Corporate Tax Consolidation and Enhanced Cooperation in the European Union

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Abstract

This article assesses the economic implications of the introduction of consolidation with formula apportionment in the European Union under alternative enhanced cooperation agreements. We find that the consolidation is likely to yield a small aggregate welfare gain in Europe, but that not all countries benefit. A coalition of winning countries reduces the welfare gain and may induce a process of adverse selection which distroys the possibility of cooperation. We find that a coalition of similar countries (in terms of the size of their multinational sector) is more feasible in achieving agreement and is actually preferred by those countries over a European-wide reform.

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1 Introduction

In 2001, the European Commission concluded that existing EU corporate tax systems are highly inefficient: they distort the international allocation of capital and create high administrative and compliance costs. The Commission argued that these inefficiencies were partly due to the system of separate accounting, under which accounts of a multinational subsidiary terminate at the border. The European Commission (2006) therefore proposed to pursue with an alternative system based on consolidation with formula apportionment. Under that regime, each multinational will identify its EU-wide consolidated profits, which will be allocated to member states on the basis of an apportionment formula, consisting of employment, payroll, assets, and/or sales. Each member state will tax the allocated profit at its own tax rate. In determining the consolidated tax base, the European Commission aims at a common definition of the tax base and one single formula. The proposal is labelled CCCTB: the common consolidated corporate tax base.

The CCCTB is likely to produce an aggregate welfare gain for Europe, although the size of this gain is probably modest (Fuest, 2008; van der Horst et al., 2007). Yet, not all countries may benefit. Indeed, the precise impact on welfare of a country will depend on the choice of the apportionment formula. If some countries are worse off, then it will be difficult to agree upon the CCCTB among 27 Members of the EU. This is especially so in light of unanimity voting with respect to tax matters. A potential way out is enhanced cooperation under which a subgroup of countries in the EU coordinate their policies. Countries that find it not in their interest to join can decide to opt out. It is sometimes seen as the only possible way towards harmonisation of business taxes in Europe.

This paper explores the welfare effects of enhanced cooperation with respect to the CCCTB in Europe. Economic theory offers a variety of predictions with respect to enhanced cooperation in taxation. For instance, it suggests that countries that stay outside an agreement will gain if tax rates are strategic complements. Moreover, countries that are more similar are more likely to form an enhanced cooperation agreement and may actually prefer this over global cooperation. We explore these prediction by simulating a CCCTB reform with a computable general equilibrium model for the European economy. The model is designed to analyse corporate tax reforms in the EU and encompasses several decision margins of firms, such as marginal investment, financial structure, foreign direct investment and international profit shifting. The model is calibrated on the basis of a careful review of the literature on behavioural elasticities and uses real world data on economic structures for 2005. It offers a valuable framework for analysing CCCTB reforms and allows to identify the most likely winners and losers of the introduction of the CCCTB in the EU27. We assess the welfare effects of a CCCTB implemented by a number of enhanced cooperation agreements and put these results in the perspective of the recent literature on enhanced cooperation agreements.

The rest of this paper is organised as follows. Section 2 provides a review of the existing literature on consolidation and formula apportionment. Then, section 3 discusses the literature on enhanced cooperation agreements and propose some expectations about feasible coalitions. Section 4 offers a description of our computable general equilibrium model. In section 5, we show simulations to demonstrate the economic implications of the CCCTB in the EU27. Section 6 analyses the CCCTB under enhanced cooperation among alternative coalitions of countries. Finally, section 7 concludes.

2 Consolidation with formula apportionment

The current system of corporate income taxation (CIT) in the European Union (EU) is based on separate accounting. It means that the accounts of a multinational enterprise (MNE) terminate at the border and profits in each country are determined by applying appropriate armslength prices for intracompany transactions. Under the alternative system of consolidation, the tax base is added up to yield a single aggregate tax base for the entire EU. In the United States and Canada as well as in the proposed CCCTB system in the EU, the consolidated tax base is apportioned to individual countries via a formula. In the US, States may use their own formula to determine the profits allocated. Factors used include sales, payroll and assets. States can apply their own rate to the apportioned part of the corporate tax base. In the EU discussion on the CCCTB, the idea is to use one single formula to allocate profits across EU Member States.

The literature on formula apportionment concentrates primarily on the distortions induced by the formula. The choice of the apportionment formula is important for two reasons. First, the formula determines the distribution of the tax base across jurisdictions. A state that is abundant in capital-intensive production facilities will receive a relatively large share of profits if capital is used in the formula; a state with many consumers but no production facilities will gain more if sales are used to apportion profits. Hence, each country will have a different interest as to what apportionment factors are used. Second, formula apportionment imposes an implicit excise tax on the apportionment factor. Indeed, firms can influence their corporate tax liability by locating the factors that enter the formula in low-tax jurisdictions. As long as tax rates differ across jurisdictions, the allocation of investment and employment will thus be influenced under formula apportionment. A well-developed empirical literature explores how the variation in the apportionment formulas and tax rates affects investment and employment by multinationals. The majority of these studies are for the US. They confirm the impact of the formula on factor allocation, see e.g. Weiner (1994), Klassen and Shackelford (1998), Gupta and Hofmann (2003) and Goolsbee and Maydew (2000). In Canada all Provinces use the same formula. As tax rates differ across provinces, however, multinationals can exploit these differences in the CIT rates by reallocating factors to low-tax provinces. Mintz and Smart (2004) use Canadian administrative tax data and find that the elasticity of taxable income to tax rates is significantly higher for firms that engage in factor shifting. Also Weiner (1994) and Klassen and Shackelford (1998) find evidence for factor shifting to low-tax jurisdictions.

Sørensen (2000, 2004b) constructs a CGE model of tax competition in the OECD and estimates the welfare gains from a complete CIT rate and base harmonisation in the EU. He does not consider a sole consolidation of the tax base. The welfare gains of harmonisation lie between 0.1 and 0.2% of GDP. While the majority of member states gains, some countries will be worse off. Sørensen argues that the welfare gains might be larger if harmonisation would succeed in considerably reducing compliance costs, which are not included in the model.

3 Enhanced cooperation agreements

An enhanced cooperation agreement (ECA) occurs if not all countries, but a subgroup among them agrees upon cooperation. Before discussing the literature, it is informative to discuss the institutional characteristics of ECAs within the EU. ECAs have been institutionalized by the treaties of Amsterdam (1997) and Nice (ratified in 2003) and must comply with a number of restrictions. First of all, the ECA can only be used when the attempts to unify all Member States have failed, that is, it is a mechanism of last resort. Second, a minimum of eight members states should participate in the ECA. Thirdly, the ECA should be authorized by the European Council following a qualified majority. This ensures that the ECA is in the interest of the majority of Member States. Fourth, the principal of openness implies that all Member States are free to participate in the ECA at any time if they prefer. Related to this is that the ECA should be fashioned such that as many Member States as possible will participate. Fifth, although participation is free and all Member States are allowed to discuss the policy enacted by the ECA, only those Member States who participate decide upon the policy adopted. Finally, the ECA should facilitate the European integration process and not work against its interest.

A number of papers discuss ECAs in either general settings or focussed on taxation. Burbidge et al. (1997) adopt a simple capital tax competition model and identify three interrelated steps in the endogenous formation of an ECA. First, a given ECA must decide on (i) the common policy and (ii) how to divide the gains from cooperation via a transfer scheme. Subsequently, given expectations on this, countries must decide which coalition is preferred. Due to asymmetries between countries, it is found that global harmonisation need not be the outcome of an endogenous coalition formation process. Both the common policy, which determines the aggregate gain from cooperation, and the transfer scheme, crucially influence the payoff for each country of a particular coalition.

Beaudry et al. (2000) study whether a central authority should stimulate the creation of an ECA. They find that an ECA is welfare improving when spillovers within the ECA are of the same sign as the spillovers between the ECA and the rest of the world. The intuition is that in this case the change in policy by the ECA, which internalises within-ECA spillovers, is to the benefit of outsider countries. When the spillovers are of different sign, the ECA is welfare improving only when the aggregate welfare improvement from internalised spillovers outweigh the decrease in welfare in the outsider countries.

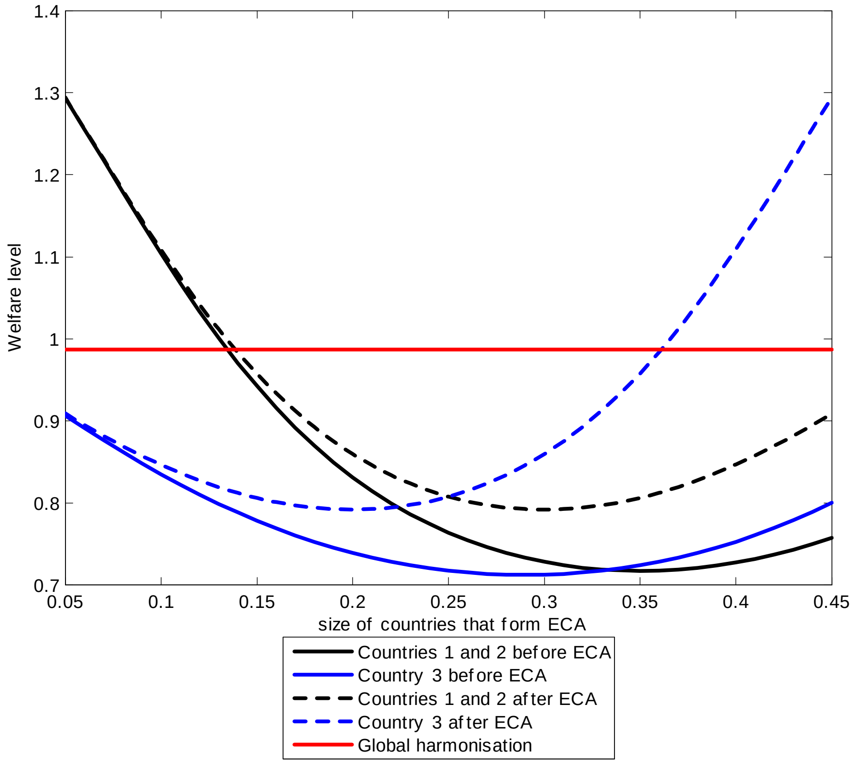
Bordignon and Brusca (2006) study whether ECAs applied to tax base harmonisation are welfare improving. Moreover, they explore how the common policy should be decided upon when, with some finite probability, full harmonisation is the preferred policy outcome in the long run. They find that ECAs are a useful in-between step when there are large policy asymmetries between countries initially. Crucial are the assumptions that a policy change is costly and that the gains from harmonisation are uncertain. Countries with comparable initial policies can, by forming an ECA, reap the benefits of a level playing field at relatively low costs. Outsider countries can join when the gains from coordination turn out to be large. However, the choice of a common policy by the ECA might influence a future global standard and, therefore, both welfare and the entrance decision of outsider countries in the future. A central planner must take this into account when forming the ECA, an issue also studied by Alesina et al. (2005). By joining an ECA, a country will benefit from a level playing field, but it must change its policy towards the common ECA policy, which is costly when the initial policy reflected national preferences more accurately. Yet, the initial ECA members might be reluctant to accept the new-comer as the benefits from increasing the level-playing field must be traded off against changes in both the common policy and the transfer scheme demanded by the new-comer. The ECA therefore creates a status quo which influences future developments.

