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Who benefits from tax competition in the European Union?

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Abstract in English

Statutory tax rates have declined in the European Union in the recent decades. An applied general equilibrium model on corporate taxation sheds light on the economic and welfare implications of tax rate reforms. Domestic distortions proof highly relevant as even unilateral reductions of the corporate income tax rate might reduce welfare if the labour tax rate has to be increased. Profit shifting induces countries to underbid each others tax rates, but this effect is sizable only if two countries are closely linked. The harmful external effects of CIT rate reductions are limited, which reduces the need for European coordination of CIT rates.

Key words: corporate income taxation, tax competition, applied general equilibrium model
JEL codes: C68, E62, F23, H25

Abstract in Dutch

Statutaire Vpb-tarieven zijn in de afgelopen decennia gedaald in Europa. Een toegepast algemeen evenwichtsmodel voor vennootschapsbelasting geeft inzicht in de economische en welvaartseffecten van belastinghervormingen. Binnenlandse verstoringen blijken belangrijk te zijn: zelfs een unilaterale verlaging van de tarieven kan ten koste gaan van welvaart door de benodigde verhoging van de belasting op looninkomen. Winstverschuiving is een belangrijke reden voor landen om onder elkaars tarieven te duiken, vooral als landen economisch sterk met elkaar verbonden zijn. De nadelige externe effecten van belastingverlagingen zijn echter beperkt, wat de noodzaak voor Europese coordinatie beperkt.

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Preface

The tax on corporate income is under pressure. During the past decade, many countries reduced their tax rates in an attempt to attract foreign investment and profits. The theoretical and empirical literature on the pros and cons of tax competition is rich, but an integrated framework is hardly used. The current research project develops an applied general equilibrium model for corporate income taxation in the European Union. In this first application of the model, a thorough analysis of tax rate changes, both unilateral reductions and coordinated changes, is made. The investigation of proposals by the European Commission for tax base harmonisation is left for further research.

Coen Teulings
Director

Summary

Capital market integration within the European has been successful. It brings about a superior allocation of capital over member states by linking capital markets. But capital market integration also links national capital income taxes. Member states have indeed reduced their statutory corporate income tax rates in order to attract highly mobile paper profits of multinational firms. Yet effective capital income tax rates have remained relatively stable. The evidence thus suggests that there is more to tax competition than the canonical tax race bottom.

The economic literature on tax competition, both empirical and theoretical, features a plethora of international spillovers. For example, tax induced capital flight constitutes a positive spillover, whereas tax exportation through foreign ownership constitutes a negative spillover. Moreover, whether or not an individual member state benefits from an unilateral change in capital income taxation depends heavily on accompanying changes of labour income or consumption taxation.

An assessment of the welfare cost of tax competition, and thus the potential welfare gain of tax coordination, depends on the size and interplay of these factors. An applied general equilibrium model is needed, bringing together the insights that are at present still scattered over the existing literature. *CORTAX* is such a model. It is custom made for the problem at hand, as it distinguishes between domestic and multinational firms in order to simulate the simultaneous impact of capital income taxation on foreign direct investment, profit shifting and tax exporting.

The international spillovers can be substantial. An unilateral reduction of the corporate income tax rate of five percentage points may cause a 0.1 percent moderation of foreign GDP, depending on the openness of the countries involved. In general, the more open member states are, and the stronger the links between their capital markets, the stronger are the spillovers.

Given the size of the spillovers, one may expect that individual member states have strong incentives to engage in tax competition. This is not necessarily true, for several reasons. First, it depends on the scope of the international linkages, which is however quite weak for many EU member states. Therefore, whether or not an individual member state benefits from an unilateral reduction of its corporate income tax rate depends not so much on the international spillovers, but crucially on the way it finances the reduction. If labour income taxation is the balancing item, then most member states do better to maintain the corporate income tax rate at its current level, or even to increase it. Finally, if it expects other member states to follow suit, the benefits are eroded further.

The relatively weak incentives imply that tax competition entails modest welfare costs. Several countries benefit from cutting their tax rates on corporate income, by attracting foreign profits and investment, but they will not completely abandon the CIT. Other countries, in contrast, should be reluctant to cut their CIT-rates, as the alternative sources of financing are too expensive. European coordination of CIT rates, either by imposing a minimum rate or by harmonising all rates, therefore benefits some countries, harm others, but hardly improves welfare for the EU as a whole.

1   Introduction

"However, a full welfare cost assessment of differences in effective corporation tax rates would require a broader analysis, taking into account the existence of other taxes and other economic parameters, as well as national preferences for equity and the provision of public goods."
(European Commission, 2001b, p. 2)

Tax competition has led to a reduction in corporate income tax (CIT) rates, but has yet not triggered a race to the bottom (Mendoza and Tesar, 2005): tax rates have declined, but tax revenues have been remarkable stable. Concerning tax rates in Europe, one CIT-reform after the other is implemented. Well known is the example of Ireland, which has cut its tax rate with 27.5%-point in ten years time (1995-2005), cf. European Commission (2006, p83). Austria[1] has cut its rate with 9 per cent to 25 per cent in 2005 and the Netherlands has cut their tax rates from 34.5% to 29% and has recently proposed to set the rate at 25.5% in 2007. Interestingly, an advisory committee of the Dutch government (Council of State) states that tax-rate reduction in the Netherlands may trigger responses in other European member states.[2] In other words, the risk of a race to the bottom is deliberately taken into account.

The theoretical tax competition literature provides an abundance of often contrastive tenets. The CIT of one member state leads to capital flight to other member states, and thus entails a positive spillover as capital flight increases foreign CIT-bases and labour productivities. The domestic CIT-bill is, however, picked up by foreigners insofar they own stocks of domestic firms, and thus entails also a negative spillover. Moreover, if a member state decides to engage in tax competition and reduces its CIT-rate, then it must mend the resulting budgetary hole, either by cutting public expenditure or by increasing the burden of alternative taxes. In particular the labour income tax carries heavy domestic distortions that make it unattractive to go down this route, even in the face of the high capital mobility within the EU.

Economists still grope in the dark regarding the empirical relevance of the contrastive tenets. Does the downward pressure on CIT-rates dominate the upward pressure, and if so, to what extent? And what is the welfare cost of tax competition, or similarly, the potential welfare gain of tax coordination, as asked for in the quote by the European Commission?[3] This requires an integrated framework.

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[1] The key motivation for the Austrian government is that "(t)his reform put Austria in a competitive position in comparison with countries like Slovenia and the Czech Republic as a destination for foreign direct investment (FDI). The business location Austria now offers the second lowest corporate tax rate to corporate investors within the European Union." (www.austriantrade.org/united-kingdom/austria-in-the-uk/news/article/1031/2147/hash/3215d1e339/en/)

[2] Council of State, Advice No. W06.06.0125/IV, The Hague, May 10, 2006.

[3] In this paper we focus on competition and coordination in tax rates. In a subsequent paper, we intend to simulate proposals on the consolidation of the tax base.

CORTAX is an applied general equilibrium model of the EU tailor made for the problem at hand. It builds on the model presented by Sørensen (2004a). *CORTAX* goes, however, in some directions one step further. Notably the savings decision is derived from dynamic utility maximisation. Not only does this do justice to the inherently dynamic nature of saving, but it also allows a consistent welfare analysis. Moreover, *CORTAX* investigates a wider array of tax coordination proposals. A central result of the simulations is that a typical member state has only a small incentive to unilaterally reduce its CIT-rate. Consequently, the welfare cost of tax competition is relatively small, and may even be negative for some member states. The main reason is that if alternative tax instruments are used as balancing items, the benefits of a lower CIT are partly or entirely outweighed by the costs of a higher labour income or consumption tax. This is a fortiori true if member states expect their opponents in the tax competition game to follow suit.

If the incentives for member states to engage in tax competition are weak, then the welfare cost of tax competition or the welfare gain of tax coordination are modest. The costs or gains are, however, unequally distributed over member states. In fact, under either tax competition or tax coordination some member states win, while others lose. These conflicting interests explain why progress in tax coordination is difficult to achieve in practice, all the more since the total welfare gain in the EU seems to be quite modest.

This paper does not deviate from the custom to enumerate the contents of the remaining sections. Section 2 reviews the theoretical tax competition literature and presents the stylised facts regarding international CIT developments. Section 3 presents our applied general equilibrium model *CORTAX*. Sections 4 and 5 are dedicated to the results of simulated unilateral and multilateral CIT-reductions. Section 6 contains a sensitivity analysis, and section 7 concludes.

2 Theory and facts

This section sets the stage for our model simulations. It contains a review of the stylised facts regarding international CIT developments, as well as a review of the distinct tenets of the theoretical tax competition literature. An eclectic confrontation of facts and theory is, however, insufficient to estimate the welfare cost of tax competition or the welfare gain of tax coordination. For such an exercise an AGE model of the EU is needed, with a focus on CIT institutions.

2.1 Capital market integration and tax competition

The shaping of the internal market of the EU has been particularly successful with respect to the freedom of movement of capital. Investment and portfolio positions have become international, as indicated by Figure 2.1. It displays the sum of foreign assets and liabilities of eighteen EU member states as a proportion of their combined GDP. This measure of capital market integration has increased from 0.6 in 1970 to 5.0 in 2004, with a clear acceleration from 1992 onwards, the year in which the treaty of Maastricht was signed.

Figure 2.1 Capital market integration for the EU18[a]
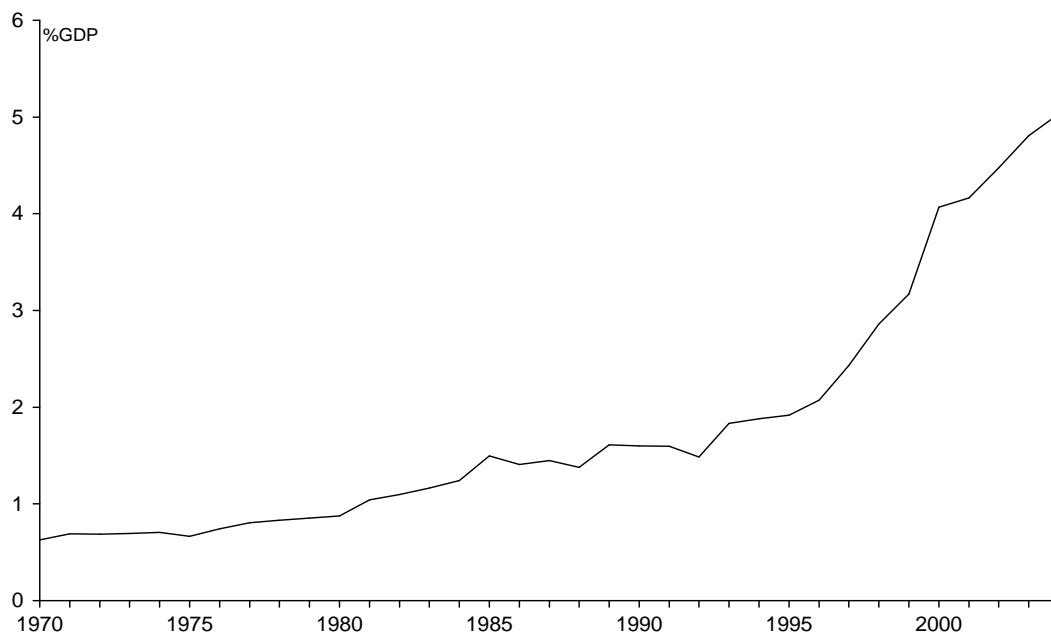
[a] Source: own calculations for the EU15, CZE, POL and HUN on the basis of Lane and Milesi-Ferretti (2006). Integration is measured as the sum of foreign assets and liabilities as a fraction of GDP.

A by-product of capital market integration is that multinational firms can more easily reduce their total corporate income tax (CIT) bill by shifting real and financial capital to low tax

member states. Therefore, member states that decrease their (effective) CIT rate attract FDI and paper profits. Capital market integration also implies that part of the CIT bill is picked up by foreigners as they hold a substantial proportion of the corporate stocks. Therefore, member states that increase their (effective) CIT rate 'export' a part of the CIT burden. In either case, corporate income taxation comprises international spillovers, albeit contrastive ones.

Disregard of international spillovers may lead to unilateral CIT reforms that are suboptimal from the perspective of the EU as a whole. The welfare cost of these reforms depends on the sign and magnitude of the spillovers. An extensive welfare analysis should, however, also include the CIT induced change of savings and the CIT induced change of capital flows between the EU and the rest of the world. They determine the total stock of investment for which member states compete. Hence tax competition is not a zero sum game for the EU.

Eyeball analyses of CIT developments suggest that the balance of international spillovers tips towards a downward pressure on CIT rates. Figure 2.2 shows that both statutory and effective rates in the OECD have decreased in conjunction with capital market integration. The mean statutory rate has, however, decreased more rapidly than the mean effective marginal tax rate (EMTR) and the mean effective average tax rate (EATR).[4] It implies that the decrease of the statutory CIT rate has partly been financed by broadening of the CIT base, in particular by restrictions on depreciation allowances. Consequently, the CIT revenue as a percentage of either GDP or total tax revenues has remained relatively stable.

Falling (effective) CIT rates are only indicative of countries underbidding each others' tax rates. There are alternative explanations of the observed trends. Rate reductions with base broadening are not confined to CIT, but have taken place elsewhere in tax systems. There international spillovers are much weaker, suggesting that purely domestic considerations related to equity, efficiency, and simplicity play a role. Moreover, the strong lobby of multinational firms may have resulted in the reforms that disproportionately benefits them. Furthermore, governments may seek to attract the highly profitable investment projects, which net return responds relatively strongly to rate reductions, and relatively weakly to base broadening. Finally, governments may mimic successful tax reforms of their neighbours without a clear understanding of their strategic interdependence.

Hence economists have sought to test tax competition more directly. Brueckner and Saavedra (2001) and Büttner (1999) find a positive slope of best response functions of local jurisdictions, implying that the a decrease of the tax burden in one jurisdiction is matched by a decrease in neighbouring ones. In a similar vein Devereux et al. (2004) present evidence of CIT competition at the country level. Carlsen et al. (2005) find that jurisdictions hosting a relatively large amount of mobile firms set relatively low tax rates. Krogstrup (2004) distills a number of testable

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[4] For a discussion of the calculation and interpretation of effective tax rates, see European Commission (2001a) and Gorter and De Mooij (2001).

Figure 2.2 Downward pressure on statutory and effective CIT (% change 1982-2001)
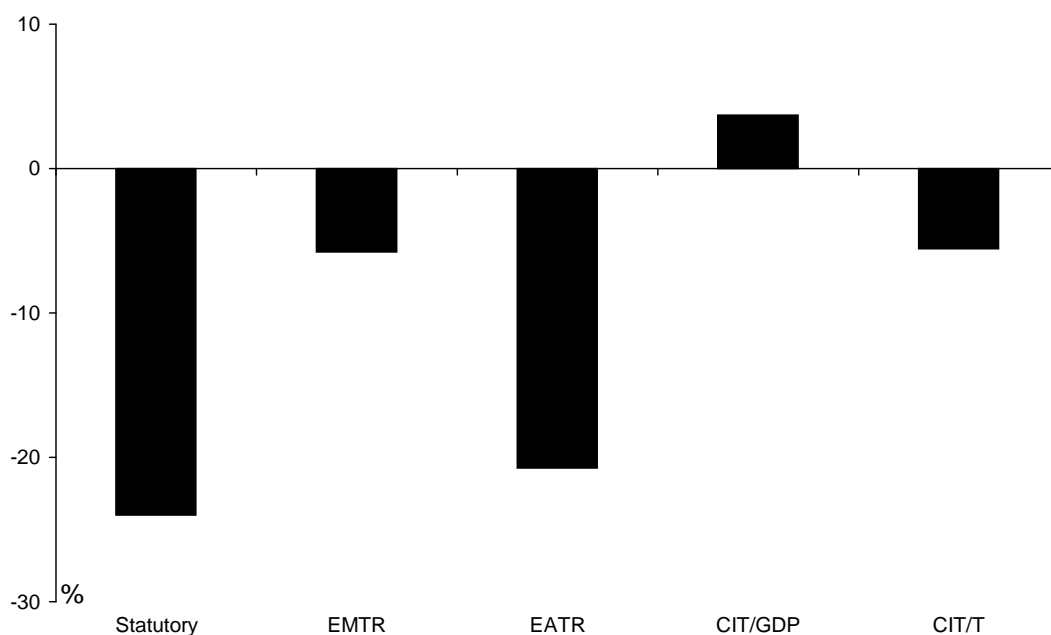
hypotheses from the theoretical tax competition literature. She finds strong evidence of a negative relation between international capital mobility and CIT burdens, and somewhat weaker evidence of a positive relation between country size, agglomeration, or foreign ownership and CIT burdens.

2.2 Domestic considerations

Opponents of tax competition implicitly assume that a CIT is worth having in the first place. This is not an undisputed conclusion. The CIT distorts investment decisions and may hurt economic growth, a relation indeed found by Lee and Gordon (2005). Furthermore, the CIT is sometimes criticised for its indirectness, since its final incidence falls not on corporations, but on individual stockholders as lower dividends and on individual employees as lower wages.

Allocating corporate income to individual stockholders carries, however, prohibitively high transaction costs. Hence Cnossen (2003) concludes that the choice is not between the CIT and other capital income taxes, but between the CIT and no capital income tax at all. If indeed the curtain would fall for the CIT, governments would have to resort to levying potentially more distorting taxes. After all, the CIT creams off economic rents generated by infra-marginal investment projects, while the deadweight loss at the margin of the labour income tax may be substantial due to the height of the prevailing rates.

De Mooij (2005) puts forward some additional arguments in support of the CIT. It serves as a backstop for the personal income tax as it discourages entrepreneurs to incorporate for evasion purposes. It also mitigates disincentives to invest in human capital as it creates a level playing field for investment in physical and human capital. Often overlooked is its function as an quasi insurance as it reduces the variation in after-tax rates of return. Finally, it facilitates income redistribution.

2.3   International considerations

2.3.1   Positive spillovers – profit shifting

The basic tax competition story is simple. Capital market integration prompts member states to undercut each others CIT rates in order to attract internationally mobile capital. This puts the solvency of public budgets under pressure.[5] It leaves member states with the dilemma either to decrease public good provision and income redistribution, or to increase the tax burden on labour income or consumption.

