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An applied analysis of ACE and CBIT reform in the EU

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The responsibility for the contents of this CPB Discussion Paper remains with the author(s)

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Abstract in English

We assess the quantitative impact of two reforms to corporation tax, which would eliminate the differential treatment of debt and equity: the allowance for corporate equity (ACE) and the comprehensive business income tax (CBIT). We investigate the impact of these reforms on various decision margins, using an applied general equilibrium model for the EU calibrated with recent empirical elasticities. The results suggest that, if governments adjust statutory corporate tax rates to balance their budget, profit shifting and discrete location render CBIT more attractive for most individual European countries. European coordination makes a joint ACE more, and a joint CBIT less, efficient. A combination of ACE and CBIT is always welfare improving.

Key words: Corporate tax reform; European Union; Tax coordination; Computable General Equilibrium model; ACE; CBIT.

JEL code: D58; H25

Abstract in Dutch

Dit artikel onderzoekt de kwantitatieve effecten van twee hervormingen in de vennootschapsbelasting die de discriminatie tussen de financiering van eigen en vreemd vermogen wegneemt: de aftrek van eigen vermogen (ACE) en de alomvattende heffing op inkomen van ondernemingen (CBIT). We onderzoeken de invloed van deze hervormingen op diverse beslissingen van bedrijven met behulp van een toegepast algemeen evenwichtsmodel voor de EU. Het model is gekalibreerd op basis van recente empirische schattingen uit de literatuur. De resultaten laten zien dat, als overheden hun VPB-tarieven gebruiken om het overheidsbudget neutraal te maken na een hervorming, CBIT het meest aantrekkelijk is voor de meeste Europese landen. Dit is het geval vanwege gunstige effecten op winstallocatie en de vestiging van winstgevende bedrijven. Als Europa een gecoördineerd beleid kiest, dan is de ACE echter aantrekkelijker. Een combinatie van ACE en CBIT is altijd welvaartsverbeterend.

Steekwoorden: Vennootschapsbelasting; Europese Unie; Belastingcoördinatie; Toegepast algemeen evenwichtsmodel; ACE; CBIT.

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Summary

The comprehensive business income tax (CBIT) and the allowance for corporate equity (ACE) have recently gained interest in European policy debates as a way of restructuring corporate tax systems. Indeed, a number of countries have experimented or actually implemented reforms in the direction of an ACE. Others have put limitations to the deductibility of interest, which goes in the direction of CBIT. This report explores the economic implications of ACE and CBIT reforms in two different ways. First, we theoretically analyse ACE and CBIT in an open-economy framework capturing various behavioural responses. It sheds light on the key trade-offs in designing such reforms. Second, we adopt an applied general equilibrium model for Europe to quantitatively assess the effects of ACE and CBIT in EU countries. The model encompasses several decision margins of firms, such as marginal investment decisions, their financial structure and the choice of multinational companies with respect to foreign direct investment and international profit shifting.

The results suggest that ACE reforms in an individual country generally improve efficiency by removing the distortion between debt and equity finance and by reducing the cost of capital. As long as governments finance the ACE with higher lump-sum taxes to households, welfare in Europe expands by 0.6% of GDP. The ACE is particularly attractive in countries featuring high corporate tax rates and a broad tax base such as Germany, Italy and Spain. If ACE is accompanied by higher corporate tax rates to make up for the lost revenue, however, this erodes the corporate tax base through profit shifting and by adversely affecting the discrete location choice of multinationals. It illustrates the key trade-off for the ACE between a low tax on the normal return on capital and a low corporate tax rate on economic profit. If base erosion is strong, ACE tends to reduce welfare. This occurs in most Western European countries. Eastern European countries still benefit from ACE since they host a relatively small multinational sector. A joint European ACE is more likely to improve welfare since European cooperation eliminates fiscal spillovers within the EU, thus mitigating the erosion of the corporate tax base in response to higher corporate tax rates.

CBIT in an individual country yields a similar effect as ACE on the financial structure of companies. However, by disallowing a deduction for interest, it increases the cost of capital, thereby exacerbating investment distortions. When the extra revenues raised by CBIT are used for higher transfers, welfare in the EU falls by 0.7% of GDP. This holds most notably in countries with high corporate tax rates. If CBIT is combined with lower corporate tax rates, however, the corporate tax base expands through several channels, especially via inward profit shifting and by improving the location advantage for profitable investments. If these channels are strong, CBIT is found to raise welfare in a typical European country by around 0.7% of GDP. Countries featuring high corporate tax rates, such as Germany and France, and countries that are relatively sensitive to profit shifting due to a large multinational sector, such as the Netherlands and the UK, gain most from a unilateral introduction of CBIT and lower corporate

tax rates. Under a European CBIT, lower corporate tax rates exert smaller welfare gains since fiscal spillovers within Europe are mitigated. A European CBIT no longer raises welfare.

A revenue-neutral combination of ACE and CBIT reforms is able to improve efficiency by alleviating distortions in the debt-equity choice of companies. A higher cost of capital on debt-financed investment is now offset by a lower cost of capital on equity-financed investment. Aggregate investment slightly increases. Welfare is found to expand by 0.2% of GDP on account of a more efficient financial structure.

The results suggest that a policy of corporate tax base broadening and rate reduction is likely to continue if European countries will not cooperate. CBIT-like reforms fit into this direction. This is consistent with recent trends in corporate tax policy in the EU. If Europe succeeds in cooperation, it might be able to relax fiscal spillovers and thus allow countries to design more efficient corporate tax systems with higher statutory rates. An ACE might then become a more serious alternative.

1 Introduction¹

The comprehensive business income tax (CBIT) and the allowance for corporate equity (ACE) have recently gained interest in policy debates as a way of restructuring corporate tax systems. Today's systems allow a deduction of interest but not for equity. Such systems lead to excessive leverage, discrimination against risky or volatile businesses and create arbitrage opportunities that erode corporate tax bases. ACE and CBIT both aim to neutralise these distortionary effects of corporate taxes.

