on labour in the central case and transfers to old and government expenditures in the sensitivity analysis. These variables change in order to counteract the positive and negative effect the CIT reform may have on government budget balance. The results show that in terms of GDP and welfare, the most positive effects are observed when Germany decides to reduce CIT in isolation. The impact that homogenizing the CIT rates in all countries may have in the EU are negligible in relation to welfare and mildly negative on GDP. In general, these results are quite robust and persist under different closure rules.

Annex A. Macroeconomic indicators used in the calibration

Population and Employment

Population and employment statistics used in the calibration come from the United Nations. Figures for population aged 20+ have been summed from the five year age groups reported in UNECE (2015) (EU countries and USA) and UNESCAP (2015) (Japan). Figures for population aged 15-64 have been summed from the five year age groups reported under the medium fertility projections of the World Population Prospects (UN 2013). Additional employment statistics, on annual hours worked, number of employees, number of self-employed and total employment are from Eurostat (database tables lfsi_emp_a, lfsq_eegaed, lfsq_esgaed, lfsq_ewhan2), except for the United States and Japan for which we use 2011 values (latest available) from the OECD (2009). Data on number of persons engaged, number of employees, total hours worked by persons engaged and total hours worked by employees are from the World Input Output Database (2015) (the successor of KLEMS) as documented in Timmer et al. (2015).

National accounts

National accounts data using the expenditure and income approaches are from the OECD (2015) and Eurostat (database tables: gov_a_main, nama_gdp_c, gov_10dd_edpt1 and ert_bil_eur_a for exchange rates). Purchasing power parity (PPPs) exchange rates are from the IMF (2015) and Eurostat (database table prc_ppp_ind). General government consolidated gross debt as a percentage of GDP is from DG ECFIN's Ameco Database.

National accounts data on labour and capital income shares determine the capital and labour parameters for the calibration of the model. The location-specific production factor is set at 2.5% of value added in each country, a value which was necessary for CORTAX to produce a reasonable result in terms of the corporate tax to GDP ratio. A sensitivity analysis with a lower share (1.5%) was not found to produce qualitatively distinct results (reported in Bettendorf et al., 2009).

Foreign Direct Investment

The CORTAX model requires bilateral FDI positions as part of the calibration. For these, we start with the Eurostat bilateral positions. Data on Foreign Direct Investment (FDI) flows by country of origin and country of receipt are from Eurostat (financial account, direct investment, reporting economy, database table bop_fdi_pos_r2). However, Germany, Luxembourg, Iceland, Switzerland, Cyprus and Japan do not report the country of origin for about half of the 30 countries considered. For the remaining countries information is missing only for about 2-4 countries of origin, typically those from outside the EU. Following the original calibration practice (Bettendorf and van der Horst, 2006):

(a) Missing values on inwards FDI were filled using the corresponding relationship from the outwards FDI table. In effect, information on FDI that is not reported by the receiving economy is obtained using information reported by the originating economy.

(b) For a small number of country pairs where neither inward nor outward information was available, FDI was approximated using information on the FDI behaviour of similarly-sized and/or neighbouring countries. For instance, inwards FDI to Luxembourg from Germany has been approximated by looking at the corresponding relationship between Luxembourg and Austria: First calculating Austrian FDI into Luxembourg as a share of total Austrian FDI in the EU and then multiplying this share by the total amount of German FDI in the EU.

For some countries, however there the FDI data raised concern given the relative importance of special purpose entity (SPE) activity. While SPEs are typically used by companies to isolate the firm from financial risk, they can also be used for debt shifting purposes between related parties, see Dharan (2002). We check all country aggregates and, in our case, there is concern about the values obtained for CYP, MLT, LUX and NLD. [3] In order to correct for this, we use non-SPE data where available. The first choice of source for this data is the OECD Benchmark Definition 4 (BMD4), which provides data on FDI specifically for SPEs and non-SPEs.[4] The most recent data set was released in March 2015, and currently provides data for 2013 only at an aggregate level (bilateral flows are not given). Furthermore data is only available for select countries. Of the four countries, only LUX has non-SPE FDI data listed for OECD BMD4,[5] and the inward and outward positions are adjusted based on these data. The UNCTAD FDI data also removes SPEs. For the remaining three countries, we check against the UNCTAD non-SPE totals.[6] [7] Based on these figures, adjustments are

[3] Ireland was also considered, but the UNCTAD non-SPE data did not suggest that the Eurostat figures were excessive, and the OECD BMD4 data are not given.