Zodrow and Mieszkowski (1986) were among the first to coin a formal model of the basic story. Governments uncooperatively set source based taxes on capital income. They do this in a world where capital is perfectly mobile. Thus taxation leads to capital flight as investment flows towards locations where it yields the highest *net* rate of return. Since capital flight broadens foreign tax bases, capital income taxation comprises a positive international spillover. Hence, in the Nash equilibrium of the tax game, tax rates are suboptimally low.

In the parsimonious basic model, the suboptimally low tax rates lead to a deficient supply of public goods. In the richer models of Gottschalk and Peters (2003), Huber (1999), Kessler and Myers (2002) and Sinn (1998a) low tax rates also imply deficient income redistribution.

2.3.2   Negative spillovers – tax exporting

Member states may, however, also be tempted to set excessively high CIT rates. The rationale is export of the CIT burden. It runs through two channels. First, Huizinga and Nielsen (1997) point out that foreign stockholders contribute to domestic CIT revenues. Second, Bucovetsky (1991) and Kanbur and Keen (1993) show that foreign capital owners contribute to domestic CIT revenues if the CIT decreases the gross rate of return to investment on the international capital market. Similarly, Davies (2005) and Noiset (2003) show that foreign consumers contribute to domestic CIT revenues if the CIT leads to higher prices on international consumer markets. Thus tax export may be direct and indirect through price changes on international imperfectly competitive markets.

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[5] These spillovers are considered positive as a tax *increase* would *benefit* other countries.

The empirical evidence of tax export is mixed. Gravelle and Smetters (2001) conclude on the basis of simulations with a calibrated model of the US economy and the rest of the world that a large part of the CIT burden is indeed exported to foreign investors. Eijffinger and Wagner (2001) and Huizinga and Nicodeme (2006) also report a substantial tax export. In contrast, Krogstrup (2004) finds only a weak relation between foreign ownership and CIT rates. Moreover, the conjunction of capital market integration and decreasing statutory and effective tax rates suggests that, however important tax export may be, classical tax competition dominates. This is in line with Sørensen (2001a), who argues that foreign ownership of domestic firms would have to be implausibly large, for the tendency toward overprovision of public services due to the potential for tax exporting, to outweigh the downward pressure on service levels from tax competition.

2.4   Other considerations

2.4.1   Public goods

If relatively high CIT rates are made up for by a highly educated workforce, by superior infrastructure, or by other public goods that raise the marginal productivity of capital, then tax induced capital flight is mitigated. Therefore, Devereux et al. (2002) claim that actual tax competition is much weaker than suggested by the basic tax competition model.

Nevertheless, distortions remain. Haufler and Schjelderup (2000) claim that the ability of multinational firms to shift paper profits across borders by transfer pricing or thin capitalization, detaches the CIT base from real investment. Thus, multinational firms can make use of public goods in one member state, while paying CIT in another. For this reason Sinn (1998b) doubts that an efficient supply of public goods can be financed with benefit taxes on capital income. It may be necessary to subsidise this factor in the sense that some of the public goods it uses will have to be covered by taxes on other factors. But even if capital income taxes suffice to finance an efficient supply of public goods, the outcome may still be suboptimal. Matsumoto (2004) demonstrates that a tax benefit system with internationally mobile production factors leads to excessive expenditure on public goods that complement the mobile factor.

2.4.2   Leviathan

If governments are not benevolent welfare maximisers, then a downward pressure on CIT rates may be a blessing as it tends to tame the 'leviathan'. In an attempt to formalise this argument Edwards and Keen (1996) assume that government officials maximise a utility function that includes both the welfare of their residents and the tax revenue diverted to their own purposes. Tax competition limits their ability to do so, and thus may be beneficial if the propensity among officials to waste revenue is relatively large. Huizinga and Nielsen (2001) give a more subtle argument along the same line. Government failure outweighs market failure if tax revenue has to

be raised (partly) by distortionary taxes on capital income. Also in this case tax competition countervails the implied excessive size of the public sector.

2.4.3 Agglomeration rents

CIT does not lead to capital flight insofar profits are location specific. Governments can, and should tax these profits as they constitute an immobile base. The new economic geography literature explains why profits are location specific, even if capital is internationally mobile *ex ante*. Agglomeration externalities – a catchall for the benefits of co-location of firms – lock capital into relatively productive core locations. Baldwin and Krugman (2004) and Kind et al. (2000) demonstrate that this gives rise to a sustainable tax gap, being the maximum difference between the tax burden in the core and the periphery. Agglomeration externalities let in the possibility of a tax rate to the top: market integration as measured by decreasing trade costs may strengthen the benefits of co-location, and thus increase the sustainable tax gap.

2.5 Tax competition and welfare

Since both statutory and effective CIT rates have decreased over the last decades, and since more sophisticated empirical analyses reveal a net downward pressure, tax competition seems to dominate tax export. This suggests that CIT rates tend to be inefficiently low, at least if one abstracts from waste of tax revenues by officials of a leviathan government.

Moreover, statutory CIT rates have decreased more rapidly than effective CIT rates. This can be understood by distinguishing between different kinds of capital. Paper profits constitute a highly mobile tax base that responds primarily to variation in statutory CIT rates. Real investment constitutes a less mobile tax base that responds to variation in effective CIT rates since depreciation allowances and other measures that broaden the CIT base are linked not to paper profits but to buildings, machinery and inventories. Governments fearing an erosion of their CIT base by capital flight thus do wise to pamper paper profits.

The theoretical and empirical literature on tax competition does not allow a rock solid conclusion about the welfare cost of tax competition, or the (potential) welfare gain of tax coordination. Distinct contributions, focusing on distinct facets of tax competition, yield conflicting results. Griffith and Klemm (2004) note that while the view that capital mobility puts downward pressure on corporate income taxes is more widely held than the opposite view, there is little consensus on whether this is beneficial, harmful or irrelevant to economic welfare. Zodrow (2003) concludes therefore that what is needed is a model that integrates the contributions, and that allows a quantification of the negative as well as the positive spillovers. The next paragraph surveys the brief literature on applied models, which previews our own contribution in this area.

2.5.1 Applied general equilibrium models on corporate taxation

Applied general equilibrium (AGE) models are designed to provide an integrated approach quantifying the positive and negative effects of tax policies.

One strand of literature apply highly stylised models to tax competition between (blocks of) countries. Mendoza and Tesar (1998) apply a model for the US and Europe to analyse the economic effect of several tax reforms in the US. In their 'two-country' model, the spillovers from the US to Europe are significant. In a follow-up, Mendoza and Tesar (2005) develop a model for a few large countries in the EU. An interesting feature of their simulations is the distinction between labour-tax and consumption-tax financing. In both cases, however, the gains from coordination (starting from a Nash equilibrium) are limited (up to 0.26% of lifetime consumption). This indicates, in contrast to their first paper, that the international spillovers are of limited size. In their 2005 paper they explain the difference in results as follows: "Thus, our findings suggest that these estimates of the benefits of tax reforms may be significantly overstated because they do not take into account the high degree of international capital mobility and the incentives it provides for strategic behaviour in tax policy setting."

In similar vein, Sørensen (2000, 2004b) develops a model for optimal government behaviour in four regions (Nordic countries, continental Europe, UK and US). The key international spillovers are tax exporting (leading to too high uncoordinated tax rates) and competition for the elastic supply of capital (implying low uncoordinated tax rates). The latter effect dominates in the simulations: a coordinated (between the three EU-blocks) CIT-policy generates an increase in CIT-rates of 12%-points on average, generating a welfare gain of less than 0.2% of GDP (Sørensen, 2000, Table 4). Similarly small welfare effects are obtained by Brueckner (2001) who shows with simulations of a stylised model that the welfare loss due to tax competition is less than 1% of GDP and Parry (2003) who shows in the same vein that the welfare gains of tax coordination are fairly modest, and may even disappear in the light of Leviathan behaviour of governments. The contribution of this literature is that it highlights the key mechanisms behind tax competition in an integrated way. The limitation is, however, the still highly stylised nature, implying that the simulations should be seen as 'theory with numbers'.

The answer is a more realistic modelling with institutional detail for a large group of countries, which comes, however, at the expense of theoretical rigour – for example tax competition where countries optimally respond to each other cannot be investigated anymore. An example is Sørensen (2002, 2004a) who developed the model *OECDTAX* for 24 OECD countries.[6] In his 2002-paper on German tax reforms, Sørensen concludes that the effects of the German reform on other OECD economies are quite small. Sørensen (2004a) simulates an European harmonisation of both the tax rate and the tax base. He finds welfare effects between a small loss of 0.04% GDP in Denmark and Sweden and a welfare gain of 0.28% GDP in Belgium.

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[6] See section 3.2.6 for a technical comparison of our model with *OECDTAX*.

On average, the EU benefits slightly (0.18%GDP) ".. since harmonization of the source-based corporation tax reduces cross-country differences in required pre-tax rates of return, leading to a more efficient allocation of capital across Europe" (Sørensen, 2004a, p. 111). Finally, Copenhagen Economics (2004) use an updated version of *OECDTAX* to investigate tax base harmonisation, with various assumptions on tax rate policies, like harmonisation of the tax rate or a minimum tax rate. Their simulated welfare effects are more diverse than in Sørensen (2004a), ranging between a loss of 0.2%GDP and a gain of 0.7%GDP.

Our contribution to this literature is a thorough investigation of the economic and welfare effects of unilateral and multilateral tax reforms in Europe, by developing and simulating the applied general equilibrium model *CORTAX* for corporate taxation in Europe. This provides insight in how individual member states might be affected by CIT-reductions in either the home country or in other member states. In addition, we show which countries gain from imposing a European minimum tax rate or, similar to Sørensen (2004a), from even harmonising their tax rates. The *OECDTAX*-version used in Copenhagen Economics (2004) also uses country-specific fiscal depreciation rates (but these values are not reported). In contrast to our approach, this rate is calibrated with the ratio of corporate tax revenue to GDP. As a major consequence, Germany is characterised by a narrow tax base, while the opposite holds in our model. This different choice explains differences in results, as Germany is a dominating economy in the EU.

3 Overview of the model and calibration

This section describes the general equilibrium model *CORTAX*, which is designed for the analysis of corporate income taxation in the EU. After the model is non-technically described, the calibration procedure is briefly discussed. We have been inspired by *OECDTAX*, which has been developed by Sørensen (2001b). A final subsection compares our model with *OECDTAX*.

3.1 Non-technical description of the model

The model is applied to 17 EU countries, covering the 15 old member states (with BEL and LUX joined) and three largest new member states (CZE, HUN and POL). Each of these countries is modelled as a small, open economy. All countries produce one homogenous good at the exogenous world price. The rate of return on the two assets, debt and equity, are given from the world capital market; i.e. we assume the EU to be unable to affect interest rates.[7] We briefly discuss the structure of *CORTAX* per sector; a complete technical description can be found in Bettendorf and Van der Horst (2006).

3.1.1 Households

The specification of the households is based on the overlapping generations model of Diamond, which endogenises savings and allows for welfare analysis in a dynamic context. An individual is assumed to live for two periods: a working period and a retirement period.[8] As a consequence, one young generation coexist with one old generation in each period.

Taxes on labour and consumption might serve as alternatives for the corporate income tax. Labour is supplied elastically by young households in order to allow for employment and welfare effects of labour-tax changes. Older households have stopped working. Households receive labour income (when young), capital income (when old) and lump sum transfers. Total income is spent on consumption when young and old. Resulting savings can be invested in bonds and stocks. Since both asset types are specified as imperfect substitutes, an investor will always diversify his portfolio over both assets (bonds of different origin are considered perfect substitutes, and the same holds for domestic and foreign equities). Household decisions follow from maximising lifetime utility.

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[7] In section 5.2 we consider an extension in which world interest rates are affected by reforms in the EU.

[8] A period is assumed to span 40 years. The model is expressed in annual terms by assuming that behaviour is the same in each year of the period when young and when old.

3.1.2 Firms

Three types of firms are distinguished: domestic firms, multinational headquarters and subsidiaries of multinationals. The introduction of multinationals is essential for the analysis of the impact of corporate income taxation on profit shifting and FDI, see section 2.3. The three types of firms all produce one homogenous good. Production of each firm requires the input of labour, physical capital and location specific capital. Labour is not subject to tax competition as it is assumed to be internationally immobile. Location specific capital is internationally immobile too, and, in contrast to labour, supplied inelastically. Its return (an agglomeration rent) is assumed to fall under the corporate income tax, which makes this part of the tax on corporate income nondistortive. The corporate income tax is only distortive when the tax base exceeds the income earned by location specific capital.

Physical capital is perfectly mobile internationally. Although the gross rate of return is fixed at the world capital market, the user cost of capital depends on country-specific corporate and personal taxation systems. Investments can be financed by issuing bonds or by retaining profits (issuing new shares is not allowed). The firm can deduct interest payments on bonds from its taxable profits, next to depreciation allowances. As a consequence, debt financing is in general the most attractive alternative. To avoid extreme debt positions and guarantee that investments are partially financed with equity, a cost on extreme debt positions is incurred.[9]

Optimal input demands are derived from maximising the value of the firm. The rate at which future profits are discounted has to be equal to the rate of return required by the marginal equity holder. The marginal investor is assumed to live in the home country, implying that the required return on the firms' equity is determined by the domestic household and therefore by the tax rate the latter has to pay on equity income.

Multinationals differ from domestic firms by assuming that they operate a subsidiary in each foreign country.[10] Decisions of a multinational aim to maximise the sum of the values of all its firms. This implies that the fraction of the subsidiary's capital stock that is not debt financed (i.e. foreign direct investment) should yield the rate on return required on the parent's equity. Production in a subsidiary needs in addition an intermediate input that is provided by its parent company. Since tax bases are not consolidated, profits can be shifted between countries by charging a transfer price for intermediate inputs that deviates from the real cost. Profit shifting remains bounded by specifying compliance costs on transfer pricing. Fixed income generated by a subsidiary is assumed to accrue to residents of the home country. Raising the CIT rate thus decreases the after-tax fixed income of foreign beneficiaries, which allows countries to export part of the tax burden.

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[9] Reasonable values for the debt ratio are obtained by specifying that the firm has to bear financial distress costs when the debt ratio deviates from a threshold level.

[10] Multinationals do not decide on the location of its subsidiaries, only on its sizes. Multinationals are assumed to operate only in other EU countries, but not in the rest of the world (and vice versa). As a consequence, profit shifting is limited to the EU.

3.1.3 Government

Tax revenues consist of source-based taxes on corporate income and residence-based taxes on labour income, dividends, capital gains, interest income and consumption. The focus on the pure regime for corporate taxation can be motivated by the observation in Devereux (2004) that 'Although in many countries the legal basis of taxation is on a residence basis, in practice the vast bulk of the international taxation of company equity income is on a source basis'. He also states that only little revenue is raised in the residence country.

The expenditures side contains government consumption, interest payments on bonds[11] and lump sum transfers. We abstract from government objectives like maximising households wealth or their own revenues, which excludes the analysis of strategic interactions and leviathan behaviour. The key function of the government is to remain solvent by compensating corporate income tax reductions by alternative sources of finance or a reduction in (non-distortive) income transfers.

3.1.4 Market equilibrium

The equilibrium condition for each market is as follows:

- The labour market: domestic supply has to meet domestic demand; wages are therefore country specific.
- The goods market: the surplus of production over domestic demand leads to net exports; the goods price acts as numeraire.
- The bonds market: all types of bonds (domestic or foreign, issued by firms or government) are perfect substitutes with fixed return; the net supply of bonds by the rest of world is assumed perfectly elastic.
- The equity market: all types of equity (domestic or foreign) are perfect substitutes with fixed return; the net supply of equity by the rest of the world is assumed perfectly elastic.
- The balance of payments is balanced (i.e. the current account equals the change in the net foreign asset position) if all previous markets are in equilibrium (due to Walras law).

3.2 Calibration

We discuss the most important assumptions and choices we have made in the calibration of the model. We refer to Bettendorf and Van der Horst (2006) for a more detailed discussion. Whenever possible, we have used 2002 as our reference year, the final year for which the required data is available.

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[11] Debt accumulation follows from the assumption that the public debt/GDP ratio is constant.

3.2.1 Households

The consumption share in GDP is taken from the National Accounts (source OECD). Statistics on labour force, employment in persons and hours worked per person are combined to calculate labour supply. Population growth is uniform at the EU-average. Values chosen for key parameters are listed in Table 3.1.

Table 3.1 Key parameters and (semi-)elasticities for households

	min	max
Population growth		0.5%
Real return on bonds		2.0%
Real return on equity		4.0%
Rate of time preference		1.0%
Elasticities of substitution		
Intertemporal		0.5
Intratemporal (consumption-leisure)		1.0
Bonds-Equity		4.0
Implied (semi-)elasticities	min	max
Labour supply to wage	0.12	0.28
Savings to interest rate	0.35	0.80

Evers et al. (2005) conclude from a meta analysis that the uncompensated wage elasticity of labour supply is about 0.1 for men and 0.5 for women. Our simulated wage elasticities for all workers, using the partial model for household behaviour, fit nicely in this range.

The real interest rate proxies the average of 2003-2005 of the yield of the 30-years index-linked OATs. The range of implied interest elasticities of total savings shows small but positive values.

3.2.2 Production

The capital and labour parameters in the production functions are predominantly determined by the country-specific labour income shares (corrected for the self-employed). Little evidence is available for the share of intermediate inputs in the production function of subsidiaries. The share of imported intermediate inputs in GDP can be obtained from the National Accounts (about 12% on average), but likely overestimates the intra-firm trade of intermediates. We therefore fix this share at the lower level of 10% (Sørensen (2001b)). The income share of location specific capital, which proxies agglomeration rents, is fixed at 2.5% (cf. 5% in Sørensen (2001b)). Country specific TFP-levels are endogenous in the calibration, but its growth rate is fixed at 1.5%. Given the long-run character of our model, we allow for a substantial amount of substitution between labour and capital (see Chirinko (2002)).

By fixing the amount of location specific capital used by domestic firms and multinational headquarters, we assume that domestic firms produce about twice as much as multinational parents (the precise figure is 0.7/0.3; cf. Sørensen (2001b)). The amount of location specific capital used by each subsidiary is calibrated from OECD-data on bilateral FDI-stocks.

