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Can formula apportionment really prevent multinational enterprises from profit shifting? – the role of asset valuation, intragroup debt, and leases

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Abstract The European Commission has been supporting a transition from a system of separate accounting to a system of formula apportionment. In 2011, it presented a proposal for a council directive on a Common Consolidated Corporate Tax Base (CCCTB). Formula apportionment is often considered more resistant to profit shifting and assumed to reduce compliance costs. We use a dynamic model of tax accounting based on neoclassical investment theory and effective tax rates to determine whether, and to what extent, formula apportionment mitigates the efficiency of typical profit-shifting measures. We focus on the roles of transfer pricing and intragroup debt financing (through loans and leases) under both separate accounting and formula apportionment. Our results show that instead of eliminating tax planning strategies, the proposed system will simply induce a shift from manipulating reported profits to influencing the apportionment key. Inside the European Union, the CCCTB may be able to render thin capitalisation rules and transfer pricing documentation redundant. However, formula apportionment invites new forms of tax planning involving manipulating the book value of assets rather than profit shifting.

Keywords Effective Tax Rate · CCCTB · Formula Apportionment · Tax Planning · Profit Shifting · Debt Financing · Leasing

JEL Classification H20 · F21, 23 · D21

1 Introduction

Affiliated companies of a multinational enterprise (MNE) are currently taxed based on separate taxation (ST). Several areas of dispute have arisen from this taxation method: To reduce their tax burden, MNEs try to shift revenue to lower tax countries by using transfer pricing (TP)[1] or debt financing[2] to account for as much revenue (expenses) as possible in the lower (higher) tax state. To prevent dwindling tax revenues, fiscal authorities require transfer prices to be set at arm's length or limit interest deduction through thin capitalisation rules. Further problems arising from ST are the administrative burden and high compliance costs of the taxation method, the general lack of cross-border loss offset, the potential for double taxation and qualification conflicts, and the generation of seemingly 'unfair' tax competition.[3] To cope with or at least mitigate these issues, the European Commission (EC) submitted a proposal to reform corporate taxation within the EU by implementing a Common Consolidated Corporate Tax Base (CCCTB)[4]. The CCCTB implies a switch towards a system of unitary taxation (UT) for corporate groups in the EU.[5] Instead of TP, UT uses formula apportionment to allocate shares of a consolidated tax base (CTB) to Member States in which the group is active.

Technically, the proposed CCCTB works in four steps: First, a qualifying MNE decides whether to 'opt in'.[6] Afterwards, the tax results are computed per entity but with a common set of tax accounting rules. In a third step, the single group member results are consolidated[7] for the entire group, eliminating intragroup transactions. Finally, the consolidated result is shared among Member States by applying a formula. Hence, harmonisation of corporate tax rates across Europe is assumed to be unnecessary. By contrast, the CCCTB is regarded as a basis for fair and transparent competition with respect to tax rates.[8]

[1] In this case, transfer prices differ from prices set according to the 'arm's length principle'.
[2] See, e.g., Egger and Eggert et al. (2010), who empirically examine the influence of taxes on debt financing in
[2] See, e.g., Egger and Eggert et al. (2010), who empirically examine the influence of taxes on debt financing in
MNEs, pp. 97, 104. See also Mintz and Smart (2004).
[3] EC (2011), p. 4.
[4] EC (2011).
[5] UT is already implemented in the US and Canada. See, e.g., Weiner (1999), Stetter and Spengel (2006), and Mintz and Smart (2004).
[6] This optional approach is criticised since it might allow for further tax planning strategies. See, e.g., Mintz (2004), p. 231; Oestreicher and Koch (2011). Consequently, European Parliament has voted for the CCCTB to be compulsory. See European Parliament (2012).
[7] For an examination of tax planning via strategic (non)consolidation, see Buettner, Riedel and Runkel (2011).
[8] EC (2011), p. 4.

The UT system is considered to be more efficient, particularly in terms of compliance costs[9], and more robust against tax planning activities by MNEs.[10] On the one hand, the EC assumes that the system will offer companies previously using TP 'fewer opportunities for tax planning' and generate fewer mismatches in Member States' tax systems. Consequently, the EC expects that the UT system will 'improv[e] the tax neutrality conditions between domestic and cross-border activities to better exploit the potential of the Internal Market'[11]. On the other hand, the EC is aware of future developments in business tax planning. Anticipating changes in tax accounting practices, the EC aims to implement several safeguard clauses and anti-abuse rules in the final directive. These clauses and rules are intended to apply if the apportionment formula 'doesn't fairly represent the extent of business activity'[12] in a Member State.

Quite in contrast to the EC's view that the proposed system will offer more neutrality and less opportunities for tax planning, we expect a simple shift in tax planning strategies to occur from the calculation of the tax base to the determination of the apportionment factors. Therefore, we examine whether 'traditional' tax planning tools for profit shifting (TP, intragroup debt, and leases) are still effective in a UT system. For this purpose, we use effective tax rates (ETRs) in a multiperiod neoclassical setting to quantify the profit shifting potential and reduction in tax burdens. In contrast to those of quasi-empirical impact studies[13] using historical data, our approach allows us to explicitly model behavioural responses in MNEs' tax accounting policy. In this vein, our paper contributes to the discussion on the possible definition of an apportionment formula in a CCCTB. We do not examine how a system change would affect tax planning activities beyond periodic income recognition, e.g., changes in the organisational structure of MNEs that may imply a re-allocation of assets, staff, or productive units, as well as a redesign of contractual relations apart from loans and leases.

The structure of the paper is as follows: Section 2 briefly discusses the definition of the apportionment formula in light of previous research. Section 3 introduces the applied ETR

[9] See, e.g., Devereux (2004), p. 83, EC (2006), p. 3, Mintz (2004), p. 221.
[10] See, e.g., Riedel and Runkel (2007), who show that a UT system with a water's edge may lead to less profit shifting to tax havens compared to an ST system. According to Mintz and Weiner (2003), p. 698, shifting profits is more difficult under formula apportionment. Hines (2010), p. 117, mentions 'the undeniable appeal of reducing certain opportunities of tax-motivated international income reallocation' even though he is very sceptical towards UT.
[11] EC (2011), p. 5.
[12] EC (2011), p. 6.
[13] See Fuest, Hemmelgarn and Ramb (2007), Devereux and Loretz (2008), and Oestreicher and Koch (2011).

concept and derives ETRs for the discussed scenarios. Section 4 analyses and discusses the results on the basis of a numeric analysis. Section 5 concludes.

2 The importance of the apportionment formula under UT

The apportionment formula, its factors, and their weightings are highly disputed in the literature.[14] On the one hand, the formula should reflect the nexus to a jurisdiction and should correctly determine the local economic activity[15] of an MNE's entity. On the other hand, the formula should provide evidence against manipulation by MNEs and should not lead to excessive tax competition by governments.[16] A formula that is based on macroeconomic criteria and that is not firm specific is the least prone to manipulation. However, there is broad consensus that such a formula would not be politically viable in the EU.[17]

The EC proposes a firm-specific apportionment formula equally relying on sales (by destination), labour (equally consisting of payroll and number of employees), and assets.[18] However, each factor has its own advantages and drawbacks,[19] and apportionment based on these three factors effectively 'creates three separate taxes, each with complicated incentive effects'.[20] The share of the CTB apportioned to a specific Member State is essentially proportionate to relative factor use with respect to the total (EU-wide) factor use of the group.[21]

If sales (on a destination basis) are chosen as a key factor, tax revenue will be shifted from states where goods are produced to states where goods are sold. Hence, the distribution of the corporate tax would be similar to the allocation of VAT among EU Member States. Such an expansion of the destination principle would affect countries with large trade surpluses, such as Germany. Thus, there is potential for dispute, given that tax decisions in the EU must be reached unanimously. Using the (origin-based) value added instead of sales would avoid such

[14] Based on quasi-empirical estimations, Hines (2010) strongly criticises the explanatory power of the proposed apportionment formula. Anand and Sansing (2000) show that single jurisdictions have incentives to deviate from a harmonised formula to increase their welfare. See also Oestreicher and Koch (2011), pp. 83 ff, for a discussion.
[15] See Nielsen, Raimondos-Møller and Schjelderup (2010), p. 122.
[16] See, e.g., Pethig and Wagener (2007) and Anand and Sansing (2000) for the tax competition implications of different allocation factors.
[17] See, e.g., Sørensen (2004), p. 96, and Wellisch (2004), p. 37, who also note that such a formula would have far-reaching consequences for the nature of tax competition in the EU.
[18] This approach is similar to the 'Massachusetts formula' applied in most US federal states for UT; see, e.g., Anand and Sansing (2000). In Canada, however, only sales and payroll are used in the formula, see, e.g., Mintz (2004), p. 223, Mintz and Smart (2004), p. 1150, and Stetter and Spengel (2006).
[19] For a detailed discussion of the components of the apportionment formula as well as their 'architecture', see, e.g., EC (2007).
[20] Gordon and Wilson (1986), p. 1357; McLure (1980).
[21] The EC plans to implement a harmonised formula. For welfare effects caused by a deviation thereof, see Anand and Sansing (2000).

a shift in tax revenues but would again lead to a problem of TP, as transfer prices are needed to calculate the value added in each entity of an MNE.[22] In addition, the tax burden may be passed onto customers.[23]

By contrast, using payroll as a key factor entails taxing labour, which may be problematic for countries facing high labour costs.[24] However, payroll may be considered an adequate approximation for intangible assets, such as patents and software, or, more generally, for (original) goodwill, as these items should not be included in the factor property/assets because of their evaluation risks.[25] If the difference in labour costs among European countries is large, using payroll as a key factor implies that tax revenue is apportioned to states with a high payroll level. Paradoxically, states with a low payroll level would only receive a small part of the tax base even though their low payroll level may have contributed to high profits. MNEs located in member states with high labour costs and high taxes may find it even more attractive under UT than under ST to relocate production plants to lower-tax Member States.[26] This effect has also been shown for the two-part labour factor (including payroll and headcount) in the EC proposal.[27]

Finally, the choice of assets as an apportionment factor leads to allocation and valuation problems. Allocation problems emerge particularly for rented or leased assets. Additionally, firms may try to invest in land and other nondepreciable assets in a lower tax country to increase the part of the CTB that is apportioned to this Member State.[28] Further, they may increase their leverage only in higher-tax countries if debt is allocated to single group members directly. The EC proposal suggests to simply apply assets' average annual residual book value (RBV). We argue that this method will offer a primary lever for tax planning activities. In the recognition of taxable group income, some room for discretion will inevitably exist, which will be used by MNEs to manipulate key factor 'asset values' to minimise taxation. Furthermore, Member States use elements of income determination, e.g., accelerated depreciation, as a tax incentive for different political reasons. We think that a substantial number of national tax allowances and incentives are highly likely to survive the harmonisation of the tax base. The EC unintentionally confirms our view by noting that the

[22] See Hellerstein and McLure (2004), p. 214, Lodin and Gammie (2001), p. 49 and Sørensen (2004), p. 97. Remember that UT is intended to abolish problems and costs arising from TP documentation.
[23] See Wellisch (2004), p. 36.
[24] See Sørensen (2004), pp. 95 f.
[25] See Weiner (2005), p. 53.
[26] See Weiner (1999), p. 13-15.
[27] See Eberhartinger and Petutschnig (2014).
[28] See Bettendorf et al (2009), p. 8, Mintz and Weiner (2003), p. 700.

weighting should 'be carried out at political level', as weighting is 'not a technical issue'[29]. Because tax decisions are subject to the unanimity requirement, concessions to Member States in terms of allowed alternative treatments are a realistic assumption.