[4] The OECD data claim to set "the world standard for collecting direct investment statistics". Based on the arguments made (see http://www.oecd.org/investment/fdibenchmarkdefinition.htm for details), we consider this our preferred source for non-SPE FDI data aggregates.

[5] We use the directional principle data, which is adjusted to 2012 using the growth/reduction in assets over this period. The figures are total inward and outward positions with the rest of the world. Therefore, these are adjusted for the share of positions for the EU and USA and Japan out of the rest of the world, based on UNCTAD shares estimates http://unctad.org/Sections/dite_fdistat/docs/webdiaeia2014d3_LUX.pdf.

[6] The inward and outward FDI stocks are available here: http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx.

made to the inward position for Cyprus and the outward position for Cyprus, Malta and the Netherlands.

Annex B. Additional results: sensitivity analysis

Table B3.1. Economic effects of raising CIT in Ireland compensated with Transfers to old

	Capital	Wage	Employm.	GDP	Rev_CIT	Rev_tax	Welfare
	%	%	%	%	% of GDP	% of GDP	% of GDP
AUT	0	0	0	0	0	0	0
BEL	0	0	0	0	0	0	0
DNK	-0.01	0	-0.01	0.01	0.01	0.01	0.01
FIN	-0.01	0	-0.01	0	0.02	0.02	0.01
FRA	-0.01	0	-0.01	0	0.01	0.01	0.01
DEU	0	0	0	0	0	0	0
GRC	0	0	0	0	0	0	0
HRV	0	0	0	0	0	0	0
IRL	-8.79	-4.73	-1.8	-5.43	2.67	1.08	-1
ITA	0	0	0	0	0	0	0
LUX	-0.09	-0.01	-0.08	0.02	0.16	0.15	0.08
NLD	-0.02	0	-0.01	0.04	0.02	0.02	0.01
PRT	0	0	0	0.01	0	0	0
ESP	-0.01	0	0	0	0.01	0.01	0
SWE	-0.01	0	-0.01	0.01	0.01	0.01	0.01
GBR	0	0	0	0.01	0.01	0.01	0.01
CYP	0	0	0	0	0	0	0
CZE	0	0	0	0	0	0	0
EST	0	0	0	0	0	0	0
HUN	0	0	0	0	0	0	0
LVA	0	0	0	0.01	0	0	0
LTU	0	0	0	0	0	0	0
MLT	-0.01	0	-0.01	-0.01	0.01	0.01	0.01
POL	0	0	0	0	0	0	0
SVK	0	0	0	0	0	0	0
SVN	0	0	0	0	0	0	0
BGR	0	0	0	0.01	0	0	0
ROM	0	0	0	0	0	0	0
USA	0	0	0	0	0	0	0
JPN	0	0	0	0	0	0	0
EU	**-0.08**	**-0.04**	**-0.02**	**-0.04**	**0.04**	**0.02**	**-0.01**

[7] As for Luxembourg, the data are adjusted by the share of the inward and outward positions for the EU and USA and Japan out of the world totals.

Table B3.2. Economic effects of reducing CIT in Germany compensated with Transfers to old