Among the two, economists typically favour ACE. This grants equity holders a certain allowance equal to a notional risk-free return. This is attractive as it reduces the effective marginal tax rate to zero, implying that ACE is a tax on economic rent. As such, it does not distort decisions about the scale of investment, though even a tax on economic rent can affect discrete investment choices that depend on an effective average tax rate. A potential disadvantage of ACE is that its narrower tax base reduces corporate tax revenue and thus requires higher tax rates to yield the same revenue.

By contrast, CBIT disallows the exemption of interest. It turns the corporate income tax into a broad-based tax on capital at the level of the firm. This raises the overall cost of capital so that investment declines. The broadening of the base under CBIT will raise corporate tax revenue and, if revenue is to be maintained, allows for a lower corporate tax rate. A lower rate will typically not be sufficient to prevent a rise in the effective marginal tax rate, which is why CBIT has not gained the same popularity as ACE.

However, this paper argues that these traditional economic arguments need to be balanced by other factors created by changes in statutory tax rates. Specifically, multinational profit shifting – driven ultimately by differences in statutory rates – has become increasingly important due to internationalisation of businesses and the growing importance of intangible assets. In addition, evidence indicates that discrete location choices – driven by effective average tax rates – are relatively responsive to taxation. For these reasons, it is attractive for individual countries to broaden their tax base and cut the rate, as under CBIT, as opposed to narrowing the tax base and raising the rate, as under ACE.

However, this depends on the nature of the reform. Cross country flows of profit and capital depends on relative differences in tax rates. If one country can cut its statutory rate relative to others, then it may gain an advantage with respect to both profit shifting and discrete location choices. However, for a co-ordinated reform in the EU, the gains from lowering the statutory rate will be reduced if all countries reduce their rates. That is, European coordination mitigates international spillovers via statutory corporate tax rates and increases the relative importance of effective marginal tax rates. European coordination may thus render ACE more and CBIT less

¹ We are grateful to Albert van der Horst and Leon Bettendorf for research support and valuable comments and discussions. Marcel Gerard, an anonymous referee and participants at seminars in Oxford and Venice provided valuable comments.

efficient as a system to tax corporate income. This implies that ACE may still be an attractive system for a coordinated reform in the EU as a whole.

We use an applied general equilibrium model for Europe to quantitatively illustrate these effects of ACE and CBIT.² The model encompasses several decision margins of firms, such as marginal investment, financial structure, foreign direct investment, location choice by multinationals, and international profit shifting. Behavioural elasticities are calibrated on the basis of a careful review of the literature. Together with real world data on economic structures, the model allows us to identify for which European countries ACE and CBIT are welfare improving. Moreover, we quantify the difference between unilateral reforms undertaken by a single country, and a joint European reform. For reasonable parameter values, we show that if introduced by a single country and given a specific revenue requirement from the tax, it is plausible for most Western European countries that CBIT is preferred over ACE. As a joint European reform, however, ACE dominates CBIT.

One qualification of our quantitative approach should be noted: we do not take account of the role of risk. In principle, this can be important in identifying the impact of a revenue-neutral introduction of ACE. Devereux (2009) argues that, in the presence of risk, the expected revenue from ACE, or a cash flow tax, would depend on the risk premium. If the risk premium is high relative to the risk-free rate of return, then the expected revenue-neutral rate required under an ACE would not be as high. The estimates in this paper of the required change in the statutory rate to maintain the same revenue with an ACE do not allow for this factor.

The paper is organised as follows. The next section describes the two reforms in more detail, and reviews existing studies which aim to quantify their effects. Section 3 describes the applied general equilibrium model used in our analysis. The following sections show the results of the analysis. Section 4 considers the simulations. We start with the case in which each reform – ACE or CBIT – is introduced in a single country. In this case, the corporation tax rate is assumed to be unchanged – any revenue gains or losses from the reform are assumed to be covered by changes to lump-sum transfers. Then, we consider the case in which each reform is introduced in only one country, but instead assumes that the reform has to be revenue neutral, with the corporation tax rate being adjusted to ensure that the government's budget is balanced. We also consider an alternative way of balancing the budget by combining ACE and CBIT reforms. That is, we allow part of the costs of debt and equity finance to be deductible from tax. Each type of finance is equally treated; the proportion of financing costs relieved is chosen to make the reform revenue neutral. Finally, we consider the case in which the EU countries agree to cooperate, and all countries introduce the ACE or the CBIT. We assume in this case again that corporation tax rates are adjusted to balance the budget. Section 5 concludes.

² For a more extensive analysis and sensitivity analysis, see De Mooij and Devereux (2009).

2 Studies on ACE and CBIT

Most corporate tax systems in the world allow interest to be deductible as expenditure when calculating taxable profits. The normal return on equity is usually not deductible as a cost. Therefore, corporate tax systems discriminate against equity finance. To avoid distortions and arbitrage, governments have introduced anti-avoidance regulation and thin capitalization rules. A more comprehensive solution would be to implement an allowance for corporate equity (ACE) or a comprehensive business income tax (CBIT).

2.1 Allowance for corporate equity

The ACE system was originally proposed in 1991 by the Capital Taxes Committee of the Institute for Fiscal Studies (IFS, 1991, Devereux and Freeman, 1991). It was based on an earlier idea of Boadway and Bruce (1984), who suggested an allowance for corporate capital (ACC). Their idea was to abolish the deductibility of actual interest payments and to replace it by an allowance of the normal return, applied to the book value of the entire firm's capital according to the tax accounts. The ACE is slightly different in that it maintains the current deductibility of actual interest payments. It adds to this a notional return on equity to be deductible against corporate profits. Since the tax advantage associated with the deduction for equity is certain, the appropriate notional return of the ACE is the risk-free nominal interest rate, e.g. the rate on government bonds (Bond and Devereux, 1995).

The ACE is known to have several attractive features. First, it obtains neutrality between debt and equity finance. Thus the ACE makes thin capitalization rules redundant. Second, ACE is neutral with respect to marginal investment decisions. In fact, by allowing a deduction for both interest and the normal rate of return on equity, the ACE system leaves capital income untaxed and is a tax on economic rent. A third property of the ACE is that it offsets investment distortions induced by differences between economic depreciation and depreciation for tax purposes. Accelerated depreciation for tax purposes will reduce the book value of assets in the tax accounts, thereby also reducing the ACE in later years. This exactly offsets the benefits from earlier depreciation in present value terms. Indeed, the present value of the sum of the depreciation allowance and the ACE allowance is independent of the rate at which firms write down their assets in the tax accounts.