Table 3.2   Key parameters and (semi-)elasticities of production

Technological growth		1.5%
Economic rate of depreciation		5.0%
Income share of location specific capital		2.5%
Elasticity of substitution		
Labour-capital		0.7
Implied semi-elasticities	min	max
Capital stock to statutory CIT	– 0.46	0.09
Incoming FDI to statutory CIT	– 1.91	– 0.48
Debt to statutory CIT	0.23	0.38
Incoming transfer price to statutory CIT	0.74	2.14

3.2.3   Government

Key parameters of the corporate income tax are the statutory tax rate and the fiscal depreciation rate measuring the broadness of the tax base. The legal tax rates are taken from the Institute for Fiscal Studies, see Devereux et al. (2002), except for CZE, HUN and POL (source: Finkenzeller and Spengel (2004)) and DNK (source: Nexia International (2005)). Starting point in the calibration of the tax base is the marginal effective tax rate (METR) as calculated for debt and equity financing by IFS. We assume that 25% of the new investment projects are financed with debt and 75% with equity. This is lower than the actual debt-equity mix (40%,60%) in order to ensure reasonable (depreciation) allowances.

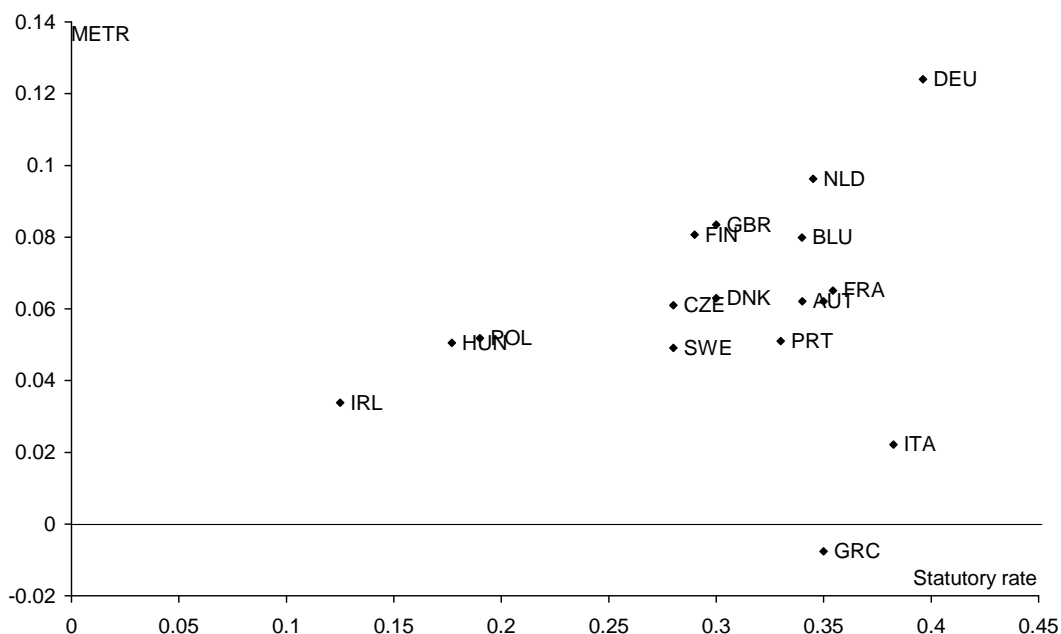**Figure 3.1   Statutory and marginal effective tax rates**

Figure 3.1 shows a scatter of the statutory and the resulting marginal effective tax rates (METR). The fiscal depreciation rate is calibrated such that this METR is reproduced, as it is the best measure of how corporate income taxes affect the profit-maximising decision on marginal investments.[12] We restrict the fiscal depreciation rate between 5% and 15%, where the lower bound is given by the economic rate of depreciation and the upper bound is imposed to avoid the undesirable 'taxation paradox' (see e.g. Sørensen (2002)).[13] When one allows for generous depreciation allowances (large difference between fiscal and economic rate of depreciation), simulating a reduction in the corporate tax rate might result in an increase in the cost of capital and a reduction of the capital stock.

A drawback of this calibration procedure is that we cannot take all country-specific details of tax regimes into account. For Germany this is indicated by the finding that the high METR is not in line with the relatively low CIT-revenues. Another example concerns the special tax rulings in the Netherlands aiming at attracting the location of headquarters. As a result, the simulated tax revenues deviate from the observed tax revenues: the average revenues are lower than observed (2.6% versus 3.0%). In an alternative procedure, we calibrated the fiscal depreciation rate on the observed corporate tax revenues. However, this resulted in implausible high values for this rate, that would give rise to a negative response of the capital stock to a reduction in the corporate tax rate.

With respect to the labour and consumption tax rates, we follow Mendoza et al. (1994) to determine the effective average tax rates from the OECD Tax Revenues and National Accounts (NA). Government expenditures are also taken from the NA. Transfers are used to close the government budget (ranging between 14 and 28%GDP).

3.2.4   Semi-elasticities of international linkages

FDI is one of the key links between countries. From a meta study De Mooij and Ederveen (2003) report a typical semi-elasticity of FDI with respect to the CIT rate of -2.4 (see De Mooij (2005, Table 2)). The simulated semi-elasticity in Table 3.2 of about -1.0 is smaller than the mean value of the meta study, but falls in the range of estimates for the semi-elasticity with statutory tax differentials. The latter semi-elasticity is the combined effect of the two components of FDI, namely the foreign capital stock and the share of equity capital in foreign capital. In view of lacking information, we assume that the capital-intensity of subsidiaries is similar to that of domestic firms and that the share of bond-financing in both firm types is similar. Both assumptions imply that the stock of foreign capital is as responsive to tax changes as the stock of domestic capital, where the responsiveness of domestic capital is limited by the complementarity with immobile labour and location specific capital.

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[12] European Commission (2001b, Annex A, Tables 22-23) reports statutory allowance rates for buildings and machinery for the EU15 in 2001. Our calibrated depreciation rate is remarkably close to the allowance rate for buildings (correlation = 0.82), but it is hardly correlated with the allowance rate for machinery (-0.24).

[13] Only in Greece, the small tax base still implies the taxation paradox, where a tax increase raises investments.

Transfer pricing is the second link between countries. The impact of transfer pricing on tax revenues is significant if transfer prices respond strongly to tax rate differentials *and* if the share of intermediate inputs in multinational firms is large. Unfortunately, the evidence for calibrating both elements is weak. The calibration of the latter share at 10% is already explained above. The limited evidence on the elasticity of transfer prices to tax changes points to a range between 0 and 0.5, see De Mooij (2005). Evidence on the elasticity of profit shifting is given by Huizinga and Laeven (2006), who find a macro semi-elasticity of reported profits with respect to the top statutory tax rate of 1.43 in Europe. In the model multinationals can only shift profits by applying transfer prices to intra-firm flows of intermediates. To capture the more general practice of profit shifting, we model transfer prices more sensitive to tax rate differentials in line with Huizinga and Laeven (2006). The calibration implies an improvement of the tax revenues due to profit shifting in the range of 10-40% of the ex ante reduction of tax revenues.

The third international link concerns the repatriation of the return to location specific capital to the home country. The size of this link depends on the income share of 2.5%.

3.2.5 Base path

The calibration results in the base path are given in Table 3.3. We comment some typical features that will explain differences in simulation outcomes over the countries.

1. The marginal effective tax on corporate income is much smaller than the statutory rate due to the depreciation allowances and the deductibility of interest payments. Note that the METR is the key signal of the CIT-distortion. Whereas the statutory rate ranges from 13% in Ireland to 40% in Germany, the METR varies between −1% in Greece and 12% in Germany. The high statutory tax rate in Greece is more than compensated by a high fiscal rate of depreciation, explaining the effective subsidy on marginal investments.

2. The labour and consumption tax rates vary considerably between countries. This will matter in tax reforms where a reduction in the CIT-rate has to be compensated with an increase in the labour or consumption tax rate.

3. The cost of capital is mainly determined by the common gross rates of return and the economic rate of depreciation, which explains its (relative) invariability. Still, the cost of capital is higher in countries with high tax rates and broad tax bases.

4. The transfer price of incoming intermediates is considerably below unity in countries with a low tax rate (IRL, HUN, POL and CZE) in order to boost the tax base in these countries.

5. In countries with a low share of wage income, which is mirrored by a high share of capital income, the tax on corporate income is relatively more distortive than the tax on labour income, ceteris paribus.

6. Foreign subsidiaries are important in small countries, as BLU, IRL and NLD, as indicated by the inward FDI. The tax base in these countries is therefore highly sensitive to tax differentials.

7. The net foreign asset position is defined as the difference between the value of all assets a country owns and the total value of all assets issued. Countries with a positive NFA-position are therefore net exporters of capital. We treat the NFA-position as endogenous in the calibration procedure.

Table 3.3   Key variables and elasticities in the basic scenario

	AUT	BLU	DNK	FIN	FRA	DEU	GRC	IRL	ITA
Tax rate on corporate income	0.34	0.34	0.30	0.29	0.35	0.40	0.35	0.13	0.38
Marginal effective tax rate	0.06	0.08	0.06	0.08	0.07	0.12	– 0.01	0.03	0.02
Fiscal depreciation rate	0.08	0.06	0.07	0.06	0.08	0.05	0.15	0.05	0.12
Tax rate on labour income	0.39	0.38	0.34	0.38	0.38	0.34	0.26	0.17	0.35
Tax rate on consumption	0.25	0.23	0.47	0.35	0.22	0.20	0.21	0.33	0.17
Cost of capital	0.08	0.08	0.09	0.09	0.08	0.09	0.08	0.08	0.08
Wage share (fraction GDP)	0.71	0.72	0.69	0.63	0.67	0.65	0.68	0.60	0.65
Transfer price (in)	0.95	1.00	0.97	1.00	1.01	1.09	1.01	0.70	1.05
Employment[a]	0.46	0.40	0.47	0.44	0.38	0.41	0.42	0.45	0.38
Capital (fraction GDP)	3.18	2.99	3.27	3.85	3.71	3.71	3.61	4.48	4.06
Inward FDI (stock, fraction GDP)	0.13	0.60	0.21	0.15	0.10	0.09	0.04	0.58	0.04
Gross Domestic Product (EU=1)	1.17	1.17	1.19	1.10	1.19	1.05	0.76	1.48	1.00
Consumption (fraction GDP)	0.61	0.58	0.50	0.49	0.50	0.55	0.59	0.51	0.54
Net foreign assets (fraction GDP)	0.18	– 0.51	– 0.85	– 1.49	– 0.88	– 0.36	0.16	– 0.74	– 0.98

	NLD	PRT	ESP	SWE	GBR	CZE	HUN	POL
Tax rate on corporate income	0.35	0.33	0.35	0.28	0.30	0.28	0.18	0.19
Marginal effective tax rate	0.10	0.05	0.06	0.05	0.08	0.06	0.05	0.05
Fiscal depreciation rate	0.06	0.08	0.08	0.08	0.06	0.07	0.05	0.05
Tax rate on labour income	0.31	0.24	0.28	0.47	0.22	0.35	0.33	0.25
Tax rate on consumption	0.28	0.26	0.17	0.36	0.20	0.24	0.33	0.21
Cost of capital	0.09	0.08	0.08	0.09	0.09	0.09	0.09	0.09
Wage share (fraction GDP)	0.69	0.77	0.64	0.72	0.74	0.60	0.63	0.68
Transfer price (in)	1.02	0.98	1.00	0.94	0.92	0.88	0.71	0.75
Employment[a]	0.41	0.50	0.44	0.48	0.47	0.51	0.40	0.44
Capital (fraction GDP)	3.15	2.50	4.01	2.99	2.57	4.17	4.03	3.45
Inward FDI (stock, fraction GDP)	0.34	0.11	0.07	0.24	0.15	0.11	0.13	0.08
Gross Domestic Product (EU=1)	1.21	0.77	0.94	1.13	1.16	0.64	0.57	0.46
Consumption (fraction GDP)	0.54	0.64	0.56	0.51	0.62	0.46	0.47	0.58
Net foreign assets (fraction GDP)	0.25	2.57	– 0.24	– 0.76	1.79	– 1.37	– 0.88	0.51

[a] Employment as fraction of the available time for a working-age person, where each person has 2500 hours available for work annually.

3.2.6 Comparison with *OECDTAX*

The specification and calibration of our model *CORTAX* is heavily based on *OECDTAX* (as explained in Sørensen (2001b)), but some important differences should be noticed. On the one hand, we have dropped some features of *OECDTAX* to get a clearer insight into the main mechanisms driving the outcomes. In contrast to our approach, *OECDTAX* considers national capital markets with endogenous rates of return. We have simplified taxation systems and abstract from modelling housing stocks, financial institutions, imperfect labour markets and tax havens.[14]

A key extension of the model is the use of a Diamond framework with overlapping generations to model household behaviour instead of a representative agent model. The advantage is that all behavioural equations are consistently derived from dynamic optimisation, allowing for a proper welfare analysis. In particular the labour-supply choice appears to be crucial in tax reforms. As in Sørensen (2001b), we will only consider the stationary long run version of the model. Calculation of the full transition path is beyond the scope of the current project.

Furthermore *OECDTAX* is applied to 24 OECD-countries, including US, whereas we focus on the EU block. Finally, we also made some different choices in the parameterization of the model. In particular, whereas Sørensen (2001b) considers only country-specific statutory CIT-rates, our calibration also takes into account country-specific tax bases to mimic the tax-distortions of marginal investment decisions.

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[14] In *OECDTAX*, the tax haven issues bonds that only can be held by foreign household investors (i.e. firms can not benefit from the tax haven). The fraction of these assets in total bond holdings by EU-households is small (ranging from 0.3% to 1.4%).

4 Unilateral reduction

What are the economic and welfare effects for a country and the other EU members if a single country reduces its CIT rate? This question is investigated for France (section 4.1) and the other EU countries in our model. The analysis for France highlights the key effects for the home country and the other EU member states. In section 4.2, we extend the analysis to unilateral reductions in the CIT-rate in all other countries, under the assumption that other countries do not respond.[15]

4.1 Unilateral reduction of the CIT-rate in France

4.1.1 Implications for the economy and welfare in France

Consider a reduction in the CIT-rate of France by 5%-point, which amounts to an ex-ante reduction in tax revenues of 0.41% GDP. In the first discussion of this CIT-reduction, we assume that the revenues needed to finance this reduction are raised in a non-distortive way, i.e. by a cut in income transfers. What are the implications of the unilateral reduction in the CIT-rate for the French economy? We discuss successively the economic changes, the impact on the government budget and change in welfare.

Table 4.1   Production in France[a]

Cost of capital	− 1.17
Wage rate	0.53
Incoming transfer price	− 7.54
GDP	0.54
Employment	0.13
domestic	0.09
subsidiaries	0.86
Capital	1.33
Inward FDI	5.75
Intermediate inputs	0.53
Pure profits (domestic)	8.23
Debt ratio[b]	− 1.69

[a] Relative change in response to a 5%-point reduction of the CIT-rate in France.
[b] Deviation from base path in percentage points.

The tax reduction clearly stimulates production in France: GDP improves by about a half percent, the capital stock expands by more than 1 percent and an equivalent of 34 thousand jobs are created. The direct cause of this expansion is the reduction in the cost of capital due to the

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[15] We have chosen France, because it is a large country, with substantial FDI in at least one other country, namely Belgium and because the distortiveness of its corporate income tax, as measured by the METR, is near the EU-average.

tax reduction. This stimulates firms to expand their capital stock as less profitable investments will now meet the required return. As capital and labour are complementary inputs, a reduction in the cost of capital will raise the demand not only for capital, but also for labour. Wages increase to which households respond by substituting leisure for labour. This expansion of employment together with the larger capital stock are the key determinants of the GDP growth.

Behind the scene, a shift in production towards subsidiaries can be observed: inward FDI increases much stronger than the average stock of capital and employment in subsidiaries increases by nearly 1%-point. The FDI-response has two components: nearly 50% of the response is due to an increase in investments whereas the other part is caused by a shift in ownership towards equity capital. The first part of the relatively stronger FDI-response is due to subsidiaries using more intermediate inputs to benefit from transfer pricing. The second part of the FDI-response, namely the reduction in the debt rate, is due to the impact of the tax cut on the deductibility of debt: the cost of debt financing increases relative to the cost of equity financing, which results in a reduction of the debt ratio by 1.7%-points.

We have seen that a single country like France is able to attract FDI by reducing its tax rate. In addition, it will reduce the profit shifting by French multinationals to other EU countries with lower tax rates. (Note that France has one of the highest tax rates in the EU – only Germany and Italy have higher tax rates). The channel for profit shifting in our model is transfer pricing. French multinationals benefit from the tax cut by charging a higher price for the intermediate inputs they deliver to their subsidiaries. Of course, foreign multinationals also benefit from the French tax cut, by charging a lower price to their French subsidiaries. Though the cut in the incoming transfer price is substantial (-7.5%), the total shift of profit income is limited. It amounts to 0.12%GDP and generates an increase in tax revenues of only 0.04%GDP.

Profit shifting is only one channel in which the government may recover the reduction in revenues of 0.41%GDP. A summary of the change in tax revenues and public expenditures is provided in Table 4.2. Only a tenth of the reduction in tax revenues is regained by a broadening of the CIT-base. Quantitatively more important is the expansion of the other tax bases, in particular of the labour tax, summing to nearly two-thirds of the initial revenue loss. The remaining deficit in the government budget is covered by a reduction in lump-sum transfers to households of 0.12% GDP.

Why is the broadening of the CIT-base so small? Table 4.2 shows a decomposition of the tax-base broadening. The first element is the broadening of the base due to an expansion of the operating surplus which consists of the return to both mobile and location-specific capital income. The contribution of this term is small given the increase in the capital stock of 1.34%. However, the expansion of the capital stock is largely offset by the reduction in its gross return: the reduction in the cost of capital is matched by a similar reduction in the marginal productivity of capital. The second part of the tax base contributing to additional revenues is the deduction of less interest payments. Firms reduce their debt ratio as the tax-rate reduction makes

Table 4.2   Government revenues and expenditures in France[a]

Revenues

CIT-tax (ex ante)	− 0.41
Tax base expansion[b]	0.04
Of which gross operating surplus	0.02
change in debt ratio	0.08
value of depreciation allowances	− 0.08
profit shifting	0.04
CIT-tax (ex post)	− 0.37
Labour tax	0.17
Consumption tax	0.05
Wealth taxes	0.03
Total tax revenues	− 0.12

Expenditures

Transfers (to old)	− 0.12
Government consumption[b]	0.00
Total expenditures	− 0.12

[a] Change in %GDP in response to a 5%-point reduction of the CIT-rate in France.

