

# Literature review of the dynamic effects of corporate income taxation

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VATT MIMEO

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## Summary

This mimeo provides a literature review of corporate income taxation. The results in the literature are then used to try to understand the most likely implications of a Finnish corporate income tax rate cut in 2014. The literature identifies a number of margins that respond to corporate income taxation and suggests that profit-shifting and investment decisions are the most important decision margins for the corporate income tax base of a country. These margins are also the most relevant internationally as they make corporate tax bases interact across countries. From a government perspective the tax base responses are of great importance, because tax revenue diverges from that suggested by a static budget calculation.

A corporate income tax cut is likely to increase the corporate tax base in the home country, but it is also likely to decrease corporate tax bases abroad. Thus a reduction in tax revenue is partially offset by a larger tax base. Part of this offsetting is, however, at the expense of other countries. The interaction between countries' tax bases encourages countries to enter into strategic considerations and to cut their corporate tax rates. Both of these have also been observed empirically.

Finland implemented a change in the corporate income tax rate from 24.5% to 20% in the beginning of 2014. According to empirical estimates shown in the literature, about 50% of the tax revenue decrease following this tax rate cut is likely to be offset by behavioral responses. We point out a few caveats regarding these results. First, the empirical estimates are only approximations of the true effects and these effects may also differ across countries. Second, changes in the corporate income tax rate may also have equilibrium effects influencing prices, wages, hours of work, consumption and so on. These may affect the tax base responses to the tax rate change. For instance, if the tax rate change also increases hours worked, then the tax base increase is larger than when this effect is ignored. The equilibrium effects are beyond the scope of this mimeo.

## Yhteenveto

Tässä muistiossa tehdään kirjallisuuskatsaus yritysverotusta koskevaan taloustieteelliseen kirjallisuuteen ja pyritään tämän valossa arvioimaan Suomen yhteisöveron laskemisen mahdollisia seurauksia. Yritysverokirjallisuus tunnistaa useita eri tapoja, joilla yritykset reagoivat yhteisöveron muutoksiin. Näistä tärkeimpiä ovat voitonsiirrot ja ulkomaiset suorat investoinnit, jotka ovat myös kansainvälisesti merkittävimmät, koska näiden välityksellä eri maiden yritysveropohjat ovat yhteydessä toisiinsa. Valtion kannalta veropohjamuutokset ovat tärkeitä, koska niiden vuoksi verotulot poikkeavat staattisen laskelman mukaisista verotuloista.

Samalla kun yhteisöveron lasku tyypillisesti kasvattaa kotimaista yhteisöveropohjaa ja rahoittaa näin itseään takaisin, se myös pienentää ulkomaisia yhteisöveropohjia. Veropohjan kasvu, joka tapahtuu osittain muiden maiden kustannuksella, kannustaa valtioita yhteisöverokannan strategiseen käyttämiseen. Tällaisesta strategisesta käyttäytymisestä, verokilpailusta maiden välillä onkin olemassa selkeää näyttöä.

Suomessa yhteisöveroaste laski vuoden 2014 alusta 24,5 prosentista 20 prosenttiin. Taloustieteellisen kirjallisuuden tarjoamien estimaattien valossa veroasteen laskemisen itserahoitusaste olisi noin 50 prosenttia. Tuloksen taustalla on syytä huomioida seuraavat asiat: Empiiriset arviot sisältävät epävarmuutta, ja lisäksi ne voivat poiketa maittain. Yhteisöveroasteen laskemisella voi myös olla tasapainovaikutuksia, joiden vuoksi esimerkiksi hinnat, palkat, työtunnit ja kulutus voivat muuttua. Näiden seurauksena yhteisöveron muutoksen vaikutukset voivat muuttaa muotoaan merkittävästi. Jos esimerkiksi yhteisöveron muutos aiheuttaa myös työtuntien lisääntymistä, kasvaa veropohja enemmän kuin silloin, kun tämä on jätetty huomiotta. Tällaiset tasapainovaikutukset on jätetty tämän muistion ulkopuolelle.

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## 1 Introduction

Taxes on corporate income are important revenue sources for many countries. Their share of tax revenue is on average around 8% in the OECD countries. In spite of this ability to generate revenue, the taxes have been accused of introducing distortions to behavior. These distortions are believed to cause substantial revenue and welfare losses. Economic research has shown that these problems are likely to be present in a closed economy (no cross-border activity), but that they are particularly complex and important in an open economy context where multinational companies have a prominent role.

The goal of this report is to review the literature concerning the effects of corporate taxes in an international environment. The report discusses the relevant tax rules and shows how they are likely to affect the behavior of both firms and countries. The focus is, nevertheless, on reviewing the results and approaches of recent empirical research in the subject area. The report was produced for the National Audit Office as a subproject of a larger research project evaluating the effects of recent changes in capital income and corporate taxation in Finland.<sup>1</sup>

The report starts (chapter 2) by characterizing the central aspects of corporate tax systems in a national and international context. It then demonstrates (chapter 3) the potential behavioral implications of tax rules using a simple model of a multinational enterprise (MNE). It highlights how taxes can affect financing decisions and decisions on where to locate investment and profits in an international environment. Chapter 4 provides a survey of the empirical evidence of these effects. Chapter 5 summarizes.

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<sup>1</sup> Contract between the National Audit Office of Finland, ETLA and VATT: Yhteisö- ja pääomaverotuksen dynaamisia vaikutuksia koskeva tutkimus, 15./21.10.2013.

## 2 Taxation of business income – central institutions

All developed countries levy corporate taxes on the net income of incorporated business firms. While some countries have introduced rules that take into account the relationships between the units of a corporate group, the prevailing practice is still that corporate tax is paid by every incorporated legal entity regardless of whether it is a subsidiary of a corporate group or an independent company. This is called the principle of separate accounting (SA).<sup>2</sup>

The tax base of corporate tax is usually net business profit, i.e. gross profit minus business expenses including debt costs. Investment expenses are deducted using schematic depreciation rules. Similarly, special rules apply to inventory accounting and loss-offsetting. Dividends from an affiliate in the same corporate group are usually tax-exempt, as may be capital gains from the sale of shares. Despite some international coordination, individual countries have wide autonomy in defining both the base and rate of corporate taxation. As a consequence, corporate tax systems differ much in detail across countries.

In an international environment where investors and companies operate across borders, many obvious questions arise. How is cross-border income taxed? Which country has the primary entitlement to tax profits? How is the potential problem of double taxation solved?

The current practice, guided by the OECD Model Tax Convention on Income and Capital and implemented in bilateral tax treaties, can be illustrated by distinguishing between two basic principles. Under the source principle, a country is permitted to tax all income that arises within its geographical borders, whether such income accrues to residents or to foreigners. The other is the residence principle, which recognizes the right to tax all income accruing to domestic residents whether from domestic or foreign sources. Hence residence-based taxation taxes the worldwide income of domestic residents.