While the ACE system is more neutral than current corporate tax systems to investment and its financial structure, the narrower tax base reduces corporate tax revenue. It requires higher corporate tax rates to balance the government budget.³ The ACE would then shift the tax burden from the marginal return to capital towards economic rents. This implies that decisions as to the scale of investment would not be affected by the tax.

³ Note that an ACE should not necessarily be financed by higher corporate tax rates. The economic effects can be markedly different under an alternative way of balancing the government budget.

However, discrete choices are affected by the effective average tax rate, which is not zero under the ACE. An important example of a discrete choice is the decision of where to locate part of a multinational company (Devereux and Griffith, 1998). Further, higher tax rates under an ACE may be unattractive in light of international profit shifting. Multinational firms have a variety of options to shift profits across their affiliates through tax planning activities. These incentives are determined by differences in statutory tax rates.⁴

There is some experience with ACE-type reforms in Austria, Croatia, Italy, Brazil and Belgium (see Klemm, 2007 for an overview). Yet, empirical studies cannot give us clear-cut evidence on the economic implications of ACE reforms, either because of lack of data, or because the ACE was part of a multiple reform package, which makes it difficult to identify the impact of ACE alone. Simulation models have been used to numerically assess the economic consequences of the ACE in individual countries. Keuschnigg and Dietz (2007) use a dynamic computable general equilibrium model to assess the ACE as part of a broader reform package in the taxation of capital income in Switzerland. They derive household decisions from an overlapping generations framework with endogenous labour supply and an endogenous portfolio composition of savings. On the firm side, the model distinguishes between domestically owned corporate and non-corporate firms, as well as domestic subsidiaries of home and foreign based multinational firms. Firms endogenously determine their debt share, dividend payout and investment behaviour. In the simulations, Keuschnigg and Dietz finance the ACE-part by an increase in the value-added tax by 1.5 percentage points. The first column in Table 2.1 shows their results. It shows that the reform reduces the cost of capital for Swiss firms by 1.5 percentage points. This raises investment by 7.8%, and also raises employment and GDP. The more neutral treatment of debt and equity causes a decline in the debt/asset ratio by 3.8 percentage points. Welfare in their analysis is probably best reflected in the rise in private consumption by 1.4%.

Radulescu and Stimmelmayer (2007) also use a computable general equilibrium model for Germany called IfoMod to perform a similar experiment as Keuschnigg and Dietz. The model includes two countries and is based on an infinitely lived agent who works in either of two sectors: a corporate or non-corporate sector. The model describes the investment behaviour and financial behaviour of these firms. In the simulations, the cost of the ACE allowance is financed by a higher VAT rate. The second column of Table 2.1 reports their findings. The authors find that the ACE is rather costly and requires a 5.1 percentage point increase in the VAT rate to balance the budget for the government. The cost of capital falls by 6.3%, which causes an increase in investment by more than 20%. GDP expands by more than 9% in the long run.

⁴ Profit taxes may also affect investment in the presence of capital-market imperfections by reducing net internal funds. Empirical evidence supports the impact of net internal funds on investments (see Hubbard, 1997, for an overview). However, this aspect of the tax is not included in the CORTAX model used here.

2.2 Comprehensive business income tax

The CBIT eliminates the favourable fiscal discrimination of debt financed investment by disallowing a deduction for interest payments. The CBIT was proposed by the US Treasury (1992). In that proposal, a distinction is made between so-called CBIT entities and non-CBIT entities. Most firms will be CBIT entities (only small firms will not) who are disallowed interest deductibility. This also applies to financial companies, including banks. To avoid double taxation of interest, the interest received by firms or banks from other CBIT entities is either exempt or credited. The interest that firms or banks receive from non-CBIT entities remains subject to tax, including interest from households and government bonds. Interest received from abroad will be subject to tax, although an exemption or credit could be applied if this interest comes from a CBIT entity, e.g. if other countries also introduce a CBIT.

CBIT transforms the corporate income tax into a broad-based tax on capital. All capital income will thus be taxed at source.⁵ A disadvantage is that it raises the cost of capital. Fewer investment projects will be profitable at the margin so that investment will decline. Yet, for a revenue-neutral reform, the broadening of the base allows for a lower corporate tax rate. This may attract mobile economic rents or paper profits of multinationals. The trade-off is therefore opposite from the ACE: CBIT shifts the tax burden away from rents towards marginal investment returns. On balance, the effect is ambiguous: the cost of capital on low-yielding investments financed by debt will rise, leading to lower investments. Highly profitable investments financed by equity will be taxed more lightly so that these investments will expand.

There are no real-world experiments of actual CBIT regimes. However, countries have imposed reforms that limit the deductibility of interest in some way, usually through thin-capitalisation rules. These rules imply that the interest is not deductible from profit if the debt-equity ratio exceeds a certain threshold. Buettner et al. (2008) report that in 2005 approximately 60% of the European countries had thin-capitalisation rules in place and that these rules were effective in reducing debt-equity ratios.

Radulescu and Stimmelmayer (2007) have also analysed the economic effects of a CBIT in Germany with the Infomod model. The third column of Table 2.1 shows that CBIT allows for a cut in the value-added tax rate by 4.3 percentage points. The model predicts an increase in the cost of capital by almost 10%, which reduces investment by a similar amount. GDP falls by more than 5%, inducing welfare to drop by 0.7% of GDP.

⁵ In the US treasury proposal, CBIT is accompanied by an abolition of personal taxes on capital. We only consider the reform in the corporate tax.