[b] The tax base of a country j is (loosely) defined as (see Bettendorf and Van der Horst (2006) for the precise definition):

$$\widehat{\Pi}(j) = \left[Y - \sum_{i \neq j} q(j,i) - wL \right] - d_b \hat{r}_{wb} K - \delta_t D + \sum_{i \neq j} \left[(p_q(i,j) - 1) q(i,j) + (1 - p_q(j,i)) q(j,i) \right]$$

where the first term denotes the gross operating surplus, the second refers to the deductibility of debt, the third are the depreciation allowances and the final term indicates profit shifting.

equity-financing relatively cheaper. Thirdly, the expansion of the capital stock increases the depreciation allowances, which tempers the broadening of the tax base. The final element of the tax base is profit shifting. However, for a large country like France, with a limited share of production by multinationals (as measured by the share of FDI in GDP), the scope for profit shifting is limited: less than 10% of the CIT-reduction is recovered by the shift in profits towards France.

Households in France benefit from the increase in their labour income and from a higher return to their location specific capital, but face a reduction in the transfers they receive from the government. The net effect is an expansion of their lifetime income which induces an expansion in consumption of about 0.4% in both periods. Savings increase as the income expansion is concentrated in the first period (labour income). The increase in savings is, however, smaller than the increase in investment which implies a worsening of the net foreign asset position of France of about 5%GDP.

The reform where the tax on corporate income tax is financed with a reduction in lump-sum transfers raises welfare, see Table 4.3. The welfare gain is equivalent to an increase in transfers of 0.21% GDP, which is about 50% of the initial impulse.[16] The welfare gain is due to the

[16] We evaluate a welfare gain in money-terms by calculating the change in lump-sum transfers to households which would

Table 4.3   Consumption and welfare in France[a]

Consumption (young)	0.45
Consumption (old)	0.42
Savings	0.95
Net foreign assets (% GDP)[b]	– 4.93
Welfare (% GDP)[b]	0.22

[a] Relative change in response to a 5%-point reduction of the CIT-rate in France.
[b] Deviation from base path in percentage points.

attraction of foreign profit income, the increase in foreign direct investment and the reduction of investment distortions of both domestic and multinational firms. At this moment, we cannot conclude which source has the largest contribution to welfare. The next section, where we investigate alternative means of financing the CIT-reduction will shed light on this.

4.1.2   Alternative financing

The previous section clearly shows the benefits of a reduction of the corporate income tax rate. The reliance on transfers to close the budget is, however, unrealistic. Lump-sum taxes (like the British poll tax) or lump-sum transfers are quite rare. More realistically is that a reduction in the CIT-rate has to be financed with either a cut in government expenditures or a reduction in alternative tax rates, like the taxes on labour or consumption.

To investigate these – more realistic – scenarios, we consider the same unilateral reduction of the French CIT-rate, but now the budget is closed with changes in the tax rates on labour or consumption. Table 4.4 shows the impact on the revenues of the government, where the first column repeats the transfer-financed CIT-reduction of the previous subsection. The first indication of the distortiveness of the labour and consumption taxes is the required increase in tax revenues. An increase in labour tax revenues of 0.33%GDP or an increase in consumption tax revenues of 0.22%GDP is required instead of a reduction in transfers of 0.12%GDP in the first scenario.

Perhaps surprisingly, the broadening of the CIT-base is hardly affected by the financing rule. The clue to this neutrality result is that several elements of the tax base, in particular transfer pricing and the change in the debt ratio, depend on the CIT-rate only. In addition, the changes in the gross operating surplus and in the depreciation allowances depend crucially on the capital stock, but largely offset each other. As a result, the expansion of the CIT-base recovers only a small fraction of the lost revenues irrespective of the financing rule.

How do the alternative tax reforms affect the economic and welfare responses? Table 4.5 summarises the key effects of the three tax reforms. First, both the higher tax on consumption

generate an equivalent change in welfare. To allow for comparison across countries we express this transfer as a percentage of GDP.

Table 4.4   Government revenues and expenditures in France under alternative sources of financing[a]

	Transfers	Labour tax	Consumption tax
Financing instrument[b]	– 0.12	0.66	0.53
Revenues			
CIT-tax (ex ante)	– 0.41	– 0.41	– 0.41
Tax base expansion[c]	0.04	0.03	0.04
Of which gross operating surplus	0.02	– 0.03	0.00
change in debt ratio	0.08	0.08	0.08
value of depreciation allowances	– 0.08	– 0.06	– 0.07
profit shifting	0.04	0.03	0.03
CIT-tax (ex post)	– 0.37	– 0.38	– 0.37
Labour tax	0.17	0.50	0.12
Consumption tax	0.05	– 0.04	0.27
Wealth taxes	0.03	– 0.09	– 0.02
Total tax revenues	– 0.12	0.00	0.00
Total expenditures	– 0.12	0.00	0.00

[a] Change in %GDP in response to a 5%-point reduction of the CIT-rate in France.
[b] Change in transfers as %GDP (first column) or percentage-point change in tax rates (second & third column).
[c] See note [b] in Table 4.2.

and in particular on labour reverse the effect on employment. For the labour tax this is obvious as a tax on capital income is replaced by a tax on labour income, which likely boosts capital and reduces employment via a reduction in the supply of labour. The higher consumption tax also reduces the supply of labour as it induces a shift from the consumption of goods towards the consumption of leisure.

Secondly, Table 4.5 shows that the reductions in employment are mimicked by similar reductions in the capital stock and production. In other words, neither the capital-labour ratio nor labour productivity are significantly affected by the financing rule, which implies that the change in the wage rate is quite similar in the three tax reforms. Only the cost of capital, which is independent of the labour and consumption tax rates, determine the amount of capital and production per unit of labour.[17] For similar reasons, neither the change in labour productivity nor the pure profits per labour hour are affected by the financing rule. The implication of this is that neither the labour tax nor the consumption tax distort the investment and production decisions of firms.

Third, the closure rule does not affect transfer pricing nor the choice between debt and equity capital. Both depend only on the statutory CIT-rates.

[17] The slight change in the wage rate, which mimics similar differences in the responses of the capital-labour ratio and labour productivity, are due to the fixed factor, namely location specific capital, in the production function. As a result, the production function exhibits decreasing returns to the accumulable production factors.

Table 4.5   Economic and welfare effects in France of alternative tax reforms

Production side	Transfers	Labour tax	Consumption tax
GDP	0.54	0.11	0.37
Employment	0.13	– 0.32	– 0.05
domestic	0.09	– 0.37	– 0.09
subsidiaries	0.86	0.45	0.70
Capital	1.33	0.89	1.16
Inward FDI	5.75	5.33	5.58
Intermediate inputs	0.53	0.55	0.54
Pure profits (domestic)	8.23	7.76	8.05
Wage rate	0.53	0.55	0.54
Cost of capital	– 1.17	– 1.17	– 1.17
Debt ratio[a]	– 1.69	– 1.69	– 1.69
Incoming transfer price	– 7.54	– 7.54	– 7.54
Consumption side			
Consumption (young)	0.45	– 0.35	0.13
Consumption (old)	0.42	– 0.26	0.14
Savings	0.95	– 2.69	– 0.70
Welfare (% GDP)[a]	0.22	– 0.07	0.10

[a] Deviation from base path in percentage points.

Fourth, the realistic reliance on the labour or consumption tax significantly affects consumption: the consumption expansion disappears like snow in summer (with a higher consumption tax rate) or even turns into a decline (with labour-tax financing). In both cases, the labour/leisure choice is distorted, resulting in a higher demand for leisure at the expense of the demand for consumption goods.

This distortion of the labour/leisure decision reduces the welfare gain of the CIT-reduction. With labour-tax financing, the aggravated distortion in the labour supply decision dominates the alleviation of the corporate income distortions as indicated by the welfare loss of 0.07%GDP. The tax reform where the reduction in the CIT-rate is compensated by a higher consumption tax is still beneficial in France as indicated by the welfare gain of 0.10%GDP. These welfare gains imply a ranking of tax distortions in France (at the current tax rates): the consumption tax is least distortive, the labour tax is highly distortive and the CIT is in between.[18] In contrast to the labour tax does the consumption tax not only bear on the working-age population, but also makes consumption for the retired workers more expensive. Their income does not only consist of delayed labour income, but also includes profit income and transfers. These income sources cannot be influenced by workers, and taxing them is therefore non-distortive.

[18] The observation that the alternative source of financing matters is in line with Mendoza and Tesar (2005). In contrast, Copenhagen Economics (2004, p. 26) observe hardly any difference between financing with transfers or with labour tax rates in a simulation of tax-base and tax-rate harmonisation. They point at the inelasticity of labour supply to explain their results.

Therefore, the desirability of a CIT-reduction in France depends significantly on how the domestic distortions in the economy are aggravated by the alternative means of financing the government expenditures, as discussed in section 2.2.

4.1.3 Spillovers to other EU countries

Tax competition is about countries affecting each other. In section 2.3.1 we pointed at the positive spillovers, like profit shifting, where a tax reduction in one country hurts other countries. However, a tax reduction may also benefit other countries (a negative spillover) if fewer taxes are exported, see section 2.3.2. In this section we investigate how other member states benefit or lose from a tax rate reduction in France. In this section, we investigate a tax reform where both France and all other member states close their government budgets with endogenous changes in the labour-tax rate.[19] To start, Table 4.6 shows how other countries are directly affected by a tax reform in France.

Table 4.6   How France affects the rest of the EU – on average and in a selection of countries

	Rest EU	BLU	GRC	NLD	GBR	HUN
CIT-rate	0.33	0.34	0.35	0.35	0.30	0.18
Profit shifting[a]	– 0.24	– 1.43	– 0.04	– 0.46	– 0.39	– 0.04
Tax exportation[a]	0.04	0.41	0.01	0.21	0.02	0.00
FDI (in)[b]	0.04	0.09	0.08	0.06	– 0.30	– 0.47
FDI (out)[b]	0.74	0.78	0.51	0.66	0.61	– 0.15

[a] Percentage change relative to CIT-base in the EU (minus FRA) respectively BLU.
[b] Percentage change relative to inward or outward FDI in the EU (minus FRA) respectively BLU.

Consider first the negative spillover where the rest of the EU *benefits* from the reduction in tax exportation as profit income from France towards the non-French owners of location-specific capital is taxed less. Of course, countries with significant interests in the French economy, like Belgium & Luxembourg and the Netherlands, benefit most from this reduction in the tax on profit income.

Second, this effect on foreign ownership is counteracted by the positive spillover of profit shifting which declines for all EU-countries (except France of course) as France becomes a relatively more attractive country to report profits. For high-tax countries this implies an aggravation of the loss in CIT-revenues, whereas low-tax countries benefit less from their tax-rate advantage. Observe that the relative change in profit shifting varies strongly across countries. This variation is linked to the bilateral FDI of each country with France. If bilateral FDI is very small, as in the case of Greece and Hungary, very few multinationals are able to benefit from the tax differential from their home country with France. In these cases, the scope

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[19] How the budget is closed hardly matters for the points we make in this subsection. Alternative closing rules are therefore not shown in this section.

for profit shifting is limited. The reverse holds of course for profit shifting between Belgium and France, where there are many multinationals able to exploit the tax differential.

Third, for all countries the change in their outgoing FDI (towards France) exceeds the incoming FDI (from France). Outgoing FDI represents the additional investments by non-French multinationals in France, benefiting from the lower tax rate. Incoming FDI (in the other EU-countries) does hardly change on average, as the first column shows, but increases in countries with high tax rates and declines in countries with low tax rates. What causes the variation in FDI-responses between countries, where FDI is intensified between France and most other countries, but reduced between France and Hungary? To start with the latter, why do French multinationals cut their FDI in Hungary, and why do Hungarian multinationals even reduce their FDI in France? The reason is the link between FDI and transfer pricing. Transfer pricing has both a price and a volume component: not only the price per unit of intermediate input matters, but also the amount of intermediates determine the value of profits shifted between countries. As France cuts its tax rate, the reasons to shift profits towards low tax countries, like Hungary, diminishes. In the first place, this induces a dampening of the transfer prices (i.e. they come closer to the unit price). In addition, profit shifting towards Hungary is dampened by a reduction in the volume of intermediate deliveries from French multinationals to their Hungarian subsidiaries and vice versa. As intermediates and capital are complementary, the amount of FDI in Hungary diminishes too.

The same connection between FDI and intermediate inputs also explains part of the improvement in FDI between France and say the Netherlands. But the distinction between inward and outward FDI points at another element playing a role. As the tax on corporate income in France declines, investment in that country becomes more attractive, not only for French firms, but also for foreign firms with French subsidiaries. Dutch multinationals therefore respond to the French tax reduction by intensifying their foreign investments (in France).

Figure 4.1 Reduction in tax revenues in other countries have to be compensated with higher labour tax rates[a]
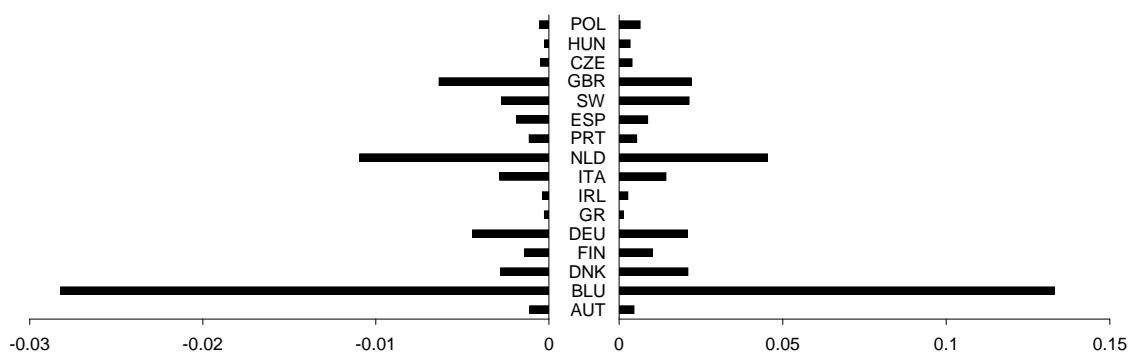

[a] Left panel shows the impact of the CIT reduction in France on the CIT revenues (in %GDP) in the other member states; right panel shows the required %-point change in the labour tax rate.

What do these spillovers imply for the European economies and for welfare? Figure 4.1 shows that the tax reform in France affects the CIT-revenues in the other member states negatively as

profits are shifted away. This reduction in revenues has to be compensated by an increase in the labour tax rate, where the figure clearly shows that a relatively large loss of tax revenues has to be compensated by a relatively large increase in the labour-tax rate. However, even for Belgium & Luxembourg, which are most severely hit by the French tax cut, a modest change in the labour tax rate of 0.13%-point suffices to recover the loss in tax revenues.

Figure 4.2 Production and welfare decline in rest of the EU[a]
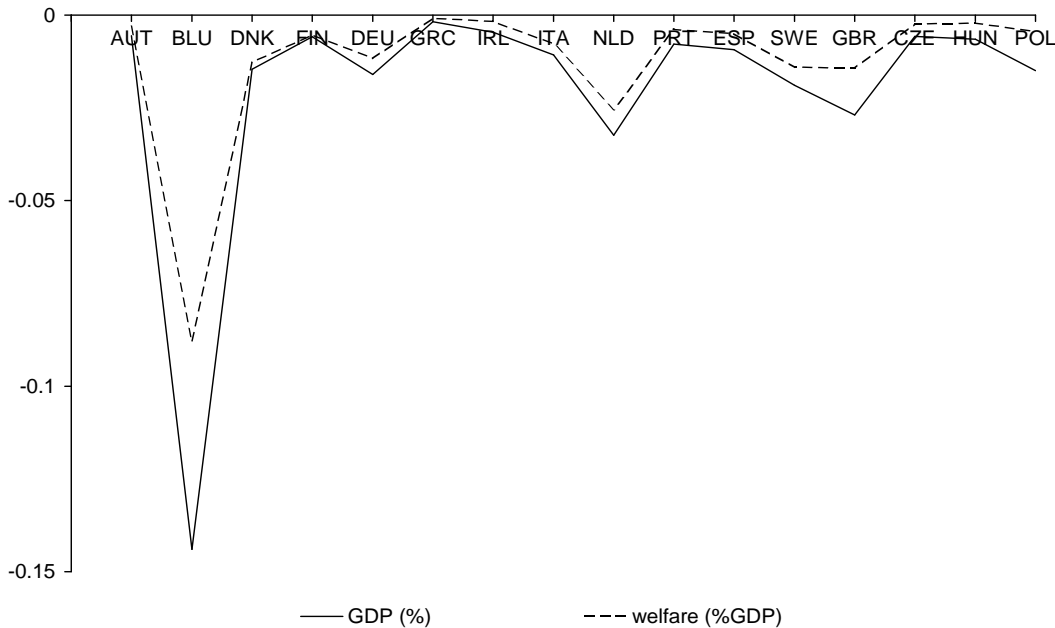
Change in GDP (%) and welfare (%GDP) in the other member states in response to the CIT reduction in France.

The higher tax on labour is in turn harmful for employment, investment and GDP, where the latter is shown in Figure 4.2. The relation between the tax change and the GDP-effect is clear: a larger tax increase induces the largest reduction in GDP, up to 0.14% in BLU.

The reduction in GDP announces a reduction in welfare, implying that a CIT-reduction in France negatively affects the other member states. Countries with many subsidiaries in France (or with many subsidiaries from French multinationals), like Belgium/Luxembourg, the Netherlands and the United Kingdom are most severely hit by the tax-reform in France. In addition, countries like Sweden with a highly distortive labour tax suffer heavily from the required increase in the labour-tax rate.

The reduction in both production and welfare shows that the impact of profit shifting towards France, which harms other member states, dominates the impact of the diminished tax export. Tax reforms in which a country unilaterally reduces its CIT-rate is therefore a beggar-thy-neighbour policy, albeit a modest one.

4.2 Unilateral reduction of the CIT-rate, country by country

We now broaden the analysis to the other countries. Do the main observations for France extend to the other member states? Consider that each country reduces its CIT-rate *unilaterally* with 5%-points, and finances this with a change in the labour tax rate, which is the single most important source of government revenues in the EU. Table 4.7 summarises the implications for the economy and for welfare in each country.

