ACE vs. CBIT: Which is Better for Investment and Welfare?

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Abstract

This paper analyses the switch to an ACE or to a CBIT type of tax system from the present German tax system. Although the conventional literature states that it might be arguable whether the ACE is the right measure applied by a small open economy, since the required tax rate has to be higher to achieve a given tax revenue, we show that in case such a reform is financed by an increase in the VAT and not in the profit tax, an ACE might be preferred to a CBIT even in the context of an open economy. Moreover, the required exogenous increase in the profit tax rate can not ensure revenue neutrality on its own due to the negative general equilibrium effects it triggers on the whole economy in case of implementing an ACNE. For a CBIT, the exogenous reduction in the tax rates on corporate and non-corporate profits leads to better results than when we allow for an endogenous change in the VAT, however, these results turn out to be inferior to the outcome of introducing an ACE.

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1 Introduction

The two major reform proposals which have been the focus of discussions all over the world are on the one hand a so called Comprehensive Business Income Tax (CBIT) and on the other hand the Allowance for Corporate Equity (ACE)[1]. While the first provides that neither debt interest nor a return on equity may be deducted from the profit tax base such that the user cost of capital for debt financed investment is increased, the second provides besides the deduction of debt interest also for the deduction of an imputed return on equity from the profit tax base thus reducing the cost of capital of an investment financed by retentions (Bond, 2000; Cnossen, 2000; Devereux and Freeman, 1991). The ACE in its pure form would also require disregarding interest taxes at the personal level as well, such that this tax system would largely resemble a cash-flow income tax (Lammersen, 2002).[2]However, we disregard this last aspect and just model the deduction of a protective interest rate on firm level since we are just interested in comparing the two proposals with respect to their investment incentives and revenue implications. Although this is a major distinction between the two proposals, they both follow the same purpose, namely to achieve an increased neutrality with regard to the investment and financial decision of the firm and to reduce the distortions inherent in the tax system.

This paper analyzes these two different proposals with regard to their implication on investment and welfare and considers as an example reforming the German tax system, as has been lately often discussed.

Assuming that both reforms have to be revenue neutral, we argue that the ACE would require either a higher corporate income tax rate or the reform should be financed by an increase in the VAT since in this case the income tax base is narrower than in case a CBIT is introduced. Moreover, an ACE reform proposal is highly sensitive to the choice of the imputed rate of return. Accordingly, neutrality with respect to the source of finance or use of funds is only achieved when the imputed rate of return on equity

[1]For a detailed discussion on the ACE see Devereux and Freeman (1991)

[2]Under the cash flow tax, investment expenditures can be immediately written off when they are undertaken (Boadway and Bruce, 1984)

equals the interest rate paid on debt. In case this protective interest rate is higher, non-profitable investments might even be subsidized, an outcome which is similar to the effects of introducing accelerated depreciation.

In case the ACNE is financed by an exogeneous increase in the tax rates on corporate and non-corporate profits, these increases are not sufficient to finance the reform and needs to be accompanied either by an additional reduction in transfers or increase in the VAT. This outcome occurs since withtin the framework of our dynamic general equilibrium model, the tremendous rise in the profit tax rate has considerable negative economy-wide repercussions leading to capital decumulation and a shrinking tax base for all other taxes as well. In case we simulate the opposite reform proposal, namely the CBIT, the exogeneous decline which may accompany such a reform has positive effects and leads to better results than if the reform is financed by an endogenous change in the VAT. Nevertheless, overall, the ACNE leads to the most superior outcome for investment, capital accumulation and welfare.

The paper is structured as follows: Section 2 contains a thorough comparison of the diametrically opposite reform alternatives. The next section introduces the general equilibrium model with special focus on the investment and financial behavior of corporate and non-corporate firms under the two reform proposals. Section three presents the simulation results and the last Section concludes.