Several papers have studied ECAs with respect to harmonising capital taxation. Konrad and Schjelderup (1999) consider a model with symmetric countries from which a subset decides to form a partial union. Based on the assumption of strategic complementarity between the tax rates of the outsider countries and the union, the authors find that the countries involved in the partial union will unambiguously experience an increase in welfare after marginally increasing their joint tax rate. Interestingly, the model studied incorporates positive spillovers both within the union and between the union and the rest of the world, which implies that, following Beaudry et al. (2000), partial harmonisation is also in the interest of the outsider countries.

Vrijburg (2009) studies partial tax harmonisation in a model with three asymmetric countries, which differ in size. With respect to the strategic behaviour of the countries, Vrijburg studies both the case of pure Nash competition and the case where the countries that form the partial union behave as a Stackelberg leader. He finds, in accordance with Beaudry et al. (2000) and Konrad and Schjelderup (1999), that welfare in both the partial union and the outsider country is increased whenever the tax rates of the outsider country and the union are strategic complements. However, strategic complementarity cannot be guaranteed in general. To be more specific, when two small countries form a partial union the tax rates of the large outsider country and the union are strategic substitutes for relative low values of the substitution elasticity between public and private goods. In this case, partial harmonisation will increase (decrease) welfare in the outsider country and decrease (increase) welfare in the union under Nash (Stackelberg) competition.

Another interesting finding by Vrijburg (2009) is the welfare gain from partial versus global tax harmonisation. He distinguishes three ranges of size, where different outcomes are optimal for harmonisation. Figure 1 presents the results for the case of Nash competition. First, if merging countries (1 and 2) are both small relative to the outsider country (3), then forming an ECA is preferred by the merging countries compared to global harmonisation. Intuitively, the merging countries internalise the fiscal spillovers between the two countries, but they are still able to compete against the relatively large outsider country. This competition is beneficial for welfare in the union as long as the countries are sufficiently small. However, the outsider country would prefer global harmonisation. Second, if different countries are more similar, then complete harmonisation is preferred over partial harmonisation for all countries. In that case, internalising fiscal externalities yields bigger gains than the opportunity to compete vis a vis the third country. As long as the third country is not too small, it also finds it attractive to opt in the global agreement. Finally, if the merging countries are relatively large compared to the outsider country, the merging countries would prefer global harmonisation over partial harmonisation. However, the outsider country will not find it in its interest to join the ECA. Instead, while it benefits from the formation of the ECA, it gains from competition as long as it is sufficiently small. The result suggests that countries will more likely cooperate if they are sufficiently similar. If one country is very different, then either this country will find it desirable to opt out or the ECA will find it desirable to keep that country outsider the coalition. Recog-

Figure 1: Welfare effects of partial and full tax harmonisation when countries differ in size



nize that in the latter case, partial harmonisation cannot be regarded as a first step to global harmonisation. Either the outsider country or the merging countries always prefer partial harmonisation over global harmonisation. Only when the asymmetries are not to pronounced, can partial harmonisation be a first step towards global harmonisation.

Conconi et al. (2008) find that an ECA can be optimal from a global perspective when individual governments face commitments problems concerning the taxation of capital. Consumers will make an inefficient savings decision when they expect that the government will raise capital taxes in the future. Cross-country mobility of capital constrains the government from raising taxes too high and might therefore improve the savings decision by consumers; it serves as a commitment mechanism for the government. An ECA might therefore be preferred to global harmonisation as the latter completely removes the commitment mechanism.

Haufler and Wooton (2003) study the welfare effects of ECAs when countries compete for inward FDI in the presence of location specific rents. They find that the ECA enables the participating countries to internalise positive cross-country spillovers from the MNE locating within the union and to eliminate wasteful internal competition for the MNE. This allows the countries to obtain a larger share in the location specific rents earned by the MNE.

Riedel and Runkel (2007) consider an ECA on the CCCTB and focus on profit shifting through transfer pricing. They find that, in the short run when countries are unable to change their statutory tax rates, profit shifting between the countries that introduce formula apportionment and the rest of the world is reduced. This is because total profit shifting between the partial union and the outsider country is a function of the difference between the statutory tax rate of the outsider country and the effective tax rate in the partial union. After the introduction of formula apportionment, MNEs will reallocate investment towards the low-tax union country, which causes the effective tax rate of the partial union to be lower than the average pre-harmonisation statutory tax rates of the countries that form the partial union. This decreases the incentive to shift profit out of the partial union, a result that follows from the assumption of a convex marginal concealment cost of transfer pricing. Gerard (2007) focuses on transfer pricing through a financing detour in an un-active affiliate in a low tax country. Contrary to Riedel and Runkel, this water's edge characteristic does not depend on the size of tax rate differentials. Therefore profit shifting remains when tax havens are not included in the ECA. Gerard suggests that the ECA should operate a credit system vis-à-vis the rest of the world (EU) to minimise tax revenue losses. Becker and Fuest (2007) find that an ECA with formula apportionment might result in too little tax enforcement effort by individual member countries as they have to share the gains from this effort with the other members of the partial union.

Sørensen (2000, 2004a) uses his CGE model to study regional harmonisation of capital taxation. In accordance with Konrad and Schjelderup (1999), he finds that the countries that form an ECA will increase their level of capital taxation and that welfare for both the ECA members and the outsider countries increases. The increased level of taxation by the ECA members causes a capital flow towards the rest of the world. This capital outflow causes the ECA members to prefer full cooperation above enhanced cooperation, while outsider countries are better off under enhanced cooperation. The model implies that the cost of tax competition is mainly in the form of a lower degree of income redistribution. As a result, Sørensen (2000) finds that the welfare effects from coordination are positively correlated with the preference for redistribution. The mobility of capital between the ECA and the rest of the world is essential. When capital is more mobile within the ECA as compared to the rest of the world, the welfare gains from the ECA are larger. Furthermore, those countries with initial high capital taxes gain from coordination, while initial low tax countries might lose. Finally, net capital importers are found to experience a larger welfare gain as the coordinated increase in taxation lowers net interest payable.

Using a more complex model, Brøchner et al. (2006) study an ECA between the 12 EMU Member states concerning harmonising corporate tax policy. The ECA policy is either a weighted or an un-weighted average of the individual country policies. The aggregate welfare gain from this ECA is found to be much smaller than under full cooperation. Countries that are confronted with higher effective tax burdens due to the ECA both experience an increase in tax revenues and a decrease in domestic investment. From this it follows that the losers (winners) in terms of welfare of the introduction of an ECA are those countries that experience an increase (decrease) in tax revenues complicating the design of compensating schemes. In addition, Brøchner et al. (2006) study a base harmonisation. As countries with small tax bases tend to have high tax rates and vice versa, base harmonisation might increase tax rate differentials. It is therefore not at all clear whether an improvement in the allocation of capital can be expected. Those countries that are forced to broaden their tax base typically lose from base harmonisation following an increase in the effective tax level.

In this paper, we consider the welfare effect of an ECA in the CCCTB in the EU. We compare a selection of exogenously chosen coalitions that adopt an exogenously chosen CCCTB reform. The results are compared to the impact of an EU-wide reform. We consider neither an endogenous formation of a coalition nor of the CCCTB design. The analysis will thus shed light on whether (i) feasible coalitions can be formed; (ii) how countries that opt out are affected; (iiii) countries that form an ECA can actually be better off than under EU-wide harmonisation.

4 The model

We use the CORTAX model to assess the economic impact of harmonisation proposals. CORTAX is an applied general equilibrium model describing the 27 countries of the European Union, the US and Japan. It is designed to simulate the economic implications of unilateral and multilateral corporate tax policies. The structure of each country is the same and countries are linked via trade in goods and capital and via multinational firms. We set shares to replicate aggregates from national accounts data in 2005 and data on firm accounts in the ORBIS database. ORBIS is a comprehensive set of over 9 million companies provided by the Bureau van Dijk, based on standardized balance sheet information of companies. Parameters in CORTAX are set also so as to replicate empirical elasticities found in the economic literature. CORTAX is heavily inspired by the OECDTAX-model of Sørensen (2001). An earlier version was used for European tax policy analysis in Bettendorf et al. (2006, 2007) and van der Horst et al. (2007). A detailed description of the structure and parameterisation of the model can be found in Bettendorf and van der Horst (2008). This section presents the main features of CORTAX.

4.1 Households

Following the overlapping generations model of Diamond, households live for two periods. One may interpret one period to cover 40 years. We express all variables in annual terms to facilitate the interpretation in terms of national accounts data. Behaviour within each 40-year period is assumed to be constant. Households make their decisions regarding work, consumption and saving by maximising a life-time utility function subject to an intertemporal budget constraint. When young (i.e. the first period), households choose to allocate their time between leisure and work. When old (i.e. the second period) households do not work but only consume. Young households receive after-tax wage income and lump-sum transfers. This income at a young age is allocated over consumption and savings. Savings are invested in a mix of bonds and stocks, which are assumed to be imperfect substitutes and which yield different rates of return. In the second period, households are retired. Consumption at old age is financed by the assets saved from the first period plus an after-tax rate of return and by lump-sum transfers. Moreover, the older generation is assumed to own the fixed factor used by firms. Therefore, the old receive the economic rents.

Household optimization yields expressions for labour supply, savings and the optimal asset portfolio. Asset returns are determined on world markets and we do not explore residence-based taxes on capital in this paper. Therefore, saving is not affected by the policies explored here. The most important distortion is related to the consumption/leisure choice. Labour supply behaviour in CORTAX is governed by the usual income and substitution effects. Most empirical studies suggest that substitution effects dominate income effects so that the uncompensated elasticity of labour supply is positive. In CORTAX, we set for all countries the utility parameters so that we obtain an uncompensated elasticity of labour supply of 0.19 on average (values differ slightly due to country variation in shares).

4.2 Firms

In CORTAX, one representative domestic firm and one representative multinational headquarter is located in each country. The multinational owns a subsidiary in each foreign country. With 29 countries in CORTAX, we thus have 30 different firms operating in each country, namely the representative domestic firm, the representative headquarter and 28 subsidiaries that are owned by the headquarters in the other countries.

Each firm maximises its value – equal to the net present value of all future cash flows – subject to the accumulation constraints and a production function. The production function features three primary factors: labour, capital and a fixed factor. Labour is immobile across borders and wages are determined on national labour markets. Capital is assumed to be perfectly mobile internationally so that the return to capital (after source taxes) is given for each country on the world capital market. The fixed factor is location-specific (e.g. land) and is supplied inelastically. The income from the fixed factor reflects an economic rent.

In calibrating the model of the firm, capital and labour parameters are determined by national accounts data on labour- and capital income shares. The fixed factor is – somewhat arbitrarily – set at 2.5% of value-added in each country. This value ensures that CORTAX yields appropriate corporate tax-to-GDP ratios. Investment is determined by the cost of capital. The responsiveness of investment depends on the substitution elasticity between labour and capital. Most general equilibrium models adopt values between 0.5 and 1.0. We use a value of 0.7. It corresponds to an elasticity of investment to the user cost of capital of -0.9, which is consistent with empirical estimates (Hassett and Hubbard, 2002).