Current international agreements grant source countries prior entitlement to tax business income from permanent establishments of firms operating within their borders. This, together with the fact that residence countries of MNEs usually exempt foreign-source corporate income (exemption method), means that the current practice, especially in Europe, is close to the source principle: profits of affiliates of MNEs are taxed primarily or only in the countries where those affiliates are located. Very few countries apply residence-based taxation, i.e. tax the worldwide profits of domestic MNEs and provide relief for double taxation by crediting foreign taxes against domestic tax on that income (credit method). In Table 1 we list the tax treatment of foreign-source dividends in 15 countries in 1991, 2005 and 2012. We observe that all countries except Ireland and the USA apply the exemption method. Within the time span several countries have switched from credit to exemption.

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<sup>2</sup> The opposite of separate accounting, unitary taxation (UT), treats corporate groups as single entities. One variant of UT is where the corporate group calculates its aggregate worldwide profit and apportions it to host countries based on an apportionment formula. Each country then levies taxes on its portion of the aggregate tax base at its own tax rate. State-level corporate taxation in the USA and Canada is based on UT and the European Commission has launched a proposal that would allow multinational firms to opt for UT for taxation of their Europe-wide profits.

As for personal income, international agreements assign the entitlement to tax to countries of residence. This applies to wages, dividends and income earned on financial and intangible assets in particular. Hence, the source principle is mostly applied to the taxation of productive activity and the residence principle to the taxation of individual-level wage and capital income.

Table 1. Treatment of foreign source dividends received by parent companies in selected countries

Country	1991	2005	2012	Change
Denmark	Exemption	Exemption	Exemption	-
Finland	Exemption	Exemption	Exemption	-
Iceland	Credit	Exemption	Exemption	X
Norway	Credit	Exemption	Exemption	X
Sweden	Exemption	Exemption	Exemption	-
France	Exemption	Exemption	Exemption	-
Germany	Exemption	Exemption	Exemption	-
Ireland	Credit	Credit	Credit	-
Italy	Credit	Exemption	Exemption	X
Poland	Credit	Credit	Exemption	X
Spain	Credit	Exemption	Exemption	X
United Kingdom	Credit	Credit	Exemption	X
Canada	Exemption	Exemption	Exemption	-
Japan	Credit	Credit	Exemption	X
United States	Credit	Credit	Credit	-

Sources: ZEW (2012): Effective Tax Levels Using the Devereux/Griffith Methodology, Final Report 2012, Project for the EU Commission TAXUD/2008/CC/009, and OECD (1991): Taxing Profits in a Global Economy, OECD, Paris.

One requirement for being able to enforce the source principle is the existence of some rules to guide the allocation of the worldwide profits of MNEs to the various countries where the MNE operates. The current practice relies on a combination of separate accounts and the so-called arm's length principle, which requires transactions between the various units of a MNE to be priced in the same way as transactions between unrelated parties. It is up to national tax laws to specify how arm's length prices are determined. Proper reference prices are often difficult to obtain, and therefore the system may leave corporations with considerable scope for profit-shifting using over- or under-invoicing of internal transactions.

While source-based taxation of corporate profits can be implemented by exempting foreign profits when repatriated to the residence country (parent company's residence), the residence principle is satisfied when the residence country credits foreign taxes against domestic tax on worldwide income. In the latter case, a large part of the total tax bill may be paid to the source country, but under pure credit the effective tax burden on foreign-source income is the same as on domestic income. Therefore residence-based taxation leads to equal taxation of business operations whether they are domestic or foreign, seen as an important advantage. However, the implementation of the principle is difficult and usually very incomplete in practice. Credit is

commonly limited to the amount of domestic tax, and worldwide income is defined to include only those foreign profits that are repatriated (credit with deferral). Therefore the equalization of tax rates on domestic and foreign operations does not necessarily occur. This implies that the system distorts location decisions of new investments and may create incentives to defer the repatriation of foreign profits.

To summarize, the current system of international taxation of MNEs has the following stylized features. The system relies on the source principle, i.e. countries where affiliates of MNEs are located have the prior right to tax their profits and repatriated foreign profits are tax exempt in the residence country of the MNE. The allocation of profits of a MNE between the various locations of its operations is based on separate accounting and the arm's length principle.

These features have important implications for incentives and efficiency. A MNE can affect its total tax bill by changing the location of its production and other activities. It has also some leeway in affecting the allocation of its profits across its units in different locations. As we will see in the following chapters, these incentives may have dramatic behavioral implications. The pure residence principle would be free from these distortions.

To avoid problems in their source-based tax systems, many countries have implemented regulations that can be interpreted as steps towards the residence principle. One such element is so-called controlled foreign corporation legislation (CFC), which allows the residence country of an MNE to tax income reported by an affiliate in a low-tax jurisdiction as if the income originated in the residence country. A typical condition is that this income can be considered as "passive income" indicating tax-planning motives. CFC rules have been implemented by most OECD countries, including Finland. Similarly, a large number of countries apply so-called thin capitalization and income-stripping rules to constrain excessive interest payments. Debt costs are normally tax-deductible, so they may serve well as a profit-shifting vehicle. While thin capitalization rules create a ceiling for the debt-to-assets ratio, income-stripping rules establish a ceiling for interest payments compared to gross operating profit.<sup>3</sup>

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<sup>3</sup> The report "Addressing Base Erosion and Profit Shifting" (BEPS) released by the OECD in February 2013 started a project which aims at reforming the existing international tax framework. Its action plan, of July 2013, contains 15 measures including a plan of model tax rules to restrict interest deductions and to strengthen the national CFC rules.

### 3 Incentive effects of corporate taxation

In this section we introduce a conceptual framework to discuss the central incentive implications of domestic and international tax rules applying to corporate taxation. Our approach is to set up a model of an MNE and derive the conditions for various decisions relating to the MNE's intensive margin. Due to the limits of the model framework, some important decisions along the extensive margin are left out, such as the location choice of a subsidiary and change of domicile of the MNE. We also touch on the welfare implications of the effects dealt with and outline some optimal policy choices from the point of view of a single jurisdiction. The model follows the approach of Fuest et al. (2005).

Consider a bi-national MNE that consists of a parent company, resident in the home country (h-country), and a subsidiary, operating in a foreign country (f-country). The parent produces at home using h-country capital  $K^h$  as the only production factor. Similarly, the subsidiary produces abroad using foreign capital  $K^f$ . Let  $Y^h = F(K^h)$  be production at home and  $Y^f = F(K^f)$  production abroad (with standard properties). Capital is mobile between the countries.

The firm finances investments with debt  $B$  and equity  $E$ . Therefore, the stock of capital is  $K^i = B^i + E^i$ ,  $i = h, f$ . The firm pays interest costs on debt at the exogenous rate  $r$ . Interest cost is deductible from the corporate tax base. The owner's rate of return requirement on equity is  $r$ . The equity of the affiliate,  $E^f$ , is provided by the parent.

The h-country collects corporate taxes at the rate  $\tau^h$  and the f-country at the rate  $\tau^f$ . Assume first that the two countries apply the exemption method to the taxation of repatriated foreign profits. Hence foreign profits are subject only to f-country corporate tax at the rate  $\tau^f$ . Assume further that the parent can transfer profits to the subsidiary by manipulating the prices of intra-company trade in goods and services. Denote the transferred amount  $C$ . However, manipulating transfer prices causes the firm costs in terms of administrative burdens, inefficiency caused by distorted price signals and fines. We assume this cost,  $a(C)$ , is non-deductible, borne by the parent, and a convex function of the amount shifted,  $C$ .