Focusing on assets as an allocation factor[30] allows us to directly compare the power of tax planning instruments that target the location and valuation of assets under ST and UT.[31]

3 The model

3.1 Effective tax rates

ETRs are a generally accepted tool for measuring the extent to which investments are influenced by taxation.[32] Studies on corporate taxation in the Single Market published by the EC[33] adopt this approach. ETRs differ from statutory tax rates (STRs) because the latter only reflect the share of the tax base that the revenue office claims. Because the tax base (determined by tax accounting) regularly differs from *economic* objective variables (e.g., cash flow), STRs fail to mirror the exact part of economic success that is 'lost' to taxation. ETRs circumvent this problem by using pre- and post-tax economic objective variables instead of legal tax bases; thus, ETRs indicate whether the tax code provokes discriminatory or preferential taxation.[34] ETRs are calculated by referring to an economic objective value (OV), such as the net present value (NPV) of an investment before and after taxes.[35] In its simplest version, the ETR τ^{eff} reads

$$\tau^{eff} = \frac{OV - OV_{\tau}}{OV} \quad . \tag{1}$$

OV_t is the objective value after taxes. Hence, the numerator represents the share of economic success that is lost through tax payments and that thus cannot be reinvested or consumed (tax wedge). ETRs can generally only be used for decision making if critical nontax assumptions for all investment alternatives are identical.[36] Rather, decisions should be based on NPV (or its transformations, namely, rate of return or future value). Because the calculation of ETRs relies on NPVs, one may assume that ETRs are redundant, after all. However, their merit is

[29] EC (2007), p. 2.
[30] For a similar approach, see, e.g., Mintz and Smart (2004).
[31] Other allocation factors may also be vulnerable to manipulation, as empirical studies have shown. See, e.g., Klassen and Shackelford (1998), pp. 400, 404, for empirical evidence of sales apportionment factor management under UT. See also Riedel (2010), pp. 238, 250, 257 f, for evidence of payroll formula distortion.
[32] ETRs were first introduced by King and Fullerton (1984).
[33] See European Commission (2001 and 2003).
[34] See Schreiber, Spengel and Lammersen (2002), p. 3.
[35] Alternatively, the return or the future value might be used as objective values.
[36] Knirsch (2002), p. 17.

their simple comparability with STRs: ETRs reflect both the interaction of STRs with their corresponding tax bases and the time aspect in one figure.[37] In practice, ETRs are often used for (re)location decisions in different states.[38]

Extending the models of King and Fullerton (*KF*) (1984) and Devereux and Griffith (*DG*) (2003), Ruf (2002) designs an ETR concept for a multiperiod setting for both marginal and inframarginal investments.[39] His approach overcomes the problems of marginality (the restrictive assumption in the *KF* setting) and the limited time horizon (the restrictive assumption in the *DG* setting). If economic depreciation is identical to tax depreciation, both the *KF* effective *marginal* tax rate and the *DG* effective *average* tax rate will correspond to the STR. Accordingly, the STR can be regarded as a yardstick for tax distortions.[40] According to Ruf, ETRs may be considered indifference tax rates, showing at which level STRs must be set under neutral taxation to make an investor forego (accept) a tax (dis-)advantage in the legal tax base or timing of tax payments. This indifference tax rate measures distortions of the legal tax base by relating it to a neutrally taxed alternative investment with its corresponding tax burden and thus by calculating the relevant modifications of the STR. If the STR were set at this modified level, the investor would be indifferent between paying this hypothetical STR=ETR (applied to a tax base calculated with economic depreciation) and paying the actual STR times the actual (distorted) tax base. We base our calculations on the Ruf ETR. Analytical deductions are presented in sections 3.3 to 3.5.

3.2 A dynamic model of tax accounting – general assumptions

The parent company of the considered MNE is located in state H. It may engage in investment projects directly or may outsource activities to its subsidiaries in states H and F. Both states have constant corporate tax rates τ^H and τ^F. In line with most EU countries' tax law, dividends within the MNE are exempt from corporate tax and withholding tax and can hence be repatriated without restriction.[41] The representative owner of the MNE is a resident of and is fully taxable in state H. Dividends received from the MNE are taxed at a proportional income tax rate τ^D, whereas earnings from an alternative interest-bearing investment are subject to the income tax rate τ. Apart from investing in bonds yielding an interest rate i, the MNE may invest in a project of limited scale offering a pre-tax rate of

[37] Ruf (2011).
[38] See Devereux and Griffith (1998), pp. 353, 362.
[39] See Ruf (2002, 2011).
[40] See Knirsch (2002), p. 5.
[41] See Council of the European Union (2011), 'Parent-Subsidiary Directive', or Art. 11 c) of the Draft Council Directive on a CCCTB.

return r and a pre-tax NPV of at least zero. The project's cash flows decrease exponentially by the factor d, implying that the investment's capital stock economically depreciates at that same rate, based on replacement costs. For nontax reasons, the initial investment I_0 is split up between state F (share f) and state H (share $h = (1 - f)$). Nearly, all assumptions are based on the neoclassical investment model, particularly the assumption of an infinite time horizon and the periodic economic depreciation of the investment[42], whose payouts are a proportional function of its remaining capital stock. In contrast to the neoclassical approach, our approach uses no explicit production function. Instead, the maximum amount of investment is an exogenous variable. In contrast to the original model of Jorgenson (1963, 1967), our model is formulated in discrete rather than continuous form.

The total tax burden depends on (1) the timing of profit recognition and (2) the tax rate of the jurisdiction in which profits are generated. Moreover, the initial investment is entirely funded by retained earnings[43], which could otherwise be distributed to the representative owner. Cash flows from the investment are completely distributed to shareholders at any time to exclude tax effects from dividend policy. The investment is depreciated according to the declining balance method in both countries. Nevertheless, the respective write-off rates w^i (for $i = H, F$) do not have to be identical. At first glance, different write-off rates seem plausible only under ST because each state has its own tax code with specific depreciation rules. However, under UT, with its standardised rules of tax accounting, different write-off rates may arise from some room for discretion that tax law can never completely exclude.[44] [45] Different write-off rates could also result from a specific nonsymmetric distribution of assets between countries F and H.

With respect to the apportionment formula under UT, we assume that both states use only tangible assets as the apportionment factor.[46] Furthermore, both states agree on the same definition of property by using RBV only. Otherwise, double taxation or undertaxation would occur.

[42] This assumption indicates that the investment thoroughly consists of depreciable capital. Therefore, the results hold particularly true for high firm-specific capital intensity; see Oestreicher, Reister and Spengel (2009), p. 64.
[43] See, e.g., Corbett and Jenkinson (1997) for the empirical relevance of finance by retained earnings.
[44] Such room for discretion may result from ambiguity in legal texts or differences in their interpretation among Member States. Additionally, Art. 41 of the Draft Directive on a CCCTB allows for 'exceptional depreciation', which may also be subject to some discretion of management.
[45] Mintz and Weiner (2003), p. 702 f, claim that countries wish to offer tax incentives, which will be hampered under UT. The possibilities to offer tax incentives could increase under UT, as common depreciation rates are expected to broaden the tax bases on average (for broadening tax bases, see Spengel and Oestreicher (2011)).
[46] The use of only tangible assets as the apportionment factor is stipulated by Art. 92, EC (2011) and matches the US approach; see Weiner (2002), p. 526.

3.3 ETRs for a domestic investment

We define NPV as the economic objective value of the MNE. Based on cash flows from the investment

$$CF_t = r \cdot I_0 \cdot (1-d)^{t-1} \tag{2}$$

and periodic tax depreciation

$$TD_t = w \cdot I_0 \cdot (1-w)^{t-1}, \tag{3}$$

the NPV for a domestic investment after taxes for $t = 0,1,\ldots,n$ is generally written as follows:

$$NPV_{0,\tau}(I) = -(1-\tau^D) \cdot I_0 + (1-\tau^D) \cdot \left[(1-\tau^H) \cdot \sum_{t=1}^{n} CF_t \cdot q_\tau^{-t} + \tau^H \cdot \sum_{t=1}^{n} TD_t \cdot q_\tau^{-t} \right] \tag{4}$$

with

$$q_\tau = 1 + i \cdot (1-\tau) = 1 + i_\tau . \tag{5}$$

The first summand within the large brackets is the present value of all taxed cash flows, whereas the second summand represents the present value of the tax shield caused by writing off the investment I_0. As the investment is financed by retained earnings, its opportunity cost is $(-(1-\tau^D) \cdot I_0)$. If the MNE decides to invest, the representative owner forgoes a distribution of I_0 that would be taxed at τ_D. Now as a point of reference, imagine a neutral tax system that allows for economic depreciation ED_t of an investment based on its replacement costs. The NPV for this investment taxed at the indifference tax rate τ^{eff} for all discussed scenarios is

$$NPV'_{0,\tau^{eff}}(I) = -(1-\tau^D) \cdot I_0 + (1-\tau^D) \cdot \left[(1-\tau^{eff}) \cdot \sum_{t=1}^{n} CF_t \cdot q_\tau^{-t} + \tau^{eff} \sum_{t=1}^{n} ED_t \cdot q_\tau^{-t} \right]. \tag{6}$$