	Capital	Wage	Employm.	GDP	Rev_CIT	Rev_tax	Welfare
	%	%	%	%	% of GDP	% of GDP	% of GDP
AUT	0.05	0.01	0.04	-0.13	-0.08	-0.07	-0.04
BEL	0.04	0.01	0.03	-0.02	-0.04	-0.03	-0.02
DNK	0.02	0	0.02	-0.06	-0.04	-0.04	-0.02
FIN	0.01	0	0.01	-0.04	-0.03	-0.03	-0.01
FRA	0.1	0.02	0.07	-0.03	-0.09	-0.07	-0.05
DEU	8.52	3.66	1.58	4.07	-2.55	-0.96	0.83
GRC	0	0	0	-0.02	0	0	0
HRV	0.01	0	0.01	-0.06	-0.01	-0.01	-0.01
IRL	-0.01	-0.01	0	-0.09	-0.01	-0.02	-0.01
ITA	0.02	0	0.02	0	-0.03	-0.02	-0.01
LUX	0.05	0.01	0.04	-0.04	-0.29	-0.28	-0.03
NLD	0.05	0.01	0.04	-0.14	-0.07	-0.06	-0.03
PRT	0.01	0	0.01	-0.02	-0.02	-0.01	-0.01
ESP	0.05	0.01	0.03	-0.01	-0.04	-0.03	-0.02
SWE	0.03	0	0.03	-0.06	-0.05	-0.05	-0.03
GBR	0.02	0	0.02	-0.08	-0.04	-0.03	-0.02
CYP	0	0	0	-0.02	0	0	0
CZE	0.01	-0.01	0.01	-0.08	-0.02	-0.02	-0.02
EST	0	0	0	-0.01	0	0	0
HUN	0.03	-0.01	0.03	-0.13	-0.03	-0.03	-0.03
LVA	0	0	0	-0.02	0	0	0
LTU	0	0	0	-0.03	0	0	0
MLT	0.52	0.21	0.35	-0.37	-0.32	-0.22	-0.22
POL	0	0	0.01	-0.05	-0.01	-0.01	-0.01
SVK	0.01	0	0.01	-0.05	-0.01	-0.01	-0.01
SVN	0	0	0	-0.03	-0.01	-0.01	-0.01
BGR	0	0	0	-0.03	0	0	0
ROM	0	0	0	-0.03	0	-0.01	-0.01
USA	0.03	0	0.01	0	-0.02	-0.02	-0.01
JPN	0.01	0	0	0	-0.01	-0.01	0
EU	**1.46**	**0.62**	**0.29**	**0.65**	**-0.55**	**-0.22**	**0.15**

Table B3.3. Economic effects of homogenizing CIT in the EU compensated with Transfers to old

	CIT_rate	CoC	Capital	Wage	Employm.	GDP	Rev_CIT	Rev_tax	Welfare
	pp	pp	%	%	%	%	% of GDP	% of GDP	% of GDP
AUT	2.7	0.09	-1.33	-0.64	-0.21	-0.73	0.4	0.11	-0.18
BEL	-6.3	-0.01	0.19	0.21	0.01	0.15	-0.19	-0.11	0.11
DNK	2.7	0.08	-1.04	-0.44	-0.14	-0.48	0.3	0.1	-0.12
FIN	3.2	0.08	-1.04	-0.46	-0.15	-0.48	0.34	0.12	-0.12
FRA	-9.4	-0.35	3.97	1.59	0.51	1.71	-1.02	-0.29	0.52
DEU	-3.3	-0.11	1.67	0.74	0.3	0.76	-0.48	-0.16	0.19
GRC	7.7	0.12	-2.15	-1.07	-0.5	-1.16	0.79	0.39	-0.18
HRV	7.7	-0.04	0.62	0.18	0.05	0.04	0.04	0.11	0.05
IRL	15.2	0.42	-7.15	-3.8	-1.5	-4.5	2.2	0.91	-0.75
ITA	-3.6	-0.02	0.43	0.24	0.13	0.23	-0.24	-0.12	0.04
LUX	-1.1	-0.04	0.61	0.31	0.1	0.33	-0.33	-0.22	0.12
NLD	2.7	0.08	-0.79	-0.42	-0.07	-0.56	0.19	0.02	-0.17
PRT	-2.3	-0.04	0.68	0.28	0.14	0.29	-0.24	-0.14	0.02
ESP	-7.6	-0.35	5.34	2.48	0.96	2.52	-1.42	-0.51	0.64
SWE	1.4	0.03	-0.44	-0.18	-0.08	-0.19	0.15	0.06	-0.03
GBR	3.7	0.28	-3.33	-1.22	-0.42	-1.42	0.72	0.28	-0.35
CYP	17.7	0.29	-5.92	-2.81	-1.49	-3.65	1.96	0.98	-0.35
CZE	8.7	0.26	-4.1	-2.11	-0.77	-2.21	1.31	0.56	-0.37
EST	6.7	0.04	-0.34	-0.33	-0.09	-0.37	0.35	0.23	-0.07
HUN	6.9	0.22	-3.47	-1.74	-0.66	-1.85	1.08	0.33	-0.41
LVA	12.7	0.06	-1.45	-0.73	-0.45	-0.95	0.75	0.46	-0.05
LTU	12.7	0.09	-1.66	-0.89	-0.45	-1.01	0.86	0.55	-0.07
MLT	-7.3	-0.26	4.02	1.97	0.7	2.38	-1.04	-0.5	0.37
POL	8.7	0.37	-6.05	-2.99	-1.28	-3.2	1.73	0.73	-0.59
SVK	8.7	0.07	-1.56	-0.79	-0.4	-1	0.65	0.35	-0.08
SVN	9.7	0.2	-2.77	-1.13	-0.5	-1.34	0.93	0.44	-0.21
BGR	17.7	0.33	-6.4	-3.11	-1.56	-3.6	2.17	1.24	-0.35
ROM	11.7	0.24	-4.48	-2.15	-1.1	-2.49	1.48	0.68	-0.35
USA	0	0	0	0	0	0	0	0	0
JPN	0	0	0	0	0	0	0	0	0
EU	0	0	-0.18	-0.11	-0.07	-0.18	-0.06	0.01	0.05