The reported profit of the parent company of the MNE net of taxes and costs of finance can now be written ( $rE^h$  illustrates the opportunity cost of equity)

$$(1) \quad P^h = F(K^h) - r(B^h + E^h) - C - a(C) - \tau^h[F(K^h) - rB^h - C]. \quad (\text{parent, h-country})$$

The net profit of the subsidiary is:

$$(2) \quad P^f = F(K^f) - rB^f + C - \tau^f[F(K^f) - rB^f + C]. \quad (\text{subsidiary, f-country})$$

The MNE's total net profit is given by  $P = P^h + P^f$ .

#### *The effects on financing decisions*

Let us start the analysis of the effects of corporate taxation from the domestic financing decision. We consider this issue by deriving the cost of capital (i.e. the required pre-tax rate of

return) for two investment projects, one financed with equity and the other with debt. To do this, use  $K^h = B^h + E^h$  and differentiate  $P^h$  in (1) with respect to  $E^h$  and  $B^h$  to get:

$$(3) \quad F'(K^h_E) = \frac{r}{1-\tau^h}, \quad F'(K^h_B) = r$$

We observe that the cost of capital for equity-financed investment is higher than the cost of debt. For equity-financed investments, taxation drives a wedge  $\omega_E$  between the interest rate  $r$  and the pre-tax return on investment. The size of this wedge is  $\omega_E = \tau^h r / (1 - \tau^h) > 0$ . For debt  $\omega_B = 0$ . This difference follows from the asymmetric tax treatment of the costs of debt and equity. Debt is deductible from the tax base while the opportunity cost of equity is not. Hence conventional corporate tax provides incentives to finance investments with debt with the result that taxation distorts the firm's capital structure. Since firms cannot rely only on debt in financing their investments,<sup>4</sup> corporate tax also distorts investment.

Many reform proposals have considered the so-called allowance for corporate equity (ACE) as a solution to the distortions discussed above (see e.g. Griffith et al, 2010). This proposal allows a firm to deduct the opportunity cost of equity ( $rE$  in our model) from the corporate tax base in the same way as it may deduct the realized costs of debt. As a result the investment condition becomes  $F'(K) = r$  both for debt and equity.

In a multinational environment an additional issue arises: in which country should the MNE issue debt? This is an important question when tax rates differ between countries. We address the issue by deriving the cost of capital for f-country investment financed by issuing debt in the h-country. We assume that funds collected in the h-country are transferred to the f-country in the form of equity. To analyze this policy, consider the effect of a marginal increase in  $K^f$  and  $B^h$  on  $P$ , while keeping the other variables constant. Assume the h-country tax rate is higher than the f-country tax rate. We get

$$F'(K^f_B) = \frac{1-\tau^h}{1-\tau^f} r < r.$$

The cost of capital is below the nominal cost of debt due to the asymmetry in the tax treatment between costs and returns. The cost reduction can be substantial if the difference in tax rates is large:

$$r - \frac{1-\tau^h}{1-\tau^f} r = \frac{\tau^h - \tau^f}{1-\tau^f} r.$$

Hence the current international tax system, where the source principle dominates and national tax rates vary greatly, creates substantial incentives to locate debt issues in high-tax countries.

#### *The effect on international investment*

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<sup>4</sup> Finance literature explains this as follows: an increase in indebtedness increases the risk of costly bankruptcies and may also lead to interest conflicts between lenders and equity owners.

Let us make the model simpler by dropping the cost of finance and assuming that the aggregate stock of capital  $S=K^h+K^f$  is fixed. Differentiating  $P = P^h + P^f$  with respect to  $K^h$  and  $K^f$  gives the profit-maximizing investment condition in the case of source-based taxation:

$$(4) \quad (1 - \tau^h)F'(K^h) = (1 - \tau^f)F'(K^f)$$

Under the source principle the MNE equates the after-tax marginal product of capital. The condition defines the allocation of capital across the two countries. This implies that the size of the h-country capital stock  $K^h$  is a function of the domestic and foreign tax rates. Consider the effects of a change in policy, where the foreign tax rate  $\tau^f$  decreases while the domestic tax rate stays constant. A cut in the foreign tax rate is followed by a flow of capital from home to abroad. This continues until equation (4) again is satisfied. In the new equilibrium  $K^h$  is lower and  $K^f$  higher than before the tax-rate change.

If we assume a pure residence principle, where foreign repatriated profits are subject to foreign tax credit at home, and, therefore, taxed effectively at the h-country tax rate  $\tau^h$ , the investment condition becomes:

$$(5) \quad (1 - \tau^h)F'(K^h) = (1 - \tau^f)F'(K^f) \Leftrightarrow F'(K^h) = F'(K^f)$$

Now the tax terms cancel out and the MNE equates the before-tax marginal products of capital. Taxation has in principle no effects on the allocation of capital between the countries. A tax rate change in the f-country has no effects on the capital stocks of the h- and f-countries. This neutrality implication also applies to the decision concerning the location of debt discussed above. The tax-motivated incentive to finance investments located in a low-tax country by issuing debt in a high-tax country vanishes despite the difference in tax rates.

These considerations suggest that the distortions to investment produced by corporate taxation in an international context have their roots in the application of the source principle. Foreign income is exempt at home and therefore foreign tax rules determine the final tax burden of foreign-source income. If tax rates are low there, investors facing the incentive exploit the benefits of the low tax rate abroad.

We can take a step further and use the model to outline some implications for optimal policy concerning the tax rate. Following Feldstein and Hartman (1979), assume that the h-country maximizes domestic income, i.e. the sum of domestic profit and repatriated foreign profit net of foreign taxes:

$$(6) \quad NI = F(K^h) + (1 - \tau^f)F(K^f)$$

Maximizing this over  $\tau^h$  gives the condition

$$(7) \quad [F'(K^h) - (1 - \tau^f)F'(K^f)] \frac{\partial K^h}{\partial \tau^h} = 0.$$

Since the partial derivative is in general non-zero, the bracketed term must be zero. By substituting  $(1 - \tau^f)F'(K^f)$  from condition (4), we obtain  $\tau^h = 0$ . Hence, under the source principle,

the h-country maximizes its national income by setting the domestic corporate tax at zero. This straightforward equilibrium result, widely discussed in literature, demonstrates the incentive effect faced by national governments when capital is mobile and tax systems are based on the source principle.<sup>5</sup>