The present values of cash flows, tax depreciation, and economic depreciation are briefly written as

$$PV_{CF} = \sum_{t=1}^{n} CF_t \cdot q_\tau^{-t}, \quad PV_{TD} = \sum_{t=1}^{n} TD_t \cdot q_\tau^{-t}, \quad PV_{ED} = \sum_{t=1}^{n} ED_t \cdot q_\tau^{-t}, \tag{7}$$

and hence, we obtain

$$NPV_{0,\tau}(I) = (1-\tau^D)\left(-I_0 + (1-\tau^H) \cdot PV_{CF} + \tau^H \cdot PV_{TD}\right) \tag{8}$$

and

$$NPV'_{0,\tau^{eff}}(I) = (1-\tau^D)\left(-I_0 + (1-\tau^{eff}) \cdot PV_{CF} + \tau^{eff} \cdot PV_{ED}\right). \tag{9}$$

Finally, by equating

$$NPV'_{0,\tau^{eff}}\left(I\right) = NPV_{0,\tau}\left(I\right) \tag{10}$$

and solving for τ^{eff}, the ETR for a domestic investment with τ^{H} as a yardstick is

$$\tau^{eff} = \tau^{H} \cdot \frac{PV_{CF} - PV_{TD}}{PV_{CF} - PV_{ED}} \ . \tag{11}$$

If $PV_{TD} = PV_{ED}$, then $\tau^{eff} = \tau^{H}$. In case PV_{TD} exceeds (falls short of) PV_{ED}, preferential (discriminatory) taxation results in $\tau^{eff} < \tau^{H}$ ($\tau^{eff} > \tau^{H}$). Hence, any tax advantage (disadvantage) in the tax base makes the indifference tax rate sink beneath (rise above) the STR τ^{H}. The higher the return and the present value of cash flows are, the smaller the impact of differences between present values of economic and tax depreciation will be. Consequently, for high rates of return, the indifference tax rate converges towards the STR.

3.4 Separate taxation

3.4.1 Separate taxation without profit shifting (base case)

Under ST, profits are accounted for in the state where they originate – either in the affiliate's or in the parent company's location. In the base case, we assume that any intermediate inputs between the units of the MNE are priced adequately, that is, according to the arm's length principle. The MNE does not try to undertake any profit shifting from a unit in one state to a unit in another state. Hence, the ETR is 'mixed', comprising corporate tax rates τ^{F} and τ^{H} of the two states. Using equation (7), the post-tax NPV of each state reads

$$\begin{aligned} NPV^{F}_{0,\tau}\left(I^{F}\right) &= \left(1-\tau^{D}\right)\left(-I_0^{F} + \left(1-\tau^{F}\right)PV_{CF^{F}} + \tau^{F} \cdot PV_{TD^{F}}\right) \\ NPV^{H}_{0,\tau}\left(I^{H}\right) &= \left(1-\tau^{D}\right)\left(-I_0^{H} + \left(1-\tau^{H}\right)PV_{CF^{H}} + \tau^{H} \cdot PV_{TD^{H}}\right) \end{aligned} \tag{12}$$

with $PV_{CF^{F}} = f \cdot PV_{CF}$, $PV_{CF^{H}} = \left(1-f\right) \cdot PV_{CF}$,

and $PV_{TD^{F}} = f \cdot \sum_{t=1}^{n} w^{F} \cdot I_0 \cdot \left(1-w^{F}\right)^{t-1} \cdot q_{\tau}^{-t}$, $PV_{TD^{H}} = \left(1-f\right) \cdot \sum_{t=1}^{n} w^{H} \cdot I_0 \cdot \left(1-w^{H}\right)^{t-1} \cdot q_{\tau}^{-t}$.

Now, condition (10) must be fulfilled again:

$$\begin{aligned} &NPV'_{0,\tau^{eff}}\left(I\right) = NPV^{F}_{0,\tau}\left(I^{F}\right) + NPV^{H}_{0,\tau}\left(I^{H}\right) \\ &\left(1-\tau^{D}\right)\left(-I_0 + \left(1-\tau^{eff}\right)PV_{CF} + \tau^{eff}\,PV_{ED}\right) \\ &= \left(1-\tau^{D}\right)\left(-I_0 + PV_{CF} - \tau^{F}\left(PV_{CF^{F}} - PV_{TD^{F}}\right) - \tau^{H}\left(PV_{CF^{H}} - PV_{TD^{H}}\right)\right) \end{aligned} \ . \tag{13}$$

After simplification, we obtain

$$\tau_{bc}^{eff} = \frac{\tau^F \left(PV_{CF^F} - PV_{TD^F}\right) + \tau^H \left(PV_{CF^H} - PV_{TD^H}\right)}{\left(PV_{CF} - PV_{ED}\right)} . \tag{14}$$

Thus, the ETR depends on the STRs and the respective depreciation schemes in both states.

3.4.2 Separate taxation with profit shifting using transfer prices

If the MNE can influence profit recognition in both states through TP, it will seek to shift as much profit as possible to the lower-tax state.[47] Henceforward, we assume $\tau^F < \tau^H$, and the amount transferred from state *H* to state *F* via TP is termed X_t. Without further restrictions, the MNE would shift all its profits to the lower-tax state F. In reality, the fiscal authority of *H* will check transfer prices and adjust them unless they are set 'correctly' as between unrelated parties. We assume that state *F* accepts the profit recognition of the MNE and possible adjustments made by H. We further assume that the parent company in state *H* must report a minimum profit corresponding to an interest rate z on assets invested in state *H* before tax depreciation at the beginning of the year. For this purpose, fiscal authorities use the book values of fixed assets given in the tax balance sheet. This procedure can be interpreted either as a 'cost-plus method' of TP with depreciation serving as the cost basis or as a 'income-based method' where z is defined as the ordinary return on capital before depreciation. Under this restriction, the parent company chooses as the transfer price an amount X_t ensuring the recognition of the required minimum profit:

$$X_t = r \cdot I^H \left(1-d\right)^{t-1} - z \cdot I^H \left(1-w^H\right)^{t-1}. \tag{15}$$

To adjust the model for ST to profit shifting, only the present value of the amount X_t

$$PV_X = \sum_{t=1}^{n} X_t \cdot q_\tau^{-t} \tag{16}$$

times the respective STR must be added to the parent company's NPV and subtracted from the affiliate's NPV. All else being equal, we obtain

$$\begin{aligned} NPV_{0,\tau}^F\left(I^F\right) &= \left(1-\tau^D\right)\left(-I_0^F + \left(1-\tau^F\right)\cdot PV_{CF^F} + \tau^F \cdot PV_{TD^F} - \tau^F \cdot PV_X\right) \\ NPV_{0,\tau}^H\left(I^H\right) &= \left(1-\tau^D\right)\left(-I_0^H + \left(1-\tau^H\right)\cdot PV_{CF^H} + \tau^H \cdot PV_{TD^H} + \tau^H \cdot PV_X\right) \end{aligned} . \tag{17}$$

To determine the ETR, condition (10) must be fulfilled again:

[47] Note that we do not include a cost function for TP, as in, e.g., Nielsen, Raimondos-Møller and Schjelderup (2010).

$$
\begin{aligned}
&NPV'_{0,\tau^{eff}}\left(I\right) = NPV^{F}_{0,\tau}\left(I^{F}\right) + NPV^{H}_{0,\tau}\left(I^{H}\right) \\
&\left(1-\tau^{D}\right)\left(-I_0 + \left(1-\tau^{eff}\right)PV_{CF} + \tau^{eff}\cdot PV_{ED}\right) \\
&= \left(1-\tau^{D}\right)\left(-I_0 + PV_{CF} - \tau^{F}\left(PV_{CF^{F}} - PV_{TD^{F}} + PV_{X}\right) - \tau^{H}\left(PV_{CF^{H}} - PV_{TD^{H}} - PV_{X}\right)\right)
\end{aligned}
\quad . \quad (18)
$$

After simplifications, the ETR reads

$$
\tau^{eff}_{TP,ST} = \frac{\tau^{F}\cdot\left(PV_{CF^{F}} - PV_{TD^{F}} + PV_{X}\right) + \tau^{H}\cdot\left(PV_{CF^{H}} - PV_{TD^{H}} - PV_{X}\right)}{PV_{CF} - PV_{ED}} \quad . \quad (19)
$$

3.4.3 Separate taxation with profit shifting through intragroup debt

In the subsection that follows, we analyse how ETRs are influenced by intragroup financial transactions, such as loans or leases.[48] We do not model any legal limitation to profit shifting using debt capital to create a general model of the influence of financial decisions under the regimes of ST and UT. Although many countries do have thin-cap rules in place, no logical boundary to (intragroup) debt exists, as interest payments help to shift a firm's marginal return on investment to another jurisdiction, whereas TP diminishes inframarginal returns on investment.

We examine investment funding via long-term intragroup debt where the company in state F acts as the financing company granting debt to the parent company (or to other affiliates) in state H. Interest payments will raise the taxable income of the financing unit in state F and will reduce the taxable income of the debtor unit in state H. Under ST, these interest payments reduce the total tax burden of the MNE by the amount of interest payments times the difference in STRs. In the capital allocation model by Mintz and Weiner (2003), the actual economic costs of tax-induced financing decisions are taken into account by a linear-homogenous cost function.[49] We do not include such costs in the model because a possible resulting gap in ETRs is sufficient to show distortions induced by the tax regime. Cost functions reduce this gap and dilute the results.

In a first step, the loan component can be determined by splitting the invested amount in each Member State into equity and debt capital:

[48] Discriminatory taxation of dividends on equity capital compared to interest on debt capital is a common element of most Member States' tax codes. (The 'Notional Interest Deduction' in the Belgian CIT is an exception.) Therefore, the ETR of an indebted firm can be below the STR even in a single country setting. Yet, the objective of UT is not to solve this problem (Devereux 2004, p. 83); thus, financial transactions between a MNE and its owners are ignored in this paper. We focus instead on financial transactions within the consolidated MNE. For tax planning via lending and borrowing, see also Mintz and Smart (2004).