Table 4.7   Unilateral tax reforms with 5%-point CIT-reduction and labour-tax financing

Country[a]	Tax rates and revenues				Economic effects			Welfare	
	METR	METR	CIT	τ_l	K	GDP	FDI(in)	CV	CV_{EU}
	(b)	(a)	(y)	(a)	(r)	(r)	(y)	(y)	(y_{EU})
AUT	0.06	− 1.08	− 0.22	0.45	0.93	0.20	6.42	− 0.03	− 0.002
BLU	0.08	− 1.44	− 0.19	0.14	1.50	0.75	6.52	0.23	− 0.011
DNK	0.06	− 1.20	− 0.26	0.69	1.02	0.22	5.54	− 0.09	− 0.002
FIN	0.08	− 1.60	− 0.34	0.67	1.68	0.52	5.91	0.07	− 0.002
FRA	0.07	− 1.11	− 0.25	0.66	0.89	0.11	5.33	− 0.07	− 0.013
DEU	0.12	− 1.99	− 0.35	0.61	2.24	0.68	5.48	0.21	− 0.017
GRC	− 0.01	0.36	− 0.03	0.32	− 0.55	− 0.28	5.32	− 0.18	0.000
IRL	0.03	− 1.42	− 0.54	1.10	1.53	0.78	10.10	− 0.10	− 0.003
ITA	0.02	− 0.23	− 0.08	0.44	− 0.03	− 0.18	3.26	− 0.10	− 0.005
NLD	0.10	− 1.66	− 0.24	0.22	1.76	0.65	5.00	0.30	− 0.013
PRT	0.05	− 0.89	− 0.11	0.37	0.73	0.15	5.48	− 0.02	− 0.001
ESP	0.06	− 1.06	− 0.21	0.66	0.99	0.23	5.79	− 0.01	− 0.003
SWE	0.05	− 0.98	− 0.21	0.62	0.68	0.08	5.96	− 0.19	− 0.004
GBR	0.08	− 1.61	− 0.26	0.53	1.49	0.35	6.83	0.05	− 0.022
CZE	0.06	− 1.22	− 0.19	0.75	1.31	0.43	6.84	− 0.02	− 0.001
HUN	0.05	− 1.53	− 0.20	0.84	1.57	0.48	9.34	− 0.05	− 0.001
POL	0.05	− 1.48	− 0.14	0.73	1.41	0.36	9.03	− 0.04	− 0.002
Corr[b]	0.81	− 0.64	− 0.23	− 0.45	0.69	0.70	− 0.13		− 0.58

[a] METR: marginal effective tax rate (its base value (b) and its absolute change (a)); CIT: change in CIT-revenues (in %GDP of home country); τ_l: change in labour tax rate; K: relative change (r) in capital stock; GDP: relative change in gross domestic product; FDI (in): change in inward FDI; CV: change in welfare in home country, CV, and in the rest of the EU, CV_{EU}, (in %GDP of EU).
[b] Correlation of each variable with the change in welfare.

4.2.1   Common elements

Consider first the common elements in the economic responses to the unilateral tax reforms. First, CIT-revenues decline in all countries and have to be compensated with an increase in the labour-tax rate. Second, the reduction in the CIT-rate stimulates investment in nearly all countries. Very clearly, investment is depressed significantly in countries with a distortive tax on corporate income and is therefore highly stimulated by the tax relief. Third, higher investments boost production, just as a reduction in GDP is caused by a lower investment level. Fourthly,

inward investment grows in all countries, even in countries with a negative effect on total investments. Behind the scene, capital is shifted from domestic firms and multinational headquarters towards foreign-owned subsidiaries. In addition, the tax reduction induces a shift from debt-capital towards equity capital.

4.2.2 Variation between countries

Besides the similarities, the large variation between countries strikes the eye. Production is stimulated in most countries, but not in all. Some countries gain (in terms of welfare) from an unilateral tax reform, others lose. Figure 4.3 provides the key explanation for the variation in results: it is due to the variation in the distortiveness of the corporate income tax as measured by the marginal effective tax rate (METR).

Figure 4.3   The welfare change (%GDP) depends on the initial tax distortion
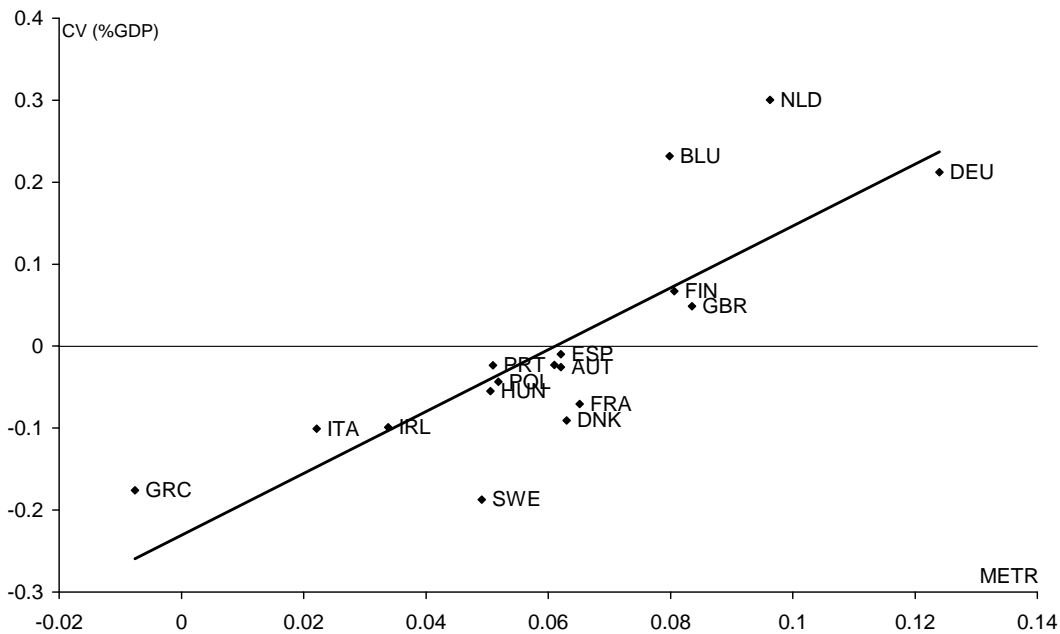
For countries with a small CIT-base, like Greece and Italy, a reduction in the tax rate hardly reduces the distortions in the investment decision, but the implied increase in the labour tax rate aggravates the labour-supply distortion. For these countries, both welfare and GDP decline. In contrast, countries with a highly distortive tax on corporate income, like Germany and the Netherlands, the partial replacement of the CIT with a tax on labour improves both production and welfare.[20]

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[20] At both extremes, GDP and welfare point in the same direction. For many countries, however, the small increase in production is insufficient to generate a welfare gain.

The comparison between countries reveals some interesting additional observations. First, Spain and Sweden face the same reduction in CIT-revenues and a similar increase in the labour-tax rate. Despite the similarity in impulses, Sweden faces a significant welfare loss, unlike Spain. The reason is the difference in distortiveness of the labour income tax, which is much higher in Sweden (with an initial average tax rate τ_l of 0.47) than in Spain (where $\tau_l = 0.28$).

Second, the effective tax rate on marginal investments (the METR) is determined by the tax rate and the tax base. Ireland and Italy have similar METRs, but the first combines a broad tax base with a low rate whereas the opposite holds for Italy. This matters significantly for the economic effects of a reduction in the tax rate: it induces a much stronger reduction in the cost of capital, but also takes much more tax revenues in Ireland. In terms of welfare both effects cancel out: the reduction in the cost of capital stimulates investment, employment and GDP, but the required strong increase in the labour-tax rate distorts the labour-supply decision and turns the welfare gain into a loss.

Thirdly, the United Kingdom and the Netherlands have similarly distortive CIT-systems (as measured by the METR in the base) and even the change in the marginal effective tax rate and the reduction of tax revenues are similar. Nevertheless, the required increase in the labour-tax rate is much larger in GBR than in NLD, implying a much larger welfare gain in the latter country. The difference in profit shifting, which is related to the share of FDI in each country, can explain this difference. Profit-shifting raises tax revenues in the Netherlands by 0.11%GDP against only 0.03%GDP in the UK. Economies hosting many multinationals (both parents and subsidiaries) have therefore stronger incentives to reduce their tax rate on corporate income.

4.2.3   Spillovers

In section 4.1.3, we have pointed at the negative consequences of a unilateral CIT-reduction in France for the other member states. The final column in Table 4.7 shows that this observation translates to other countries: very robust, but limited in size, are the negative spillovers towards other countries. The fact that these numbers are very small, however, strikes the eyes. One reason is that we measure the impact of a change in the tax-rate in *one* country for welfare in the *whole* European Union. So the foreign effects are being spread over a large number of countries. Alternatively, these small figures might also be due to the limited size of the spillovers. In order to investigate the relative size of the international linkages, we express both the domestic and the sum of the foreign welfare effects as fraction of the reduction in CIT-revenues (in the home country).

Figure 4.4 shows the domestic and foreign welfare effects (in Euro) of each Euro reduction in the CIT-rate. For France, for example, a reduction in ex-ante CIT-revenues of 1 Euro, compensated with an increase in the labour-tax rate, reduces welfare by 20 cents in both France and in the rest of the EU. In Germany, the welfare gain at home of about 40 cents goes at the expense of a 10 cents reduction in the rest of the EU. Clearly, the foreign effects are sizable, and

Figure 4.4 Spillovers are substantial, but are spread over many countries[a]
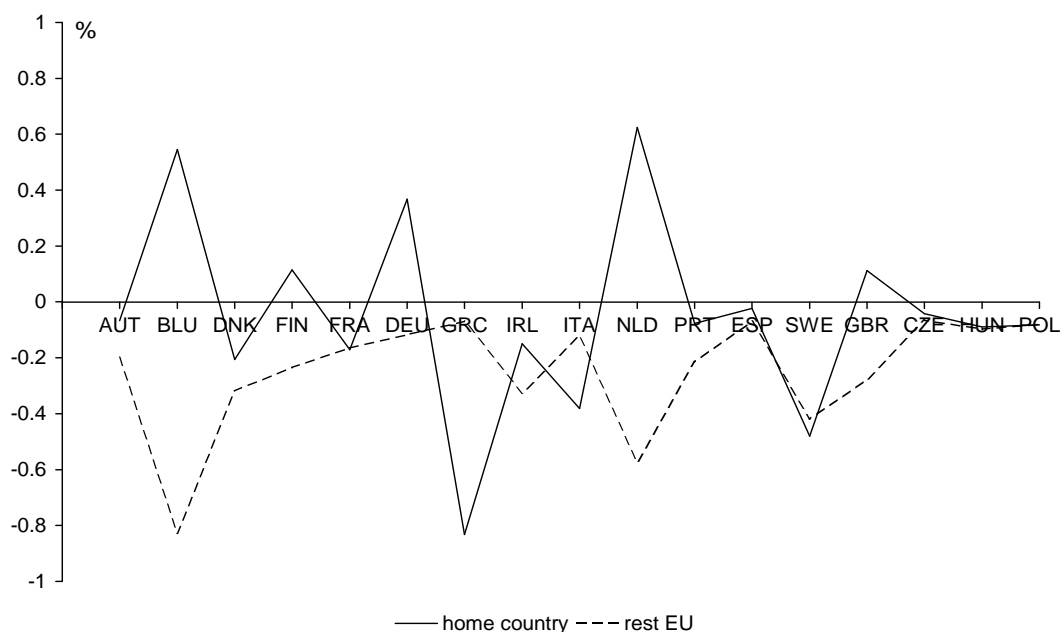
[a] Welfare change in home country and in rest of the EU of unilateral reductions in the CIT-rate, expressed as fraction of the initial (or ex ante) reduction in CIT-revenues.

in many cases comparable to the domestic effects. However, when spread over many (16) countries, the welfare effects per country are quite limited.

4.2.4   Alternative financing matters

Of course, the welfare effects are more favourable with a tax reform with indirect taxation to close the budget, let alone with transfer-financing, see Figure 4.5. When financed with the labour tax, we have seen that only 5 countries have an incentive to reduce their CIT-rate. Would, however, countries be able to raise their tax on consumption expenditures, reducing the CIT-rate is welfare improving for all but two countries. Where does this difference come from?

The key to understand the difference is the choice households make between labour and leisure. Both the labour income tax and the consumption tax affect this choice: a higher labour tax makes leisure relatively more attractive than employment, whereas a higher consumption tax induces a substitution from consumption towards leisure. However, as consumption is partly financed by income from non-labour income, the tax on consumption is less distortive that the labour tax, see section 4.1.2.

Even more attractive is, of course, the switch from corporate income taxation to transfers. The welfare gains from this – practically infeasible – reform are substantial. Compared with the ex ante reduction in CIT-revenues, the welfare gains range from 25% in Italy to 80% in the Netherlands (with the exception of Greece, facing a welfare reduction even with transfer financing).

Figure 4.5   Gains from tax reform depends on alternative sources of financing[a]
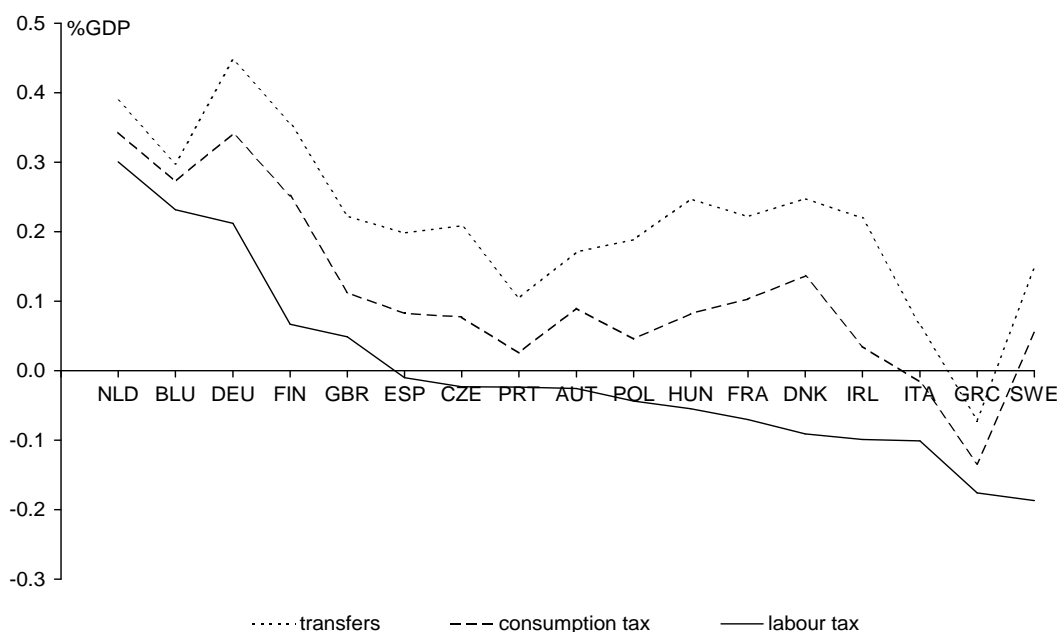
[a] Welfare change (%GDP) of unilateral reductions in the CIT-rate financed with income transfers, consumption tax or labour tax.

To sum up, a race to the bottom is unlikely with labour-tax financing, but much more likely when the consumption tax can be applied. If countries have an incentive to reduce their tax rate, does this result in a race to the bottom, i.e. to the complete abandoning of the corporate income tax? Figure 4.6 reveals that the answer is certainly: no! The figures show the actual and optimal CIT-rates. Optimal CIT-rates are calculated under the assumptions that the loss of CIT-revenues have to be financed with a change in either the labour tax rate or the tax rate on consumption *and* other countries do not respond. In all countries and for both financing rules, it is optimal to maintain the corporate income tax. To summarise, no single country has an incentive to abandon unilaterally its tax on corporate income. This conclusion holds, however, under the assumption that other countries do not respond. The next section investigates whether strategic underbidding would result in zero tax rates.

4.3   Optimal response to tax cuts in other countries

At current levels of taxation, a reduction in CIT rates is optimal for most, but not for all countries. Very likely, however, tax reductions in one country, or in a couple of countries, will not remain unanswered. Is it optimal for countries to underbid each others tax rates, thus participating in a race to the bottom?

   Ideally, we would investigate this question by considering the strategic behaviour of all countries responding to all others. The size of this problem is huge, however, as 17 asymmetric

Figure 4.6 Corporate income taxes should not be abandoned, but in some countries even increased[a]
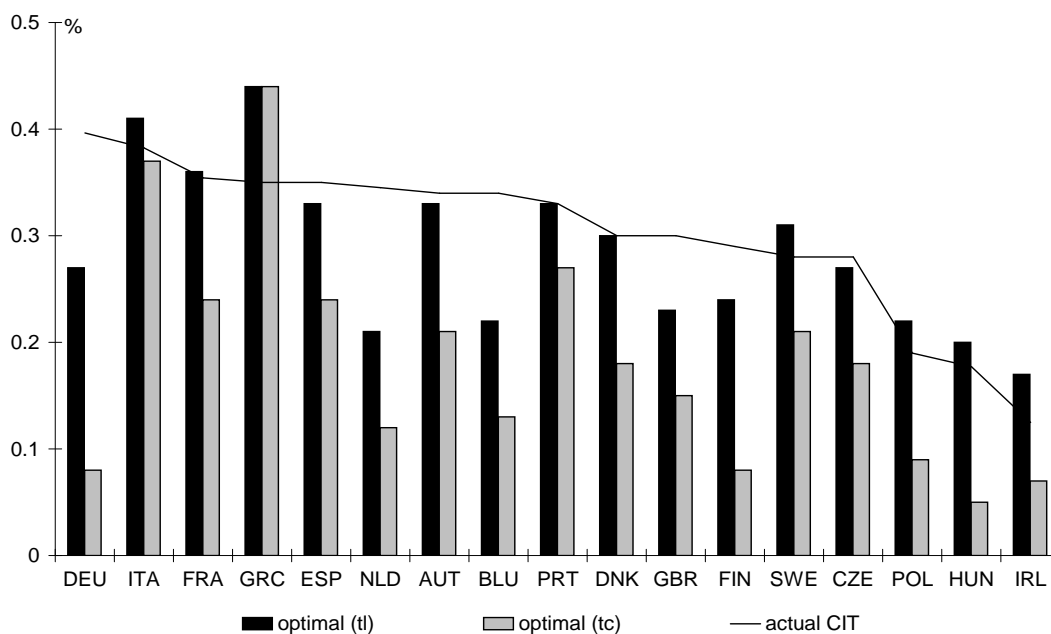
a Actual and optimal CIT-rates, with labour-tax and consumption-tax financing.

countries have to respond optimally to 16 other member states. We can still investigate the likeliness of a race to the bottom by simplifying the analysis to the optimal response of each country to tax cuts in all other countries. Suppose that all countries except one (say France) reduce their tax rates in steps of 10%, starting from the current tax rates and ending in a situation where all but France have abandoned their tax on corporate income. How should France optimally response to the tax cuts in the other member states? Table 4.8 shows the optimal response of France and for the other countries in similar experiments.[21]

The second column of Table 4.8 repeats Figure 4.6 showing the optimal tax rate of each country *if* all other countries stick to their current tax rates. The third to sixth column show how this optimal tax rate changes if other countries cut their tax rates. Very clearly, countries should be reluctant to follow other countries in cutting their tax rate. Each individual country will only reduce its tax rate with 0-3%-point if the rest of Europe reduces its CIT-rates with 10%-point. Even if all other countries abandon their tax on corporate income (see last column), it is optimal for each individual country to retain its CIT. According to our simulations, countries would set their tax rate between 14% in the Netherlands and 40% in Greece.