However, the source principle is not the only factor at fault for these incentives. To illustrate this, consider source-based taxation of foreign profits combined with an ACE deduction as discussed above. Return to the model with financing costs but abstract from debt financing and profit shifting. The ACE allowance exempts marginal investment of taxation and the international investment condition becomes

$$(8) \quad F'(K^h) = F'(K^f).$$

The tax terms vanish and the MNE equates the before-tax marginal returns on investment. As a result taxation does not distort the allocation of capital between countries. A further implication is that governments face no incentive to compete over tax rates. Hence the result suggests that even under the source principle we might get rid of distortions to the allocation of capital between countries if we allow firms to deduct the opportunity cost of equity from the tax base. However, as shown by Haufler and Schjelderup (2000), this favorable result relies on the assumption that there are no opportunities for shifting profits between countries. Besides, the result plausibly breaks down if we allow extensive margin decisions such as the location choice of a whole production plant. In this case it is no longer just the taxation of marginal investment that matters. Therefore the ACE allowance, which only affects marginal investment, is not a sufficient tool to grant neutrality.<sup>6</sup>

#### *Tax-motivated profit shifting between countries*

Let us move on and consider the original model, which includes the variable  $C$ , which models the amount of profits generated in the h-country but shifted to the f-country using intra-firm transfer prices. Profit-shifting is assumed to incur costs denoted  $a(C)$ . To assess the incentive to shift profits, let us maximize  $P = P^h + P^f$  over  $C$ . We get the following condition:

$$(9) \quad \tau^h - \tau^f = a'(C)$$

The left-hand side gives the benefit in terms of saved taxes when 1 euro of domestic tax base is transferred to the f-country. The right-hand side gives the marginal cost accruing to the MNE from shifting 1 euro of profits. The condition implies that the firm shifts profits up to the point where the marginal saving per euro equals the marginal cost from shifting. If the h-country tax rate is higher than the foreign tax rate,  $C$  takes a positive value.

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<sup>5</sup> For the same result in a broader model, including two tax instruments and a public goods provision, see Fuest and Huber (2002).

<sup>6</sup> The so-called CBIT model is another tax system that is sometimes seen as a partial solution to problems of corporate taxation (Bond, 2000). Under it the deductibility of debt costs is abolished. Therefore it may improve neutrality with respect to financing forms and abolish incentives for debt-shifting. But it is no wholesale solution to other problems of source-based corporate taxes in an international environment.

The simple way to model profit-shifting used here, allowing a deduction  $C$  from one country's tax base and adding the same amount to the other country's tax base, is general and has no reference to actual practices. These practices may include e.g. manipulating transfer prices of internal trade in goods and services. They may also include intra-company financing decisions and relocating the MNE's intangible assets (patents and other property rights) to low-tax countries.

To consider the implications of profit-shifting from the point of view of national welfare, derive national income in the presence of profit-shifting:

$$(10) \quad NI^S = F(k^h) + (1 - \tau^f)F(k^f) - \tau^f C - a(C)$$

By comparing this expression to equation (6), we may conclude that profit-shifting reduces national income by cutting domestic tax revenue (term  $\tau^f C$ ) and incurring shifting costs (term  $a(C)$ ): assume they represent costs from tax-planning and reduced efficiency due to distorted price signals). This analysis is strongly simplified but suggests that measures to prevent income-shifting would improve h-country welfare. One potential source of effects neglected in the analysis is the possible effects via the domestic capital stock if returns are subject to a low foreign tax rate.

We noted previously that source-based taxation does not provide firms with incentives for capital flight nor governments with any incentive to compete over corporate tax rates, if firms may deduct the opportunity cost of equity from the corporate tax base. We referred to the finding of Haufler and Schjelderup (2000) that this neutrality result assumes no profit-shifting and breaks down if firms can transfer profits between countries. The authors further show that, in that case, the socially optimal tax rates are positive (non-zero) but lower than in the absence of profit shifting.

#### *Summary of incentive effects caused by corporation tax*

Above we have briefly demonstrated that source-based conventional corporate taxation with separate accounting produces incentives for multinational firms to invest in and to shift profits to low-tax countries. We also showed that the conventional practice of allowing debt costs to be deductible from the tax base but not allowing deduction of the opportunity cost of debt distorts financing choices. In an international environment, it leads to locating debt issues in high-tax countries even when investments are made in low tax countries.

We also outlined some aspects of the optimal policy of a single country. We demonstrated that when a country takes other countries' taxation as given, the country maximizes its national income by reducing the domestic tax rate to zero. In the literature this result is also derived in a broader framework, which includes two production factors, one mobile (capital) and one immobile (labor), and several tax instruments. The zero-tax result is explained as follows. Immobile factors bear the burden of the tax on mobile factors. It is more efficient to tax immobile factors directly using, for example, labor taxation rather than levying tax on mobile capital.

We also stated that introducing an ACE model allowing deductibility of equity costs in taxation or switching to residence-based taxation do not represent solutions for individual countries. They may help, the latter option as a coordinated move, but they do not solve the incentive problems entirely.

## 4 Review of empirical results on the effects of corporate income taxation

There is a vast literature studying the effects of corporate income taxation. This literature has considered - both theoretically and empirically - several behavioral margins that have been observed to respond to corporate income taxation. Profit-shifting and foreign direct investment (FDI) activities have been at the center of this discussion.

If corporate income taxes had no effect on tax bases, there would be no distortions and the calculation of corporate tax revenues would be a more straightforward task. Empirical literature suggests, however, that corporate income taxes do have some dynamic implications. An increase in corporate income taxation is likely to erode the tax base, yet estimates of the magnitudes of these effects exhibit some variation. This variation may reflect differences between regions or countries (US states vs European countries) or between the aggregation level of the data (aggregate vs firm-level) or between some other dimensions of the data (cross-sections vs panel data) or the effects might differ at different points in time.

*De Mooij and Ederveen (2008; DE)* study the corporate income tax (CIT) base responses to corporate income taxation. They review the empirical literature on semi-elasticities in the corporate tax base<sup>7</sup> by considering five decision margins that have been observed to respond to corporate income taxation: the organizational form (incorporated vs non-corporate businesses), the financial form (debt vs equity), profit-shifting (shifting taxes to low-tax countries), intensive margin of investment (size of investment) and extensive margin of investment (location of investment). Their analysis tries to shed light on which of these margins are quantitatively the most important for the tax base. They split the aggregate semi-elasticity ( $\varepsilon$ ) of the tax base into five different parts with the aim of decomposing the overall effect into these components:<sup>8</sup>

$$(11) \quad \varepsilon = \varepsilon^{OF} + w^N \varepsilon^{DE} + w^M \varepsilon^{PS} + w^N \varepsilon^{INV} + w^F \varepsilon^{LOC}$$

The first component in the DE decomposition,  $\varepsilon^{OF}$ , reflects the CIT base response to the change in the CIT rate caused purely by the distortion in the organizational form. The difference between the CIT and the personal income tax affects the decision of whether to incorporate the business or not. A lower CIT makes an incorporated business more attractive relative to a non-corporate business and vice versa. Therefore the expected sign of  $\varepsilon^{OF}$  is

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<sup>7</sup> Semi-elasticity measures the percentage change in the corporate tax base as a response to a one percentage point change in the tax measure. For example, when considering the organizational form, the relevant tax measure is the difference between the corporate income taxes and the personal income taxes, whereas for profit-shifting margin the relevant tax measure is the difference between tax rates of countries.