2 ACE vs. CBIT

Since in most countries tax law provides for a deduction of debt interest when computing the profit tax base, debt finance is at an advantage compared to financing an investment via retained earnings. In order to equalize the opportunity cost of debt and equity, tax professionals have designed two different alternatives to counteract this problem. Both reform alternatives were advanced at the beginning of the nineties. The ACE was elaborated by the IFS Capital Taxes Group (1991) and the idea of considering an imputed interest on equity was first advanced by Boadway and Bruce (1984). The reformers

introduced the idea of such a tax system since they considered several shortcomings of the British tax system of that time. First, omitting the cost of equity finance drives a wedge between the pre- and post-tax returns of an investment financed by equity. Therefore, investments that do not provide sufficient returns which cover both the tax bill and offer the investor at least the market rate of return, will not be taken into consideration (IFS Capital Taxes Group 1991). Moreover, by still providing for debt interest deductibility, there continues to exist a bias in favor of debt-financed investments (Bond, 2000).[3] Thus, in a closed economy, the cost of capital for an investment financed via retained earnings is reduced (Bond, 2000) and as long as the deducted costs of equity and debt finance are equal, there is no particular advantage for one of the two sources of finance. Under these circumstances the ACE is favoured relative to the CBIT since it reduces the overall cost of capital of the firm. If in addition, interest income is also tax exempt at the personal level, such a tax systems is equivalent to a cash-flow income tax (Lammersen, 2002; Wagner, 1999; Fehr and Wiegard, Devereux and Freeman, 1991) In essence, such a tax system will exempt the cost of raising finance at the company level from taxation and will just subject the profits exceeding a 'normal rate of return' to taxation (IFS Capital Taxes Group, 1991). However, the implementation of such a tax system poses some difficulties since a large amount of information is required about which interest rate should be imputed[4] (Boadway and Bruce 1984, Bond and Devereux 1999). An intertemporal and investment neutrality is achieved since the post- and pre-tax rates of return are the same (IFS Capital Taxes Group, 1991). An additional question to be asked in this context regards the issue whether the ACE should be extended such as to apply to the self-employed as well. In this constellation, some difficulties might arise since it is problematic to distinguish which assets belong to the company and which to the shareholder (Isaac, 1997). Considering the definition of the equity to be deducted, this could be measured for instance as the book value of assets less

[3] Additionally, since at the beginning of the nineties, British companies still relied on the historical cost accounting method for reporting profits, the effect of inflation was to increase the tax base in nominal terms such that the burden of taxation increased (IFS Capital Taxes Group, 1991)

[4] The IFS Tax Group favors in this case a medium-term gilt (IFS Capital Taxes Group, 1991)

debt (Devereux and Freeman, 1991) Regarding the viability of such a tax system in a world of high capital mobility, for outward investments by German companies abroad, an ACE would just apply to remitted and distributed profits to Germany. In the case of inward investment, for countries which apply the exemption system for double tax relief, things would not change to a large extent while in countries which apply the tax credit system (like the US), the taxpayer would have to pay the difference to the higher tax bill[5] As also noted by the IFS Capital Taxes Group (1991), the ACE system would tend to favour domestic investment because of the neutrality of the domestic tax system versus the non-neutrality of other countries' systems.

A controversial aspect emerges if we consider the fact that the ACE basically just taxes economic rents. Therefore, firms which earn just or less than the minimum required return would pay little or even no tax, while the most profitable enterprises will face the highest tax bill since they earn the highest returns. Clearly, it is debatable whether such a situation is desirable, mostly if we consider multinational companies to be usually the most profitable ones (Bond, 2000).

The main critique raised with regard to the ACE addresses the fact that the narrowing of the tax base has to be accompanied by a higher tax rate to achieve a certain tax revenue (Isaac, 1997). Such an outcome is less desirable in a world of high capital mobility where a higher statutory tax rate has a negative signalling effect for multinational firms. Nevertheless, because of the limitation of the imputation system under the IFS Capital Taxes Group (1991) proposal, additional revenue can be achieved from taxing distributed profits at the personal level. Under a full imputation system, the tax on all profits can be credited against the shareholder's personal income tax, while under the new proposal only the tax paid on the normal rate of return can be credited against the shareholder's personal tax bill. Therefore, Devereux and Freeman (1991) compute using an average of real revenues over the period 1971-1990 a revenue-neutral tax rate of 45% - accordingly ten percentage points higher than the tax rate prevailing in the

[5]See also Isaac (1997) fot the discussion on the effect of the ACE on inward and outward investment in the case of the UK.