As before, the main reason to tax corporate income is that the alternative of taxing labour is even more distortive. Profit shifting is on the other side of the balance: harmful tax reductions by other countries can be coped with a tax cut at home. The dominance of the first implies that no single country gains from abandoning its tax on corporate income.

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[21] How would country *i* optimally set its tax rate if all other countries $j \neq i$ reduce their rate in steps of 10%-point?

Table 4.8   Optimal response to tax cuts in other countries[a]

	Current tax rate	Optimal tax rate	Optimal response if other countries cut their tax rates with:			
			10%	20%	30%	40%
AUT	0.34	0.33	− 0.01	− 0.02	− 0.04	− 0.06
BLU	0.34	0.22	0.01	− 0.01	− 0.03	− 0.05
DNK	0.30	0.30	− 0.03	− 0.04	− 0.07	− 0.08
FIN	0.29	0.24	− 0.01	− 0.03	− 0.05	− 0.06
FRA	0.35	0.36	− 0.02	− 0.04	− 0.07	− 0.08
DEU	0.40	0.27	0.00	− 0.01	− 0.03	− 0.04
GRC	0.35	0.44	− 0.01	− 0.02	− 0.04	− 0.04
IRL	0.13	0.17	0.00	− 0.01	− 0.02	− 0.02
ITA	0.38	0.40	− 0.01	− 0.02	− 0.05	− 0.06
NLD	0.35	0.21	− 0.01	− 0.04	− 0.06	− 0.07
PRT	0.33	0.33	− 0.01	− 0.03	− 0.05	− 0.06
ESP	0.35	0.33	0.00	− 0.01	− 0.02	− 0.03
SWE	0.28	0.31	− 0.02	− 0.05	− 0.08	− 0.09
GBR	0.30	0.23	0.00	− 0.02	− 0.03	− 0.05
CZE	0.28	0.27	0.00	0.00	− 0.01	− 0.01
HUN	0.18	0.20	0.00	0.00	0.00	− 0.01
POL	0.19	0.22	0.00	0.00	− 0.01	− 0.01

[a] The optimal response to the tax reductions in the other countries is given in deviation of the optimal tax rate at current levels of taxation (given in the second column).

5 Multilateral and coordinated changes in the corporate income tax rate

When a country reduces its tax rate, other countries may respond by reducing their tax rates too. In this section, we investigate the economic and welfare effects of multilateral and coordinated changes in the CIT-rate.

5.1 Multilateral reduction

Suppose that all countries simultaneously reduce their corporate income tax rate with 5%-point. For each country, we compare the economic and welfare effects of this multilateral tax reform with the unilateral reduction of the tax rate. Very likely, the potential gains from a reduction of the CIT rate, like favourable profit shifting and the inflow of foreign direct investment, will diminish. We start the comparison of the multilateral and unilateral tax reforms, summarised in Tables 5.1 respectively 4.7, with the international linkages. In both reforms, governments close their budgets by adjusting their labour tax rate.

Table 5.1 Multilateral tax reform with 5%-point CIT-reduction and labour-tax financing

| Country[a]	Tax rates and revenues				Economic effects			Welfare
	METR	METR	CIT	τ_l	K	GDP	FDI(in)	CV
	(b)	(a)	(y)	(a)	(r)	(r)	(y)	(y)
AUT	6.21	− 1.08	− 0.25	0.56	0.87	0.07	3.64	− 0.09
BLU	7.99	− 1.44	− 0.30	0.70	1.20	0.10	5.40	− 0.15
DNK	6.30	− 1.20	− 0.30	1.00	0.87	− 0.03	3.71	− 0.28
FIN	8.06	− 1.60	− 0.37	0.88	1.57	0.35	4.74	− 0.04
FRA	6.51	− 1.11	− 0.27	0.80	0.81	− 0.01	4.35	− 0.15
DEU	12.40	− 1.99	− 0.37	0.72	2.19	0.59	6.94	0.15
GRC	− 0.76	0.36	− 0.03	0.34	− 0.55	− 0.30	4.37	− 0.19
IRL	3.38	− 1.42	− 0.56	1.29	1.41	0.31	2.81	− 0.22
ITA	2.21	− 0.23	− 0.09	0.49	− 0.06	− 0.22	3.31	− 0.13
NLD	9.63	− 1.66	− 0.34	0.64	1.56	0.30	4.06	0.07
PRT	5.10	− 0.89	− 0.13	0.43	0.71	0.05	3.72	− 0.07
ESP	6.20	− 1.06	− 0.22	0.69	0.98	0.18	4.59	− 0.03
SWE	4.91	− 0.98	− 0.25	0.96	0.46	− 0.26	3.25	− 0.41
GBR	8.35	− 1.61	− 0.29	0.65	1.43	0.20	3.68	− 0.02
CZE	6.10	− 1.22	− 0.20	0.79	1.28	0.36	2.17	− 0.05
HUN	5.05	− 1.53	− 0.20	0.89	1.51	0.37	0.36	− 0.09
POL	5.18	− 1.48	− 0.14	0.76	1.38	0.29	1.20	− 0.06
Corr[b]	0.60	− 0.45	− 0.07	− 0.36	0.59	0.72	0.27	
Corr[c]		− 0.85	− 0.52	0.15	0.83	0.68	0.46	0.60

[a] See Table 4.7 for explanation of the symbols.
[b] Correlation of each variable with the change in welfare.
[c] Correlation of each variable with the METR in the base case.

Both inward and outward FDI are affected by the accompanying reduction in CIT-rates in the other member states. Each country is less able to attract FDI if other countries take part in the tax reform. On the other hand, outward FDI increases as multinationals residing in each country benefit from the tax reductions in all other countries by raising the capital stock of their subsidiaries.[22] Secondly, the fact that all countries reduce their CIT-rate simultaneously implies that the scope for profit shifting diminishes significantly: countries are no longer able to benefit from a change in the tax gap with other countries. Transfer prices are set closer to the real price since the costs associated with transfer prices are now deducted at a lower CIT rate. Stated differently, a given tax differential (of say 10%-point) induces more profit shifting between two high-tax countries than between two low-tax countries. The third international linkage, namely tax export, will in contrast be enforced by a multilateral reduction of CIT-rates as each country will benefit from the increase in the net return on location specific capital in all other EU-countries.

Figure 5.1 Countries benefit less from a multilateral tax reform; implications for tax revenues (left panel) and GDP (right panel)[a]
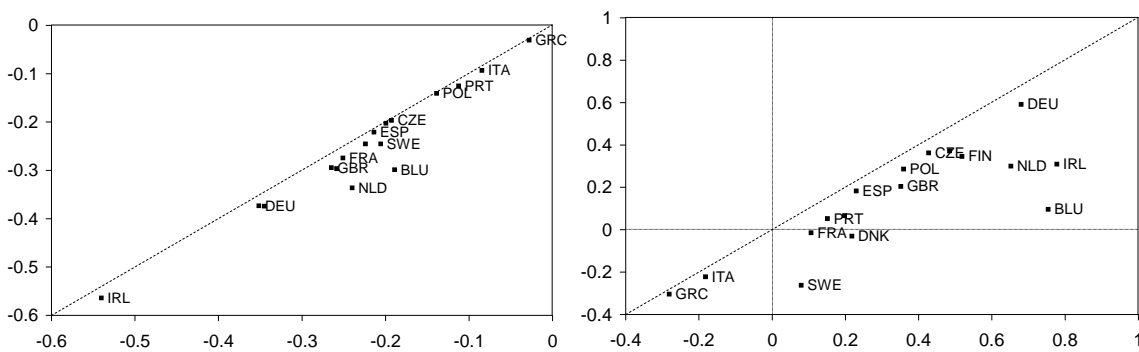
[a] All reforms consists of a 5%-point reduction in the CIT-rate financed with an endogenous change in the labour-tax rate. The unilateral changes in CIT-revenues (left panel) and GDP (right panel) correspond with Table 4.7; the multilateral changes are taken from Table 5.1.
[b] The x-axis shows the change in CIT-revenues respectively GDP under *unilateral* reductions of the CIT-rates. The y-axis shows the corresponding changes in the *multilateral* simulation.

The reduction in profit shifting and the intensification of tax exporting materialise in diminished broadening of tax bases, implying larger reductions in CIT-revenues. This is shown in the left panel of Figure 5.1, which plots changes in CIT-revenues from unilateral (on the x-axis) against multilateral reforms (on the y-axis). As all countries are situated below the 45°-line, the figure clearly show that all countries lose in terms of tax revenues if their own CIT-reduction is accompanied with similar tax reforms in other countries.

[22] Outward FDI is not included in Table 5.1, but is similar to inward FDI; on average it exactly equals inward FDI. In the unilateral simulations of Table 4.7, outward FDI is much smaller than inward FDI, as the inward FDI of a *single* country has to be met by the outward FDI of all other EU countries.

How do these spillovers determine the economic responses to a multilateral compared to unilateral reductions of CIT-rates? First, the reductions in CIT-revenues ask for an additional increase in the labour-tax rates. This induces a stronger reduction (or smaller increase) in employment, investment and GDP. The latter is shown in the right panel of Figure 5.1, where the location below the $45°$-line implies that the stimulus to GDP is weakened if other member states follow a countries' reduction in its CIT-rate. For many countries, the accompanying reduction of CIT-rates by other countries hardly matters. These are the countries with limited international linkages. The small and open economies, like Ireland, the Benelux and the Scandinavian countries, are all situated towards the bottom-right of both figures indicating a significant reduction in CIT-revenues and GDP in a multilateral tax reform (compared to unilateral reforms). These countries were able to benefit significantly from profit shifting if other countries do not respond to their tax reform – a benefit which disappears however in a multilateral setting. Second, the differences between both scenarios cannot be explained by differences in marginal investment decisions, as the changes in the METR are equivalent in both scenarios.

Figure 5.2 Most countries do not benefit from a multilateral tax reduction[a]
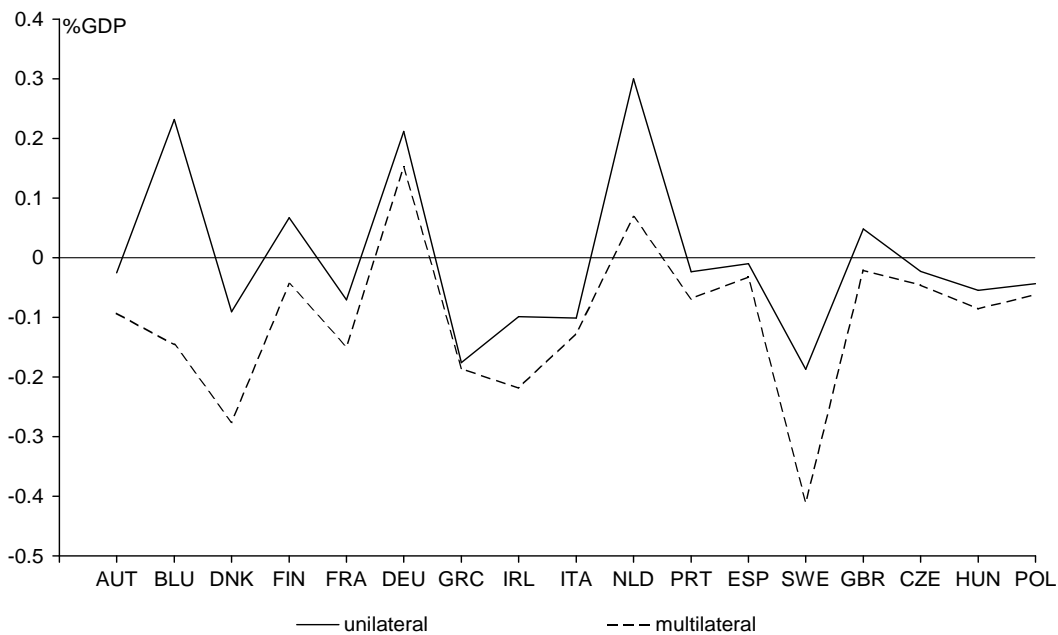
a Welfare effect (%GDP) of multilateral and unilateral reductions in the CIT-rate; government budgets are closed with changes in the labour-tax rate.

How do these effects on tax revenues and GDP translate to welfare? Figure 5.2 shows that a multilateral reduction in CIT-rates is less beneficial (or more harmful) than an unilateral tax reform. Welfare losses of all countries are aggravated and only two countries, namely Germany and the Netherlands, benefit from an EU-wide reduction of the CIT-rate. Only in these countries, the labour tax is less distortive that the corporate income tax, at current tax rates. Which

countries are most strongly hit if their policy is followed by other countries? In the first place, countries with many multinationals – as indicated by a large share of gross FDI in GDP – benefit most from an unilateral reduction. For example, the welfare gain from an unilateral reduction in Belgium/Luxembourg turns into a loss if other countries follow their policy. For the Netherlands, welfare still improves but by only a third of the unilateral welfare gain. Secondly, countries with a highly distortive labour tax, like Sweden, face a very strong reduction in welfare in a multilateral tax reform as its required change in its already high labour-tax rate rises from 0.6 to 1.0%-point.

5.2   Indirect tax export

Until now we have assumed that European member states, and even the EU as a whole, are small players on the world capital markets, such that the impact of tax policies on the world return on assets is negligible. For individual member states this assumption is quite reasonable, but a multilateral reduction in the corporate income tax might affect the rate of return on bonds and equity. How might world capital markets respond to European tax changes and how does this affect the European economies?

Table 5.2   World capital markets – in response to a multilateral reduction in CIT-rates[a]

	Bonds	Equity
Supply of capital	– 4.3	– 1.8
Demand for capital	– 3.7	6.0
Net demand	0.6	7.8
Rate of return[b]	0.6	7.7

[a] Deviation from base path in percentage points.
[b] Change in rate of return in base points.

Based on empirical evidence surveyed by European Commission (2004, p. 155), we assume that an increase in the net supply of capital goods in the EU of 1%GDP reduces the world return on bonds and equity by 1 base point. This begs the question by how much the demand and supply of capital in terms of bonds and equity change in response to a multilateral 5%-point reduction in CIT-rates. Table 5.2 shows the changes in the supply by households and the demand by firms and government (only bonds) and the corresponding changes in the rates of return on both assets.

Most remarkable is the different change in firms' debt and equity. This is due to the different treatment of debt and equity-financing by the corporate income tax. Debt costs are subtracted from the corporate tax base unlike returns on equity. A reduction in the tax rate therefore increases the cost of debt-financed capital. The CIT-reduction therefore increases the total demand for capital *and* induces a shift from bonds to equity. On the supply side, aggregate savings decline as income declines in the first period due to the higher labour tax and increases in

the retirement period due to the lower tax on the return to location specific capital. The reduction is biased towards bonds, because the largest share of wealth (about two-thirds) is held in bonds.

The capital shortage in Europe raises the interest rate on equity and bonds by 8 respectively 1 base point, reflecting the stronger imbalance in the supply- and demand effects on equity. This does not only increase net savings in the rest of the world, but raises savings and reduces investments in Europe too. This is shown in Table 5.3, which summarises the economic and welfare changes for Europe of the tax reform with fixed and endogenous rates of return.

Table 5.3 Multilateral reduction in CIT-rates, with fixed and endogenous rates of return[a]
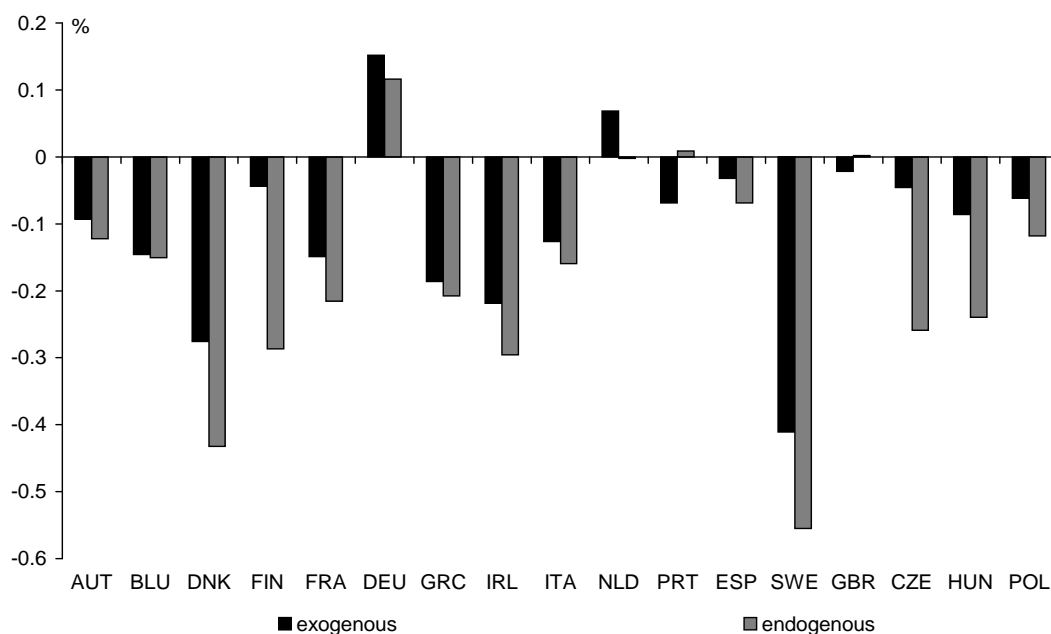
	Fixed return	Endogenous return
Labour tax rate	0.69	0.70
Cost of capital	− 1.37	− 0.90
Wage	0.60	0.40
Gross domestic product	0.17	0.01
Employment	− 0.24	− 0.26
Capital	1.12	0.64
FDI (inward)	4.34	3.13
Debt ratio[a]	− 1.66	− 1.32
Consumption (young)	− 0.25	− 0.45
Consumption (old)	− 0.18	0.07
Savings	− 1.97	− 1.77
Welfare (%GDP)	− 0.04	− 0.09

[a] Deviation from base path (which is the same in both scenarios) in percentage points.