<sup>8</sup> The  $w$ 's are included in the equation because the behavioral responses take place only in part of the corporate tax base in each margin.  $w^N$  corresponds to the share of normal return on equity in the total corporate tax base, which also comprises economic rents,  $w^M$  corresponds to the share of profits made by multinationals and ,  $w^F$  corresponds to the share of assets owned by foreigners.

negative and thus this choice is assumed to erode the corporate tax base when CIT is increased.

For the empirical results regarding the choice of organizational form, DE refer to *Goolsbee (2004)* and *De Mooij and Nicodème (2008)*. Both of these studies base their results on the estimation of models where the corporate share of business is explained by a measure of the relative taxation of corporate income (relative to personal income). Goolsbee (2004) employs state-level cross-sectional US data and reports semi-elasticity of  $-0.4$ , whereas De Mooij and Nicodème (2008) employ panel data on European Union member countries and report semi-elasticity of  $-1.0$ . DE adopt the average of these two,  $-0.7$  ( $\varepsilon^{OF} = -0.7$ ), as their estimate for this semi-elasticity.<sup>9</sup> The interpretation of this estimate is that a one percentage point increase in the CIT rate shifts part of what would otherwise be corporate income to non-corporate income and therefore reduces the corporate share of business and also the CIT base by 0.7 percent.

Other studies than those that are mainly interested in corporate tax base responses have also observed the organizational form to respond to corporate taxation. *Da Rin, Di Giacomo and Sembenelli (2011)* have studied the organizational form responses to CIT. They study entrepreneurship, firm entry and corporate income taxation using European data and find that corporate income taxation has a significant negative effect on entry rates, which measure the ratio of number of firms entering the industry to the number of active incumbents in the industry. They argue that for *low levels* of taxation the biggest driving force for the effect is the distortion in the organizational form. In their most preferred specification a reduction in the corporate tax rate from 30.08% to 27.57% implies a 0.88 percentage point (i.e. 12.5%) increase in the (mean) entry rate. This relative change in the entry rate is obviously much larger than the corresponding change in the tax base.<sup>10</sup> The organizational form has been observed to be responsive to other taxes too. *Elschner (2013)* studies the effects of a special tax, a tonnage tax, on the organizational form. She finds that firms respond to the tax incentive in their organizational form structure. In particular, firms organize as pass-through firms (receiving full tax relief) when tonnage tax is available to all firms.

As the second behavioral margin DE consider the CIT-induced distortion between debt and equity financing. Debt financing is typically tax-favored relative to equity financing, because the interest on debt is deductible in many countries, whereas the return on equity is not. In section 3 we showed with our stylized model that in this case the cost of capital for equity-financed investment is higher than the cost of debt. Because of this favoritism, a higher CIT rate increases incentives for debt financing compared to equity financing and thus some of what would otherwise be equity financing may take the form of debt financing. This distortion is likely to erode the CIT base.

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<sup>9</sup> Another way to describe the tax base responses and the corresponding degrees of self-financing of the tax change would be by providing a range of estimates. Because the estimates vary a lot, we do not concentrate on the estimates of neither end of the range, but focus on providing those estimates that are considered to be the most likely ones in the literature.

<sup>10</sup> Entering firms are just a fraction of all firms, they might be smaller than firms on average and not all of these firms are profitable.

The empirical models employed in estimating the semi-elasticity  $\varepsilon^{DE}$  use tax parameters (simulated, statutory or average tax rates) to explain the debt-equity ratio (or debt-to-asset ratio). The estimates reviewed in DE vary between  $-0.25$  and  $-0.4$ . Based on these estimates DE adapt their estimate for the semi-elasticity to  $-0.3$  ( $\varepsilon^{DE} = -0.3$ ). *Huizinga, Laeven and Nicodème (2008)* employ a firm-level dataset of European multinationals and divide the overall semi-elasticity (due to the debt-equity distortion) into a domestic leverage effect and an international debt-shifting effect and report semi-elasticities of  $-0.18$  and  $-0.12$  respectively.<sup>11</sup> They suggest harmonizing top CIT rates internationally in order to eliminate international debt-shifting and argue that otherwise the international debt-shifting remains an important policy for multinationals worldwide. DE conclude that the debt-equity response matters only for normal returns on capital and not for economic rents, because only normal returns on capital are distorted by the corporate income taxes. DE assume that the share of normal returns is one half ( $w^N = 0.5$ ). Thus the tax base response due to financial distortion is  $-0.15$  ( $w^N \varepsilon^{DE} = -0.15$ ).

Some research on the financial margin has been conducted after DE. *Graham (2011)* argues that the effect of the tax rate on debt is moderate (a 10 percentage points higher tax rate leads to 0.7 percent higher debt usage) and that an increase in debt (extra debt) does not increase the probability of encountering distress, although in theory higher debt rates in firms might make them more vulnerable to downturns in the economy. *De Mooij (2011)* reviews the tax elasticity of corporate debt and reports that a one percentage point higher CIT rate increases the debt-asset ratio by between 0.17 and 0.28. He also concludes that debt bias distortions have become more important over time. *Feld, Heckemeyer and Overesch (2013)* provide a recent review of the empirical literature on the impact of CIT on debt financing. They combine 48 previous studies and find a substantial impact, with a predicted marginal tax effect on the debt ratio of about 0.27, which means that a 10 percentage point increase in the marginal tax rate (e.g. from 25% to 35%) increases the debt-to-asset ratio by 2.7 percentage points (e.g. from 0.6 to 0.627). Their study also shows that the estimated effect is typically bigger when using simulated marginal tax rates than when using statutory tax rates.

Johannesen (2014) contributes to the literature on the capital structure of MNEs by introducing a theoretical framework for hybrid instruments, which are treated as equity in one country and debt in another. He shows that firms can avoid taxes on investment by using a cross-border hybrid instrument.

Some solutions to the debt-equity tax bias have been suggested. *Devereux (2012)* suggests an allowance for corporate equity (ACE) as a solution for removing the debt-favoring feature of tax systems. *Fatica, Hemmelgarn and Nicodème (2012)* discuss the consequences of and solutions to the debt-equity tax bias. They argue that the welfare reductions may be even larger than what has been found in the literature (0.08 – 0.25 percent of GDP) and that ACE or Business Enterprise Income Tax (BEIT) or a combination of these may provide suitable

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<sup>11</sup> Therefore the financing margin is also related to the profit-shifting margin discussed later. Part of the debt-equity ratio change may also be observed in the profit-shifting margin.

solutions to this tax bias. They also conclude that these solutions have not been acted upon in very many countries.

The third component in the DE decomposition captures the CIT base erosion due to profit shifting. This activity where the profits are taken from high-tax countries to low-tax countries has been debated a lot and multiple ways for profit shifting have been observed. These include tax-favorable distortion of intra-firm transfer prices, relocation of patents or other profitable assets (licencing) and inter-company debt. The discussion of the profit shifting in the theoretical context is given in section 3.