To determine the size of corporate tax changes on investment, we need to assess the impact of the corporate tax on the cost of capital. This depends on the initial corporate tax system and is best measured by the effective marginal tax rate (EMTR). Taking these effects together, we can compute tax-rate elasticities of investment in CORTAX. On average, the tax-rate elasticity is -0.3, i.e. a 1%-point higher corporate tax rate reduces investment by 0.3%. It ranges from zero in Estonia to -0.6 in Spain (with a high EMTR). Investment thus becomes more responsive to tax if the EMTR in a country is larger.

Firms finance their investment by issuing bonds and by retaining earnings (issuing new shares is excluded in CORTAX). The optimal financial structure depends on the difference between the after-tax cost of debt and equity. Along the lines of the trade-off theory, we include a financial distress cost associated with high debt positions. The marginal cost of debt finance increases in the debt share. In CORTAX, the convexity of the financial distress cost determines the impact of corporate taxation on a firms' financial policy. We set the parameters in this function so as to obtain a semi-elasticity of the debt share with respect to the corporate tax rate between 0.2 and 0.4, which is based on recent empirical studies (see Weichenrieder and Klautke, 2008). The convexity of the cost function implies that the semi-elasticity falls in the corporate tax rate.

4.3 Multinationals

In maximising the value of the firm, multinationals take the sum of its headquarter and all subsidiaries. The subsidiaries are assumed to be wholly owned by the headquarter. Rents earned by subsidiaries accrue to the households in the parent country. In the calibration of CORTAX, the size of the fixed factor in each subsidiary is determined by data on bilateral foreign direct investment (FDI) stocks. Given the fixed factor, multinationals decide how much capital and labour to employ in each foreign subsidiary. If a corporate tax raises the cost of capital somewhere, this reduces the investment the multinational is willing to invest. Thus, inward FDI in a location is governed by the effective marginal tax rate.

In CORTAX, foreign subsidiaries need intermediate inputs to produce output. These are supplied by the parent company. As there is only one homogeneous good in the model, the arms-length price for this intermediate input is equal to the market price of the numeraire good, i.e. equal to one. However, the parent company can charge a transfer price for intra-company deliveries that deviates from this arms-length price. In particular, a headquarter company has an incentive to set an artificially low (high) transfer price for supplies to subsidiaries in countries that feature a lower (higher) statutory corporate tax rate. In this way, the multinational is able to shift profits from high to low-tax countries, thereby reducing its overall tax liability. To ensure an interior solution, we specify a convex cost function to capture the costs associated with manipulated transfer pricing. Hence, profit shifting to countries with very low corporate tax rates becomes increasingly costly at the margin. The elasticity of transfer pricing with respect to the corporate tax rate is determined by the parameters in the cost function and is set to obtain a tax elasticity of transfer pricing of around -1.4 on average over all countries. The tax elasticity ranges between -0.8 in low-tax countries and -2 in high-tax countries. To compare this to the empirical evidence on profit shifting, we translate it into a semi-elasticity of the corporate tax base. It requires that we multiply the tax elasticity of transfer pricing with the share of intrafirm trade (which, in CORTAX, is proportional to bilateral FDI stocks). These stocks differ considerably between countries in the EU. Luxembourg stands out with a sum of the inward and outward FDI stock of 9 times its GDP. Stocks are generally small in Central and Eastern Europe, especially the outward stocks. They are large in some small Western EU countries, like the Netherlands and Belgium. Together, the elasticity of the transfer price and the size of multinationals determine the sensitivity of the total corporate tax base for changes in the corporate tax rate. The tax-rate elasticity of the corporate tax base has an average value of -0.23, implying that the corporate tax base shrinks by 0.23% due to profit shifting if the corporate tax rate is increased by 1%-point. The majority of countries feature a smaller elasticity as their multinational sector is small. For countries where multinationals are more important, elasticities are larger. The largest elasticities are reported for Belgium and the Netherlands which feature the largest multinational sectors. In the Netherlands, a 1%-point higher corporate tax rate reduces the tax base via profit shifting by 0.8%. The semi-elasticity is small in the Central and Eastern European countries where multinationals are relatively unimportant.

4.4 Losses

In CORTAX, representative firms are equal ex-ante. Ex-post, however, firms differ due to random shocks. We assume that random shocks occur in output or, equivalently, in the value of sales. In the good outcome, the revenue from sales is larger than in the bad outcome. In the latter case, profits become negative. Hence, ex-post there are both profit making firms and loss making firms. Still, as firms are equal ex-ante, the possibility of different ex-post outcomes introduces ex-ante uncertainty. We assume that firms are risk neutral and decide on their optimal levels of investment, employment, debt shares, and transfer prices before knowing whether they are subject to a negative shock. Hence, they base their input decisions on expected output values and expected marginal productivities. The probabilities of profit and loss are assumed to be independent so that shocks for a firm are not correlated between years.

In today's corporate tax regimes in Europe, losses can be carried forward and offset against future profits within the same country. It implies that losses are treated asymmetric from profits for two reasons. First, the year at which losses can be offset is usually bounded so that some losses cannot be offset against future profits. Second, firms can only carry forward nominal losses, i.e. without indexation. Due to discounting, the value of these losses declines over time. In CORTAX, we assume that losses can be carried forward one year. If the company makes a loss in two consecutive years, the first-year loss dries up and cannot be offset against profits in the future. Although this may underestimate the current opportunities for loss compensation (losses can usually be carried forward more than one year), the assumption of uncorrelated shocks tends to overestimate the amount of losses that can be offset.

We use ORBIS to obtain information about the average loss probability and the aggregate ratio of loss/profit in the EU. The average loss probability is around 0.2; the aggregate ratio of loss/profit equals $\frac{1}{4}$. As the ratio of loss/profit probabilities 0.2/0.8 matches the aggregate loss/profit ratio, the average loss in a loss-making firm is assumed to be equal to the average profit in a profit making firm.

4.5 Government

Government behaviour in CORTAX is exogenous, Hence, the government does not optimize its policies and we simply modify tax rates exogenously. In performing simulations, we keep the government budget balanced, i.e. the government does not run a surplus or deficit after a reform. On the revenue-side of the government budget constraint, we have indirect taxes on consumption and direct taxes on various sources of income: corporate income, labour income, dividends, capital gains and interest. On the expenditure side of the constraint, we find government consumption, interest payments on public debt and lump-sum transfers. We keep government consumption and public debt constant as a fraction of GDP. The initial labour and consumption tax rates are calibrated by using effective taxes computed from Eurostat (2007). The calibration of corporate tax systems plays an important role for the outcomes of tax reforms. These systems are calibrated on tax data for 2005. In the baseline, corporate tax changes in 2006 and 2007 are simulated so that reforms are considered relative to the systems in 2007. In the calibration, we modify the tax base indicator for two countries: Estonia and Belgium. Belgium introduced in 2006 the Allowance for Corporate Equity (ACE) system. As we include reforms up to 2007, our baseline captures this Belgium ACE. In Estonia, the value of fiscal depreciation is zero as no depreciation allowances are available. However, Estonia does not tax retained profits. Indeed, it only levies a 22% tax rate on profit distributions. Hence, corporate profits in Estonia go untaxed as long as they are not repatriated to the parent or distributed to shareholders. To correct for this special feature of the Estonian tax system, we modify its corporate tax base by assuming a positive allowance. It is set so as to replicate the corporate-tax-to-gdp ratio for Estonia. We maintain the Estonian corporate tax rate at

22%.

4.6 Consolidation and formula apportionment

Consolidation of the tax base for a multinational implies summing up the tax bases of all subsidiaries. This tax base is apportioned to the participating tax authorities according to a prescribed formula. Each country is assigned a share ϕ_{ij} of the tax base (where i and j represent the home and host country, respectively), which it may tax at its own tax rate $\tau_{\pi,j}$. The share is calculated as a weighted average of three factors: employment, capital stock and production:[1]

$$\phi_{ij} = f^L \frac{L_{ij}}{L_i} + f^K \frac{K_{ij}}{K_i} + f^Y \frac{Y_{ij}}{Y_i} \tag{1}$$

The weights of the three factors, denoted by $f^{L,K,Y}$, sum up to one. The variable L_{ij} denotes employment by a subsidiary in source country j of a multinational from home country i. Total employment by multinational i is thus given by $L_i = \sum_j L_{ij}$. When the consolidated tax base is allocated according to the labour shares, jurisdiction j thus receives a fraction L_{ij}/L_i. The same notation applies to capital and production. One can easily check that the shares sum to one for each multinational ($\sum_j \phi_{ij} = 1$). Our starting point is a broad formula with equal weights on employment, capital and production, i.e. $f^L = f^K = f^Y = 1/3$.

The tax rate relevant for decisions by multinationals can be written as a weighted average of the tax rates applied by the participating jurisdictions:

$$\tau_{\pi,i}^{fa} = \sum_j \phi_{ij}\, \tau_{\pi,j} \tag{2}$$

In the determination of optimal input demands, multinationals take into account that they can affect the ϕ-shares to minimise the overall tax rate τ_π^{fa}. In other words, they can still relocate mobile factors under formula apportionment if corporate tax rates differ across jurisdictions. We assume that the formula apportionment system is mandatory for all multinationals.

[1] In practice, it is difficult to define capital and to a lesser extent employment and production. This issue is outside the scope of the current paper, see e.g. Martens-Weiner (2006). We consider production instead of sales as a factor in the apportionment formula. In our model, we are unable to define the destination of sales, as only the net exports of each country are known. This prohibits the use of sales in the formula.

4.7 Equilibrium and welfare

Equilibrium must hold on each market. On the goods market, a homogenous good is traded on a perfectly competitive world market. Thereby, countries cannot exert market power so that the terms of trade is fixed. On asset markets, bonds and equity of different origins are perfect substitutes and are freely traded on world markets so that returns are fixed for individual countries. Debt and equity are imperfect substitutes. The current account equals the change in the net foreign asset position for each country (including rest of the world), due to Walras law. As labour is immobile internationally, wages are determined nationally on competitive labour markets. We focus on the steady state outcomes of the model.

We compute the compensating variation to measure the welfare effects of policy changes. It is equal to the transfer that should be provided to households to maintain their utility at the pre-reform level. A positive compensating variation implies a welfare loss. In presenting the welfare effects of reforms, we put a minus for the compensating variation so that a positive value denotes an increase in welfare. We express the welfare effect in terms of GDP.

5 Analysing a CCCTB in Europe

This section analyses the introduction of a common consolidated corporate tax base (CCCTB) in all EU-countries (see van der Horst et al., 2007). The reform can be decomposed into two parts. First, the introduction of a common base in Europe, implying common rules for depreciation, investment incentives, loss treatment, etc. Second, we consider the shift from separate accounting with transfer pricing towards consolidation with formula apportionment.

5.1 Common base

We introduce a common base at the current EU-average. This choice of the common base differs from the proposals by the European Commission, which involve a net broadening of the corporate tax bases in Europe in combination with a reduction in corporate tax rates (see e.g. CCCTB Working Group, 2007). In our simulations, we assume that the EU develops a set of rules regarding tax depreciation, loss offset and tax incentives which produces a tax base that is equal to the aggregate base generated by the variety of regimes currently in place. Hence, some countries broaden their tax base while others narrow it. The common base applies to both multinationals and domestic firms. If tax revenues change in a country, we assume that lump-sum transfers are used to balance the government budget.