[49] Mintz and Smart (2004), p. 1152 f.

$$\begin{aligned} I_0^F &= f \cdot \left(I^{F,Eq} + I^{F,deb} \right) \\ I_0^H &= \left(1 - f\right) \cdot \left(I^{H,Eq} + I^{H,deb} \right) \end{aligned} . \tag{20}$$

The debt ratio for the entity in i – with $i = H, F$ – is

$$g^i = \frac{I^{i,deb}}{I^{i,Eq} + I^{i,deb}} = \frac{I^{i,deb}}{I^i} . \tag{21}$$

Because the debt ratio does not influence the return on the investment and because the sum of capital invested remains unchanged, cash flows from the base case (without profit shifting) and from interest payments $CF_t^{H,Cr}$ and $CF_t^{F,Cr}$ are additive. ρ denotes the interest rate, and λ is the percentage of the repayment of the outstanding loan.

$$\begin{aligned} CF_t^{F,Cr} &= \rho \cdot g^H \cdot I^H \cdot \left(1 - \lambda\right)^{t-1} \\ CF_t^{H,Cr} &= -\rho \cdot g^H \cdot I^H \cdot \left(1 - \lambda\right)^{t-1} \end{aligned} . \tag{22}$$

The outstanding loan amount decreases exponentially at a constant λ, and with it, interest payments decline. Note that a slower redemption plan for the loan would increase the total amount of profit shifted via interest expenses from state H to state F. The tax rate spread would then be exploited even more. Nevertheless, we abstain from this alternative for two reasons: First, this assumption would require us to model the redemption period separately. Second, the amortisation rate should 'match' the decline of the cash flow and therefore the rate of economic depreciation. For $\lambda = d$, leverage is constant over time with respect to the market value before tax of the investment; for $\lambda = w$, leverage is constant in terms of the book value of the investment.

Interest paid is treated as an expense of the debtor in state H.[50] The creditor in state F has interest income taxable in state F. As a nonresident in state H, the creditor is typically not subject to withholding tax in state H. The respective NPVs read

$$\begin{aligned} NPV_{0,\tau}^F \left(I^F \right) &= \left(1 - \tau^D\right) \cdot \left(-I_0^F + \left(1 - \tau^F\right) \cdot PV_{CF^F} + \tau^F \cdot PV_{TD^F} - \tau^F \cdot PV_{Cr} \right) \\ NPV_{0,\tau}^H \left(I^H \right) &= \left(1 - \tau^D\right) \cdot \left(-I_0^H + \left(1 - \tau^H\right) \cdot PV_{CF^H} + \tau^H \cdot PV_{TD^H} + \tau^H \cdot PV_{Cr} \right) \end{aligned} . \tag{23}$$

After equation (23) is inserted into condition (10), the ETR for debt financing under ST reads

$$\tau_{Cr,ST}^{eff} = \frac{\tau^F \cdot \left(PV_{CF^F} - PV_{TD^F} + PV_{Cr} \right) + \tau^H \cdot \left(PV_{CF^H} - PV_{TD^H} - PV_{Cr} \right)}{PV_{CF} - PV_{ED}} \tag{24}$$

with the present value of interest payments on debt

[50] Limitations to deductibility such as thin-cap rules or, e.g., the German 'business income tax' are neglected.

$$PV_{Cr} = \sum_{t=1}^{n} CF_t^{Cr} \cdot q_\tau^{-t} = \rho \cdot g^H \cdot I^H \cdot \frac{1 - \left(\frac{1-\lambda}{1+i_\tau}\right)^n}{i_\tau + \lambda} \,, \tag{25}$$

which – for an infinite time horizon $n \to \infty$ – simplifies to

$$PV_{Cr} = g^H \cdot I^H \cdot \frac{\rho}{i_\tau + \lambda} \,.$$

3.4.4 Separate taxation with profit shifting through leasing

Instead of granting a loan to finance an investment, the financing entity could acquire the investment asset and lease it out to another group member. The tax effects of such a lease depend on the tax treatment of the lease. When the lease is qualified as a 'finance lease' by both tax jurisdictions, the lessee must show both the asset and the related lease obligation on his balance sheet. Leasing an investment asset in this case is equivalent to financing the investment through an intragroup loan, and the tax effects are generally the same as those in 3.4.3. We therefore focus on an intragroup lease that is qualified as an 'operating lease' by both countries. In this case, the lessor shows the asset on his balance sheet. The lessor further has the depreciation expense and income from the lease payment. The lessee's tax base is reduced by the amount of his lease payments to the lessor.[51]

Neglecting transaction costs, the lease payment comprises two components: (1) the cost of capital and (2) some compensation for the deterioration of the leasing item. Under full knowledge and in the absence of any information asymmetries, component (1) should be equal to the interest on the equivalent intragroup loan in the previous section, and component (2) must be equal to the economic depreciation d of the asset. In this case, profit is shifted from the lessee's jurisdiction to the lessor's jurisdiction exactly by the amount of the (implicit) interest in the lease payment, which should offer the same tax reduction as an equivalent loan. When d is not observable, as we have assumed, some additional profit shifting may be possible through the lease. We formalise the problem to determine the conditions for profit shifting through leasing.

We define the lease payment as a proportion k of the time value of the leasing object with a component for interest ρ and a component for amortisation λ; hence, $k = \rho + \lambda$. Rental payments are declining geometrically – similar to the investment's cash flow and service payments for the intragroup loan in section 3.4.3. We use the debt ratio g^i, equation (21), to

[51] If the leasing object is accounted for in both countries ('double-dip lease'), the possibility for the MNE to reduce its tax burden is evident; hence, this case will not be examined (see, e.g., Mehta (2005), p. 95 f).

define the share of the total investment that is realised under the leasing agreement. A share g^H of the investment in state *H* is now acquired by the affiliate in state *F* and leased out to the entity in state *H* (parent or other group member). The affiliate in state *F* has income from the lease payment and an expense from the depreciation of the leased asset that it owns. The entity in state *H* has the lease payment as an expense but not the depreciation on the leased asset, which it could have as an expense if it were the economic owner of the asset (as is the case when the investment in state *H* is financed by equity or debt). The respective NPVs realised in countries *F* and *H* from the investment (partially) under an intragroup lease are

$$NPV_{0,\tau}^{F}\left(I^{F}\right)=\left(1-\tau^{D}\right)\cdot\left(-I_{0}^{F}+\left(1-\tau^{F}\right)\cdot PV_{CF^{F}}+\tau^{F}\cdot PV_{TD^{F}}-\tau^{F}\cdot PV_{L^{F}}\right)$$
$$NPV_{0,\tau}^{H}\left(I^{H}\right)=\left(1-\tau^{D}\right)\cdot\left(-I_{0}^{H}+\left(1-\tau^{H}\right)\cdot PV_{CF^{H}}+\tau^{H}\cdot PV_{TD^{H}}+\tau^{H}\cdot PV_{L^{H}}\right) \quad (26)$$

with

$$PV_{L^{i}}=g^{H}\cdot I^{H}\cdot\sum_{t=1}^{n}\left[k\cdot\left(1-\lambda\right)^{t-1}-w^{i}\cdot\left(1-w^{i}\right)^{t-1}\right]\cdot q_{\tau}^{-t}, \quad (27)$$

which for $n\to\infty$ simplifies to

$$PV_{L^{i}}=g^{H}\cdot I^{H}\cdot\left[\frac{k}{i_{\tau}+\lambda}-\frac{w^{i}}{i_{\tau}+w^{i}}\right]=g^{H}\cdot I^{H}\cdot\left[\frac{\lambda+\rho}{i_{\tau}+\lambda}-\frac{w^{i}}{i_{\tau}+w^{i}}\right]. \quad (28)$$

Using equation (10), we obtain the following for the ETR:

$$\tau_{L,ST}^{eff}=\frac{\tau^{F}\cdot\left(PV_{CF^{F}}-PV_{TD^{F}}+PV_{L^{F}}\right)+\tau^{H}\cdot\left(PV_{CF^{H}}-PV_{TD^{H}}-PV_{L^{H}}\right)}{PV_{CF}-PV_{ED}}. \quad (29)$$

The ETR can be reduced if profit can be shifted to low tax state *F* through the lease, that is, if $PV_{L^F}>0$. As argued before, this scenario arises for $w^F=w^H=d=\lambda$. In this case, profit can be shifted by the amount of the implicit interest price within the lease payment. If d cannot be observed, this means of profit shifting holds as long as $w^F=w^H=\lambda$.

If $w^F\neq w^H$, profit shifting becomes more complicated: in this case, the tax savings may be higher (lower) than the amount of the implicit interest payment if $\tau^F\cdot PV_{L^F}-\tau^H\cdot PV_{L^H}$ is positive (negative), that is, if the tax reduction from depreciating the leasing good in state *F* is more (less) valuable than the forgone tax savings in state *H*.

Our results also allow us to discuss whether an intragroup lease out of the high tax state into the low tax state can reduce the MNE's ETR. Henceforth, we assume that state *F* is the higher tax jurisdiction ($\tau^F>\tau^H$), and for reasons of simplicity, we assume that $w^F=w^H$. Then, a

lease will reduce the ETR if $PV_{L^F} = PV_{L^H} < 0$. This requires that $\frac{\lambda + \rho}{i_\tau + \lambda} < \frac{w^i}{i_\tau + w^i}$ or, in other words, a contract with total payments lower than the acquisition cost of the leasing object. Hence, a lease would not be contracted between unrelated parties, as such a lease is not compatible with the arm's length principle and should not be accepted by tax authorities – at least not in state H. We refer to the numeric analysis in section 4 for a more detailed discussion.

3.5 Unitary taxation

In this section, ETRs for UT using formula apportionment are derived. Again, we define a base case without profit shifting as a benchmark before introducing measures of tax planning.