The empirical estimation of income-shifting mostly employs the approach of *Hines and Rice (1994)*, where the logarithm of pretax profits of multinational affiliates (where pretax income is considered to be the sum of true income and shifted income) is regressed on the tax incentive parameter (tax rate differential across countries). Hines and Rice (1994) employ country-level macro data and find a semi-elasticity of  $-2.25$ , which is much larger, in absolute terms, than observed in the more recent empirical literature, which uses new and richer sources of data. For example, *Huizinga and Laeven (2008)* employ firm-level data and report the overall semi-elasticity of  $-1.31$ . In addition to firm-level estimations they also conduct aggregate-level estimations, analogous to Hines and Rice, and find a much smaller estimate. They conclude that the difference might arise because Hines and Rice include many non-European tax havens in their analysis. *Huizinga and Laeven (2008)* also report country-specific semi-elasticity estimates. For Finland this estimate is  $-0.58$ . DE refer to the review article of *De Mooij (2005)* and adopt a tax base semi-elasticity of  $-2.0$  ( $\epsilon^{PS} = -2.0$ ) due to profit-shifting. The share of profits made by multinational firms is 60 percent in Europe ( $w^M = 0.6$ ). Thus they conclude that the impact on the CIT base from profit-shifting is  $-1.2$  ( $w^M \epsilon^{PS} = -1.2$ ).

*Dharmapala (2014)* provides a more recent review of base erosion and profit-shifting (BEPS). He concludes that a representative consensus estimate for the semi-elasticity from the literature, based on a meta-regression study by *Heckemeyer and Overesch (2013)*, is  $-0.8$ . This means that a 10 percentage point increase in the tax rate differential between an affiliate and its parent would increase the pretax income reported by the affiliate by 8 percent. This estimate is much smaller, in absolute terms, than the  $-2.0$  reported in DE. *Dharmapala (2014)* also concludes that more recent literature, which uses new and richer (micro) data, reports smaller estimates than earlier literature. The reduction in the magnitude of estimates may be because firm-level micro data allows for controlling country-specific and industry-specific factors. Although the estimates using the Hines-Rice approach have decreased over time, this may just reflect that the measurement of the effect has become more precise. *Clausing (2009)*, *Grubert (2012)* and *Klassen and LaPlante (2012)* report evidence of an increase in income-shifting among multinational U.S. firms.

Profit-shifting is observed to take multiple different forms. One of these is via the choice of location of the firm. *Voget (2011)* studies relocations of headquarters in the context of international taxation. There are two clear incentives for multinationals to relocate their

headquarters across borders. First, multinationals have an incentive to avoid controlled foreign company (CFC) rules that constrain their ability to defer taxes and shift profits within the group. The empirical results support this hypothesis as they indicate that the presence of CFC legislation increases the probability of relocating headquarters.<sup>12</sup> Second, multinationals from tax credit (unlike exempt) countries have an incentive to avoid residual taxes on their foreign-source dividends. The results show that the additional tax due in the home country upon repatriation of foreign profits has a positive effect on the probability of relocation: an increase in the repatriation tax by 10 percentage points would raise the share of relocating multinationals by 2.2 percentage points.<sup>13</sup> *Barrios et al. (2012)* study international taxation and multinational firm location decisions. They show that both host and additional parent country taxation have a negative impact on the location decisions of MNEs. The marginal effect is between -0.6 and -0.9. *Dishinger, Knoll and Riedel (2013)* study the role of headquarters in multinational profit-shifting strategies in Europe. They show that profit-shifting activity from subsidiaries to parents is larger when the parent has a lower corporate tax rate than the subsidiary, compared to cases where the parent's tax rate is higher (profit-shifting towards the parent).

One of the issues discussed in profit-shifting is the possibility of a multinational enterprise (MNE) shifting profits by distorting royalty prices between operating entities and the intangibles-owner. There are two special motives why from a firm perspective licensing provides an attractive way for profit shifting: patented technologies are considered to be drivers of future profits and they simultaneously constitute a major source of transfer-pricing opportunities, because the transfer-pricing process for patent-related royalty payments is often highly intransparent and therefore the arm's length prices for these royalty payments are commonly not available to tax authorities. *Karkinsky and Riedel (2012)* study the locations of patents and show that the CIT rate exerts a negative effect on the number of patent applications by a subsidiary. Griffith, Miller and O'Connell (2014) also consider the link between corporate tax rates and patent applications, but with a more flexible model which allows tax effects to vary across locations. They find that corporate tax rates are important determinants of location choice and that the unobserved heterogeneity in behavior is important for explaining location choices.

Heckemeyer and Overesch (2013) show that the dominant profit-shifting channels used by MNEs are transfer pricing and licensing (70%), not intra-firm debt (30%). *Grubert and Altshuler (2013)* evaluate a series of proposals for the reform of the U.S. system of taxing cross-border corporate income. They emphasize the importance of parent-developed intangibles and their role in shifting income from the United States. They find that a per-country minimum tax with expensing would have many advantages with respect to the multiple margins they consider.

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<sup>12</sup> *Ruf and Weichenrieder (2012, 2013)* study the effects of CFC rules and report a semi-elasticity of 77%.

<sup>13</sup> In the data 6 percent of MNEs have relocated headquarters within the last decade.

*Fuest et al. (2013)* provide illustrative examples of some observed sophisticated IP-based profit-shifting mechanisms<sup>14</sup> and suggest policies to reduce profit-shifting. The profit-shifting mechanisms introduced employ the flaws and loopholes arising from inter-country differences in tax treatments. They conclude that unilateral measures on interest license deductions, fundamental reforms of the international tax system and country-to-country reporting should at least be elaborated before being introduced. In the short run they suggest extending withholding taxes in an internationally coordinated way. Their suggested long-run solution is a fundamental reform, like formulary apportionment or a destination-based tax.<sup>15</sup>

The two last margins considered in the DE decomposition are extensive and intensive margins of investment. MNEs may choose the location (extensive margin) of their subsidiaries and the amount (intensive margin) to be invested in a given location. The extensive margin response depends on the effective average tax rate (EATR), whereas the intensive margin response depends on the effective marginal tax rate (EMTR). A short theoretical discussion is given in section 3.

The effects are typically estimated by regressing a measure of foreign capital on a measure of the company tax burden. The impact of the corporate tax on investment can be seen as a result of two effects, the effect of corporate tax on the cost of capital and the effect of the cost of capital on investment. The effect of corporate tax on the cost of capital depends on the tax system (and is measured by EMTR)<sup>16</sup> and the effect of the cost of capital on investment depends on the behavior of investors.<sup>17</sup>

Based on the studies reviewed in DE they conclude that the semi-elasticity for the size of investment (intensive margin) is likely to be about  $-0.8$  ( $\varepsilon^{INV} = -0.8$ ). As the share of normal returns in the corporate tax base is  $0.5$  ( $w^N = 0.5$ ), they conclude that the change in the tax base is  $-0.4$  ( $w^N \varepsilon^{INV} = -0.4$ ) due to the intensive margin response. Their meta-analysis also shows that all the additional capital invested in response to a reduction in the cost of capital comes from abroad.