Table 2.1 Simulation outcomes from previous country studies on ACE and CBIT

Country		Keuschnigg & Dietz	Radulescu &	Radulescu &
		(2007) ^a	Stimmelmayer (2007) ^b	Stimmelmayer (2007) ^b
		Swiss ACE	German ACE	German CBIT
Corporate tax rate	Level	23.2	38.3	38.3
Value-added tax rate	Δ	1.5	5.1	- 4.3
Cost of capital	Δ	- 1.5	n.a.	n.a.
	$\% \Delta$	n.a.	- 6.3	9.7
Debt ratio	Δ	- 3.8	n.a.	n.a.
Employment	$\% \Delta$	0.4	1.7	- 1.4
Capital stock	$\% \Delta$	7.8	20.5	- 10.2
GDP	$\% \Delta$	2.6	9.1	- 5.3
Private consumption	$\% \Delta$	1.4	4.6	- 4.7
Welfare (in % GDP)	Δ	n.a.	0.08	- 0.7

^a We take the results from table 3 of their study, in particular, the difference between the fourth and third column.

^b We take the results from the first column of tables 3 and 4 of their study.

2.3 Comparing ACE and CBIT

Economists traditionally favour an ACE system as a means to eliminate both investment and financial distortions. CBIT has less appeal since it exacerbates marginal investment distortions. The outcomes from numerical CGE models confirm this, as Table 2.1 reveals. This view ignores, however, international distortions induced by high statutory corporate tax rates. Such distortions have gained more importance during recent decades in light of the internationalisation of businesses. Indeed, empirical studies on profit shifting and multinational location decisions suggest large international responses. In particular, international distortions render low effective marginal tax rates less important and low statutory tax rates more important for individual countries (see also Bond, 2000). This implies that CBIT-type reforms may enhance welfare more while ACE reforms may have lost some potential for welfare gains. The rest of this paper explores whether this is indeed plausible for realistic parameter values.

2.4 Combining ACE and CBIT

We also consider a combination of ACE and CBIT reforms. ACE gives full relief for the cost of debt and equity finance, while CBIT gives relief for neither. It is clearly possible to imagine a tax which gives partial, but equal, relief for debt and equity. We consider a case in which the reform introduces a partial allowance for equity, and reduces the relief for debt, so that the same proportion of the costs of equity and debt are relieved. The proportion is chosen to make the reform revenue neutral. Such a reform eliminates the distortions in the financing choice between debt and equity. The effect on the cost of capital lies between that of ACE and CBIT.

3 The CORTAX model

This paper uses the CORTAX model to quantify the trade-offs in ACE and CBIT reform in Europe. 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.

Table 3.1 Calibration of CORTAX, data 2007

	Corporate tax rate	NPV of depreciation allowances	EMTR	Inbound + outbound FDI	Investment elasticity w.r.t. CIT rate	Elasticity of debt share w.r.t. CIT rate	Elasticity of CIT base w.r.t. CIT rate via transfer pricing
	%	% Price	%	% GDP	Semi- elasticity	Semi- elasticity	Semi- elasticity
Austria	25	37	8.9	46	- 0.4	0.2	- 0.1
Bulgaria	10	40	2.8	18	- 0.3	0.3	0.0
Cyprus	10	42	3.1	76	- 0.2	0.3	- 0.1
Czech Republic	24	39	8.3	30	- 0.5	0.3	0.0
Germany	36	36	12.4	48	- 0.5	0.2	- 0.2
Denmark	25	46	4.9	75	- 0.2	0.2	- 0.2
Spain	33	33	13.4	40	- 0.6	0.2	- 0.1
Finland	26	40	7.4	65	- 0.3	0.2	- 0.1
France	33	40	10.3	63	- 0.3	0.2	- 0.2
United Kingdom	30	39	9.4	74	- 0.3	0.3	- 0.3
Greece	25	41	6.9	8	- 0.5	0.2	0.0
Hungary	16	35	5.8	40	- 0.4	0.3	- 0.1
Ireland	13	36	4.3	153	- 0.3	0.3	- 0.1
Italy	37	38	13.0	19	- 0.5	0.2	- 0.1
Lithuania	18	50	2.1	12	- 0.1	0.3	0.0
Latvia	15	46	2.6	14	- 0.2	0.3	0.0
Netherlands	26	36	8.5	240	- 0.2	0.2	- 0.6
Poland	19	37	6.8	17	- 0.5	0.3	0.0
Portugal	27	40	7.7	35	- 0.3	0.3	- 0.1
Romania	16	44	3.2	12	- 0.2	0.3	0.0
Slovak Republic	19	44	4.5	28	- 0.3	0.2	0.0
Slovenia	23	46	6.3	14	- 0.1	0.3	- 0.1
Sweden	28	40	7.7	98	- 0.3	0.2	- 0.3
Unweighted average	23	40	7.0	53	- 0.3	- 0.3	- 0.2

We set shares to replicate aggregates from national accounts in 2005 and data on firm accounts in ORBIS, a comprehensive set of standardized balance sheet information, profit and loss accounts and ownership information for over 9 million companies, provided by Bureau van Dijk. Parameters are set so as to replicate empirical elasticities found in the economic literature. CORTAX is heavily inspired by the OECDTAX-model of Sørensen (2001; 2004). 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. Information on key parameters and elasticities is presented in Table 3.1.

3.1 Households

Following the overlapping generations model of Diamond, households live for two periods. One may interpret each 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 maximizing 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, consumption, 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).

3.2 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 in domestic firms is location-specific (e.g. land) and is supplied inelastically. The fixed factor in subsidiaries is firms-specific (e.g. a brand name or a patent) and supply in a country depends on taxes. 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).

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.

3.3 Multinationals

In maximising the value of the firm, multinationals take the sum of its headquarter and all subsidiaries. Rents earned by subsidiaries accrue to the headquarter in the parent country, which is assumed to wholly own the subsidiary. The headquarters are assumed to be wholly owned by domestic households. 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 in a country, this reduces the amount of investment the multinational is willing to invest in that subsidiary. Thus, inward FDI in a location is governed by the effective marginal tax rate.