UK at that time. A further advantage of such a tax system, is that any schedule of depreciation allowances, i.e. providing for an immediate write-off or allowing for geometric degressive depreciation over the life of the asset - does not change the present value of tax payments (Devereux and Freeman, 1991 and Bruckner, Gassner, Riener-Micheler 2000) Regarding the treatment of risk and risky projects, since the ACE provides for the deduction of an imputed return it also makes possible return less variable since the reduced expected return of shareholders is exactly compensated by the reduced risk they bear. Thus the government acts like a silent partner which shares both the return and some of the risk of a project (Devereux and Freeman 1991).

As opposed to the first reform alternative, the CBIT, which was developed by the US Treasury Department (1992), raises the cost of capital for a debt financed investment since debt interest is no longer deductible in computing the profit tax base. Accordingly, such a reform policy scenario also brings in line the two potential ways to finance investment (Bond, 2000). While under an ACE the most profitable firms face the highest tax bill, under the CBIT, these companies will face lower tax bills due to the combination of a lower tax and a broader tax base (Bond, 2000).Although this reform induces a higher capital cost, it might be advisable for a government to adopt it if it can apply a lower profit tax rate due to the broader tax base (Cnossen, 2000). This is especially the case for a small open economy characterized by high capital mobility. Nevertheless, this line of arguments only holds if we assume that in order to achieve a given amount of government revenue, the profit tax rate has to be altered. However, under the assumption that such reforms can be also financed by a change in the VAT (so by an increase in case of an ACE), it is not clear-cut that the CBIT is to be preferred in case of a small open economy, if a country wants to attract investors both by offering low statutory tax rates and a narrow tax base for corporate profits.

3 The Model

The following section introduces a detailed modelling of each firm sector, which allows us to asses the impact of changing the tax system via an ACE or a CBIT. Moreover, since

we distinguish between the corporate and the non-corporate sector we can analyze the effects arising if the imputed return is allowed for just for corporate firms or for all types of enterprises.

Optimal investment behavior is derived from an intertemporal investment model with convex adjustment costs. Since we mainly focus on the effects of the tax reform on welfare, we model the household sector using the traditional Ramsey model of an infinitely lived household. The public sector introduces various distortions on the behavioral margins of agents through taxation and public debt. The model's fourth building block is the rest of the world.[6]

We rely on a basic neoclassical, linear homogenous production technology with capital, K and labour, L, as production factors, $Y^f = F(K^f, L^f)$. The superscript $f \in \{C, NC\}$ denotes the type (C = corporate and NC = non-corporate) of a particular firm. The price of the output good is normalized to unity. Additionally, the firm incurs adjustment costs $J^f(I^f, K^f)$ which result from disruptions due to the firm's internal reorganization.[7] The steady state adjustment costs are zero such that they do not influence the steady state solution.

Domestic firms hire labour and accumulate capital to maximize their value. To model the distortionary effects of taxation on investments and therefore on capital accumulation we consider besides the tax on corporate profits, $\tau^{P,C}$, a tax on dividends, τ^D, and one on capital gains, $\tau^{G,f}$.[8] The profits of non-corporate firms are taxed at the the personal income tax rate, $\tau^{P,N}$, of the owner of the firm.

[6] The complete model documentation can be received on request from the authors.

[7] Adjustment costs are introduced to obtain more realistic dynamics in an open economy. The adjustment cost function is assumed to be linearly homogeneous in investments, I and capital, K and convex in investment.

[8] According to the German "Halbeinkünfteverfahren", dividends, D, are first taxed on the firm level and then half of distributed dividends are once again taxed on the personal level. To account for this imputation system, we take only half of the statutory tax rate applied to dividend income for the simulations.

Moreover, effectively there is no capital gains tax in Germany but the variable, $t^{G,f}$, is carried along for reasons of completeness.

Capital expands over time whenever gross investment, I_t^f, exceeds the depreciation of the existing capital stock, δK_t^f. Therefore capital accumulation is given by:

$$GK_{t+1}^f = I_t^f + (1-\delta)K_t^f. \tag{1}$$

The growth factor $G = (1+g)$, enters the model as we allow for an exogenous trend growth in labour productivity at rate g. Thus, in a balanced growth equilibrium the capital stock as well as all other variables grow at the rate g.