Table B3.1. Economic effects of raising CIT in Ireland compensated with government expenditure

	Capital	Wage	Employm.	GDP	Rev_CIT	Rev_tax	Welfare
	%	%	%	%	% of GDP	% of GDP	% of GDP
AUT	0	0	0	0	0	0	0
BEL	0	0	0	0	0	0	0
DNK	0	0	0	0.01	0.01	0.01	0
FIN	0.02	0	0.02	0.02	0.02	0.02	-0.02
FRA	0	0	0	0.01	0.01	0.01	0
DEU	0	0	0	0	0	0	0
GRC	0	0	0	0	0	0	0
HRV	0	0	0	0	0	0	0
IRL	-7.34	-4.79	-0.19	-3.94	2.74	1.42	-2.5
ITA	0	0	0	0	0	0	0
LUX	0.07	-0.02	0.08	0.18	0.17	0.17	-0.1
NLD	0.01	0	0.01	0.07	0.02	0.02	-0.01
PRT	0	0	0	0.01	0	0	0
ESP	0	0	0	0.01	0.01	0.01	0
SWE	0	0	0	0.02	0.01	0.01	0
GBR	0	0	0	0.02	0.01	0.01	0
CYP	0	0	0	0	0	0	0
CZE	0	0	0	0	0	0	0
EST	0	0	0	0	0	0	0
HUN	0	0	0	0	0	0	0
LVA	0	0	0	0.01	0	0	0
LTU	0	0	0	0	0	0	0
MLT	0.01	0	0.01	0.01	0.01	0.01	-0.01
POL	0	0	0	0	0	0	0
SVK	0	0	0	0	0	0	0
SVN	0	0	0	0	0	0	0
BGR	0	0	0	0.01	0	0	0
ROM	0	0	0	0	0	0	0
USA	0	0	0	0	0	0	0
JPN	0	0	0	0	0	0	0
EU	**-0.06**	**-0.04**	**0**	**-0.02**	**0.04**	**0.02**	**-0.03**

Table B3.2. Economic effects of reducing CIT in Germany compensated with government expenditure

	Capital	Wage	Employm.	GDP	Rev_CIT	Rev_tax	Welfare
	%	%	%	%	% of GDP	% of GDP	% of GDP
AUT	-0.03	0.01	-0.04	-0.21	-0.09	-0.09	0.04
BEL	0	0.01	-0.01	-0.06	-0.04	-0.04	0.01
DNK	-0.02	0	-0.02	-0.1	-0.04	-0.05	0.03
FIN	-0.02	0	-0.03	-0.07	-0.03	-0.04	0.03
FRA	0.01	0.03	-0.02	-0.12	-0.1	-0.09	0.04
DEU	7.09	3.71	0.22	2.72	-2.57	-1.3	2.09
GRC	0	0	0	-0.02	0	0	0
HRV	0	0	0	-0.07	-0.01	-0.01	0
IRL	-0.03	-0.01	-0.02	-0.11	-0.01	-0.02	0.01
ITA	-0.01	0	-0.01	-0.03	-0.03	-0.03	0.01
LUX	-0.25	0.02	-0.27	-0.34	-0.3	-0.32	0.3
NLD	-0.03	0.01	-0.04	-0.22	-0.07	-0.08	0.04
PRT	0	0	0	-0.03	-0.02	-0.02	0.01
ESP	0.01	0.01	-0.01	-0.05	-0.04	-0.04	0.02
SWE	-0.02	0.01	-0.02	-0.11	-0.05	-0.06	0.03
GBR	-0.01	0	-0.02	-0.11	-0.04	-0.04	0.02
CYP	0	0	0	-0.02	0	0	0
CZE	-0.01	0	0	-0.1	-0.02	-0.02	0
EST	0	0	0	-0.02	0	0	0
HUN	-0.01	0	0	-0.16	-0.03	-0.04	0
LVA	0	0	0	-0.02	0	0	0
LTU	-0.01	0	0	-0.03	0	0	0
MLT	0.24	0.22	0.06	-0.65	-0.33	-0.27	0.06
POL	-0.01	0	0	-0.06	-0.01	-0.01	0
SVK	0	0	0	-0.06	-0.01	-0.01	0
SVN	0	0	0	-0.04	-0.01	-0.01	0
BGR	-0.01	0	0	-0.03	0	0	0
ROM	0	0	0	-0.04	0	-0.01	0
USA	0.01	0	-0.01	-0.02	-0.02	-0.02	0.01
JPN	0	0	0	-0.01	-0.01	-0.01	0
EU	1.19	0.63	0.02	0.39	-0.55	-0.3	0.43