The fixed factor in foreign subsidiaries is firm-specific and responsive to taxes. The idea is that multinationals can move an entire profitable plant to another location in response to tax. Empirical evidence supports the importance of such discrete location decisions. For instance, studies using count data on investment typically report significant negative elasticities for the average tax burden. Moreover, effective average tax rates (EATRs) are found to exert a larger and more robust impact on FDI than effective marginal tax rates (EMTRs) (see e.g. Devereux and Griffith, 1998; Devereux and Lockwood, 2006; De Mooij and Ederveen, 2008). As the EATR is a weighted average of the EMTR and the statutory tax rate (Devereux and Griffith, 2003), statutory tax rates do play a significant role for investment. In CORTAX, we set the response of the fixed factor to the statutory tax rate so as to obtain a semi-elasticity of FDI to the EATR of -6 on average in the EU. It corresponds to the outcomes of a recently updated meta analysis in De Mooij and Ederveen (2008). In the model, we assume that location choices are responsive to tax differences only within the EU, but not between the EU and other regions.

CORTAX distinguishes two types of profit shifting: transfer price manipulation within the group of 29 countries and profit shifting to outside tax havens. First, 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. To compare this to the empirical evidence on profit

shifting, we translate it into a semi-elasticity of the corporate tax base, which requires multiplying it with the share of intrafirm trade (which, in CORTAX, is proportional to bilateral FDI stocks). We thus obtain a mean value of the semi-elasticity of -0.23 , i.e. the corporate tax base shrinks by 2.3% due to profit shifting if the corporate tax rate is increased by 10%-points. This reasonably fits in the range of estimates found in the literature on transfer pricing, but is small in light of evidence on total profit shifting. The importance of FDI differs between countries (see Table A.1), which causes the semi-elasticity to differ as well. In particular, it is large in the Benelux, where FDI is relatively important, and small in the Central and Eastern European countries where multinationals are relatively unimportant.

The second type of profit shifting in CORTAX reflects the presence of tax havens outside the OECD. Multinationals decide how much effort to put in shifting the profit tax base to tax havens by trading off a marginal effort cost (e.g. a cost to set up an extra tax haven subsidiary, deal with tax haven authorities and settle disputes) against the benefit of saving tax. The effort cost is convex in the tax differential. We set the parameters in the cost function in a way that we obtain a semi-elasticity of the corporate tax base of $-\frac{1}{2}$, i.e. a 10%-point tax differential *vis a vis* the average tax haven reduces the corporate tax base by 5%. Together with transfer pricing within the 29 countries of CORTAX, the average semi-elasticity of the tax base via profit shifting thus equals -0.73 . This comes close to aggregate estimates of profit shifting reported in empirical studies. Indeed, De Mooij (2005) reviews these studies and reports an average semi-elasticity of -1.0 . Note, however, that the variation in empirical estimates is large.

3.4 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, 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 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. The values of statutory corporate tax rates, the net present value of depreciation allowances and the EMTR are reported in Table 3.1.

3.5 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 are 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 at the micro level, i.e. for firms and households. 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 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.

4 Simulating ACE and CBIT reforms

4.1 ACE and CBIT with adjustment of lump-sum transfers

We simulate ACE and CBIT reforms with CORTAX. To begin with, we assume that only one country undertakes the reform at a time. But we allow each country to undertake the reform in turn, and analyse the impact on that country. Our results show the average effect across countries of the series of unilateral reforms. Note that the effects for individual countries ignore any spillovers to other countries. The average effects should therefore not be interpreted as the EU-wide effects of a joint reform, which is analysed in Section 6.

In this section, we also assume that the government balances its budget by an adjustment of lump-sum transfers. We do not present outcomes for Belgium, Luxembourg, Estonia and Malta which are outliers due to either a peculiar economic structure (Luxembourg due to its extreme FDI positions), or special corporate tax regimes (Belgium, Estonia and Malta). For the remaining 23 European countries:

- ACE is modelled as a deduction for the equity share of capital in the tax accounts. We apply the nominal interest rate to compute the tax deduction. ACE implies a narrowing of the corporate tax base which reduces corporate tax revenues. On average for the EU, the corporate tax-to-GDP ratio drops from 2.7% to 1.4%.
- CBIT is modelled as an abolition of the interest deductibility. The interest deduction in CORTAX is determined as the product of total assets, the debt share and the nominal interest rate. CBIT raises corporate tax revenue by 1.9% of GDP on average.

Table 4.1 summarises the economic effects of the ACE and CBIT reforms on average for the 23 European countries (unweighted averages). Figure 4.1 shows country-variation for the welfare effects of the two reforms.

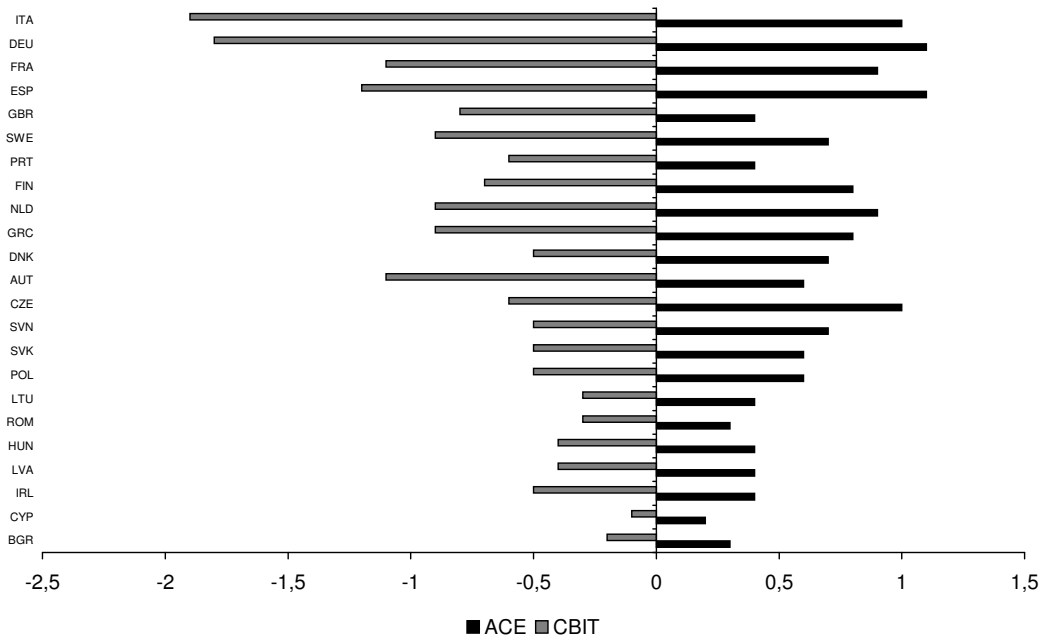
Table 4.1 Economic effects of unilateral ACE and CBIT reforms, with lump-sum adjustment^a