Concerning debt policy, we assume that interest payments on debt include an additional premium $m(b^f)$ which denotes the agency cost of debt depending on the debt asset ratio $b^f = B^f/K^f$ of a firm. The agency costs are increasing in b^f,[9] reflecting that a firm's risk of bankruptcy increases with rising indebtedness as the non-tax cost of debt increase. Debt accumulates according to:

$$GB_{t+1}^f = BN_t^f + B_t^f. \tag{2}$$

Thus, the next period's stock of debt, B_{t+1}^f, is the sum of the existing stock of debt, B_t^f, and new debt, BN_t^f.

The following equation shows net of tax profits π_t^f defined as output Y_t^f, less adjustment costs J_t^f, wage payments $w_t L_t^f$, depreciation δK_t^f, interest payments on debt $(i_t^{BH} + m^f)B_t^f$ and the tax liability of the firm $T_t^{P,f}$:

$$\begin{aligned} \pi^f &= Y^f - J^f - w^f L^f - \delta K^f - \left(i^{BH} + m^f\right) B^f - T^{P,f}, \\ T^{P,f} &= \tau^{P,f}[Y^f - J^f - w^f L^f - z_2 r^f (K^f - B^f) - \delta K^f - (z_1 i^{BH} + m^f)B^f - z_3 IN^f]. \end{aligned} \tag{3}$$

Hence $\tau^{P,f}$ has to be interpreted as a source tax on corporate profits. Here z_3 represents the tax allowances for net investments IN^f[10] and r^f denotes an imputed rate of return which can be deducted from the tax base. Under the present German tax rules $z_1 = 1$ and $z_2 = 0$ holds, implying that only interest payments on debt are tax deductible. This

[9] The agency cost of debt, $m = m(b^f)$, are increasing in the debt equity ratio, $b^f = \frac{B^f}{K^f}$, since the first, $m'(b^f)$, and the second , $m''(b^f)$, derivative are positive.

[10] If $z_3 = 0$ we have the case of economic depreciation. If $z_3 = 1$ we allow for a full immediate write-off and and t^{PC} can be interpreted as a cash-flow tax.

indicates that there is a preference for debt financed investments which accordingly leads to a higher debt asset ratio of the firm sector. If $z_2 = 1$, we model the case of an ACE. In case we set $z_1 = z_2 = 0$ we model a CBIT since neither the interest on debt nor the imputed return on equity are tax deductible and accordingly the profit tax base in broader than in the former case.

According to the cash flow identity:

$$IN_t^f = \left(\pi_t^f - Div_t^f\right) + VN_t^f + BN_t^f \tag{4}$$

net investments,[11] $IN_t^f = I_t^f - \delta K_t^f$, can be financed via a reduction in payouts (dividends) and thus out of retained earnings $\left(\pi_t^f - Div_t^f\right)$, issuing new equity, VN_t^f, or externally via new debt, BN_t^f. However, this is a general expression. Our approach is actually to model a corporate firm which finances only a small fixed fraction of marginal investments by new share issues such that retained earnings or new debt are the marginal source of finance. In case of a non-corporate firm, marginal investments are financed either by new share issues or new debt

3.1 Corporate Firms

Since we refer to a mature economy, characterized by mature firms[12], we follow the 'New View' of dividend taxation.[13] This is one approach used in the corporate finance literature

[11] We assume that replacement investments are always financed internally.

[12] According to the nucleus theory the nucleus is incorporated in the first step and then a phase of internal growth sets in. During this phase, no dividends are paid, nor are any new shares issued, but all profits are retained to finance profitable investments. After the nucleus has reached its stage of maturity, profits are distributed as dividends. The dividend tax discriminates against the initial size of the nucleus; thus in the set-up phase, the 'Old View' applies, but the dividend tax is neutral in the stage of maturity according to the 'New View' of dividend taxation (Sinn 1991).