According to the meta-analysis in DE the semi-elasticity of the extensive margin (location) is  $-3.2$  ( $\varepsilon^{LOC} = -3.2$ ).<sup>18</sup> Using the foreign ownership of capital (of European firms) reported in

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<sup>14</sup> They call these mechanisms the "Double Irish Dutch Sandwich" and the "IP-Holding Structure". The first of these takes advantage of four different tax legislations (US, Bermuda, Ireland and Netherlands).

<sup>15</sup> A comprehensive discussion of the destination-based tax is given in Auerbach and Devereux (2011).

<sup>16</sup> Firms are assumed to accumulate capital as long as the return on investment exceeds the cost of finance and depreciation. The cost of capital is then defined as the pre-tax rate of return on the marginal investment project.

<sup>17</sup> The effect of the cost of capital is derived in literature by direct and indirect methods. According to reviews of both the direct methods (Hassett and Hubbard 2002) and the indirect methods (Chirinko 2002) the investment elasticity of the cost of capital lies between  $-1/2$  and  $-1$ . These are in line with the DE estimate for the intensive margin.

<sup>18</sup> The extensive margin result in DE is based on their meta-regression, where the semi-elasticity is explained by study characteristics. The result is based on estimations using the count data for the number of locations. They also provide corresponding numbers for financial data, but here the impact of EATR on financial data captures both extensive and intensive investment. In order to disentangle the

*Huizinga and Nicodeme (2006)* (the share of assets owned by foreigners;  $w^F = 0.2$ ), the semi-elasticity of the tax base via discrete location choices is  $-0.65$  ( $w^F \varepsilon^{LOC} = -0.65$ ).

*Feld and Heckemeyer (2011; FH)* provide a recent meta-analysis of FDI and taxation. They extend the DE analysis by including more publications, additional meta-regressors and a structural strategy to choose among meta-regression models. They report a median tax semi-elasticity of FDI of 2.49 in absolute value. The mean semi-elasticity is 3.35, which is comparable with DE, whose corresponding mean is 3.3. FH show that there is a publication bias in the published estimates.<sup>19</sup> Taking the publication bias into account reduces the estimates to between 2.28 and 1.19. DE and FH share the conclusion that discrete location decisions are more responsive than continuous investments. FH also find that the more recent studies have reported on the average larger semi-elasticities than the earlier ones. However, this observed pattern may be attributable to increased capital mobility or improved economic techniques. *Diamond, Zodrow and Carroll (2013)* argue that the sensitivity of FDI to the CIT rate has increased over time.

In summary, the DE results suggest that the biggest tax base reactions in corporate income taxes take place along the profit-shifting and international investment channels. Their results suggest that a one percentage point decrease in each tax measure will increase the CIT base by 1.2 percent due to the change in profit-shifting, by 1.05 percent due to changes in investment, by 0.7 percent due to changes in the organizational form and by 0.15 percent due to changes in financial choices.

If each tax measure decreased by one percentage point as a consequence of a one percentage point decrease in the corporate tax rate, the effects via different channels would imply in total a 3.1 percent increase in the CIT base. This result would require all tax measures to increase by one percentage point and there to be no interactions between responses. However, not all the tax measures typically change by one percentage point as a response to a one percentage point change in the corporate income tax rate and, for instance, the financing margin (debt-equity ratio) is also related to the profit-shifting margin as part of the debt-equity ratio change may also be observed in the profit shifting margin.<sup>20</sup>

Finland experienced a change in its CIT rate from 24.5% to 20% in the beginning of 2014. This change would suggest a decrease of 4.5 percentage points in a static tax revenue calculation, where the tax base is kept unchanged. Taking the tax base responses into account changes the tax revenue calculation substantially. According to DE, if all tax measures followed the change in the CIT tax of 4.5 percentage points, the tax base would increase by about 14 percent

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extensive margin response from the intensive margin response, DE use count data results. The financial data responses to EATR are larger than the count data responses.

<sup>19</sup> They also show that studies with aggregate-level data report semi-elasticities that are on average 1.8 units higher than those studies that employ firm-level data.

<sup>20</sup> The results are derived using multiple tax measures, like relative tax measures between corporate taxation and personal taxation, simulated tax rates, statutory tax rates, tax differentials between countries, effective marginal tax rates (EMTR) and effective average tax rates (EATR). For a given change in the CIT rate, not all the mentioned tax measures change by the same amount.

( $0.031 \cdot 4.5 = 0.1395$ ). The dynamic tax revenue calculation implies a tax revenue decrease of 1.7 percentage points ( $(0.245 - (0.245 - 0.045) \cdot (1 + 0.031 \cdot 4.5)) = 0.0171$ ), instead of the 4.5 percentage points suggested by the static calculation. Thus, in this case, more than 60 percent of the tax revenue decrease is offset by the behavioral responses.<sup>21</sup>

The above calculation of tax base change is relative to what would have happened to the Finnish corporate income tax base in the absence of its own tax rate change. Even in the absence of this change Finnish corporate income tax base might have changed, for instance, due to actions taken by other countries. Therefore, the tax base changes observed in forthcoming years are to be considered only partly due to CIT rate change.

A possible caveat for the above calculation is that for Finland the CIT base responses to the CIT rate might differ from those reviewed in DE. First, the organizational form response for Finland might be closer to the average response in European Union countries ( $-1.0$  in De Mooij and Nicodème, 2008) rather than in the US states.<sup>22</sup> Second, according to a recent review by Dharmapala (2014), the consensus estimate for the profit-shifting response is likely to be close to the  $-0.8$  reported in Heckemeyer and Overesch (2013), not  $-2.0$  as reported in DE. Furthermore, Huizinga and Laeven (2008) provide a point estimate of  $-0.58$  for Finland. Third, Feld and Heckemeyer (2011) report slightly smaller investment responses (between 2.28 and 1.19 after taking the publication bias into account) than DE. By using these new estimates we get the result that about 50 percent of the tax revenue decrease is offset by the behavioral responses.<sup>23</sup>

In the above we reviewed the effects of the CIT rate change on CIT base by using a decomposition of various response margins. To be valid these results would require all tax measures to increase by one percentage point and there to be no interactions between responses. In order our results not to be subject to these possible problems, we will next consider two other branches of literature studying the same issue, but which are not subject to same possible problems. The first of these branches estimates the CIT base responses straightforwardly without the decomposition and the second one employs a multiperiod macroeconomic setting. If these different ways provide the same results for the semi-elasticity and the degree of self-financing, the possible problems in the decomposition should not play a role.

Even if the literature on particular responses to corporate taxation is extensive, only a few studies have estimated the elasticity of corporate taxable income. Gruber and Rauh (2007) study this elasticity by using accounting-based data on publicly traded US firms. They find that the elasticity of the corporate tax base with respect to the corporate tax rate is  $-0.2$ . Dwenger and Steiner (2012) employ German corporate tax return data and find an elasticity of  $-0.5$  (this

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<sup>21</sup> The fraction that is offset by the behavioral responses can be calculated as  $3.1 \cdot$

(CIT rate  $- 0.045$ ). Thus the amount of offsetting depends on the original level of the CIT rate.