	ACE	CBIT
Corporate tax revenue (ex-ante) (% GDP)	- 1.3	1.9
Total tax revenue (ex-post) (% GDP)	- 0.3	0.6
Debt share ($\Delta\%$)	- 4.7	- 6.8
Cost of capital ($\Delta\%$)	- 0.5	0.7
Wage (%)	2.3	- 3.1
Capital (%)	6.3	- 8.5
Employment (%)	0.8	- 1.3
GDP (%)	2.3	- 3.4
Welfare ($\Delta\%$ in GDP)	0.6	- 0.7

^a Unweighted average for 23 countries.

Source: CORTAX simulations

Figure 4.1 Welfare effects of unilateral ACE and CBIT reforms with lump-sum adjustment (countries ranked according to corporate tax rate)



Country labels: ITA = Italy; DEU = Germany; FRA = France; ESP = Spain; GBR = United Kingdom; SWE = Sweden; PRT = Portugal; FIN = Finland; NLD = Netherlands; GRC = Greece; DNK = Denmark; AUT = Austria; CZE = Czech Republic; SVN = Slovenia; POL = Poland; LTU = Lithuania; ROM = Romania; HUN = Hungary; LVA = Latvia; IRL = Ireland; CYP = Cyprus; BGR = Bulgaria

The first column of Table 4.1 shows the effects of ACE. It is determined by two effects. First, the ACE eliminates the tax-favoured status of debt over equity finance and reduces the debt share for firms. Table 4.1 shows that, on average, the debt share falls by 4.7%-points.⁶ Second, ACE raises investment by 6.3% due to the reduction in the cost of capital. The expansion of investment raises the productivity of labour. Firms will therefore increase their labour demand. This requires higher wages to stimulate workers to supply more labour as the uncompensated elasticity of labour supply is positive. The expansion of investment and employment increase GDP by 2.3%. The welfare effects of an ACE are smaller than the GDP effects for two reasons. First, part of the additional production is due to more employment. This has a cost in terms of less leisure time, which is accounted for in the welfare effects. Second, the expansion of investment is due to capital imports from abroad. While this increases domestic production, it is accompanied by an decrease in the net foreign asset position. This raises the difference between GDP and gross national income. Overall, welfare expands by 0.6% of GDP.

The effects of ACE on the cost of capital and investment differ across countries, depending on corporate tax rates and corporate tax bases. This shows up in different welfare effects in

⁶ Under ACE, the financial distortion is reduced but not entirely eliminated. The reason is that the allowance applies to the book value of equity capital in the tax accounts. In contrast, interest deductibility applies to actual debt, not the share of capital in the tax accounts. Under CBIT, the financial distortion is abolished entirely.

Figure 4.1. We see that the welfare gains of an ACE rise with the initial corporate tax rate, which serves as a proxy for the initial distortion of investment. The welfare gain of an ACE ranges from a low 0.3% for Bulgaria and Romania to more than 1% in Germany, Italy and Spain.

The effects of CBIT are shown in the second column of Table 4.1. These effects are also driven by responses in the financial structure and investment. First, CBIT eliminates the tax advantage of debt over equity, thereby reducing the debt share by 6.8 percentage points on average. However, CBIT raises the cost of capital by 0.7 percentage points. This reduces investment by 8.5%. Lower investment reduces labour productivity and, therefore, wages. This discourages labour supply and reduces employment. The reduction in capital and labour cause a decline in GDP by 3.4%. On average, welfare falls by 0.7% of GDP. Figure 4.1 shows that this welfare loss of CBIT becomes larger with the initial corporate tax rate and ranges between – 0.2% in Cyprus to – 1.9% in Italy.

Overall, our simulations illustrate the traditional message from the literature: ACE is a welfare improving policy as it removes financial and investment distortions. The simulations reveal that the magnitude of this welfare gain differs substantially across countries. CBIT is found to raise the cost of capital and, therefore, exacerbate investment distortions. This causes an additional welfare loss.

4.2 ACE and CBIT with adjustment of corporate tax rates

This section considers ACE and CBIT reforms that are revenue-neutral within the corporate sphere. First, we consider full ACE and CBIT reforms where the government balances its budget by adjusting statutory corporate tax rates. Hence, we keep the tax burden on corporate income unchanged and modify only its structure. The rate is chosen to balance the government budget ex-ante, i.e. before behavioural effects are taken into account. If government revenues change ex-post due to behavioural effects (such as changes in investment or employment), we use consumption taxes to balance the budget.⁷

Second, we allow the government to balance the budget by giving only partial relief for the cost of finance, though treating debt and equity equally. On average, a combination of 2/3 of an ACE and 1/3 of a CBIT is both revenue neutral and neutral with respect to financial structure. That is, 2/3 of the cost of finance receive tax relief.

The economic effects of these reforms are presented in Table 4.2. The figures shown are unweighted averages for the introduction of the reform in each of the 23 countries separately. Figure 4.2 shows the welfare effects of ACE and CBIT for individual countries.

⁷ This procedure is necessary to obtain feasible solutions in CORTAX. We put a cap on the corporate tax rate of 55%, which is binding for Italy in case of ACE.

Table 4.2 **Effects of ACE and CBIT with corporate tax rate adjustment, and a combined ACE-CBIT reform^a**

	ACE	CBIT	Combined
Corporate tax rate (%Δ)	17	– 11.0	0.0
Debt share (%Δ)	– 3.3	– 6.5	– 5.8
Cost of capital (%Δ)	– 0.3	0.0	– 0.1
Wage (%)	0.6	1.0	0.3
Capital (%)	3.9	0.4	0.7
Employment (%)	0.2	0.3	0.0
GDP (%)	0.8	1.1	0.3
Welfare (%Δ in GDP)	– 0.2	0.7	0.2

^a Unweighted average for 23 countries.