[13] This hypothesis on the effect of dividend taxation was developed among others by Auerbach (1979), Bradford (1981) and Sinn (1987). In contrast, the 'Old View' of dividend taxation assumes that shareholders prefer dividend distributions due to their so-called signalling function, because of a certain cash preference or since they desire to reduce managerial discretion over the use of profits. For a detailed discussion on the 'Old' and 'New View' of dividend taxation see also Sinn (1990), Sørensen (1995) and Zodrow (1991).

to characterize the relationship between taxes and the cost of capital[14]. Accordingly, dividends Div^C are determined residually (SINN, 1987). The marginal source of finance will be retained earnings $\pi^C - Div^C$ and the marginal use of funds, dividend payout. Therefore, since dividend taxes avoided today by financing investments via retained earnings can be set against as the future dividend tax payments, dividend taxes will not affect the cost of capital at all. Thus, dividend taxes are neutral with respect to the firm's financing decision.

Keeping in mind the empirical evidence provided by AUERBACH AND HASSET (2003)[15], who state that both views on the effects of dividend taxation are valid, we determine new share issues by $VN_t^C = \beta(1 - z_3\tau^{Pf})IN_t^C$. This approach is similar to FEHR (1999). New investments are largely financed by retained earnings or by new debt BN^C and only a fixed fraction, β, of five per cent is financed via new share issues. However, this approach does not apply to non-corporate firms, because these have to rely on external equity to finance investments

Plugging eq.(3) into the flow of funds equation, we derive an explicit expression for dividends Div^C as output Y^C less labor costs $w^C L^C$, interest payments $i^{BH}B^C$, new shares VN_t^C, depreciation δK^C and corporate tax payments:

$$\begin{aligned} Div^C &= \theta^{P,C}\left[Y^C - J^C - m^C B^C - w^C L^C - \delta K^C\right] - (1 - z_1\tau^{P,C})i^{BH}B^C \\ &+ BN^C + z_2\tau^{P,C}rK^C - z_2\tau^{P,C}rB^C - \left[(1-\beta)(1 - z_3\tau^{P,C})\right] IN^C. \end{aligned} \tag{5}$$

Again, the precise constellation of the parameters z_1 and z_2 allow us to model the present German tax system or a reform proposal which introduces an ACE or a CBIT. In equilibrium, the return on equity has to equal the net of tax dividend payment and the net of tax capital gains which can be derived from holding firm shares. Hence

$$\begin{aligned} r_t^V V_t^C &= \theta^{D,C} Div_t^C + \theta^{G,C}\left[GV_{t+1}^C - V_t^C - VN_t^C\right] \\ [1 + \underbrace{\frac{r_t^V}{\theta^{G,C}}}_{re_t^{VC}}]V_t^C &= \underbrace{\frac{\theta^{D,C}}{\theta^{G,C}} Div_t^C - VN^C}_{\chi_t^C} + GV_{t+1}^C \ . \end{aligned} \tag{6}$$

[14]The cost of capital is defined as the minimum pre-tax rate of return generated by an investment if it is to be undertaken.

[15]Further empirical evaluations of these two specifications were performed in an econometric study by POTERBA and SUMMERS (1983) and by applying a dynamic CGE model by HUTTON and KENC (1998).

Here r_t^V is the investor's required return that is necessary if the investor should be willing to hold the asset. This return is higher than the net return on firm or government bonds (i^{BH}) since it includes a risk premium.

Introducing the two tax factors $\gamma^{D,C} = \frac{\theta^{D,C}\theta^{P,C}}{\theta^{G,C}}$ and $\gamma^{I,C} = \left[\frac{\theta^{D,C}}{\theta^{G,C}}(1-\beta)+\beta\right](1 - z_3\tau^{P,C})$ as well as $\Omega^C = \frac{\theta^{D,C}}{\theta^{G,C}}$, the formula for χ_t^C is given by:

$$\begin{aligned}\chi_t^C &= \gamma^{D,C}\left[Y^C - J^C - m^C B^C - w^C L^C - \delta K^C - \tfrac{(1-z_1\tau^{P,C})}{\theta^{P,C}} i^{BH} B^C\right] \\ &+ \Omega^C BN^C + \tfrac{\gamma^{D,C}}{\theta^{P,C}} z_2 \tau^{P,C} r K^C - \tfrac{\gamma^{D,C}}{\theta^{P,C}} z_2 \tau^{P,C} r B^C - \gamma^{I,C}(I^C - \delta K^C).\end{aligned} \tag{7}$$

3.2 Non-Corporate Firms

As opposed to corporate firms, a non-corporate firm has no possibility to finance investments out of retained earnings, since all profits are distributed to the owner, implying $Div^N = \pi^N$. This is true for they are considered as part of the entrepreneur's income as if these profits were distributed.