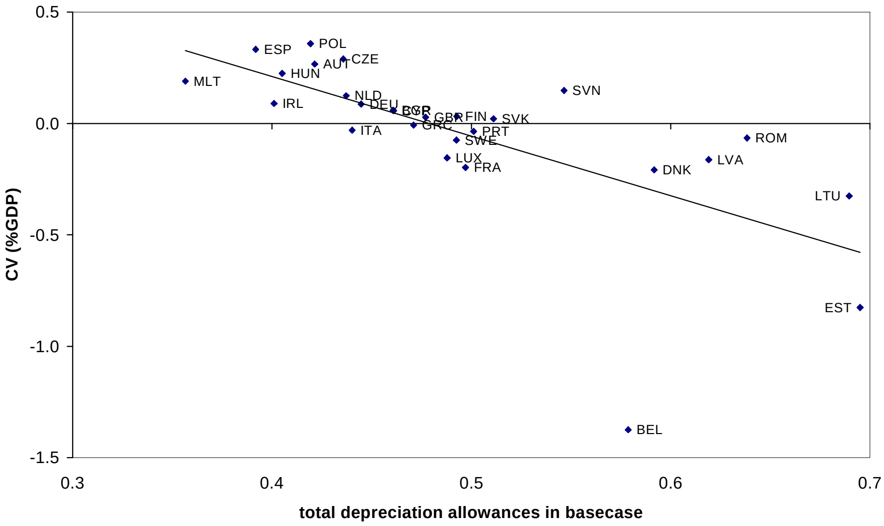
The simulations reveal that the aggregate welfare effect of the common base for Europe is small. On aggregate, welfare rises by a slight 0.006% of EU27-GDP. This is because there is no aggregate change in the tax base in the EU, only a change in individual countries. The small aggregate benefit is due to a slight reduction in the variation of effective marginal tax rates across countries, which improves capital export neutrality. The more efficient allocation of capital across countries generates a small welfare gain.

For individual countries, the common base has larger effects, depending on the change in the individual country's tax base. Figure 2 shows the welfare implications of the common base for countries, thereby assuming that each country adjust transfers to households to maintain revenue neutrality. Hence, countries that broaden their base are able to raise transfers; countries that narrow their base reduce transfers. On the horizontal axis is the initial net present value of depreciation allowances as a share of the purchase price of an investment (which lies between 0 and 1). The figure shows that countries that narrow their tax base by means of more generous depreciation allowances and tax incentives experience a welfare gain. This is because the narrower tax base reduces the cost of capital so that investment distortions decline. More investment raises the productivity of labour and is accompanied by higher wages. This encourages labour supply so that employment expands. The increase in investment and employment lead to a higher level of GDP. Welfare increases up to almost 0.4% of GDP in Poland and Spain. Countries that gain in the top-left corner of Figure 2 include also Ireland, Hungary, Malta, Austria and Czech Republic. In contrast, countries that broaden their base via less generous allowances for investment experience opposite effects. This includes Belgium (with its ACE system currently in place), Estonia, Lithuania, Denmark and France among others. Figure 2 shows that welfare falls with the size of initial allowances. The biggest loss is for Belgium that abolishes its ACE system, which substantially increases the cost of capital (see de Mooij and Devereux (2008) for an analysis of ACE reforms in the EU).

5.2 Consolidation with formula apportionment

Next, we consider the impact of consolidation and formula apportionment. To avoid mixing-up effects of a common tax base with the effects of consolidation and formula apportionment, this subsection takes the common base as a starting point for the analysis. Hence, the effects of the CCCTB with consolidation and formula apportionment are assessed relative to a European common corporate tax base. With CORTAX, we simulate the shift to consolidation and formula apportionment and assume that tax rates remain

Figure 2: Welfare effects of common base



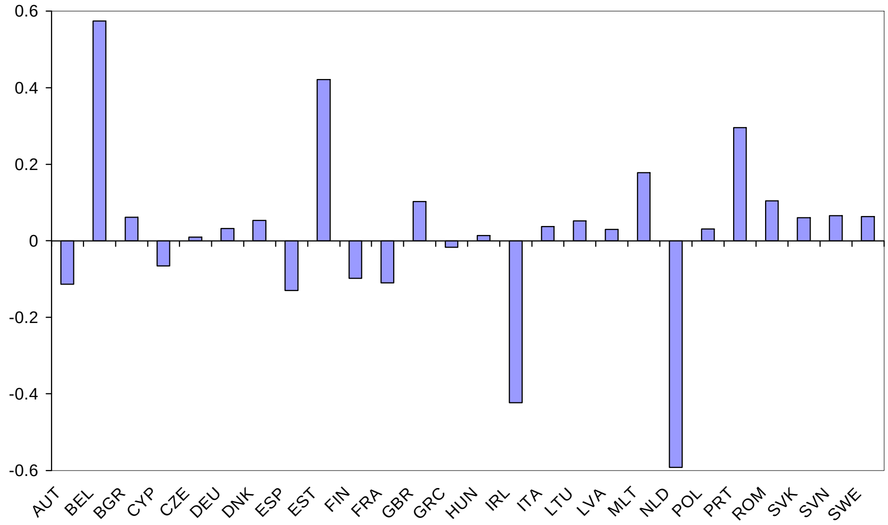
unchanged. If an individual country loses or gains in terms of corporate tax revenue, we first close the government budget by adjusting lump-sum transfers. Later, we also look at alternative closure rules. In the simulations, we use a formula of 1/3 for employment, assets and output. In CORTAX, the reform has both ex-ante effects on corporate tax revenue of countries and behavioural effects that affect economic outcomes and aggregate welfare ex-post. The next two subsections discuss these in turn. Note that the simulations ignore the impact of the CCCTB on compliance costs. To the extent that lower compliance costs would yield additional welfare gains, it would increase the likelihood that countries opt in the system.[2]

5.2.1 Ex-ante effects

We first present the ex-ante revenue effects of consolidation and formula apportionment. Corporate tax revenue is affected by two channels. First, formula apportionment modifies the distribution of the European corporate tax base across countries as compared to the

[2]This effect is difficult to predict. Yet, compliance costs may fall for a number of reasons. For instance, multinationals no longer have to put effort in determining transfer prices for complicated transactions. Moreover, firms can calculate a single European tax liability based on common rules instead of 27 different ones based on very diverse national systems. This would be particularly beneficial if a central administration became responsible for the tax treatment of the multinational. If tax authorities have to deal with two different systems, one for domestic firms and one for multinationals, administrative costs for governments may also increase. In the absence of clear-cut empirical information about how much compliance costs will fall under the CCCTB, we ignore this issue in this paper.

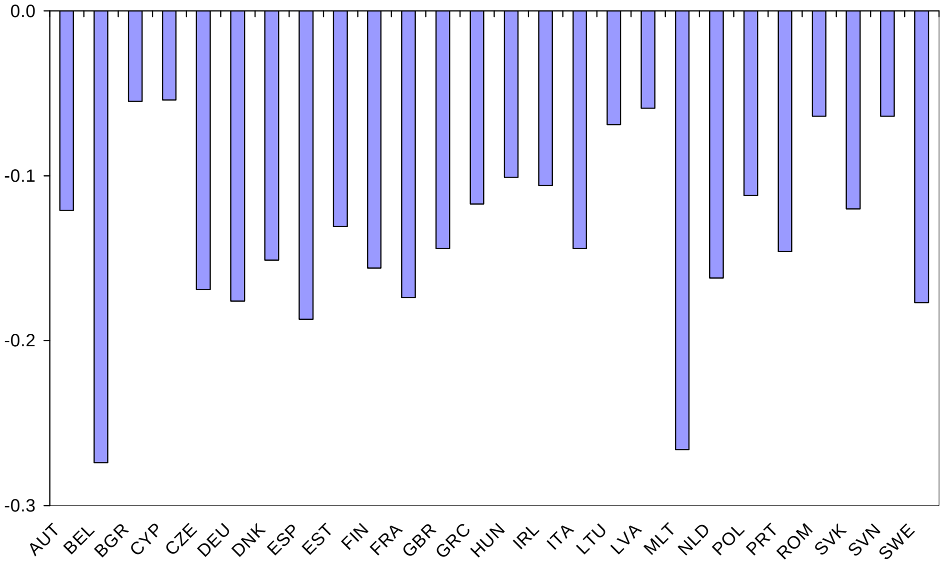
Figure 3: Ex-ante effect of a switch from separate accounting (with common base) to formula apportionment on corporate tax-to-GDP ratios



current regime with separate accounting. Some studies have analysed these distributional effects using micro data from firm accounts (see e.g. Devereux and Loretz, 2008; Fuest et al., 2007). In CORTAX, the estimated reallocation of the corporate tax base is determined by national accounts data, which determine the shares in the formula for each country. Figure 3 shows the effects for corporate tax-to-GDP ratios of individual countries. We see that the Netherlands and Ireland lose most revenue from formula apportionment, around 0.4% to 0.6% of GDP. Estonia, Belgium and Portugal gain most.

Second, corporate tax revenue is influenced by loss consolidation. In particular, under the current system of loss carry forward, some losses can not be offset, either due to limitations in the period of loss offset or because a subsidiary does not make future profits. Moreover, losses are not indexed in tax systems. Thus, they need to be discounted under loss carry forward. Under consolidation, a loss in one part of the company can be offset immediately against profits elsewhere. Hence, as long as profits elsewhere in the group are positive, losses can always be offset and without discounting. It means that the tax burden for the group under loss consolidation is lower than under loss carry forward. Assuming that all losses that occur in European subsidiaries can always be offset by profits elsewhere, we have computed the expected structural reduction in the corporate tax burden for multinationals under consolidation. Figure 4 shows the results. On average, we find that corporate tax revenue falls by 0.1% of GDP. It is equivalent to a reduction of the tax burden by about 2.5% of current revenue. The reduction is higher for countries

Figure 4: Ex-ante effect of loss consolidation as compared to loss carry forward on corporate tax-to-GDP ratios



featuring high corporate tax rates and a large multinational sector.

5.2.2 Ex-post effects

Firms change their behaviour in response to consolidation and formula apportionment. Their response depends on both the formula adopted and on how the government makes up for the revenue loss associated with loss consolidation. This section first assumes that countries use lump-sum transfers to balance their budget. Later, we also consider the reform if labour or corporate tax rates are increased to do this. The aggregate economic effects for the EU are presented in Table 1. The welfare effects for individual countries are presented in Figure 5.

The welfare effects of consolidation and formula apportionment in CORTAX are caused by three effects. First, in the new regime multinationals can no longer shift profits to subsidiaries within Europe. Indeed, profits are consolidated so any manipulation of transfer prices is worthless. The abolition of profit shifting reduces corporate tax revenue in low-tax countries and raises it in high-tax countries. Yet, it is not a zero-sum game because profit shifting allows multinationals to reduce their overall tax burden. Taking away this opportunity raises the tax burden for firms and increases the cost of capital. This discourages investment and hurts welfare.

A second effect offsets the impact of reduced profit shifting. In the old regime, firms had an incentive to relocate capital if the effective tax burden in different locations was different. In the new regime, a multinational will have an incentive to reallocate factors to low-tax jurisdictions as this changes the weights appearing in the apportionment formula. With a larger weight of low-tax countries, more income is taxed at that low rate and so the overall tax burden for the firm declines. Effectively, statutory corporate tax rates become taxes on the factors that appear in the formula. As long as tax rates differ across countries, firms will therefore have an incentive to reallocate inputs. In a sense, formula apportionment replaces one distortion in capital allocation by another distortion. The model reveals whether this improves allocatieve efficiency or not.