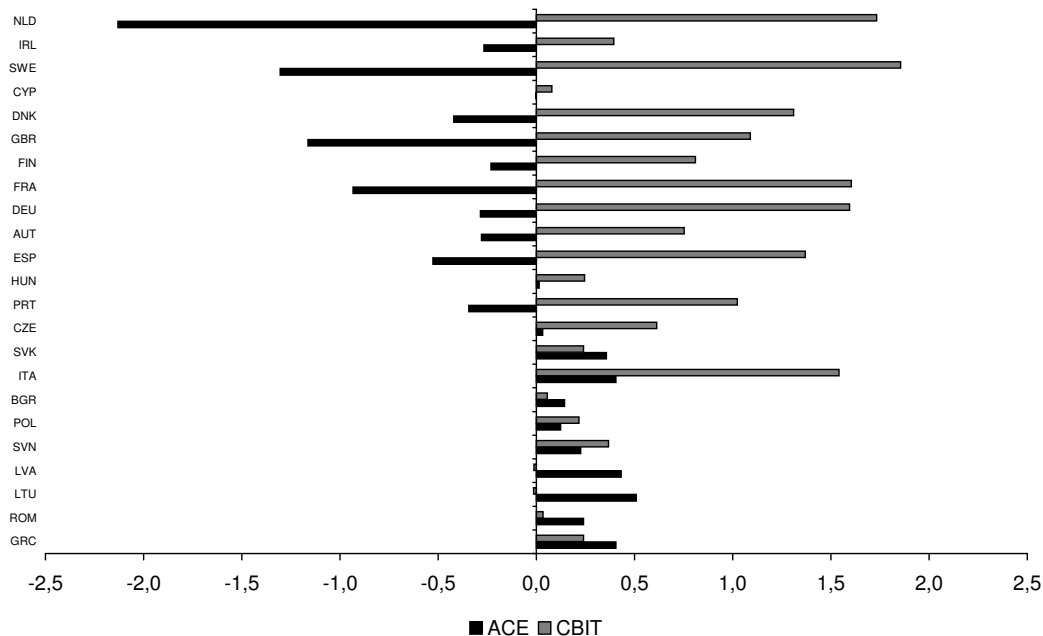
Source: CORTAX simulations

To obtain revenue-neutrality under an ACE, Table 4.2 shows that, on average in the 23 European countries, a 17 percentage point tax rate increase is required. The higher tax rate does not affect marginal investment distortions because ACE turns the corporate tax into a non-distortionary tax on economic rents. But it does affect welfare via profit shifting and discrete location. Governments thus face a trade-off when considering an ACE between the benefits of a lower cost of capital and costs associated with a higher corporate tax rate. The strength of increased transfer price manipulation within the OECD depends on the importance of multinationals in a country. The effect is relatively small in Central and Eastern European countries and relatively large in the Netherlands, Germany and the UK. Also the effect on discrete location is proportional to the size of the multinational sector. The effect on profit shifting to tax havens depends on the initial corporate tax rate due to the convexity of the cost of profit shifting. On balance, a unilateral ACE reform is found to expand employment and GDP. However, despite this, on average in the EU, welfare declines, due to profit shifting which erodes the corporate tax base and requires higher consumption taxes to balance the government budget. This reduces consumption and hence welfare. Figure 4.2 shows that the negative welfare effect induced by higher tax rates dominates in most Western European countries. In Eastern European countries, however, the welfare gain associated with the lower cost of capital dominates so that ACE is still welfare improving.

The second column of Table 4.2 shows that CBIT allows governments to reduce corporate tax rates by 11 percentage points. The lower tax rate mitigates the adverse economic effects of CBIT on investment relative to the case in the previous section, as the average increase in the cost of capital becomes smaller. In fact, investment no longer falls since the lower corporate tax rate attracts inward discrete investments. This raises marginal returns to capital and offsets the impact of the higher costs of capital on investment. GDP expands by 1.1% on average especially due to the inflow of firm-specific fixed factors. Welfare rises by 0.7% of GDP. The welfare gain is again to a large degree determined by the benefits from profit shifting. Figure

5.1 shows that the welfare gains of CBIT are especially large in Western European countries where multinationals are important.

Figure 4.2 Welfare effect of ACE and CBIT with corporate tax rate adjustment (countries ranked according to importance of multinationals)



The combined ACE – CBIT reform is presented in the last column of Table 4.2. It eliminates the discrimination between debt and equity and reduces the debt share by 3.8%-points. The effect on the cost of capital is small. Indeed, while ACE reduces the cost of capital on equity-financed investment, CBIT does the opposite for debt-financed investment. The model simulations suggest that the impact on economic variables is small, but positive. Investment rises by 0.7%, while GDP expands by 0.3%. All countries experience a welfare gain, somewhere between 0.1 and 0.4% of GDP, with an average gain of 0.2%. This gain reflects the welfare gain associated with a smaller financial distortion.

4.3 European-wide ACE and CBIT reform

If countries jointly implemented ACE or CBIT, the economic implications would differ compared to a unilateral implementation. This is due to the international spillovers induced by changes in statutory corporate tax rates. If a single country changes its rate, spillovers to other countries can be sizable. However, under a joint European reform, they would be smaller. Hence, the scope of the reform matters. This section considers multilateral ACE and CBIT reforms in the European Union, and compares the welfare effects of a joint reform with the unilateral reform analysed in the previous section. The effects of the joint reform are presented in Table 4.3. The welfare effects for individual countries are presented in Figure 4.3.