<sup>22</sup> DE base their estimate for this response ( $-0.7$ ) on the average of the responses in the European Union countries ( $-1.0$ ) and the US states ( $-0.4$ ).

<sup>23</sup> According to the new estimates tax base increase is slightly over 11 percent and the corresponding offsetting is  $0.2 \cdot (1.0 + 0.15 + 0.48 + 0.4 + 0.46) = 0.498$ .

equals 0.6 when considering the elasticity of the w.r.t. net-of-tax rate), which is more than twice the Gruber and Rauh (2007) estimate. They conclude that a reduction in the corporate tax rate is roughly one-half self-financing. This is in line with our self-financing calculations above. Devereux, Liu and Loretz (2014) employ UK tax records to study the elasticity of the taxable income w.r.t. net-of-tax rate. They find that for owner-managed companies the elasticity is between 0.53 and 0.56 and for widely held companies between 0.13 and 0.17. They estimate the corresponding marginal deadweight costs to be 29% and 6% respectively.

In addition to the tax base responses studied in DE, the growth effects of corporate income taxes have also been studied. *Arnold et al. (2011)* conduct research which aims to compare the effect of different types of taxation on the recovery from the crisis and on economic growth. They conclude that corporate income taxes are the most harmful for economic growth. This might be because corporate income taxes affect investment (as seen above), which is one of the key drivers of economic growth.

Although the above discussion has concentrated on the dynamic effects of corporate taxation in a single period, a few studies have employed multi-periodic settings to study the effects of CIT. *Romer and Romer (2010)* study the impact of tax changes on economic activity. They use narrative records to identify those legislated changes that are not likely to be related to economic conditions. By using these changes they find substantial effects, much larger than in earlier studies. They find that a 1 percent increase in the tax rate decreases GDP by 3 percent. *Mertens and Ravn (2013)* study the dynamic effects of personal and corporate taxes by using the narrative records suggested by Romer and Romer (2010). Consistent with DE, they find that an immediate impact of a 1 percentage point cut in the average corporate tax rate on the corporate tax base is about 3 percent. Despite this response they find that corporate taxes have little impact on U.S. corporate tax revenue. A one percentage point cut in the average corporate income tax rate (ACITR) raises real GDP per capita on impact by 0.4 percent and by 0.6 percent after one year. This may illustrate loopholes in the corporate tax system or arrangements for taxable incomes as part of tax planning by firms.

Both single-period and multi-period studies are shown to provide evidence of CIT base responses to the CIT rate. From these responses, which take place along multiple different channels, the profit-shifting and investment channels are observed to be the most important for the tax base. Importantly, these responses affect not only the country's own tax base but also other countries' tax bases.

The interaction between tax bases across countries provides an incentive for governments to choose their CIT rates strategically. A CIT rate cut by a single country is likely to increase its own tax base, but decreases the tax bases of other countries. Because of this interactive feature, an individual country is likely to take into account the CIT rate considerations of other countries when considering its own CIT rate. This interactive behavior is also observed in the literature. *Devereux and Loretz (2013)* provide evidence of strategic behavior between governments in choosing their corporate income tax rates.

If all countries cut their CIT rates, these would tend to zero.<sup>24</sup> However, there are also some arguments for why corporate income taxation should not be taken to zero. One argument against a zero CIT rate is its role as a backstop for personal income tax. Otherwise much of otherwise non-corporate activity would be channeled via corporations. The other argument against taking CIT rates to zero, is that tax competition is shown to be harmful and tax coordination useful (Feld and Heckemeyer (2011) and *Fuest, Huber and Mintz (2005)*). Huizinga and Laeven (2008) estimate the costs of profit-shifting to be 0.6 percent of the tax base. Fatica, Hemmelgarn and Nicodème (2012) conclude that the debt-equity financing bias may cause welfare reductions, which may be more than 0.25 percent of GDP.

Our discussion has concentrated purely on CIT base changes, leaving out all other tax base changes. For instance, changing the organizational form from entrepreneurship to an incorporated business is likely to increase the CIT base, while at the same time reducing the personal income tax base. Thus some of the distortion margins may also affect other tax bases within the country. If the CIT base change is compensated (partially) by an opposite change in some other tax base, the predicted change in government tax revenue is likely to be smaller than what the pure CIT base calculation would suggest. However, those channels observed to react the most, profit-shifting and FDI, are not likely to produce a compensating effect in other national tax bases.

To our knowledge, there is no research about how much of the CIT base changes are compensated in other tax bases. These compensating effects would be an interesting avenue for future research.

In addition to changes in the corporate tax base, the changes in the corporate income tax rate may also induce equilibrium effects in the economy. These may be accounted for in macroeconomic models that include changes in other aspects as well, like changes in prices, wages, working hours, consumption and so on. In this study we concentrate only on corporate tax base responses and leave all other such effects aside.

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<sup>24</sup> There is also a general discussion on capital taxation. The focus of this discussion is not specifically related to corporate taxation, but on more general issues. Some known theoretical results support a tax system where the capital income is not taxed at all. *Banks and Diamond (2010)* provide a comprehensive discussion on the reasoning underlying these results of no capital income taxation. *Mankiw, Weinzierl and Yagan (2009)* employ the theoretical arguments and conclude that taxation of capital income ought to be avoided. Based on these arguments they also provide guidelines for a practical level of capital taxation. In contrast, *Diamond and Saez (2011)* provide a recommendation, which supports positive taxation of capital income. They find that those studies which imply no capital income taxation, and which Mankiw, Weinzierl and Yagan (2009) rely on, are not robust enough to be policy-relevant. Some more detailed models suggest that rents should be taxed, yet the income below normal return should not be taxed.

## 5 Summary and conclusions

We have provided a literature review of corporate income taxation. This rapidly expanding literature is covered in our review up until early 2014. The literature includes micro-level studies on number of margins that are observed to respond to corporate income taxation as well as both micro-level and macro-level studies on the overall corporate tax base responses. From a government perspective these tax base responses are of great importance, because they deflect tax revenue from that suggested by a static budget calculation.

Of the multiple decision margins that have been observed to respond to corporate income taxation, profit-shifting and investment decisions are the most important for the corporate income tax base of a country. These margins are also internationally the most relevant ones, because they make the corporate tax bases interact across countries. A corporate income tax cut is likely to increase the corporate tax base in the home country, yet is likely to decrease corporate tax bases abroad. Thus a reduction in the tax revenue is partially offset by a larger tax base. One part of this offsetting is, however, at the expense of other countries, the other part is at the expense of country's own other tax bases. The interaction between countries' tax bases encourages countries into strategic considerations and possibly to cut their corporate tax rates. Both of these have also been observed empirically.

Finland implemented a change in the corporate income tax rate from 24.5% to 20% in the beginning of 2014. According to empirical estimates shown in the literature, about 50% of the tax revenue decrease following this tax rate cut is likely to be offset by behavioral responses. This tax base change is relative to what would have happened to Finnish corporate income tax base in the absence of the tax rate change. As a caveat, we point out that the empirical estimates are only approximations of the true effects and these may also differ across countries. Some new results are also now available and not all of them were available when the decision of the Finnish corporate income tax rate cut was made.

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