The last effect of formula apportionment is due to a lower tax burden associated with loss consolidation. This effect is subtle. First, loss consolidation reduces labour costs. This is because wages will always directly be deducted from the multinationals´ corporate tax bill, while this might not be the case under loss carry forward (as costs might be deductible later if profits are made). Second, loss consolidation does not necessarily reduce the cost of capital. On the one hand, deductible costs become more valuable under consolidation as such costs can be deducted earlier and always. This might not be true under loss carry forward when some costs might not or only later be deducted. On the other hand, the marginal returns on investment are also taxed immediately and cannot be postponed or waved in case of loss. This increases the cost of capital.

The upper row of Table 1 shows that Europe as a whole benefits from consolidation with formula apportionment if the revenue losses are compensated by a reduction in lump-sum transfers to households. On average, welfare expands by almost 0.1% of GDP. The main reason is that the reduction in the tax burden induced by loss consolidation (financed by lower lump-sum transfers) raises investment, employment and welfare.

The shift in the tax burden from distortionary corporate taxes towards lump-sum taxes is accompanied by efficiency improvements. It is a serious limitation of the model, however, that it does not consider the effects on the income distribution. Indeed, governments use distortionary taxes for distributional reasons and the efficiency costs of taxation reflect the social costs of equality. In principle, these should be balanced by the social gains from equality. By ignoring distribution in CORTAX, one might wrongly conclude that a switch from distortionary to non-distortionary taxes yields a social welfare gain. To avoid this, we consider simulations in which other distortionary taxes are used to balance the government budget. The second and third rows of Table 1 show that if higher corporate tax rates or labour taxes are used to balance the government budget, the positive economic effects are smaller. Higher corporate tax rates are particularly harmful for investment, while higher labour taxes especially hurt labour supply incentives and reduce employment. In these

Table 1: CCCTB average EU effects

	CoC	Capital	Wage	Employm.	GDP	Welfare
Transfers	–0.05	0.38	0.41	0.17	0.18	0.08
Corporate tax	–0.02	–0.13	0.20	0.09	–0.07	0.01
Labour tax	–0.05	0.23	0.42	0.02	0.03	–0.03

cases, the welfare effect drops to only 0.01% and −0.03% of GDP, respectively.

For individual countries, Figure 5 shows the welfare effect under lump-sum transfer adjustment. The welfare effect of individual countries is the net effect of various opposing forces. First, consolidation and formula apportionment causes a redistribution of the tax base, which benefits some but hurts other countries. Second, the abolition of profit shifting implies a benefit for high-tax countries and a loss for low-tax countries. Third, this effect is offset by distortions of the allocation formula, where low-tax countries benefit from attracting factors in the allocation formula at the expense of high-tax countries. Finally, loss consolidation involves a shift in the tax burden from firms to lump-sum taxation. On balance, the negative effects dominate for the Netherlands and France so that welfare in these countries drops. In all other countries, the net effect is positive for welfare. In general, Figure 5 suggests that the welfare effect is related to the capital/labour ratio in countries. Indeed, more capital-intensive countries tend to gain less from formula apportionment than more labour-intensive countries. This is due to the formula choice, which puts a relatively important weight on employment. As a result, the formula benefits labour-intensive countries relative to capital-intensive countries.

Figure 6 shows the welfare effects of the CCCTB for individual countries if higher labour taxes are used to offset the adverse revenue implications of loss consolidation. We see that the welfare effects are less favourable. Indeed, 11 of the 27 EU countries now do not experience a welfare gain from consolidation and formula apportionment. Spain, France and the Netherlands experience a welfare loss of more than 0.1% of GDP. Due to the ex-ante gains from redistribution under the 1/3 formula, a number of Central and Eastern European countries experience a welfare gain of more than 0.2% of GDP.

6 CCCTB and enhanced cooperation

The previous section suggests that a small aggregate welfare gain can be achieved by the CCCTB in the EU. Yet, not all countries gain from the CCCTB, especially if other distortionary taxes are used to balance the government budget. If some countries lose from the CCCTB, it raises the issue how to agree upon the proposal. Enhanced cooperation

Figure 5: Welfare effects from consolidation with equal weights, lump-sum transfer adjustment

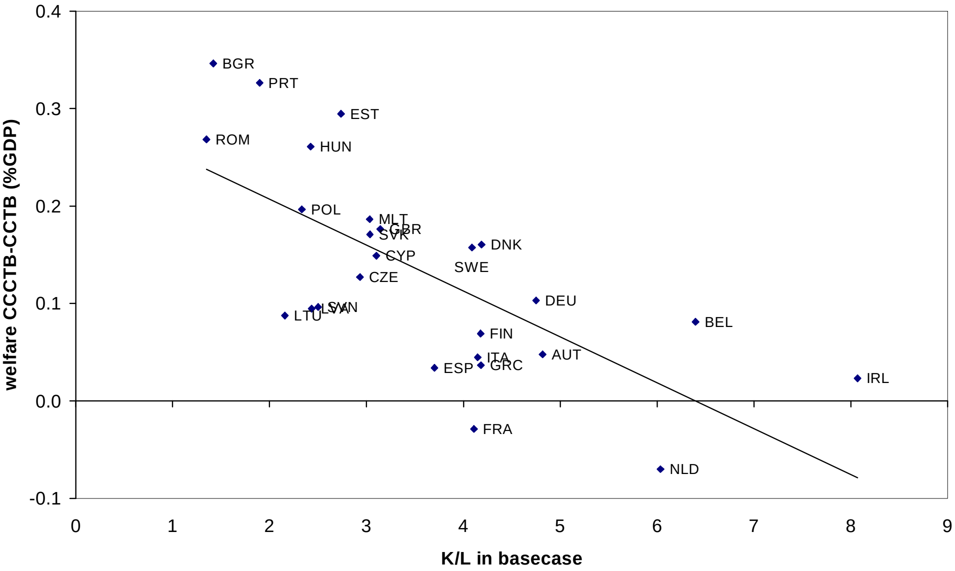
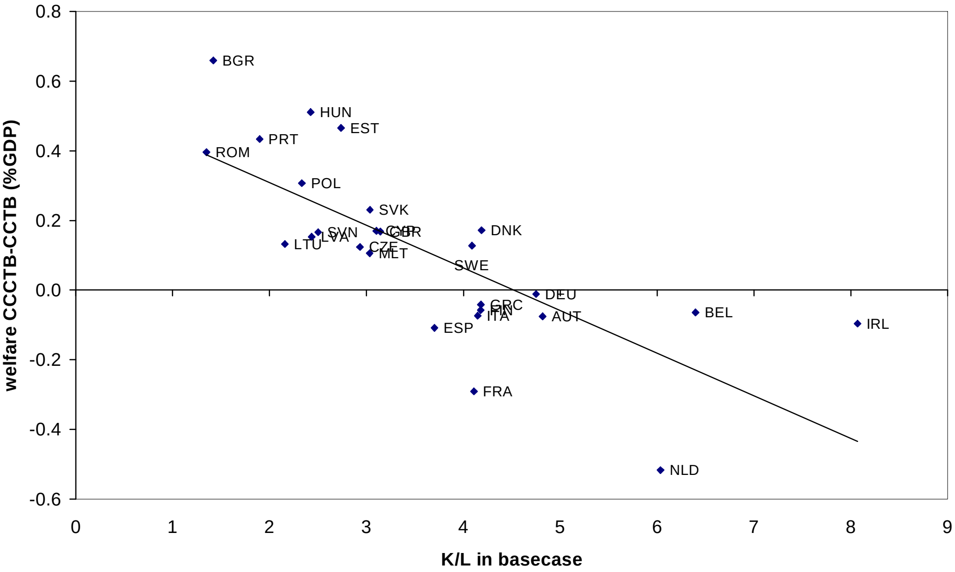


Figure 6: Welfare effects of CCCTB reform, adjustment of labour taxes to balance government budget



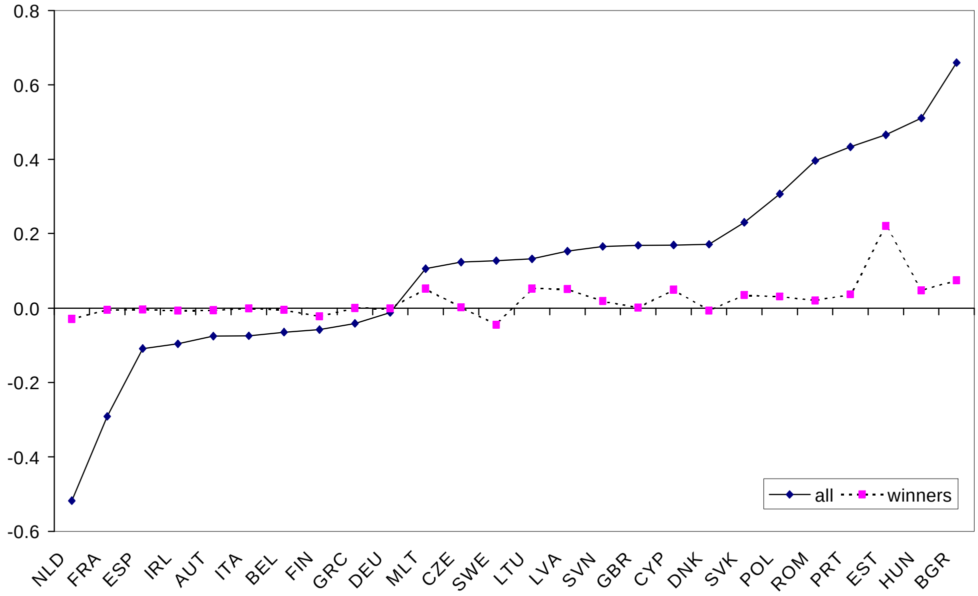
agreements might be a way out. This section analyses scenarios in which a subset of countries decides to introduce the CCCTB but others stay out. We maintain the assumption of equal weights in the apportionment formula throughout the analysis and assume that labour taxes are used to balance the government budget. We start from the assumption that a common base is imposed, i.e. we do not consider the welfare effects of base broadening or base narrowing in individual countries. This keeps the focus on consolidation and formula apportionment. Thereby, we concentrate on the welfare effects for individual countries, and especially the distinction between the opt-ins and the opt-outs.

Figure 7 shows the welfare effects of the CCCTB for individual countries when either all countries opt in the CCCTB regime or when 16 winning countries opt in and 11 countries opt out as they do not benefit from the CCCTB. The figure shows that the welfare loss for countries opting out is reduced almost to zero. Hence, we do not find that a coalition of 16 has significant effects for the outside countries. At the same time, the welfare gains for the opt ins fall as well. One important reason is that part of the benefits for these countries comes from redistribution of the tax base from losing to winning countries. As it is the losing countries that drop out, this directly reduces the benefits for winning countries. When the aggregate benefits of the CCCTB are small, then this process may lead to adverse selection: once some countries start to opt out, cooperation becomes less beneficial for the remaining countries. The subsequent adverse selection might then make any cooperation infeasible. We see, for example, that Sweden experiences a small welfare loss when the 11 countries opt out, while it experiences a welfare gain of 0.13% of GDP when all countries opt in. Yet, the aggregate welfare gain may imply that a feasible coalition may remain that mutually gains from cooperation.