The effects of higher corporate tax rates on profit shifting and discrete location would be smaller if all European countries simultaneously increased their rates since profit shifting and discrete location choices depend on the differences between rates, rather than the level of these rates. Hence, whereas individual countries would suffer from profit shifting if they unilaterally increase their corporate income tax rate, this effect would be mitigated if other European countries did the same. Table 6.1 shows that a European-wide ACE would yield a welfare gain of 0.4% of GDP in the EU compared to an average loss of 0.2% under unilateral policy. Also the effects on investment and employment would be more favourable as individual countries would no longer suffer from a decline in discrete investments under a joint European ACE. Figure 4.3 reveals that welfare would increase in most countries, including those that would suffer a welfare loss in case of a unilateral introduction of ACE. These smaller international spillovers render the ACE more attractive from a welfare perspective when implemented jointly. European coordination thus allows governments to design more efficient corporate tax systems with a lower EMTR, more investment and higher tax rates.

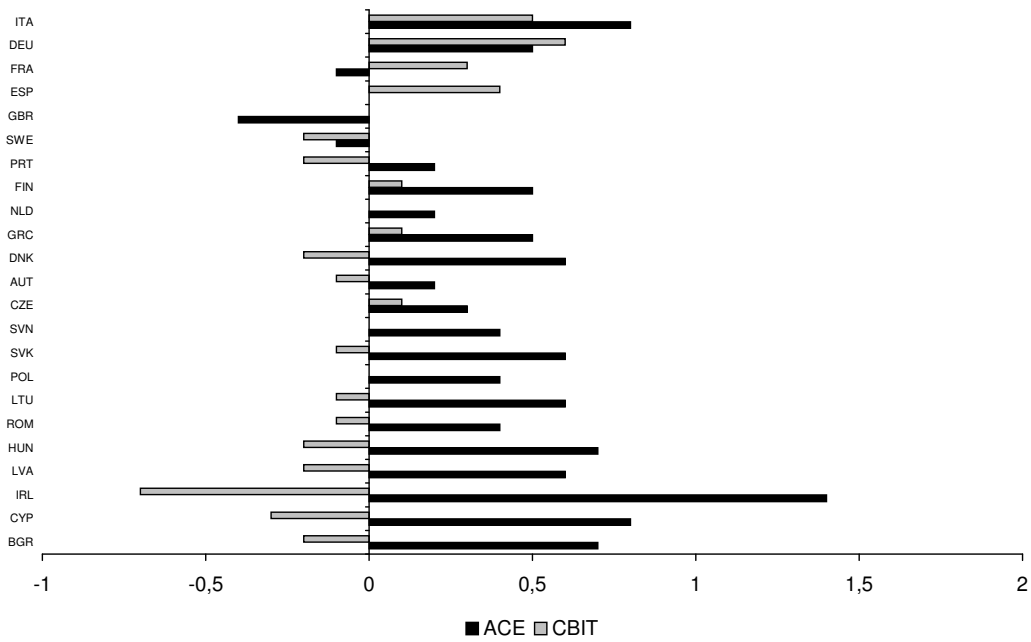
Table 4.3 Effects of joint European ACE and CBIT reforms with corporate tax rate adjustment^a

	ACE	CBIT
Corporate tax rate (%Δ)	17.0	- 11.0
Debt share (%Δ)	- 3.3	- 6.5
Cost of capital (%Δ)	- 0.3	0.0
Wage (%)	1.2	0.0
Capital (%)	4.8	- 1.0
Employment (%)	0.5	- 0.3
GDP (%)	1.8	- 0.6
Welfare (%Δ in GDP)	0.4	0.0

^a Unweighted average for 23 countries.

Source: CORTAX simulations

Figure 4.3 Welfare effects of European-wide ACE and CBIT reform, with corporate tax rate adjustment



For similar reasons, individual countries that would find it attractive to introduce CBIT and reduce corporate tax rates if implemented unilaterally, might no longer benefit from this policy if it were implemented jointly in the EU. Indeed, Table 4.3 shows that welfare would not increase, compared to a welfare gain of 0.7% under unilateral CBIT. Investment, employment and GDP would fall under a European CBIT. Figure 4.3 indicates that a number of countries would no longer benefit from a joint European CBIT, while they would gain from a unilateral introduction. The difference occurs because lower corporate tax rates would have negligible effects on profit shifting within Europe and on location choices if other countries pursued the same policy. This renders a reduction in corporate tax rates less beneficial. Indeed, by mitigating international spillovers of national policies, European cooperation makes it less urgent to cut statutory corporate tax rates. European coordination would therefore make a CBIT a less attractive way to neutralise financial distortions.

5 Conclusion

This study analyzes potential reforms in Europe in the direction of ACE and CBIT. We illustrate the key trade-offs in designing such reforms between, on the one hand, efficiency effects via distortions in investment and financial structures and, on the other hand, the welfare effects of changes in tax rates. An applied general equilibrium model for Europe is used to quantitatively assess the economic implications of ACE and CBIT in EU countries using plausible elasticities.

ACE is found to improve efficiency by removing the distortion between debt and equity finance and by reducing the cost of capital. However, if it is accompanied by higher corporate tax rates, the corporate tax base would erode due to profit shifting and adverse effects on discrete location of profitable investment. In countries where these effects are relatively strong, we find that ACE reforms could be welfare-reducing, though most Eastern European countries would benefit from the introduction of an ACE due to a small multinational sector.

Introducing a CBIT would improve welfare though smaller distortions in the financial structure of companies, though by disallowing the interest deduction the cost of capital would increase, exacerbating investment distortions. If CBIT were accompanied by lower corporate tax rates, welfare would rise in countries with a large multinational sector as lower rates generated a broadening of the tax base via inward profit shifting and by attracting discrete profitable investments. This is consistent with the way in which European countries have shaped their corporate tax policies during recent decades, with policies of base broadening and rate reduction, partly by limiting the deductibility of interest.

A revenue-neutral combination of ACE and CBIT reforms would improve efficiency as it reduced distortions to debt-equity choices. Welfare would increase a little due to this more efficient financial structure.

The simultaneous introduction of an ACE in Europe would improve welfare since the international cooperation would eliminate fiscal spillovers within the EU, which work primarily via statutory rates. In contrast, if the CBIT were introduced throughout Europe, the benefits would be reduced since the fiscal spillovers within Europe would be mitigated. Hence, if Europe coordinated policies, ACE-type reforms would be more attractive and CBIT type reforms less attractive.

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