3.5.1 Unitary taxation: base case, transfer pricing, intragroup debt, and profit recognition

Under formula apportionment, the consolidated profit of both entities is subject to a mixed tax rate ζ_t that depends on how overall profit is allocated to jurisdictions H and F via the allocation key ϕ_t:

$$\zeta_t = \phi_t \cdot \tau^F + (1-\phi_t) \cdot \tau^H = \tau^H + \phi_t \cdot (\tau^F - \tau^H). \tag{30}$$

As we want to understand the effects of capital invested as a key factor, we define ϕ_t by RBV at the beginning of the corresponding period

$$\phi_t = \frac{RBV^F_{t-1}}{RBV^F_{t-1} + RBV^H_{t-1}} = \frac{I^F (1-w^F)^{t-1}}{I^F (1-w^F)^{t-1} + I^H (1-w^H)^{t-1}} \ . \tag{31}$$

In other words, $0 \leq \phi_t \leq 1$ is the part of profit taxed in state F at τ^F at time t. Correspondingly, $(1 - \phi_t)$ is the share subject to taxation in state H. Given that the weights of both states sum to 1, both double taxation and undertaxation are avoided, which is consistent with the assumption that both states accept the same transfer price under ST. The NPVs for both entities are

$$\begin{aligned} NPV^F_{0,\tau}(I^F) &= (1-\tau^D)\left[-I^F_0 + PV_{CF^F} - \sum_{t=1}^{n} \left(\tau^F \cdot \phi_t \left(CF_t - TD^F_t - TD^H_t\right) \cdot q_\tau^{-t}\right)\right] \\ NPV^H_{0,\tau}(I^H) &= (1-\tau^D)\left[-I^H_0 + PV_{CF^H} - \sum_{t=1}^{n} \left(\tau^H \cdot (1-\phi_t)\left(CF_t - TD^F_t - TD^H_t\right) \cdot q_\tau^{-t}\right)\right] \end{aligned} \ . \tag{32}$$

Again, condition (10) must hold:

$$NPV'_{0,\tau^{eff}}(I) = NPV^F_{0,\tau}(I^F) + NPV^H_{0,\tau}(I^H)$$

Hence, the ETR for UT in the base case reads

$$\tau_{UT}^{eff} = \frac{\sum_{t=1}^{n} \left(\phi_t \cdot \left(\tau^F - \tau^H\right) + \tau^H\right) \cdot \left(CF_t - TD_t^F - TD_t^H\right) \cdot q_\tau^{-t}}{PV_{CF} - PV_{ED}} \quad . \tag{33}$$

Note that the relation between the book values of fixed assets in state F and the book values of fixed assets in state H – and with it ϕ_t – changes over time if different write-off rates are applied in both states. $\phi_t = I^F/I = f$ is constant only if $w^F = w^H$. Therefore, equation (33) cannot be simplified further. Nevertheless, by choosing $n = 100$, ETRs can be calculated rather exactly for exemplary purposes in section 4.

Under UT, any strategy involving shifting tax bases between members of the MNE is ineffective as long as the apportionment factor remains unaffected. Expenses and revenues from TP (and from intragroup debt) merely add up to zero in the consolidated result of the group, which is simply the sum of the profits of both entities in our model (see equations 16 and 25). However, debt – unlike TP – also influences asset values in both entities – creditor and debtor. To reduce the MNE's ETR, an entity in the lower tax state F must act as creditor under UT, as under ST. However, this strategy is only effective if debt is allocated directly to the contracting units and if intragroup debt positions are not excluded from the determination of the allocation factor – which would be an outright invitation for firms in engage in tax minimisation.[52]

In section 2, we mentioned a number of measures that can be used to influence book values and, with them, the allocation factor ϕ_t, all of which have been discussed in the evolution of the EC (2011) proposal: inflating the balance sheets of entities with assets that are not necessary for the business in the lower tax country and maintaining a lean balance sheet, e.g., through leases or outsourcing, in the high tax country. Tax authorities must therefore question the necessity of every single asset on the balance sheet. With respect to off-balance-sheet leases, the directive proposal suggests adding a multiple of the annual lease payment to the book value of entity.

To influence the MNE's ETR through intragroup tax planning, the allocation factor must be influenced through other, novel measures, or tax bases must be shifted from tax years with relatively high ξ_t to tax years with lower ξ_t. Formulae (30) and (31) provide a hint to a possible strategy. If $w^F < w^H$, ϕ_t will increase over time, which has a negative effect on the ETR. Therefore, the MNE's accounting strategy must be to maintain high book values for all

[52] In the EC (2011) proposal, interest income and expenses (in contracts with third parties as well) cannot be allocated directly to a single group member for this reason. Instead, they are excluded from profit recognition and then added to the consolidated result.

assets in lower tax countries (country F in our model) and to write down assets in higher tax countries as fast as possible to utilise nonscheduled depreciations whenever justified.

3.5.2 Unitary taxation with profit shifting through intragroup leases

Unless legislators take appropriate countermeasures, an MNE could use intragroup operating leases to manipulate its allocation factor. The authors of EC (2011) seem to be aware of this problem but do not offer a solution.[53] For our analysis, we assume that no anti-abuse rule is in force. An operating lease shifts book values from an operating entity (lessee) in high tax state H to a financing entity (lessor) in low tax state F. Thus, the lower STR of state F will gain weight in the mixed tax rate ξ_t. The allocation key adjusted for leasing is

$$\phi_t = \frac{\left(f + g^H \cdot (1-f)\right) \cdot I_0 \cdot \left(1-w^F\right)^{t-1}}{\left(f + g^H \cdot (1-f)\right) \cdot I_0 \cdot \left(1-w^F\right)^{t-1} + \left(1-g^H\right) \cdot (1-f) \cdot I_0 \cdot \left(1-w^H\right)^{t-1}} . \tag{34}$$

If we assume that the depreciation rates are equal across both jurisdictions ($w^F = w^H$), equation (34) simplifies to

$$\phi_t = f + g^H \cdot (1-f) . \tag{35}$$

Inserting (34) into (30), we obtain the constant mixed tax rate for an infinite time horizon:

$$\xi_t = \left(f + g^H \cdot (1-f)\right) \cdot \tau^F + \left(1-g^H\right) \cdot (1-f) \cdot \tau^H . \tag{36}$$

The CTB itself remains unchanged compared to the base case because $PV_{L^F} = PV_{L^H}$ (see section 3.4.4), as the expenses and revenues from the lease cancel each other out. The total effect of this manoeuvre is a reduction in the tax burden of the MNE.

Obviously, for $\tau^F < \tau^H$, the optimal strategy is either to invest only in state F ($f = 1$) or for $f < 1$ to choose $g^H = 1$, that is, to lease out all assets from state F to state H. This strategy minimises the mixed tax rate ξ_t and, with it, the ETR. Of course, any solution near $g^H = 1$ would most likely not stand up to a tax audit in state H.

When we allow for differing depreciation rates in state H and state F, both the CTB (shifted depreciation is no longer worth the same amount; see 3.4.4) and the mixed tax rate must be adjusted. NPVs and ETRs are influenced by the lease term L_t in the CTB and by an adjusted apportionment factor.

[53] Art. 93 of EC (2011) states that with respect to the allocation of assets, 'except in the case of leases between group members, leased assets shall be included in the asset factor of the group member which is the lessor or the lessee of the asset. The same shall apply to rented assets'. It is not clear from this sentence or from Art. 94, no. 4, whether and how an intragroup lease should be taken into account. Note that in an older publication, the recommendation was to assign the leasing object to only one group member in case of intragroup leases; only for leases with third parties is an assignment to both possible (EC (2007), p. 11).

$$NPV_{0,\tau}^{F}\left(I^{F}\right)=\left(1-\tau^{D}\right)\left(-f\cdot I_{0}+PV_{CF^{F}}-\sum_{t=1}^{n}\left(\tau^{F}\cdot\phi_{t}\cdot\left(CF_{t}-TD_{t}^{F}-TD_{t}^{H}+L_{t}\right)\cdot q_{\tau}^{-t}\right)\right)$$
$$NPV_{0,\tau}^{H}\left(I^{H}\right)=\left(1-\tau^{D}\right)\left(-\left(1-f\right)\cdot I_{0}+PV_{CF^{H}}-\sum_{t=1}^{n}\left(\tau^{H}\cdot\left(1-\phi_{t}\right)\cdot\left(CF_{t}-TD_{t}^{F}-TD_{t}^{H}+L_{t}\right)\cdot q_{\tau}^{-t}\right)\right) \quad (37)$$

with

$$\begin{aligned}L_{t}&=-g^{H}\cdot\left(1-f\right)\cdot I\cdot w^{F}\cdot\left(1-w^{F}\right)^{t-1}+g^{H}\cdot\left(1-f\right)\cdot I\cdot w^{H}\cdot\left(1-w^{H}\right)^{t-1}\\&=g^{H}\cdot\left(1-f\right)\cdot I\cdot\left[w^{H}\cdot\left(1-w^{H}\right)^{t-1}-w^{F}\cdot\left(1-w^{F}\right)^{t-1}\right]\end{aligned} \quad (38)$$

result in the adjusted mixed tax rate:

$$\zeta_{t}=\frac{\tau^{F}\cdot\left[\left(f+g^{H}\cdot\left(1-f\right)\right)\cdot I\cdot\left(1-w^{F}\right)^{t-1}\right]+\tau^{H}\cdot\left[\left(1-g^{H}\right)\left(1-f\right)\cdot I\cdot\left(1-w^{H}\right)^{t-1}\right]}{\left(f+g^{H}\cdot\left(1-f\right)\right)\cdot I\cdot\left(1-w^{F}\right)^{t-1}+\left(1-g^{H}\right)\left(1-f\right)\cdot I\cdot\left(1-w^{H}\right)^{t-1}}. \quad (39)$$

Note that the lease changes both the numerator and the denominator of the mixed tax rate (40) and that it is not constant over time. By inserting (34) and (38) into (37) and using equation (10), we derive the ETR including an intragroup lease:

$$\tau_{L,UT}^{eff}=\frac{\sum_{t=1}^{n}\left(\phi_{t}\cdot\left(\tau^{F}-\tau^{H}\right)+\tau^{H}\right)\cdot\left(CF_{t}-TD_{t}^{F}-TD_{t}^{H}+L_{t}\right)\cdot q_{\tau}^{-t}}{PV_{CF}-PV_{ED}}. \quad (40)$$

This ETR is discussed in detail in the following section.