Table B3.3. Economic effects of homogenizing CIT in the EU compensated with government expenditure

	CIT_rate	CoC	Capital	Wage	Employm.	GDP	Rev_CIT	Rev_tax	Welfare
	pp	pp	%	%	%	%	% of GDP	% of GDP	% of GDP
AUT	2.7	0.09	-1.18	-0.64	-0.06	-0.58	0.4	0.15	-0.33
BEL	-6.3	-0.01	0.03	0.22	-0.15	0	-0.19	-0.15	0.23
DNK	2.7	0.08	-0.91	-0.44	0	-0.35	0.3	0.14	-0.27
FIN	3.2	0.08	-0.89	-0.46	0.02	-0.32	0.34	0.17	-0.29
FRA	-9.4	-0.35	3.5	1.6	0.04	1.26	-1.03	-0.43	0.93
DEU	-3.3	-0.11	1.43	0.75	0.06	0.52	-0.49	-0.23	0.4
GRC	7.7	0.12	-1.57	-1.09	0.12	-0.57	0.81	0.52	-0.67
HRV	7.7	-0.04	0.71	0.17	0.14	0.13	0.04	0.11	-0.07
IRL	15.2	0.42	-5.92	-3.86	-0.15	-3.24	2.26	1.19	-2.02
ITA	-3.6	-0.02	0.26	0.25	-0.05	0.06	-0.24	-0.17	0.19
LUX	-1.1	-0.04	0.35	0.33	-0.16	0.07	-0.35	-0.26	0.39
NLD	2.7	0.08	-0.74	-0.42	-0.02	-0.52	0.19	0.04	-0.21
PRT	-2.3	-0.04	0.52	0.29	-0.02	0.13	-0.25	-0.17	0.2
ESP	-7.6	-0.35	4.53	2.51	0.17	1.73	-1.46	-0.72	1.31
SWE	1.4	0.03	-0.37	-0.18	0	-0.12	0.15	0.08	-0.11
GBR	3.7	0.28	-3.01	-1.23	-0.08	-1.1	0.74	0.36	-0.72
CYP	17.7	0.29	-4.48	-2.87	0.05	-2.2	2.01	1.25	-1.53
CZE	8.7	0.26	-3.44	-2.14	-0.06	-1.54	1.33	0.67	-1.05
EST	6.7	0.04	-0.08	-0.34	0.18	-0.11	0.36	0.27	-0.36
HUN	6.9	0.22	-3.02	-1.76	-0.18	-1.4	1.09	0.42	-0.82
LVA	12.7	0.06	-0.74	-0.76	0.28	-0.25	0.76	0.6	-0.61
LTU	12.7	0.09	-0.94	-0.92	0.3	-0.29	0.87	0.67	-0.74
MLT	-7.3	-0.26	3.31	2	-0.01	1.68	-1.07	-0.63	1.06
POL	8.7	0.37	-5.02	-3.04	-0.17	-2.16	1.78	0.95	-1.53
SVK	8.7	0.07	-1.06	-0.81	0.12	-0.49	0.66	0.45	-0.52
SVN	9.7	0.2	-2.27	-1.15	0.03	-0.84	0.94	0.53	-0.74
BGR	17.7	0.33	-4.84	-3.18	0.12	-2.01	2.23	1.44	-1.87
ROM	11.7	0.24	-3.46	-2.19	-0.02	-1.46	1.51	0.88	-1.21
USA	0	0	0	0	0	0	0	0	0
JPN	0	0	0	0	0	0	0	0	0
EU	0	0	-0.13	-0.11	0	-0.12	-0.05	-0.01	0.05

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