Therefore, a non-corporate firm can only choose between new debt, BN^N, and new equity injections, VN^N, as a possible source of finance for its investments but is not able to draw like a corporate firm on retentions.

The flow of funds equation for the non-corporate firm can be simplified to:

$$VN^N = IN^N - BN^N \tag{8}$$

The return on equity again equals dividends and net of tax capital gains:

$$\begin{aligned} r_t^V V_t^N &= Div_t^N + \theta^{G,N}\left[GV_{t+1}^N - V_t^N - VN_t^N\right]. \\ [1 + \underbrace{\frac{r_t^V}{\theta^{G,N}}}_{re_t^{VN}}]V_t^N &= \underbrace{\frac{1}{\theta^{G,N}} Div_t^N - VN_t^N}_{\chi_t^N} + GV_{t+1}^N, \end{aligned} \tag{9}$$

Introducing once again the two tax factors $\gamma^{D,N} = \frac{\theta^{P,N}}{\theta^{G,N}}$ and $\gamma^{I,N} = 1 - \frac{\tau^{P,N} z_3}{\theta^{G,N}}$ as well as $\Omega^N = 1$, the expression for χ_t^N is:

$$\begin{aligned}\chi^N &= \gamma^{D,N}\left[Y^N - J^N - m^N B^N - w^N L^N - \delta K^N - \tfrac{1-z_1\tau^{P,N}}{\theta^{P,N}} i^{BH} B^N\right] \\ &+ \Omega^N BN^N + \tfrac{\gamma^{D,N}}{\theta^{P,N}} z_2 \tau^{P,N} r K^N - \tfrac{\gamma^{D,N}}{\theta^{P,N}} z_2 \tau^{P,N} r B^N - \gamma^{I,N}(I^N - \delta K^N).\end{aligned} \tag{10}$$

From eq. (7) and (10) we can see that whether or not interest deductibility of debt and equity is provided for will affect the value of the firm which is derived in the following section from the firm's optimizing behavior.

3.2.1 Intertemporal Optimization

Firms' goal is to maximize their value by choosing an optimal investment and financial program from period t onwards. It is quite evident that the value V_t^f of the firm will increase with the size of the capital stock K_t^f and fall with the debt level B_t^f that it inherits from the past. At the beginning of the planning period, the capital stock and the debt level are exogenous, as they are given as initial conditions resulting from historical decisions. It is the future capital stock and debt which are chosen endogenously as a result of an optimal financial and investment policy. To derive an expression determining the firm value, we rearrange the valuation conditions for the corporate (6) and non-corporate firm (9) respectively:

$$V_t^{e,f} = \chi_t^f + \frac{GV_{t+1}^{e,f}}{1 + re_{t+1}^f}, \tag{11}$$

where V_t^e denotes the end of period firm value according to $V_t^{e,f} \equiv \left[1 + r_t^{e,f}\right] V_t^f$. Hence, the end of period market value of a firm is determined by the present value of all future net of tax dividend payments less new equity injections. The net dividend flow is discounted at the cost of equity which is the required gross return on firm level, $re_t^f = \frac{r_t^V}{1-\tau^{G,f}}$. Using the value function, and assuming that investment is optimized from period $t+1$ onwards, resulting in the value function $V\left(K_{t+1}^f, B_{t+1}^f\right)$, we can find today's optimal investment, labor demand and financial behavior by maximizing the *Bellman equation of dynamic programming.* (11):

$$V^{e,f}(K_t^f, B_t^f) = \max_{L^f,\, I^f,\, BN^f} \left[\chi_t^f + \frac{G}{1 + re_{t+1}^f} V^{e,f}(K_{t+1}^f, B_{t+1}^f)\right] \qquad \text{s.t. } (\textbf{??}) \text{ and } (\textbf{??}) \tag{12}$$

where χ_t^f is defined in eq.(7) and (10).