4 Numeric analysis and discussion

As ETRs under UT cannot be written in closed form, a numeric analysis is necessary to evaluate the tax planning opportunities after a system change towards UT. If not otherwise mentioned, the following data apply to all calculations: Corporate profits are taxed at a rate of $\tau^{H}=0.4$ in state H, while state F offers a lower tax rate of $\tau^{F}=0.2$. The owners' personal income tax amounts to $\tau=0.4$ for interest income and $\tau^{D}=0.4$ for dividends.[54] Thus, based on the parameters, state H represents a high tax country. The interest rate of an alternative financial investment is $i=0.1$. The investment volume adds up to $I_{0}=100$, half of which is realised in the foreign subsidiary ($f=0.5$). Economic depreciation is $d=0.2$, and the minimum rate of return before tax depreciation demanded by state H's fiscal authorities is ($z=i+w^{H}$). Hence, the reported profit must correspond to a rate of return on book capital at the level of the market rate. We examine before tax marginal investments ($r=i+d=0.3$)

[54] Taxation of profit distribution is irrelevant for the scenario of an investment financed by retained earnings used here: as can be seen in equation (4), all NPVs are cut proportionally by the factor $(1-\tau^{D})$.

as well as inframarginal investments ($r > i + d = 0.3$). The ETR of a purely domestic investment in state H is calculated as a point of reference. Depreciation rates w^H and w^F are treated as decision variables, moving within a range from 0.1 to 0.9. A large difference between w^H and w^F is helpful for illustration purposes; however, in reality, such differences will rarely arise if the investments in state H and state F have similar characteristics.[55] For loans and leases, we assume a debt ratio of $g^i = 0.5$, an interest rate of $\rho = 0.1$ (for the loan; $K = \rho + \lambda$ for the lease), and an amortisation rate of $\lambda = 0.2$. Where ETRs cannot be calculated for an infinite time horizon, we approximate them by setting $n = 100$.

For an equity-financed investment, figure 1 shows that a domestic marginal investment before taxes ($NPV = 0$) results in an ETR of 40 %, if $w^H = d = 0.2$. In this case, the economic profit of the investment is subject to the same tax load as the owner's alternative financial investment. When half of the investment is realised abroad, the ETR decreases to 30 %, creating a positive after tax NPV. This reduction occurs simply because profits that are recognised in the affiliate are subject to the lower foreign corporate tax rate. Further, their subsequent distribution to the parent company is tax exempt. Note that this ETR is the average of the STRs of the two countries. Moreover, if $w^H = w^F$, the ETR with foreign investment is identical for all three tax regimes because each tax base corresponds to economic profit at any moment. Regarding the ETR with TP, profit shifting from state H to state F is not possible because the profit recognised in state H is equal to the minimum return demanded by state H's fiscal authorities ($r = z = 0.3$).

The picture changes as soon as a higher write-off rate is selected in state H. The higher the write-off rate w^H is, the more the ETR declines for all three cases. Under ST, the decline in the ETR arises because of the maximisation of depreciation expenses. As expected, the ETR under ST with profit shifting for all $w^H > 0.2$ is lower than that without profit shifting. This result occurs because a diminishing RBV in H also induces a decrease in the minimum return required by tax authorities; the higher w^H is, the more profit shifting to state F is possible. However, for $w^H < 0.2$, the opposite result occurs:

[55] However, specific national depreciation allowances may persist in the states. Alternatively, one could imagine a MNE with two very different activities in state F and state H that require completely different assets.

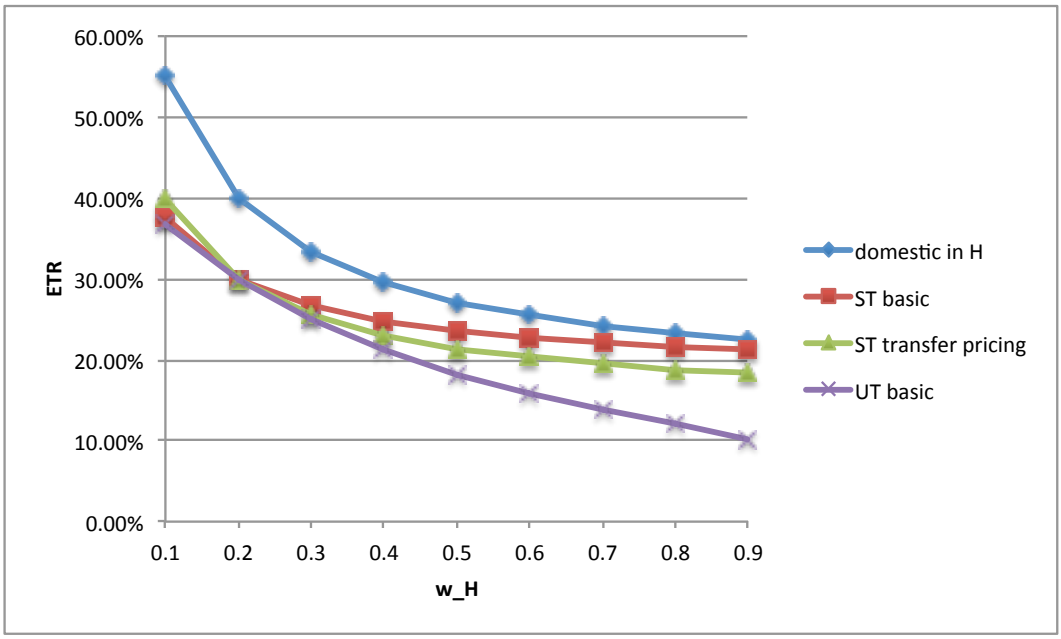

Figure 1: ETRs of a marginal investment (r = 0.3) subject to differing w_H; w_F = 0.2

The ETR with profit shifting is higher than that without profit shifting because our assumption of a required minimum return on book values produces a negative transfer price, and thus, profits are shifted from the *lower* to the *higher* tax state. Finally, the ETR under formula apportionment also drops with a rising w^H because of the following relationship: the lower the RBV of assets in state H is, the smaller the weighting of state H*'s* corporate tax rate will be in the distribution key, which decreases the mixed tax rate ζ_t for the MNE's consolidated profit. Two effects are working in opposite directions: a timing effect and a tax rate effect. The timing effect is directly affected by the respective depreciation rates in state H and state F. An increase in the depreciation rates diminishes the present value of the CTB, thus reducing the ETR ceteris paribus. On the other hand, depreciation rates induce a tax rate effect through the channel of RBVs in the mixed tax rate. An increase in w^H accelerates the shrinkage of RBV^H and hence reduces the weight of τ^H in the mixed tax rate. Therefore, with respect to w^H, the direction of both effects is the same. The ETR rises with w^H. By contrast, an increase in w^F reduces the influence of τ^F in the mixed tax rate, as the relative weight of RBV^F shrinks over time and thus pushes the ETR upwards (see figure 3). Note that in all cases, ETRs are lower under UT than under ST. This effect can reliably be reproduced with parameters other than the parameters included in our calculations, which should raise doubts about the effectiveness of UT.

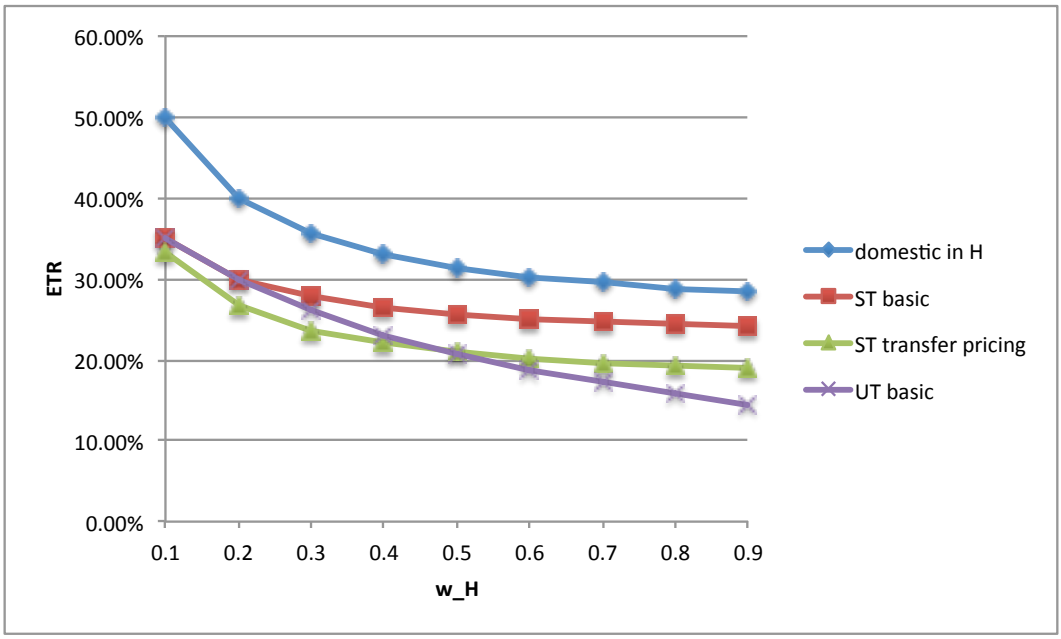

Figure 2: ETRs of an inframarginal investment (r = 0.35) subject to differing w_H; w_F = 0.2

With the rising return on the investment before taxes (figure 2), the investment abroad becomes even more favourable compared to the domestic investment. The ranking of the tax regimes generally remains unchanged. Nevertheless, a lower ETR can be observed for the case with profit shifting compared to the case without profit shifting because a greater part of the overall profit can be shifted to the affiliated company ($r > z = 0.3$). Therefore, the remaining minimum profit, which must be reported in state H, has less influence on the ETR whenever inframarginal investments are considered. Two general conclusions regarding ST can be drawn from figure 2: On the one hand, with inframarginal returns, write-off policy becomes less important for managing the ETR, as it only affects a relatively small share of the tax base. On the other hand, TP becomes more important, as a large share of the tax base can now be shifted to state F than to investments with marginal returns.

Under UT, we observe ETRs that are always below those under ST without TP and that may be higher or lower than those under ST with TP, depending on the w^H chosen for a given w^F. Of course, we cannot determine whether our 'ST with TP' case is a good model of the tax environment for MNEs. However, our 'ST without TP' case cannot be reasonably disputed as an unrealistic benchmark, as it requires fully informed tax authorities. If we accept that our ST without TP' case provides a realistic benchmark, we must conclude here that UT may be better or worse than the status quo but that it will not nearly be able to prevent MNEs from profit shifting.