The limited increase in the capital stock significantly affects GDP: the small increase in GDP in the simulation with fixed interest rates disappears altogether. The change in employment is, however, hardly affected by the change in interest rates. On the one hand, households substitute consumption of both goods and leisure (when young) for consumption in their old age. On the other hand, consumption in both periods and leisure are smaller due to a reduction in the after-tax wage rate. Both effects on leisure, and therefore on the supply of labour, cancel out. The higher rate of return on equity induces a shift from equity- to debt-financed capital, as shown by the smaller reduction of the debt ratio. Together with the smaller growth of real investments, this implies a strong reduction in the FDI-response.

The increase in the rate of the return is harmful for Europe as it aggravates, on average, the welfare loss of a labour-tax financed reduction in the CIT-rate. This welfare loss has two main causes. The first cause is the distortion of the domestic investment decisions. In addition, Lane and Milesi-Ferretti (2006) shows that Europe is a net debtor on the world capital markets. The interest payments on debt and equity increase, which reduces welfare. Part of the welfare gain thus leaks away to the rest of the world.

Figure 5.3 Indirect tax export aggravates the welfare loss of tax reforms[a]

a Welfare effect (%GDP) of multilateral reduction in the CIT-rate with fixed and endogenous rates of return.

Does this average story also hold for each individual member state? Looking at the welfare effects, depicted in Figure 5.3, the answer is affirmative: most countries are harmed by the increase in the rates of return. For example, the welfare gain in the Netherlands disappears, because the investment growth reduces from 1.6% to 1.0% and GDP-growth from 0.3% to 0.1%. For the East-European countries, their negative foreign asset position is crucial: the costs of lending increases, which aggravates their welfare loss. Only Portugal and the UK, with significant holdings of foreign assets, benefit from the higher rates of return.

Countries which are net debtors on the world market should be reluctant to reduce the CIT-rate, especially if this reform is implemented European-wide.

5.3   Minimum CIT-rate

One way in which member states might prevent a union-wide reduction in CIT-rates is to impose a minimum rate. For example, European Commission (2001a, p. 405) argues that "However, in order to avoid any negative effects of tax competition Member States might wish to agree on a minimum rate, or agree to remain within a specified band around an EU average as a revenue protecting measure." How would countries be affected by a floor under CIT-rates?

We limit the analysis to the direct impact of implementing a floor, such that only countries which are below the floor are enforced to raise their tax rate. We assume that countries with higher tax rates will stick to their current rates. An interesting second question, of how countries

could optimally respond to the introduction of a minimum rate, is beyond the scope of the current paper.

We consider a minimum CIT-rate of 30%, which enforces 6 of the 17 countries, namely Ireland, Finland, Sweden and the three Eastern European countries, to raise their tax rate. Beforehand, it is not evident that these countries will lose from this floor: in Figure 4.5 on the welfare effects of unilateral tax reforms, we have shown that these countries (except Finland) are worse off with a labour-tax financed *reduction* of the CIT-rate if other countries do not respond.

Figure 5.4   Welfare effect (%GDP) of 30% minimum CIT-rate
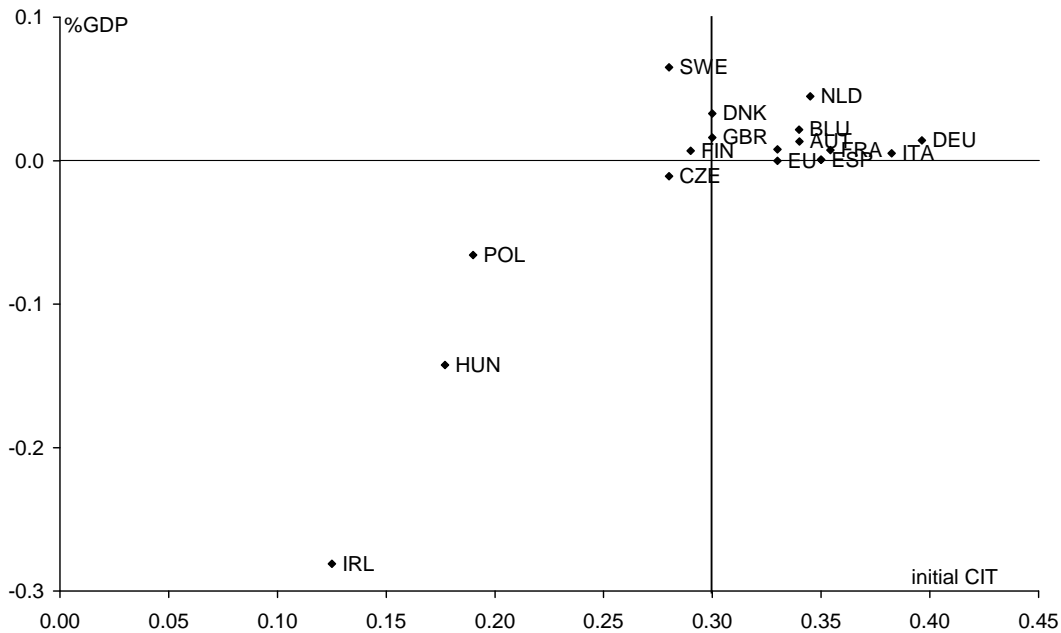
Figure 5.4 shows that this possible welfare gain will not materialise, however: Ireland, Hungary, Poland and the Czech Republic will lose welfare if they have to raise their CIT-rates with respectively 17.5, 12, 11 and 2%-points. Finland, on the other hand, slightly benefits from the minimum rate, as the gains from higher taxes in its partner countries will outweigh the loss of the limited tax increase at home (of 1%-point). Sweden enjoys the highest welfare gains arising from the reduction of the labour-tax rate. Countries which are not directly affected by the minimum rate, located to the right of the 30%-line, benefit from the reduction in profit shifting towards the low-tax countries.

For the EU as a whole, the introduction of this minimum rate is about neutral: a small increase in CIT-revenues allows for a reduction in the average labour-tax rate of 0.2%-point, which compensates the increase in the METR. GDP in the EU declines with 0.1%, but welfare hardly changes.[23]

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[23] With consumption tax financing a small welfare loss results as the additional CIT-revenues are used to reduce a less distortive tax rate.

5.4 CIT-harmonisation: all CIT-rates at EU-average

Is proposing a minimum tax rate already highly controversial, this holds a fortiori for a harmonisation of the tax rate. One reason is that countries would like to keep control over their own tax policy. But another might be that some countries fear to lose from tax rate harmonisation. In this section, we investigate the implications of tax-rate harmonisation at the current EU-average of 33%.

Figure 5.5   Welfare effect (%GDP) of harmonizing the CIT-rate at the EU average of 33%
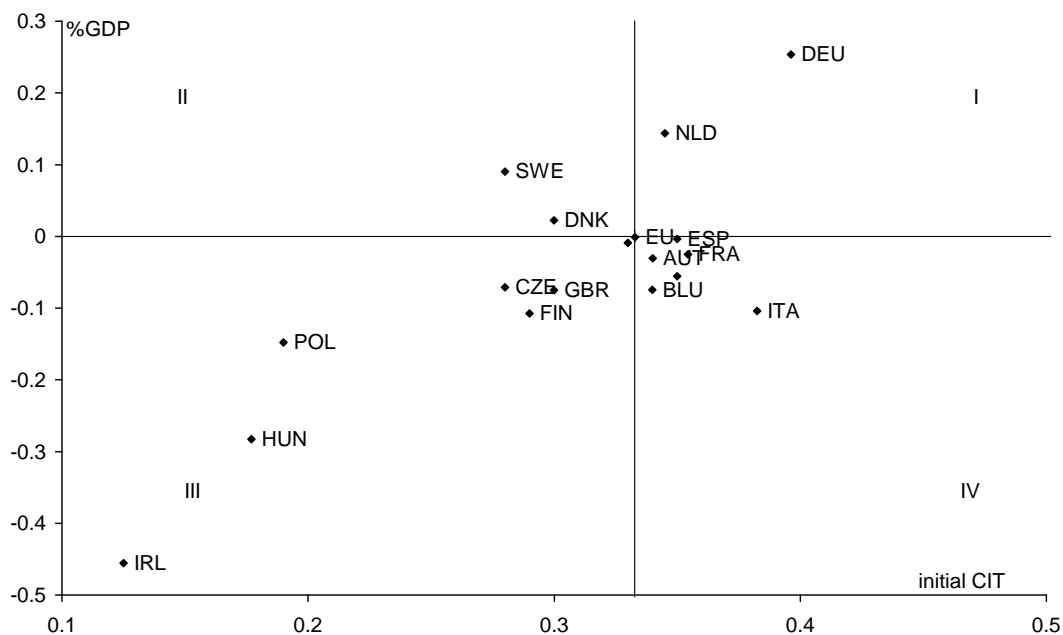
Figure 5.5 gives a very mixed picture of the welfare effects of harmonisation at the current average of 33%.[24] First, in the group of countries with above-average tax rates, there is a couple of countries (in the fourth quadrant) for which the tax-rate reduction and the accompanying increase in the labour-tax rate is harmful. For these countries the reduction in the distortion on corporate income does not outweigh the labour-tax distortion. The first quadrant contains only two countries which benefit from a CIT-rate reduction, namely Germany and the Netherlands. For both countries the corporate income tax is highly distortive, see section 3.2.3.

Within the group of countries which have to increase their tax rates under harmonisation, only Sweden and Denmark benefit: its CIT-rate is less distortive than the labour tax. This welfare gain does, however, not imply that the Swedish economy will grow: GDP declines induced by the disincentive for investment. Instead, the welfare gain stems from the reduction in the labour-tax rate leading to a diminished distortion of the choice between labour and leisure.

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[24] More details on the simulation results are presented in Table A.1 in the appendix.

For the largest group of countries, located in the third quadrant, the increase in the CIT-rate causes a reduction in their welfare. These countries will oppose harmonisation of the CIT-rate, even though it allows them to reduce the labour tax rate. The higher investment distortion and the loss of favourable profit shifting is too harmful for them.

Is tax harmonisation at the current average beneficial for the EU as a whole?[25] The point in the intersection of both lines shows that the answer in terms of welfare is clearly no! The welfare gain of winners and the welfare loss of losers cancel out. Table A.1 in the appendix shows that a similar story holds for the economic effects: the capital stock slightly expands (with 0.14%) but GDP marginally declines (with -0.02%).

Figure 5.6   Welfare effect (%GDP) of harmonizing the CIT-rate at 20%
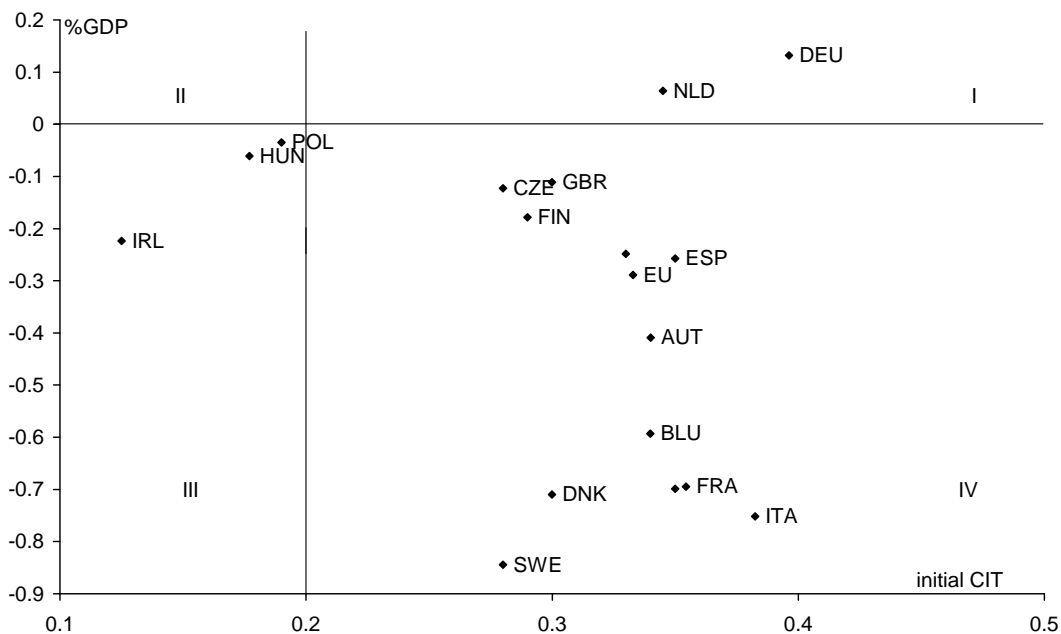
Harmonisation at the current EU-average clearly reduces welfare in many countries. Would harmonisation at a lower rate be more beneficial for individual member states and for the EU on average? Figure 5.6 shows the welfare effects of harmonising at a rate of 20%, such that only Ireland has to raise its tax rate substantially (with 7.5%-point, against 2% and 1% in Hungary and Poland). Remarkably, harmonisation at a low rate is not beneficial, not for individual member states and therefore not for the EU on average. Only Germany and the Netherlands prefer harmonisation at 20% over the current situation in which they lose tax revenues due to profit shifting.

[25] The average CIT-rate of 33% holds for 2002, the year for which we have calibrated our model. Since 2002 several countries like Austria and the Netherlands have reduced their tax rate. For these countries the change in tax rates towards the EU-average and the induced change in welfare will differ from the simulation in this section. The qualitative conclusions of this section, however, still holds. A few changes can be noted though. Austria has in 2005 a below-average tax rate; its required tax increase leads to a small welfare gain. The tax rate in the Netherlands is in 2005 at the EU average; harmonisation then hardly benefits anymore. On average, the EU still does not gain from harmonisation.

Given that harmonisation at a low rate reduces welfare, does the EU benefit from a higher uniform tax rate? Simulations with our model, where all countries choose the same rate and have to neutralise their deficits or surpluses with a change in the labour-tax rate, show that the optimal harmonised CIT-rate is 35%.[26] For the EU as a whole, this implies a tiny welfare gain of 0.01%GDP. For individual member states, however, the story that some countries lose but other gain still stand (quite similar to Figure 5.5).

To sum up, the EU has very few incentives to harmonise, as this hardly improves its economy on average, but many member states suffer. In addition, we agree with Mendoza and Tesar (2005) that if there are small costs involved in coordinating tax policy, these costs would likely eliminate the incentives for cooperation.

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[26] We ran a grid search over uniform tax rates (between 10 and 50%) and evaluate the compensating variation in all countries. The GDP-weighted sum reaches its maximum at a CIT rate of 35%.

6 Sensitivity

In the calibration of *CORTAX*, as discussed in section 3, we have made several choices. In this section, we investigate how crucial some of these choices are for the results in the previous section. To start with, we consider the degree of capital-market integration, as measured by the stocks of bilateral FDI, and question how the results change if capital markets are more integrated. In the second subsection, we explore the sensitivity of a few key results to alternative parameter settings.

6.1 Highly integrated capital markets

The integration of capital markets has accelerated since 1992, see Figure 2.1, and can be expected to grow further in the near future. Among others, this eases profit shifting between countries and facilitates the export of capital taxation to foreign owners. Does this imply that tax competition is more or less likely in highly integrated markets?

Figure 6.1 Welfare gains are larger in a highly integrated capital market[a]
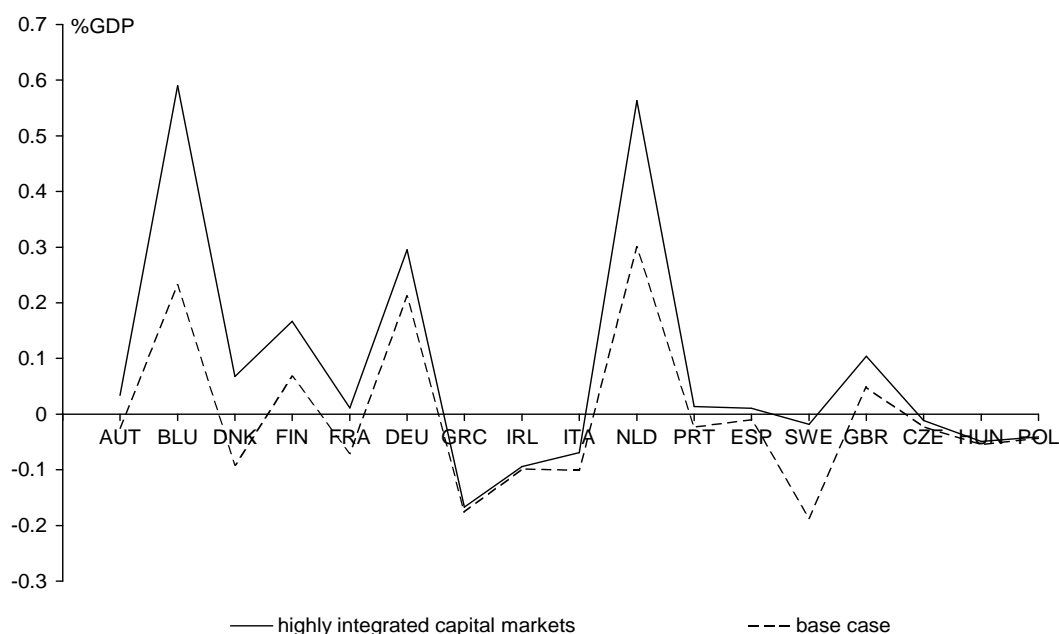
a Welfare gain (%GDP) of unilateral reductions in the CIT-rate; government budgets are closed with change in labour-tax rate.

Consider a doubling of inward and outward FDI as share of GDP, which is the key measure of capital-market integration in our model. Figure 6.1 shows the implications for welfare in unilateral tax reforms compared with the welfare changes in the base case, see section 4.2. For all countries, a highly integrated capital market improves the welfare gain (or diminishes the loss) from an unilateral reduction of the tax rate, but still many countries do not benefit from an

unilateral CIT reduction. The main reason for the additional welfare gain is that countries can more easily attract foreign profits, which broadens their CIT-base and requires a smaller increase in the labour-tax rate. For Belgium & Luxembourg and the Netherlands, countries with already intense international linkages in the base case, the CIT-reform now even allows for a *reduction* in the labour-tax rate.

For Ireland, however, the rule that a highly integrated capital market improves the welfare gain from unilateral tax reforms hardly holds. As all other countries, Ireland will be able to attract more profits than in the base case. The crux to understand the welfare loss is that Ireland has a much broader tax base to start with in highly integrated capital markets. The tax reform therefore induces a much stronger reduction in ex ante CIT-revenues, which dominates the regain of revenues through profit shifting.