Defining the shadow prices of capital: $q_t^f \equiv \frac{dV_t^{e,f}}{dK_t^f}$ and debt: $\lambda_t^f \equiv \frac{dV_t^{e,f}}{dB_t^f}$, respectively,[16]

[16]The shadow prices determine the increase in the value of the objective function resulting from a

the optimality conditions concerning the control variables labor, investment and new debt are:

$$\begin{aligned} &\text{(a)} \quad L_t^f: \quad w_t^f &&= F_{L,t}^f, \\ &\text{(b)} \quad I_t^f: \quad q_{t+1}^f &&= \left(1 + re_{t+1}^f\right)\left[\gamma^{D,f} J_I^f + \gamma^{I,f}\right], \\ &\text{(c)} \quad BN_t^f: \quad \lambda_{t+1}^f &&= -(1 + re_{t+1}^f)\Omega^f. \end{aligned} \tag{13}$$

Optimal labor demand is determined by the equality between the marginal product of labor $F_{L,t}^f$ and the labor cost w_t^f. In equilibrium, the wage rate becomes endogenous to clear the market for labor. Eq.(13b) delivers the condition which describes the firm's optimal investment policy. The shadow price q_t^f gives the increase in firm value, i.e. the present value of future dividend payments, if the firm is endowed with additional capital. Optimal investment thus equates the present value of the marginal benefit that the firm will have from one more unit of capital tomorrow in period $t+1$, $\frac{q_{t+1}^f}{1+re_{t+1}^f}$ with the marginal cost incurred for carrying out this investment $\gamma^{D,f} J_I^f + \gamma^{I,f}$. The marginal cost of investing one unit of capital today is $\frac{\theta^{D,C}\theta^{P,C}}{\theta^{G,C}} J_I^C + \frac{\theta^{D,C}}{\theta^{G,C}}$ for a corporate firm.[17]

The envelope conditions concerning the stock variables are:

$$\begin{aligned} \text{(a)} \quad K^f: \quad q_t^f &= \gamma^{D,f}\left[F_K^f - J_K^f + m_f' b_f^2 + \tfrac{z_2 \tau^{P,f}}{\theta^{P,f}} r_t^f\right] \\ &- \left(\gamma^{D,f} - \gamma^{I,f}\right)\delta + \tfrac{q_{t+1}^f}{1+re_{t+1}^f}(1-\delta) \\ \text{(b)} \quad B^f: \quad \lambda_t^f &= \gamma^{D,f}[-m_f' b_f - m_f - \tfrac{1-z_1\tau^{P,f}}{\theta^{P,f}} i^{BH} - \tfrac{z_2\tau^{P,f} r}{\theta^{P,f}}] + \tfrac{\lambda_{t+1}^f}{1+re_{t+1}^f} \end{aligned} \tag{14}$$

These equations enable us to determine the cost of capital which influences the investment decision of the firm as well as the cost of equity and debt finance which determine a firm's financing behavior. These behavioral margins are discussed in detail in the following sections.

3.2.2 Financial Behavior

Performing a comparative static analysis allows us to derive basic insights about the economic effects arising from tax reform scenarios. In the following, we compute the

marginal increase in the stock variables capital or debt.

[17] Assuming there is no accelarated depreciation so $z_3 = 0$ and there are no new share issues available to finance marginal investments, so $\beta = 0$.

effect of a marginal change in one tax rate on the marginal product of capital and the cost of equity, respectively, to examine how changes in the tax rates affect the investment and financial behavior of a representative firm. To start with, the financial behavior of the firm is considered.

In the absence of taxation and under certain additional assumptions such as [18] the market value of the firm is independent of its capital structure according to the MODIGLIANI MILLER Theorem (1958). In the presence of taxes and agency costs, however, the different tax constellations create a preference for a specific source of finance. The influence of different taxes on the source of finance are explained in the following.

The optimal level of indebtness of a firm is reached if the cost of equity finance equals the cost of debt finance. Substituting eq.(13c) into the envelope condition for the co-state variable debt shown in eq.(14b) the expression determining the optimal debt asset ratio is derived:

$$re^f_{t+1} - \frac{\gamma^{D,f}}{\Omega^f}\frac{z_2\tau^{P,f}r}{\theta^{P,f}} = \frac{\gamma^{D,f}}{\Omega^f}\left[m'_f b_f + m_f + \frac{1 - z_1\tau^{P,f}}{\theta^{P,f}} i^{BH}\right]. \tag{15}$$

If debt and equity are treated equally on the personal level, then both have to yield the same pretax return, namely $re^f = i^{BH}$.