In the following analysis, to better understand the different mechanisms of tax planning under UT, we examine variations of w^F for a given w^F (figures 3 and 4). Regardless of the pre-tax rate of return, ETRs under ST fall as w^F rises. As explained above, for a marginal investment ($r = i + d = 0.3$), MNEs cannot engage in profit shifting through TP under our assumptions; therefore, the ETRs under ST with and without TP are the same (figure 3). By contrast, the profit from the inframarginal investment (figure 4) in state H that exceeds the required minimum profit can be shifted to state F. The amount shifted is independent of w^F; that is, the ETR functions with and without TP are equidistant lines.

The behaviour of ETRs to a change in w^F under UT is somewhat less intuitive. The ETRs reach a minimum at a write-off rate of $w^F = 0.2$, which corresponds to economic depreciation. Higher write-off rates in the low tax country increase the ETRs. This result requires closer examination, as common sense implies that early and high tax depreciations increase the present value of depreciation expenses. However, this timing effect is overlaid by a tax rate effect: On the one hand, a high write-off rate w^F increases the present value of depreciation expenses. On the other hand, the RBV of assets in state F and consequently the weight of τ^F in the mixed tax rate ξ_t for all of the subsequent periods shrink. This pattern can also be observed for other write-off rates for w^H (figure 5). Whereas w^F and w^H must be set as high as possible to minimise the ETRs under ST, only w^H must be set as high as possible in high tax state H under UT.

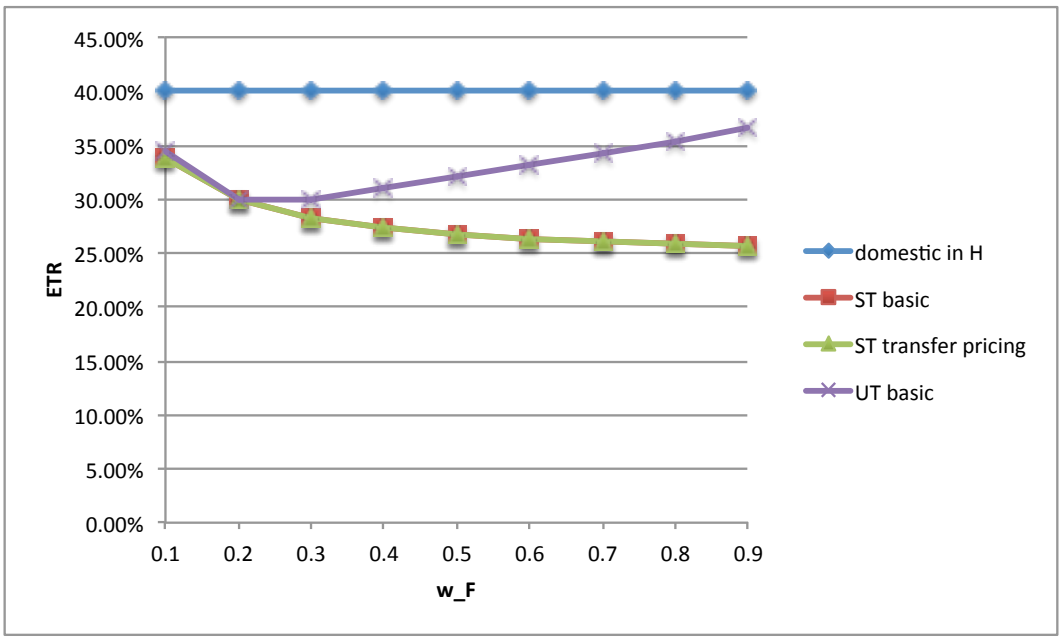

Figure 3: ETRs of a marginal investment (r = 0.3) subject to differing w_F; w_H = 0.2

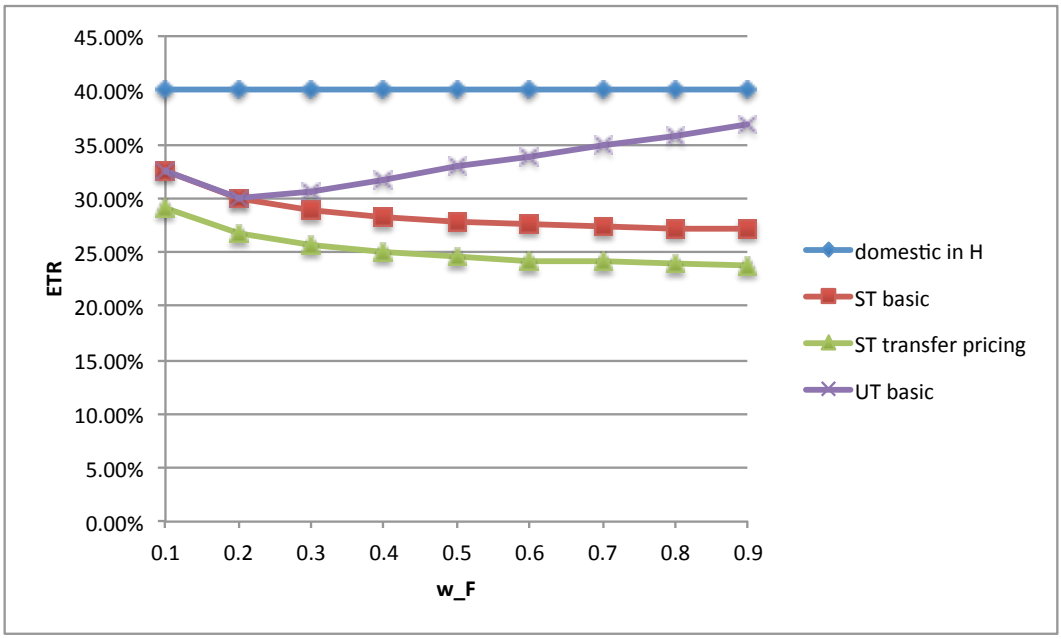

Figure 4: ETRs of an inframarginal investment (r = 0.35) subject to differing w_F and w_H = 0.2

w_F \ w_H	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0.1	37.50%	32.46%	28.92%	26.20%	24.04%	22.24%	20.67%	19.22%	17.79%
0.2	35.04%	30.00%	26.09%	23.03%	20.68%	18.80%	17.23%	15.81%	14.42%
0.3	35.25%	30.57%	26.67%	22.52%	19.39%	17.12%	15.36%	13.88%	12.48%
0.4	36.08%	31.76%	28.93%	24.78%	19.97%	16.60%	14.31%	12.58%	11.08%
0.5	37.03%	32.89%	30.84%	28.38%	23.57%	17.79%	14.12%	11.77%	10.00%
0.6	37.98%	33.92%	32.27%	30.91%	28.51%	22.73%	15.61%	11.63%	9.21%
0.7	38.93%	34.88%	33.41%	32.58%	31.56%	29.22%	22.11%	13.11%	8.87%
0.8	39.91%	35.82%	34.42%	33.83%	33.43%	32.72%	30.63%	21.63%	9.79%
0.9	40.96%	36.83%	35.43%	34.95%	34.82%	34.77%	34.49%	33.09%	21.25%

Figure 5: ETRs of an inframarginal investment (r = 0.35) based on UT subject to tax depreciation in state H and state F. Minima are shaded in grey.

As a next step, we discuss the impact of debt financing on ETRs. For identical rates of tax depreciation in both countries (figure 6), ETRs are the same under both ST in the base case and UT. However, the ETRs are only the same with other values of r or f because UT perfectly mirrors ST in this case. Under both tax regimes, debt financing and leasing nevertheless reduce the ETRs. The lease arrangements underlying the example correspond to the cases discussed in sections 3.4.4 and 3.5.2. In figures 6 and 7, debt financing indeed seems to be superior to leasing under ST. Hence, under ST, companies should prefer intragroup debt to intragroup leases.

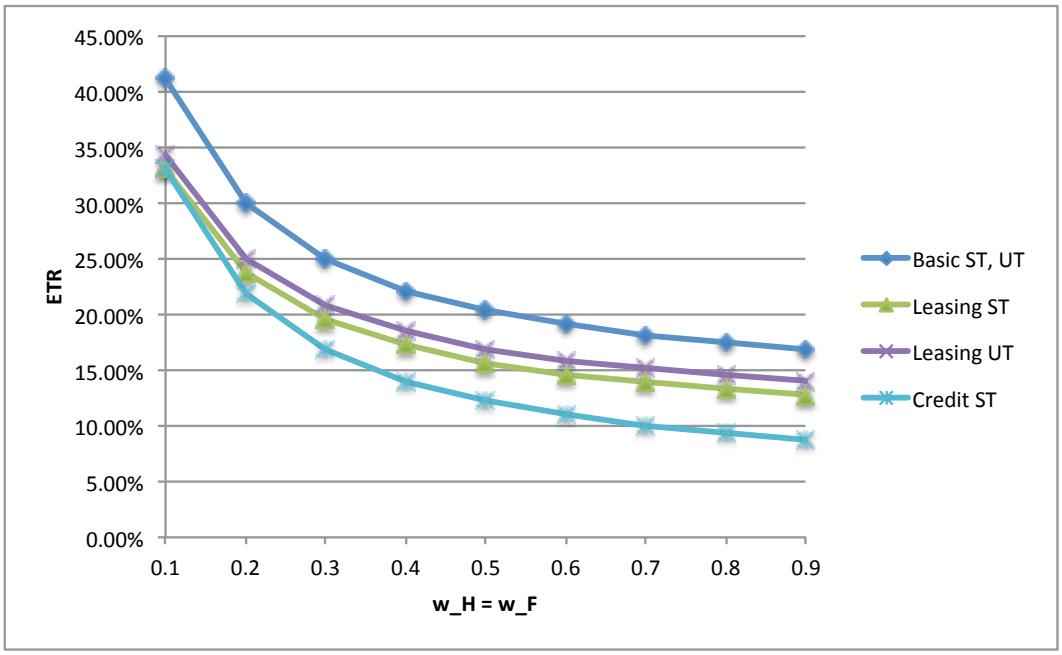

Figure 6: ETRs for a debt-financed marginal investment (r = 0.3) for equal rates of tax depreciation

Under ST, debt financing and leasing result in an almost parallel downward shift in ETRs compared to the base case. The size of this shift depends on the loan's conditions as well as the market interest rate and the return on the investment r. With increasing r, ceteris paribus, the impact of the credit's present value on ETRs decreases relative to the present value from the operating cash flows. This result can easily be shown algebraically if we compare the ETRs for ST in the base case to the ETRs for debt financing. A well-known and more intuitive explanation is that interest payments help shift marginal returns on investments (or a little more for an adequate risk premium). The higher the investment's return on investment is, the smaller the impact of debt on the ETRs will be.