Table 6.1   Unilateral tax reforms with 5%-point CIT-reduction and labour-tax financing – with highly integrated capital markets

Country[a]	Tax rates and revenues				Economic effects			Welfare	
	METR	METR	CIT	τ_l	K	GDP	FDI(in)	CV	CV_{EU}
	(b)	(a)	(y)	(a)	(r)	(r)	(y)	(y)	(y_{EU})
AUT	0.06	− 1.08	− 0.20	0.35	0.99	0.33	6.29	0.03	− 0.003
BLU	0.08	− 1.44	− 0.09	− 0.42	1.87	1.44	5.84	0.59	− 0.021
DNK	0.06	− 1.20	− 0.23	0.44	1.13	0.43	5.48	0.07	− 0.004
FIN	0.08	− 1.60	− 0.32	0.50	1.76	0.66	5.91	0.17	− 0.004
FRA	0.07	− 1.11	− 0.23	0.53	0.96	0.22	5.35	0.01	− 0.025
DEU	0.12	− 1.99	− 0.32	0.46	2.30	0.79	5.58	0.30	− 0.035
GRC	− 0.01	0.36	− 0.03	0.31	− 0.53	− 0.25	5.29	− 0.17	− 0.001
IRL	0.03	− 1.42	− 0.56	1.07	1.63	1.10	8.06	− 0.09	− 0.005
ITA	0.02	− 0.23	− 0.07	0.39	− 0.01	− 0.14	3.29	− 0.07	− 0.010
NLD	0.10	− 1.66	− 0.13	− 0.20	1.90	0.98	5.21	0.56	− 0.025
PRT	0.05	− 0.89	− 0.10	0.30	0.75	0.25	5.37	0.01	− 0.002
ESP	0.06	− 1.06	− 0.21	0.61	1.01	0.28	5.76	0.01	− 0.006
SWE	0.05	− 0.98	− 0.18	0.37	0.84	0.36	5.73	− 0.02	− 0.008
GBR	0.08	− 1.61	− 0.24	0.44	1.52	0.48	6.60	0.10	− 0.044
CZE	0.06	− 1.22	− 0.19	0.72	1.33	0.49	6.73	− 0.01	− 0.001
HUN	0.05	− 1.53	− 0.20	0.82	1.60	0.57	9.05	− 0.05	− 0.002
POL	0.05	− 1.48	− 0.14	0.72	1.44	0.42	8.81	− 0.04	− 0.003

[a] See Table 4.7 for explanation of the symbols.

Table 6.1 provides a more complete picture of the economic and welfare implications of unilateral welfare reforms in highly integrated capital markets. A comparison with the accompanying Table 4.7 reveals that the reduction in CIT-revenues and the required increase in the labour-tax rate are smaller, for all countries except Ireland. But even Ireland shows a stronger expansion of the capital stock and a higher growth of GDP. Finally, profit shifting has a downside in harming other countries more: the reduction in welfare in the rest of the EU (final column) is stronger.

In a multilateral reduction of CIT-rates, however, the degree of capital market integration hardly affects the results. A low-tax country like Ireland loses a bit (an additional welfare reduction of 0.13%GDP) as its CIT-rate reduction is applied to a broader initial tax base. A high-tax country like Germany benefits a bit more (an additional welfare gain of 0.02%GDP) for a similar reason: its initial tax base is smaller.

6.2   Sensitivity on key parameters

In section 3.2, we motivated the choices we have made for the key parameters of the model. The current section shows how alternative choices affect the simulation results. We concentrate on the unilateral tax-rate reductions, as presented in section 4.2, and compare the average economic and welfare effects. The first row in Table 6.2 shows the population-weighted average of the 17 unilateral tax-rate reductions of Table 4.7. The subsequent rows present the results of the same set of simulations under alternative parameter assumptions.[27]

Table 6.2   Unilateral tax reforms with 5%-point CIT-reduction and labour-tax financing – with alternative base paths

Country[a]	Base	New	CIT (y)	τ_l (a)	K (r)	GDP (r)	FDI(in) (r)	CV (y)	CV_{EU} (y_{EU})
Base path			− 0.23	0.57	1.20	0.30	5.85	0.02	− 0.010
Location specific capital[b]	0.03	0.05	− 0.28	1.04	0.86	− 0.03	4.89	− 0.19	− 0.011
Transfer pricing[c]	1.00	0.50	− 0.24	0.66	1.16	0.21	4.87	− 0.04	− 0.001
Capital-labour substitution[d]	0.70	0.50	− 0.23	0.59	0.80	0.18	5.46	0.01	− 0.010
Labour supply[e]	1.00	0.50	− 0.22	0.53	1.26	0.36	5.91	0.05	− 0.006

[a] See Table 4.7 for explanation of the symbols.
[b] Share of location specific capital in GDP, see Table 3.2.
[c] Elasticity of transfer pricing to tax differentials, see Table 3.2.
[d] Elasticity of substitution between labour and capital, see Table 3.2.
[e] Intratemporal elasticity of substitution, see Table 3.1.

Consider first the income share of location specific capital, which we double to 5%GDP. This broadens the CIT-base and makes it less mobile and less responsive to changes in the tax rate. The reduction of the tax rates by 5%-points, implies therefore a stronger reduction in tax revenues, which have to be financed with a larger increase of the labour-tax rate. Consequently, investment grows less and GDP even declines. In terms of welfare, the reform reduces welfare on average, but the size of the welfare loss is still limited.

Qualitatively similar effects, though quantitatively smaller, are obtained if the sensitivity of profit shifting to tax-differentials is reduced. Most distinguishing, however, is the impact for other countries: they hardly lose if profit shifting is weakened.

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[27] Country-by-country results are presented in Tables A.2 to A.5 in the appendix.

How tax changes affect the relative demand for labour and capital is determined by the substitution elasticity between them. Chirinko (2002) shows that the welfare implications of capital-tax reforms depend on the value of this elasticity. In our simulations, a limitation of the substitution possibilities reduces the responsiveness of capital to a change in the cost of capital, as is visible from the smaller growth of the capital stock. The growth of GDP is smaller too, but the average welfare change is hardly affected: the efficiency gains from a CIT-reduction are slightly smaller.

What if labour supply responds less to changes in the after-tax wage rate? Now, the key difference is on the financing side, as the required increase in the labour-income tax has a less distortive impact on labour supply. The employment reduction is smaller which explains the higher GDP-growth. The average welfare gain is also larger, as the CIT-reduction is now financed with a less distortive tax on labour.

Summarising, the sensitivity analysis confirms the key messages of the unilateral tax reforms, namely that the domestic distortion of both the CIT and the alternative source of financing crucially determine the economic and welfare effects. The international spillovers via profit shifting and tax exporting are important, but of second order. Quantitatively, the size of the effects are robust for the alternative assumptions: the welfare change is and remains small.

7   Conclusions

In an integrated Union, member states respond to each other's changes in corporate income taxation (CIT) – and for good reasons: a CIT-rate reduction in one country harms other member states, which they offset by reducing their CIT rates too.

This is not to say that all countries benefit from playing at leapfrog. Even an unilateral reduction of the tax rate is not beneficial for all countries *if* they have to finance the tax-rate reduction by a more distortive tax on labour or consumption. Moreover, taking into account that other countries will respond significantly reduces the potential gains from a CIT-reform as the inability to attract foreign profit income reduces the benefits from tax-base broadening. A reduction in the tax rate is beneficial for countries with a highly distortive CIT-tax, but not for countries with already small tax bases or low tax rates. Therefore, the latter countries will not participate in a race to the bottom.

Even countries which benefit from a tax-rate reduction will not completely abandon the tax on corporate income. At lower CIT-rates, the distortions in the alternative taxes on consumption and labour exceed the distortive effects of the corporate income tax on investment and profit shifting. We show that a further integration of European capital markets aggravates the CIT-distortions, but will still not trigger an abolishment of the CIT.

From an economic point of view, competition in tax rates is hardly worth pursuing at current levels of corporate-income taxation, and even less so at a lower level of taxation. Policies to remedy tax competition, like setting a minimum tax rate or even harmonising the CIT-rates, hardly enhance welfare in the European Union: the winners just gain enough to compensate the losers. In a subsequent paper, we investigate whether a similar conclusion holds for harmonisation of the CIT-base.

Appendix

Table A.1   Harmonisation of the CIT-rate

Country[a]	Tax rates and revenues				Economic effects			Welfare
	METR	METR	CIT	τ_l	K	GDP	FDI(in)	CV
	(b)	(a)	(y)	(a)	(r)	(r)	(y)	(y)
AUT	0.06	– 0.16	– 0.04	0.10	0.12	– 0.04	– 0.61	– 0.03
BLU	0.08	– 0.21	– 0.06	0.19	0.12	– 0.04	0.37	– 0.07
DNK	0.06	0.83	0.17	– 0.42	– 0.73	– 0.14	– 3.53	0.02
FIN	0.08	1.45	0.31	– 0.55	– 1.56	– 0.46	– 4.80	– 0.11
FRA	0.07	– 0.48	– 0.11	0.28	0.39	0.04	1.28	– 0.02
DEU	0.12	– 2.50	– 0.44	0.77	2.80	0.84	6.99	0.25
GRC	– 0.01	0.14	– 0.01	0.10	– 0.20	– 0.10	0.80	– 0.06
IRL	0.03	6.99	2.21	– 4.06	– 7.79	– 3.60	– 29.31	– 0.46
ITA	0.02	– 0.23	– 0.08	0.45	– 0.04	– 0.19	2.40	– 0.10
NLD	0.10	– 0.41	– 0.03	– 0.08	0.48	0.21	0.27	0.14
PRT	0.05	0.05	0.00	– 0.01	– 0.05	– 0.03	– 1.39	– 0.01
ESP	0.06	– 0.37	– 0.07	0.23	0.35	0.07	1.09	0.00
SWE	0.05	1.09	0.20	– 0.53	– 0.84	– 0.13	– 5.44	0.09
GBR	0.08	1.11	0.17	– 0.32	– 1.04	– 0.28	– 4.62	– 0.08
CZE	0.06	1.37	0.19	– 0.68	– 1.51	– 0.54	– 6.62	– 0.07
HUN	0.05	5.43	0.63	– 2.32	– 5.81	– 2.00	– 20.61	– 0.28
POL	0.05	4.76	0.40	– 1.99	– 4.70	– 1.31	– 18.37	– 0.15
EU	0.07	0.17	– 0.04	– 0.06	0.14	– 0.02		0.00

[a] See Table 4.7 for explanation of the symbols.

Table A.2   Unilateral reduction of CIT-rate – with larger share of location specific capital[a]

Country[b]	CIT (y)	τ_l (a)	K (r)	GDP (r)	FDI(in) (r)	CV (r)	CV_EU (y_{EU})
AUT	− 0.29	0.88	0.62	− 0.10	4.98	− 0.24	− 0.002
BLU	− 0.25	0.60	1.18	0.46	5.39	− 0.05	− 0.011
DNK	− 0.33	1.48	0.55	− 0.23	4.46	− 0.52	− 0.002
FIN	− 0.41	1.33	1.20	0.05	5.01	− 0.26	− 0.002
FRA	− 0.33	1.35	0.38	− 0.39	4.40	− 0.40	− 0.014
DEU	− 0.41	1.14	1.80	0.26	5.40	− 0.04	− 0.019
GRC	− 0.08	0.67	− 0.72	− 0.44	3.92	− 0.29	0.000
IRL	− 0.62	1.53	1.29	0.52	6.55	− 0.29	− 0.002
ITA	− 0.16	0.96	− 0.37	− 0.51	3.16	− 0.30	− 0.006
NLD	− 0.30	0.60	1.49	0.41	4.85	0.11	− 0.014
PRT	− 0.16	0.63	0.58	0.02	4.57	− 0.14	− 0.001
ESP	− 0.27	1.09	0.70	− 0.05	4.88	− 0.17	− 0.003
SWE	− 0.28	1.35	0.16	− 0.41	4.35	− 0.62	− 0.004
GBR	− 0.32	0.84	1.29	0.17	5.53	− 0.09	− 0.024
CZE	− 0.23	1.14	1.05	0.18	5.24	− 0.17	− 0.001
HUN	− 0.23	1.24	1.27	0.19	6.21	− 0.23	− 0.001
POL	− 0.16	1.04	1.19	0.14	6.12	− 0.16	− 0.002

[a] Income share of location specific capital is doubled from 0.025%GDP (in basic scenario) to 0.05%GDP. See Table 6.2 for the EU-average and explanations.

[b] See Table 4.7 for explanation of the symbols.

Table A.3   Unilateral reduction of CIT-rate – with less responsive transfer prices[a]

Country[b]	CIT (y)	τ_l (a)	K (r)	GDP (r)	FDI(in) (r)	CV (r)	CV_EU (y_{EU})
AUT	– 0.23	0.46	0.61	0.11	6.05	– 0.03	– 0.002
BLU	– 0.19	0.16	1.06	0.64	6.17	0.22	– 0.011
DNK	– 0.26	0.71	0.65	0.11	5.12	– 0.10	– 0.002
FIN	– 0.35	0.71	1.14	0.33	5.34	0.04	– 0.002
FRA	– 0.26	0.68	0.54	0.00	5.02	– 0.08	– 0.013
DEU	– 0.36	0.66	1.55	0.45	4.99	0.18	– 0.017
GRC	– 0.03	0.32	– 0.45	– 0.25	5.42	– 0.18	0.000
IRL	– 0.54	1.10	1.06	0.61	9.69	– 0.10	– 0.003
ITA	– 0.08	0.45	– 0.11	– 0.20	3.19	– 0.10	– 0.005
NLD	– 0.25	0.25	1.24	0.50	4.35	0.28	– 0.013
PRT	– 0.11	0.37	0.49	0.10	5.22	– 0.03	– 0.001
ESP	– 0.22	0.67	0.65	0.12	5.49	– 0.02	– 0.003
SWE	– 0.21	0.63	0.39	0.00	5.63	– 0.19	– 0.004
GBR	– 0.27	0.55	1.03	0.25	6.26	0.04	– 0.022
CZE	– 0.20	0.76	0.89	0.27	6.13	– 0.03	– 0.001
HUN	– 0.20	0.85	1.07	0.31	8.64	– 0.06	– 0.001
POL	– 0.14	0.74	0.97	0.23	8.43	– 0.05	– 0.002

[a] Elasticity of profit shifting to tax-differentials is reduced from 1.0 (in basic scenario) to 0.5. See Table 6.2 for the EU-average and explanations.

[b] See Table 4.7 for explanation of the symbols.

Table A.4   Unilateral reduction of CIT-rate – with less substitution between labour and capital[a]

Country[b]	CIT (y)	τ_l (a)	K (r)	GDP (r)	FDI(in) (r)	CV (r)	CV_EU (y_{EU})
AUT	– 0.23	0.46	0.61	0.11	6.05	– 0.03	– 0.002
BLU	– 0.19	0.16	1.06	0.64	6.17	0.22	– 0.011
DNK	– 0.26	0.71	0.65	0.11	5.12	– 0.10	– 0.002
FIN	– 0.35	0.71	1.14	0.33	5.34	0.04	– 0.002
FRA	– 0.26	0.68	0.54	0.00	5.02	– 0.08	– 0.013
DEU	– 0.36	0.66	1.55	0.45	4.99	0.18	– 0.017
GRC	– 0.03	0.32	– 0.45	– 0.25	5.42	– 0.18	0.000
IRL	– 0.54	1.10	1.06	0.61	9.69	– 0.10	– 0.003
ITA	– 0.08	0.45	– 0.11	– 0.20	3.19	– 0.10	– 0.005
NLD	– 0.25	0.25	1.24	0.50	4.35	0.28	– 0.013
PRT	– 0.11	0.37	0.49	0.10	5.22	– 0.03	– 0.001
ESP	– 0.22	0.67	0.65	0.12	5.49	– 0.02	– 0.003
SWE	– 0.21	0.63	0.39	0.00	5.63	– 0.19	– 0.004
GBR	– 0.27	0.55	1.03	0.25	6.26	0.04	– 0.022
CZE	– 0.20	0.76	0.89	0.27	6.13	– 0.03	– 0.001
HUN	– 0.20	0.85	1.07	0.31	8.64	– 0.06	– 0.001
POL	– 0.14	0.74	0.97	0.23	8.43	– 0.05	– 0.002

[a] Elasticity of substitution between labour and capital is reduced from 0.7 (in basic scenario) to 0.5. See Table 6.2 for the EU-average and explanations.
[b] See Table 4.7 for explanation of the symbols.

Table A.5   Unilateral reduction of CIT-rate – with less elastic labour supply[a]

Country[b]	CIT (y)	τ_l (a)	K (r)	GDP (r)	FDI(in) (r)	CV (r)	CV_EU (y_{EU})
AUT	– 0.22	0.39	1.02	0.28	6.50	0.02	– 0.001
BLU	– 0.19	0.22	1.39	0.65	6.41	0.17	– 0.007
DNK	– 0.26	0.55	1.16	0.36	5.67	0.01	– 0.001
FIN	– 0.34	0.63	1.72	0.56	5.95	0.09	– 0.001
FRA	– 0.25	0.54	1.05	0.27	5.48	0.01	– 0.008
DEU	– 0.35	0.64	2.19	0.63	5.43	0.19	– 0.011
GRC	– 0.03	0.24	– 0.39	– 0.13	5.47	– 0.12	0.000
IRL	– 0.54	1.04	1.63	0.87	10.20	– 0.06	– 0.002
ITA	– 0.08	0.34	0.13	– 0.02	3.42	– 0.03	– 0.003
NLD	– 0.24	0.31	1.64	0.54	4.89	0.24	– 0.009
PRT	– 0.11	0.34	0.78	0.20	5.53	0.00	– 0.001
ESP	– 0.21	0.61	1.08	0.32	5.87	0.02	– 0.002
SWE	– 0.20	0.41	0.90	0.29	6.17	– 0.03	– 0.002
GBR	– 0.26	0.52	1.52	0.38	6.86	0.06	– 0.013
CZE	– 0.19	0.69	1.39	0.50	6.91	0.01	0.000
HUN	– 0.20	0.77	1.67	0.58	9.44	– 0.01	0.000
POL	– 0.14	0.69	1.50	0.44	9.11	– 0.01	– 0.001

[a] Intratemporal elasticity of substitution is reduced from 1.0 (in basic scenario) to 0.5. See Table 6.2 for the EU-average and explanations.
[b] See Table 4.7 for explanation of the symbols.

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