Next, we consider a coalition of countries that are similar in terms of the size of their multinational sector.[3] Figures 8 and 9 show the welfare effects of the CCCTB when implemented either by a coalition of countries with a small multinational sector, or by a coalition of countries with a large multinational sector. In the figures, countries are ranked according to the size of their multinational sector (more left is a smaller multinational sector). The countries with a small multinational sector are primarily from Central and Eastern Europe. The countries with a large multinational sector are located in Western Europe and start with France in the Figures. We see that if the countries with a small MNE sector form a coalition for the CCCTB, the economic effects for these countries are reduced. For the opt-outs, the CCCTB has a negligible effect. Hence, Central and Eastern European countries benefit much less from the CCCTB if Western European countries do not join. The reason is that Central and Eastern European countries no longer benefit

[3] The size of a multinational sector is measured by the sum of inward and outward FDI-stocks (%GDP).

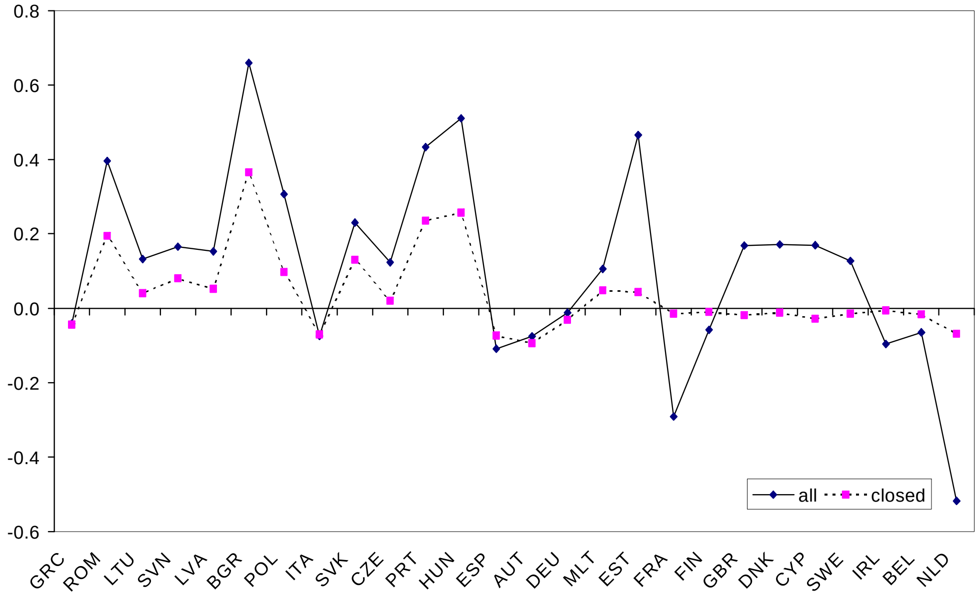
Figure 7: Welfare effects of CCCTB in winning countries



from the inflow of production factors, induced by the formula, since they feature relatively low tax rates. Moreover, ex-ante redistribution of the corporate tax base primarily takes place towards the Eastern European countries.

If countries with a large multinational sector adopt the CCCTB and other countries opt out, Figure 9 shows that the benefits for the opt-ins are actually bigger than under the European-wide CCCTB. This seems counter-intuitive. Why would Western European countries have an interest in Eastern countries not opting in? To understand this result, we need to go back to the underlying mechanisms that drive the impact of the CCCTB. On the one hand, the benefits for the opt-ins are partly due to the tax relief induced by loss consolidation. The welfare gains associated with this tax relief outweigh the welfare costs induced by the higher labour tax rate. On the other hand, if all countries join the CCCTB reform, this benefit is partly offset by two possible negative effects. The first is due to ex-ante reallocation of the tax base, which depends on the choice of the formula. The second is induced by factor reallocation towards low-tax countries. Indeed, high-tax countries suffer from an outflow of production factors by multinationals towards low-tax countries because corporate tax rates work as excises on the formula factors. If low-tax countries in Eastern Europe do not participate, this adverse welfare effect for high-tax countries disappears (although it is replaced by profit shifting to these countries). Hence, enhanced cooperation among a group of Western European countries is attractive for these

Figure 8: Welfare effects of CCCTB in a coalition of economies with a small multinational sector



countries as compared to full harmonisation. It confirms the outcomes in Vrijburg (2009) that, under certain circumstances, cooperating countries find it attractive to keep other countries outside the coalition.

The latter result is reconfirmed when we form a coalition of the old EU15 member states. Figure 10 shows the welfare effects for individual countries and ranks countries according to their capital-intensity. We find that the CCCTB in the old EU-15 yields slightly more favourable effects for the opt-ins. The countries opting out, however, no longer experience a welfare gain.

7 Conclusion

This paper finds that consolidation with formula apportionment in the EU will exert a small aggregate welfare gain of approximately 0.1% of GDP. It is mainly due to the corporate tax cut induced by loss consolidation. If corporate tax rates or labour income taxes are used to compensate for these lower revenues, then this welfare gain almost disappears.

For individual countries, the benefits from consolidation and formula apportionment are diverse and depend on the formula choice. Indeed, the formula determines the distri-

Figure 9: Welfare effects of CCCTB in a coalition of countries with a large multinational sector

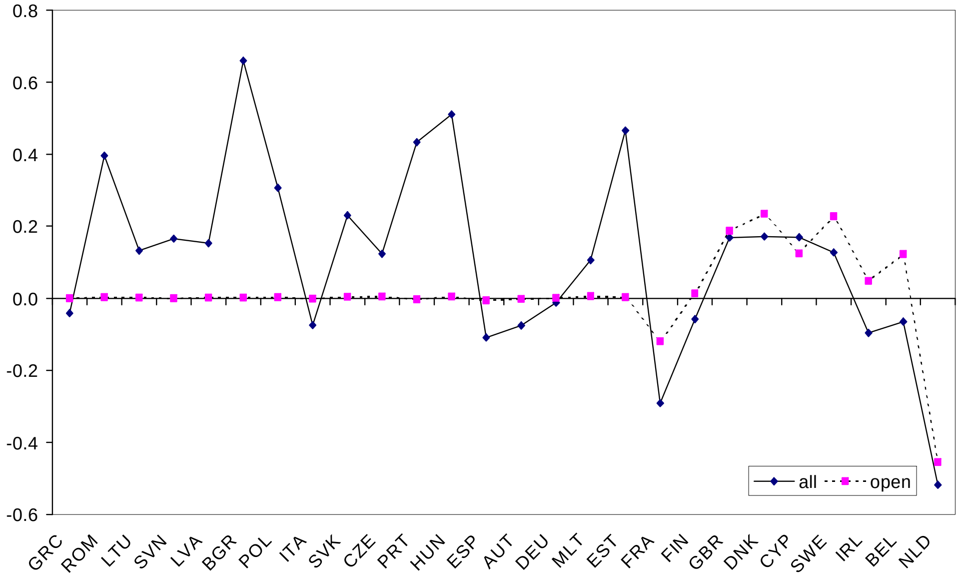
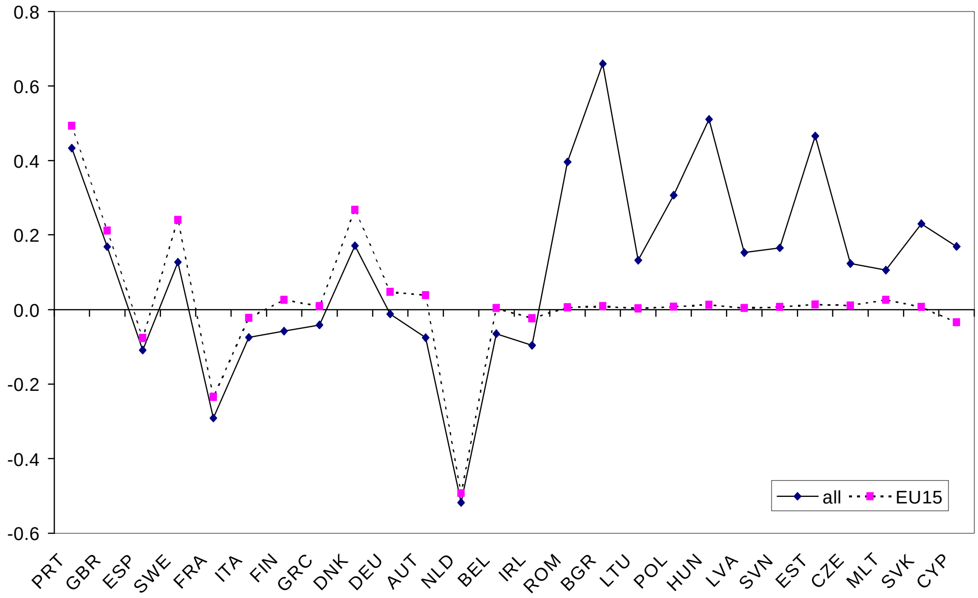


Figure 10: Welfare effects of the CCCTB in the EU15 (old Member States)



bution of the corporate tax base across countries and, thereby, the revenue implications of the reform. The formula also determines the extent to which tax rate differences across countries influence the incentives for multinationals to relocate production factors. We find that a 1/3 formula for employment, assets and output will benefit countries in Central and Eastern Europe at the expense of a number of capital-intensive countries in Western Europe. If winning countries form an enhanced cooperation agreement on consolidation, they run the risk of adverse selection where subsequently more countries decide to opt out. Indeed, some countries no longer benefit from consolidation once losing countries opt out of the agreement. A coalition of similar countries, in our case similar in the size of their multinational sector, is found to more likely yield an enhanced cooperation agreement than an EU-wide introduction of consolidation. These findings confirm predictions in the theoretical literature on enhanced cooperation agreements.

Our analysis is attractive to explore the opportunities for enhanced cooperation on actual policy proposals in the EU. Yet, it also suffers from limitations. First, while the allocative gains from consolidation are small, the reduction in compliance costs seems a key issue in the debate on the CCCTB. These effects are ignored in the present analysis. Second, a more detailed analysis of the current rules for loss carry forward and the implications of loss consolidation could shed a better light on this aspect of the consolidation proposals. Third, we have only explored one formula to allocate profits across countries while other formulas would have different distributional and economic implications. Particularly interesting is the sales formula, which is popular in the US and also part of the discussion in Europe. Due to lack of data, we are unable to explore consolidation with formula apportionment on the basis of sales by destination. Finally, most theoretical studies on enhanced cooperation agreements explore a harmonisation of tax rates rather than consolidation. The spillovers induced by tax rates are different than the spillovers induced by the determination of the tax base. Indeed, with the CCCTB reforms analysed in this paper spillovers through profit shifting are replaced by spillovers through factor reallocation. Once tax rate harmonisation is considered, the analysis of enhanced cooperation agreements will become more relevant due to the importance of international spillover effects.