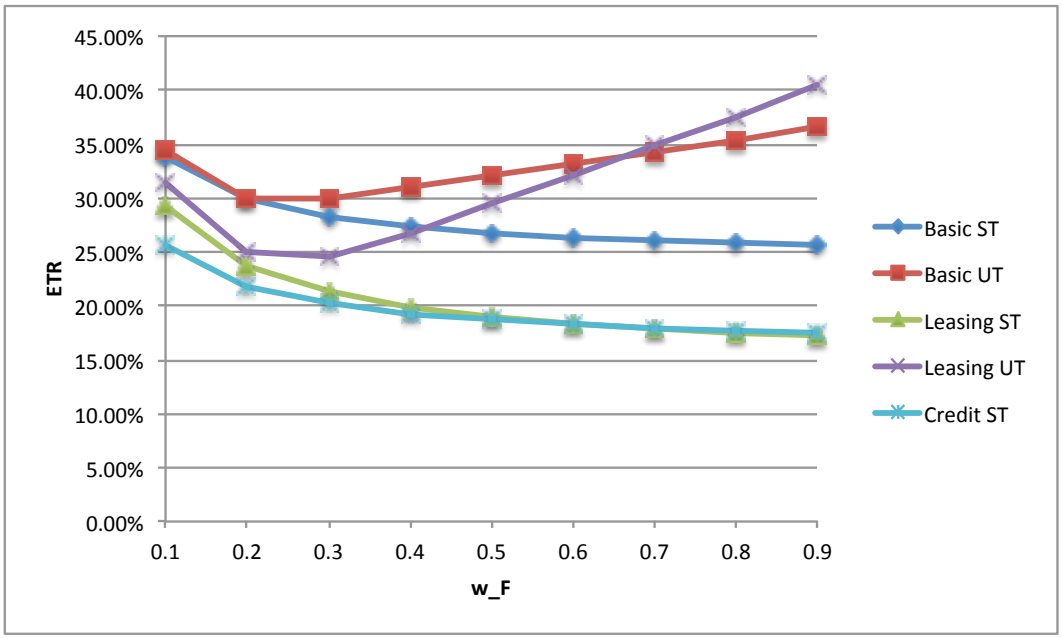

Figure 7: ETRs for a debt-financed marginal investment (r = 0.3) subject to differing w_F and w_H = 0.2

r = 0.3 (marginal investment)

w_F \ w_H	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0.1	6.88%	3.14%	0.54%	-1.51%	-3.19%	-4.64%	-5.93%	-7.17%	-8.46%
0.2	8.20%	5.00%	2.47%	0.22%	-1.60%	-3.12%	-4.43%	-5.66%	-6.92%
0.3	7.84%	5.38%	4.17%	1.72%	-0.57%	-2.37%	-3.83%	-5.12%	-6.39%
0.4	6.71%	4.24%	4.18%	3.70%	0.96%	-1.51%	-3.35%	-4.83%	-6.18%
0.5	5.36%	2.65%	2.47%	3.42%	3.39%	0.13%	-2.59%	-4.51%	-6.07%
0.6	3.99%	1.03%	0.48%	1.14%	2.72%	3.18%	-0.88%	-3.88%	-5.92%
0.7	2.61%	-0.53%	-1.40%	-1.22%	-0.19%	1.86%	3.03%	-2.26%	-5.54%
0.8	1.20%	-2.08%	-3.17%	-3.36%	-2.94%	-1.82%	0.52%	2.91%	-4.34%
0.9	-0.45%	-3.81%	-5.03%	-5.46%	-5.43%	-5.03%	-4.09%	-1.94%	2.81%

r = 0.5 (inframarginal investment)

w_F \ w_H	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0.1	5.63%	3.98%	2.67%	1.62%	0.75%	0.02%	-0.63%	-1.23%	-1.83%
0.2	6.15%	5.00%	3.70%	2.46%	1.46%	0.65%	-0.05%	-0.68%	-1.29%
0.3	5.79%	5.19%	4.72%	3.37%	2.08%	1.06%	0.25%	-0.44%	-1.09%
0.4	5.07%	4.51%	4.76%	4.57%	3.02%	1.62%	0.57%	-0.26%	-0.98%
0.5	4.26%	3.58%	3.81%	4.46%	4.46%	2.62%	1.07%	-0.03%	-0.89%
0.6	3.47%	2.65%	2.69%	3.21%	4.15%	4.39%	2.10%	0.39%	-0.76%
0.7	2.71%	1.77%	1.63%	1.90%	2.55%	3.71%	4.34%	1.37%	-0.50%
0.8	1.94%	0.92%	0.66%	0.72%	1.04%	1.70%	3.00%	4.30%	0.24%
0.9	1.09%	0.01%	-0.35%	-0.42%	-0.33%	-0.06%	0.47%	1.66%	4.27%

Figure 8: ETR differences through leasing for (infra)marginal investments using leasing under UT

For UT, the situation differs. First, intragroup debt has no effect on the ETRs, as we have argued in section 3.5.1. Nevertheless, a reduction in the ETRs can be observed for the use of

leases under UT. Again, we must distinguish the case of corresponding[56] and differing depreciation rates in state H and state F. Figure 8 shows the (dis)advantage of leasing in terms of positive (negative) ETR differences compared to no profit shifting. With identical tax depreciation rates (figure 6 and the diagonals in figure 8), leasing always reduces the ETRs by a certain number of percentage points compared to the UT base case. This result occurs because the shift of RBVs to state F through the lease generates an ETR-decreasing tax rate effect. If the depreciation rates differ in both countries, the impact of leasing on the ETRs is not clear and depends crucially on the constellation of depreciation rates and the return on investment (figure 7 and figure 8, except the diagonals).

These results arise from the interplay of timing and tax rate effects already encountered with the equity-financed investment, which are now complemented by further timing and tax rate effects resulting from the RBV and depreciation shifted to state F through the lease. A rising return on the investment r expands the 'corridor' in which leasing is able to reduce ETRs (positive ETR differences in figure 8). Note that the 'leasing corridor' in question allows for reductions in ETRs that are comparable to those observed for debt financing under ST.

Let us consider the ETRs for leasing under UT for rising values of w^F (figure 8). As under UT without leasing, two effects are working in opposite directions: On the one hand, an increase in w^F implies a higher tax shield in the CTB, leading to an ETR-decreasing timing effect. On the other hand, a rising w^F increases the mixed tax rate through the channel of RBVs accounted for in state F. The temporal shift of RBVs towards state F through leasing – resulting in a higher weight of the lower tax rate τ^F in the mixed tax rate and hence a reduction in the ETRs – is utilised more quickly as the w^F increases. Hence, very high values for w^F generate an ETR-increasing tax rate effect. The minimum of the graph for leasing under UT shows where the ETR-decreasing timing effect is dominated by the henceforward ETR-increasing tax rate effect. Figure 8 shows that ETR differences may rise or decline depending on the depreciation rate in the other country, state H. This result can again be explained by the different factors influencing the denominator of the allocation key within the mixed tax rate. There are cases[57] in which both timing and tax rate effects simultaneously decrease or increase the ETR from leasing, even though the two effects are mostly opposing. Note that – as for UT without leasing – increasing values of w^H, ceteris paribus, always

[56] This assumption corresponds to the declared intention of the proposal for a CCCTB, EC (2011). As we have argued above, we have doubts about the viability of such an assumption.

[57] Whether the timing and tax rate effects act in concert depends on the specific constellation of input variables that are used for the calculations.

decrease the ETRs because the resulting timing and tax rate effects work in the same direction. Figure 8 demonstrates that leasing is not always superior to no profit shifting. Nevertheless, in most cases, leasing allows for a further reduction of the ETRs. Finally, the impact from debt financing under ST exceeds the impact from leasing under UT in the majority of cases for marginal investments but not for inframarginal investments.

5 Conclusion

In summary, we have shown in a simple dynamic model of an MNE's tax accounting that the MNE has considerable leeway to reduce its ETR through intragroup manoeuvres. UT indeed makes TP and intragroup loans unattractive strategies for tax minimisation. However, these instruments can easily be replaced by new strategies involving strategic asset valuation and intragroup leases or similar instruments that tax strategists will certainly develop. Our numeric analysis shows that these new strategies have a potential impact on the MNE's ETR that is comparable to that of currently used instruments.

To control the use of valuation policies to influence ETRs, tax authorities will need to take actions similar to those taken today: scrutinise the MNE's determination of income and its balance sheet for possible deviations from the declarations of a stand-alone firm.

The EC is well aware of the potentially distortive impact of leasing.[58] The Draft Council Directive on a CCCTB introduces a substance-over-form clause stipulating tax depreciation of assets on the tax balance sheet of the economic rather than the legal owner. In the US, leased assets are included in the apportionment formula at eight times the annual rent.[59] The EC has proposed a similar approach.[60] These measures may be able to reduce the problem for lease agreements with unrelated parties (without solving it systematically) but will not help for intragroup leases, which have no logical solution. Allocation to the economic owner, allocation to both parties, and allocation to either party would not help to immunise the allocation formula against intragroup leases or similar constructions.

Considering these problems and the potential for the tax minimisation of the MNE via the labour factor in the apportionment formula and via related parties that are not included in the consolidation[61], one certainly must conclude that UT creates new opportunities for cross-border tax planning without destroying the old opportunities.

[58] EC (2007), pp. 11, 16.
[59] See Weiner (2005), p. 21.
[60] See Art. 94 no. 4 Draft Council Directive on a CCCTB, COM (2011) 121/4.
[61] See Riedel and Runkel (2007) for the water's edge problem. Buettner, Riedel and Runkel (2011) provide empirical evidence for strategic consolidation under UT using formula apportionment.

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