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Appendix A Country tables

The tables in this appendix show the country-specific simulation outcomes. We present the following variables:

- CIT-rate = absolute change in the corporate tax rate imposed on a multinational headquarter
- Rev_CIT = absolute change in the corporate tax revenue as a share of GDP
- CoC = absolute change in the cost of capital, average across all firms
- Wage = relative change in the wage rate
- Capital = relative change in total capital stock
- Employm. = relative change in total employment
- GDP = relative change in gross domestic product
- Welfare = (-1) x compensating variation expressed in % of base GDP (i.e. positive value reflects a welfare gain)

Table A.1: Common base (relative to Basecase)

	CIT_rate	Rev_tax	CoC	Wage	Capital	Employm.	GDP	Welfare
	(a)	(y)	(a)	(r)	(r)	(r)	(r)	(y)
AUT	0.00	–0.05	–0.16	0.81	2.13	0.25	0.81	0.27
BEL	0.00	0.30	0.97	–4.35	–11.87	–1.56	–4.56	–1.37
DNK	0.00	0.03	0.13	–0.56	–1.55	–0.14	–0.53	–0.21
FIN	0.00	0.00	–0.02	0.09	0.23	0.02	0.09	0.03
FRA	0.00	0.04	0.15	–0.57	–1.76	–0.18	–0.57	–0.20
DEU	0.00	–0.03	–0.06	0.27	0.77	0.10	0.29	0.09
GRC	0.00	0.03	0.02	–0.09	–0.24	–0.05	–0.12	–0.01
IRL	0.00	–0.05	–0.04	0.33	0.74	0.10	0.33	0.09
ITA	0.00	0.03	0.03	–0.15	–0.45	–0.07	–0.18	–0.03
LUX	0.00	0.02	0.04	–0.25	–0.48	–0.02	–0.19	–0.15
NLD	0.00	–0.06	–0.07	0.42	1.05	0.13	0.42	0.12
PRT	0.00	0.03	0.04	–0.12	–0.48	–0.04	–0.12	–0.04
ESP	0.00	–0.18	–0.23	1.10	2.99	0.36	1.12	0.33
SWE	0.00	0.01	0.05	–0.21	–0.64	–0.06	–0.20	–0.07
GBR	0.00	–0.02	–0.03	0.08	0.33	0.02	0.08	0.03
CYP	0.00	–0.05	–0.05	0.18	0.60	0.06	0.19	0.06
CZE	0.00	–0.07	–0.16	0.99	2.22	0.24	0.93	0.29
EST	0.00	0.35	0.42	–2.92	–6.08	–0.73	–2.75	–0.83
HUN	0.00	–0.05	–0.15	0.68	1.87	0.20	0.67	0.22
LVA	0.00	0.06	0.10	–0.53	–1.31	–0.17	–0.54	–0.16
LTU	0.00	0.13	0.21	–1.06	–2.71	–0.33	–1.06	–0.33
MLT	0.00	–0.13	–0.14	0.61	1.95	0.20	0.62	0.19
POL	0.00	–0.11	–0.22	1.11	2.85	0.38	1.15	0.36
SVK	0.00	0.01	0.00	0.02	0.02	–0.01	0.00	0.02
SVN	0.00	–0.04	–0.11	0.44	1.21	0.13	0.44	0.15
BGR	0.00	–0.01	–0.03	0.16	0.40	0.04	0.15	0.06
ROM	0.00	0.03	0.04	–0.17	–0.50	–0.05	–0.16	–0.06
USA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JPN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EU	0.00	–0.01	–0.01	0.10	0.22	0.03	0.09	0.01

Table A.2: CCCTB with lump-sum transfers (relative to common base)

	CIT_rate	Rev_tax	CoC	Wage	Capital	Employm.	GDP	Welfare
	(a)	(y)	(a)	(r)	(r)	(r)	(r)	(y)
AUT	–0.47	–0.11	–0.03	0.37	0.24	0.18	0.04	0.04
BEL	–4.11	–0.09	–0.13	0.25	0.32	0.09	0.44	0.08
DNK	1.65	0.01	0.05	0.51	0.45	0.16	–0.05	0.16
FIN	1.36	–0.09	0.03	0.54	0.55	0.27	0.18	0.07
FRA	–1.39	–0.18	–0.05	0.36	0.54	0.29	0.41	–0.03
DEU	–3.39	–0.09	–0.11	0.36	0.51	0.15	0.38	0.10
GRC	–0.64	–0.08	–0.05	0.32	0.34	0.16	0.18	0.04
IRL	11.06	–0.19	0.18	0.99	–0.19	0.55	–0.54	0.02
ITA	–1.77	–0.09	–0.06	0.28	0.35	0.14	0.28	0.04
LUX	0.60	–2.70	–0.22	4.53	8.45	3.70	4.34	–0.35
NLD	3.75	–0.53	0.07	0.67	0.65	0.52	0.18	–0.07
PRT	1.47	0.20	0.03	0.35	–0.33	–0.06	–0.25	0.33
ESP	–0.72	–0.20	–0.06	0.55	0.69	0.32	0.46	0.04
SWE	–0.39	–0.02	–0.02	0.42	0.25	0.11	0.05	0.15
GBR	0.32	–0.02	–0.01	0.29	–0.01	0.01	–0.01	0.17
CYP	6.60	0.04	0.17	0.54	0.00	0.19	–0.43	0.15
CZE	–0.10	0.00	–0.04	0.67	0.56	0.23	0.14	0.13
EST	–0.62	0.26	0.00	0.37	0.10	–0.10	–0.32	0.30
HUN	0.33	0.21	–0.01	0.67	0.22	0.15	–0.33	0.27
LVA	0.20	0.07	0.00	0.28	0.06	0.08	–0.10	0.09
LTU	0.04	0.06	0.01	0.25	0.08	0.07	–0.08	0.09
MLT	–1.90	–0.12	–0.11	0.64	1.28	0.23	0.61	0.19
POL	0.08	0.11	–0.02	0.55	0.43	0.16	–0.04	0.19
SVK	0.18	0.08	–0.02	0.67	1.06	0.23	–0.07	0.17
SVN	0.11	0.07	0.01	0.22	0.10	0.04	–0.07	0.09
BGR	0.08	0.34	0.00	0.73	0.48	0.13	–0.52	0.34
ROM	0.06	0.22	0.00	0.43	–0.07	0.01	–0.29	0.26
USA	0.00	0.01	0.00	–0.01	–0.01	0.00	0.00	0.00
JPN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EU	–0.82	–0.10	–0.05	0.41	0.38	0.17	0.18	0.08

Table A.3: CCCTB with labour tax (relative to common base)

	CIT_rate	Rev_tax	CoC	Wage	Capital	Employm.	GDP	Welfare
	(a)	(y)	(a)	(r)	(r)	(r)	(r)	(y)
AUT	–0.48	0.00	–0.03	0.38	0.01	–0.05	–0.19	–0.08
BEL	–4.10	0.00	–0.13	0.26	0.07	–0.19	0.18	–0.07
DNK	1.64	0.00	0.05	0.51	0.48	0.18	–0.03	0.17
FIN	1.36	0.00	0.03	0.54	0.32	0.04	–0.03	–0.06
FRA	–1.39	0.00	–0.05	0.37	0.09	–0.19	–0.05	–0.29
DEU	–3.40	0.01	–0.11	0.37	0.29	–0.08	0.16	–0.01
GRC	–0.64	0.00	–0.05	0.33	0.16	–0.01	0.00	–0.04
IRL	11.08	–0.01	0.19	1.01	–0.44	0.30	–0.78	–0.09
ITA	–1.77	0.00	–0.06	0.29	0.12	–0.09	0.05	–0.07
LUX	0.61	–0.08	–0.22	4.92	0.04	–4.64	–3.72	–3.65
NLD	3.75	–0.02	0.07	0.71	–0.25	–0.40	–0.71	–0.52
PRT	1.46	0.00	0.03	0.36	–0.13	0.13	–0.05	0.44
ESP	–0.72	0.00	–0.06	0.57	0.37	0.01	0.15	–0.11
SWE	–0.40	0.00	–0.02	0.42	0.22	0.06	0.01	0.13
GBR	0.32	0.00	–0.01	0.29	–0.02	0.00	–0.03	0.16
CYP	6.60	0.00	0.17	0.54	0.05	0.24	–0.38	0.17
CZE	–0.10	0.00	–0.04	0.66	0.55	0.22	0.13	0.13
EST	–0.62	0.00	0.00	0.36	0.45	0.29	0.03	0.46
HUN	0.33	0.00	–0.01	0.66	0.66	0.60	0.10	0.51
LVA	0.20	0.00	0.00	0.27	0.19	0.21	0.02	0.15
LTU	0.04	0.00	0.01	0.24	0.17	0.16	0.01	0.13
MLT	–1.90	0.01	–0.11	0.64	1.12	0.06	0.45	0.11
POL	0.08	0.00	–0.02	0.54	0.67	0.40	0.20	0.30
SVK	0.18	0.00	–0.02	0.66	1.19	0.37	0.06	0.23
SVN	0.11	0.00	0.01	0.21	0.23	0.17	0.06	0.17
BGR	0.08	0.00	0.00	0.71	1.12	0.77	0.09	0.66
ROM	0.06	0.00	0.00	0.42	0.22	0.30	0.00	0.40
USA	0.00	0.00	0.00	–0.01	–0.01	0.01	0.01	0.00
JPN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EU	–0.82	0.00	–0.05	0.42	0.23	0.02	0.03	–0.03

Table A.4: CCCTB with corporate tax (relative to common base)

	CIT_rate	Rev_tax	CoC	Wage	Capital	Employm.	GDP	Welfare
	(a)	(y)	(a)	(r)	(r)	(r)	(r)	(y)
AUT	0.24	–0.04	–0.02	0.02	–0.40	0.05	–0.22	–0.04
BEL	14.37	0.02	0.41	1.09	–0.09	0.37	–1.22	0.35
DNK	2.79	0.07	0.09	0.43	0.21	0.13	–0.19	0.14
FIN	2.09	–0.02	0.06	0.13	–0.18	0.15	–0.10	–0.06
FRA	–0.68	–0.08	–0.03	–0.11	–0.52	0.13	0.01	–0.17
DEU	–2.48	–0.03	–0.10	0.14	0.03	0.06	0.18	0.04
GRC	0.17	–0.03	–0.01	0.11	–0.09	0.08	–0.04	–0.01
IRL	10.50	0.02	0.18	0.05	–1.55	0.22	–1.16	–0.20
ITA	–0.57	–0.04	–0.03	0.12	–0.05	0.08	0.11	0.00
LUX	2.38	–2.81	–0.10	1.30	5.95	3.70	2.82	–2.42
NLD	4.31	–0.25	0.09	–0.67	–1.49	0.09	–0.81	–0.47
PRT	1.96	0.18	0.04	0.66	–0.12	–0.01	–0.19	0.45
ESP	0.08	–0.09	–0.03	0.01	–0.27	0.15	0.08	–0.15
SWE	0.73	0.03	0.01	0.30	–0.10	0.05	–0.10	0.13
GBR	1.48	0.02	0.00	0.26	–0.13	–0.02	–0.06	0.19
CYP	7.27	0.11	0.18	0.42	–0.31	0.14	–0.55	0.13
CZE	0.85	0.04	0.00	0.43	0.13	0.17	–0.04	0.07
EST	–0.94	0.31	–0.01	1.22	0.81	0.16	–0.45	0.49
HUN	1.04	0.23	0.01	0.58	0.02	0.12	–0.37	0.24
LVA	0.43	0.10	0.00	0.27	–0.02	0.07	–0.17	0.10
LTU	0.17	0.09	0.00	0.26	0.03	0.07	–0.15	0.09
MLT	–1.49	–0.11	–0.08	0.56	1.23	0.23	0.57	0.12
POL	0.69	0.13	–0.01	0.45	0.22	0.12	–0.09	0.17
SVK	0.65	0.12	0.01	0.65	0.99	0.22	–0.17	0.17
SVN	0.11	0.07	0.01	0.24	0.12	0.04	–0.05	0.10
BGR	0.04	0.38	0.00	0.85	0.56	0.15	–0.59	0.39
ROM	–0.33	0.24	–0.01	0.56	0.01	0.04	–0.30	0.31
USA	0.00	0.01	0.00	–0.01	–0.02	0.00	0.01	0.00
JPN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EU	0.35	–0.02	–0.02	0.20	–0.13	0.09	–0.07	0.01

Table A.5: CCCTB of winning countries with labour tax (relative to common base)

	CIT_rate (a)	Rev_tax (y)	CoC (a)	Wage (r)	Capital (r)	Employm. (r)	GDP (r)	Welfare (y)
AUT	0.00	0.00	0.00	0.00	0.02	0.01	0.02	–0.01
BEL	0.00	0.00	0.00	0.00	0.00	0.01	0.00	–0.01
DNK	–0.19	0.00	–0.01	0.27	0.24	0.03	–0.05	0.00
FIN	0.00	0.00	0.00	0.00	0.00	0.00	–0.03	–0.03
FRA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–0.01
DEU	0.00	0.00	0.00	–0.01	0.01	0.01	0.01	0.00
GRC	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
IRL	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00
ITA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LUX	0.00	0.00	0.00	0.00	0.07	0.07	0.05	–0.04
NLD	0.00	0.00	0.00	0.00	0.05	0.04	0.02	–0.03
PRT	–0.13	0.00	0.00	0.13	0.05	0.01	–0.02	0.04
ESP	0.00	0.00	0.00	0.00	0.00	0.00	–0.01	0.00
SWE	–1.77	0.00	–0.05	0.20	0.15	–0.08	–0.09	–0.04
GBR	–0.95	0.00	–0.03	0.12	0.09	–0.02	–0.04	0.00
CYP	5.54	0.00	0.14	0.26	0.08	0.06	–0.18	0.05
CZE	–0.16	–0.01	–0.04	0.32	0.10	–0.01	0.00	0.00
EST	–0.69	0.00	–0.01	0.19	0.26	0.13	–0.02	0.22
HUN	0.05	0.00	–0.01	0.19	0.16	0.05	–0.01	0.05
LVA	0.05	0.00	–0.01	0.15	0.07	0.08	0.01	0.05
LTU	0.02	0.00	0.01	0.15	0.05	0.06	0.00	0.05
MLT	–1.89	0.00	–0.10	0.36	0.01	–0.04	0.02	0.05
POL	0.00	0.00	–0.02	0.24	0.13	0.03	0.02	0.03
SVK	0.13	0.00	–0.02	0.23	0.12	0.03	0.01	0.04
SVN	–0.05	0.00	0.01	0.10	0.00	0.02	0.00	0.02
BGR	0.01	0.00	–0.01	0.14	0.22	0.09	0.02	0.07
ROM	–0.01	0.00	0.00	0.08	0.02	0.01	0.01	0.02
USA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JPN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EU	–0.14	0.00	–0.01	0.06	0.04	0.01	–0.01	0.00

Table A.6: CCCTB of closed economies with labour tax (relative to common base)

	CIT_rate	Rev_tax	CoC	Wage	Capital	Employm.	GDP	Welfare
	(a)	(y)	(a)	(r)	(r)	(r)	(r)	(y)
AUT	–0.78	0.00	–0.04	0.32	–0.03	–0.10	–0.22	–0.10
BEL	0.00	0.00	0.00	0.00	0.00	0.00	–0.03	–0.02
DNK	0.00	0.00	0.00	0.00	0.01	0.01	–0.01	–0.01
FIN	0.00	0.00	0.00	0.00	0.01	0.01	0.00	–0.01
FRA	0.00	0.00	0.00	0.00	0.01	0.00	–0.02	–0.02
DEU	–2.56	0.00	–0.09	0.31	0.16	–0.10	–0.05	–0.03
GRC	–0.60	0.00	–0.05	0.31	0.12	–0.03	–0.02	–0.04
IRL	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00
ITA	–1.26	0.00	–0.05	0.27	0.05	–0.09	–0.06	–0.07
LUX	0.00	0.00	0.00	–0.01	0.38	0.39	0.34	–0.28
NLD	0.00	0.00	0.00	0.00	0.07	0.07	0.04	–0.07
PRT	1.54	0.00	0.03	0.26	–0.08	0.06	–0.09	0.24
ESP	–0.56	–0.01	–0.05	0.41	0.14	–0.04	–0.05	–0.07
SWE	0.00	0.00	0.00	0.00	0.01	0.01	–0.01	–0.01
GBR	0.00	0.00	0.00	0.00	0.01	0.01	–0.02	–0.02
CYP	0.00	0.00	0.00	0.00	0.03	0.03	0.00	–0.03
CZE	–0.13	0.00	–0.04	0.49	0.33	0.08	0.00	0.02
EST	–0.61	0.00	0.00	0.08	0.06	0.03	–0.02	0.04
HUN	0.14	0.00	–0.01	0.45	0.42	0.34	–0.03	0.26
LVA	0.12	0.00	–0.01	0.16	0.10	0.08	–0.01	0.05
LTU	–0.01	0.00	0.00	0.16	0.08	0.06	–0.02	0.04
MLT	–1.89	0.00	–0.10	0.53	0.73	0.01	0.26	0.05
POL	0.03	0.00	–0.02	0.35	0.35	0.15	0.04	0.09
SVK	0.14	0.00	–0.02	0.52	0.88	0.25	0.00	0.13
SVN	0.06	0.00	0.01	0.16	0.15	0.10	0.02	0.08
BGR	0.06	0.00	0.00	0.46	0.79	0.46	0.02	0.36
ROM	0.01	0.00	0.00	0.26	0.17	0.17	–0.03	0.20
USA	0.00	0.00	0.00	0.00	0.00	0.00	–0.01	0.00
JPN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EU	–0.64	0.00	–0.03	0.21	0.13	0.01	–0.03	–0.02

Table A.7: CCCTB of open economies with labour tax (relative to common base)

	CIT_rate	Rev_tax	CoC	Wage	Capital	Employm.	GDP	Welfare
	(a)	(y)	(a)	(r)	(r)	(r)	(r)	(y)
AUT	0.00	0.00	0.00	0.00	0.01	0.01	0.02	–0.01
BEL	–3.94	0.00	–0.12	0.16	0.09	–0.09	0.28	0.12
DNK	1.46	0.00	0.05	0.42	0.37	0.19	0.04	0.24
FIN	0.86	0.00	0.01	0.50	0.35	0.10	0.05	0.01
FRA	–1.16	0.00	–0.04	0.29	0.12	–0.10	0.04	–0.12
DEU	0.00	0.00	0.00	–0.01	0.02	0.02	0.03	0.00
GRC	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
IRL	10.56	–0.01	0.17	1.02	–0.40	0.34	–0.62	0.05
ITA	0.00	0.00	0.00	–0.01	0.00	0.01	0.01	0.00
LUX	–2.76	–0.05	–0.40	4.04	0.58	–3.26	–2.63	–3.61
NLD	2.56	–0.01	0.04	0.56	–0.05	–0.18	–0.38	–0.46
PRT	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00
ESP	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
SWE	–0.54	0.00	–0.02	0.35	0.27	0.13	0.13	0.23
GBR	–0.40	0.00	–0.02	0.21	0.03	0.00	0.03	0.18
CYP	4.39	0.00	0.11	0.36	0.18	0.16	–0.16	0.13
CZE	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01
EST	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00
HUN	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00
LVA	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00
LTU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MLT	0.00	0.00	0.00	–0.01	–0.02	0.00	0.01	0.01
POL	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00
SVK	0.00	0.00	0.00	0.00	0.02	0.01	0.02	0.00
SVN	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00
BGR	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00
ROM	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
USA	0.00	0.00	0.00	0.00	–0.01	0.00	0.01	0.00
JPN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EU	–0.08	0.00	–0.01	0.10	0.03	0.00	0.01	–0.01

Table A.8: CCCTB of EU15 with labour tax (relative to common base)

	CIT_rate	Rev_tax	CoC	Wage	Capital	Employm.	GDP	Welfare
	(a)	(y)	(a)	(r)	(r)	(r)	(r)	(y)
AUT	2.06	0.00	0.02	0.44	0.07	0.11	–0.06	0.03
BEL	–3.50	0.00	–0.11	0.27	0.07	–0.10	0.23	0.00
DNK	2.37	0.00	0.08	0.56	0.52	0.26	0.02	0.27
FIN	2.02	0.00	0.06	0.58	0.36	0.13	0.04	0.02
FRA	–0.67	0.00	–0.02	0.38	0.06	–0.12	–0.01	–0.24
DEU	–2.06	0.01	–0.08	0.39	0.29	0.00	0.21	0.05
GRC	0.05	0.00	–0.03	0.35	0.15	0.05	0.03	0.01
IRL	11.27	–0.01	0.19	1.09	–0.49	0.35	–0.75	–0.02
ITA	–0.95	0.00	–0.04	0.30	0.12	–0.03	0.09	–0.02
LUX	1.76	–0.07	–0.15	4.89	0.45	–4.14	–3.29	–3.73
NLD	4.91	–0.02	0.10	0.75	–0.20	–0.27	–0.62	–0.49
PRT	1.56	0.00	0.03	0.39	–0.17	0.15	–0.04	0.49
ESP	–0.47	0.00	–0.05	0.58	0.34	0.03	0.15	–0.07
SWE	0.49	0.00	0.00	0.46	0.26	0.17	0.10	0.24
GBR	0.67	0.00	0.00	0.32	–0.05	0.02	–0.02	0.21
CYP	0.00	0.00	0.00	0.02	0.07	0.05	0.09	–0.03
CZE	0.00	0.00	0.00	0.00	0.02	0.01	0.04	0.01
EST	0.00	0.00	0.00	0.01	0.02	0.01	0.05	0.01
HUN	0.00	0.00	0.00	0.01	0.03	0.02	0.03	0.01
LVA	0.00	0.00	0.00	0.00	0.02	0.01	0.02	0.00
LTU	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.00
MLT	0.00	0.00	0.00	–0.02	–0.05	0.01	0.07	0.03
POL	0.00	0.00	0.00	0.01	0.02	0.01	0.03	0.00
SVK	0.00	0.00	0.00	0.01	0.04	0.01	0.03	0.01
SVN	0.00	0.00	0.00	0.01	0.02	0.01	0.03	0.01
BGR	0.00	0.00	0.00	0.01	0.04	0.01	0.04	0.00
ROM	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.01
USA	0.00	0.00	0.00	–0.01	–0.01	0.01	0.02	0.00
JPN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EU	–0.22	0.00	–0.03	0.33	0.11	–0.01	0.04	–0.02

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