However, if a profit tax applies, debt financing incorporates the advantage of interest deductibility on corporate level, inducing a preference for debt finance in the size of $\frac{1-z_1\tau^{P,f}}{\theta^{P,f}} i^{BH}$ if $z_1 = 1$. Since the larger indebtness increases the debt asset ratio, b^f, additional agency cost of $m'_f b_f + m_f$ arise, reducing the advantage of debt finance. The left hand side of the above equation is the effective cost of equity which is lower if we introduce an ACE, so if accordingly $z_2 = 1$. Therefore, both the cost of equity and the cost of debt depend on whether debt interest and/or an imputed return on equity are tax deductible from the profits tax or not. In case a CBIT is implemented, then both z_1 and z_2 equal zero and neither the cost of debt finance nor the cost of equity finance are tax deductible. Therefore, there will be no particular preference for one of these two sources

[18] (1) perfect markets (i.e. no taxes or transaction costs), (2) cash flows that are independent of financial structure and (3) riskless debt such that firms and individuals can borrow and lend at a risk free interest rate,

of finance (see eq. (17)). Such a neutrality with respect to the source of finance is also achieved in case the policy reform follows an ACE. Under this scenario both the imputed rate of return and debt interest are tax deductible (see eq. (16). Moreover, in the latter case, the preference for a particular source of finance also depends on the magnitude and choice of the imputed rate of return. Neutrality is achieved only insofar as $r = i^{BH}$ so when the imputed return equals the interest rate paid on debt (see eq. (16). The higher r will be, the higher will then the incentive be to draw on retentions to finance investments vis-a-vis new debt. In any case, the optimal debt level is achieved, if the marginal tax preference for debt is fully offset by the marginal increase in the agency cost.

The optimal debt asset ratio with ACE:

$$re^f_{t+1} - \frac{\gamma^{D,f}}{\Omega^f}\frac{\tau^{P,f} r}{\theta^{P,f}} = \frac{\gamma^{D,f}}{\Omega^f}\left[m'_f b_f + m_f + i^{BH}\right] \tag{16}$$

The optimal debt asset ratio with CBIT

$$re^f_{t+1} = \frac{\gamma^{D,f}}{\Omega^f}\left[m'_f b_f + m_f + \frac{1}{\theta^{P,f}} i^{BH}\right] \tag{17}$$

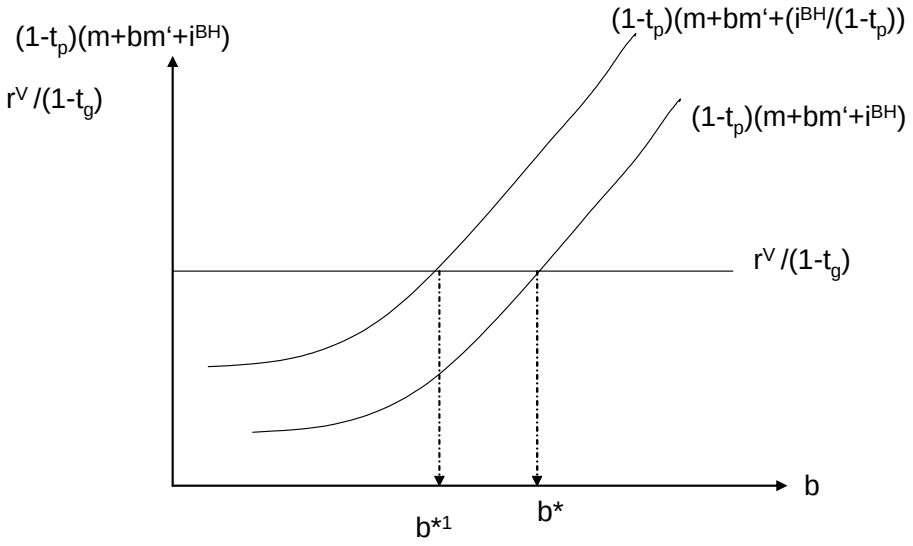
To evaluate the effects of a marginal change in the tax rates on the financial decision of a firm, we analyze the change in the cost of equity stemming from a marginal change in the tax rate under consideration.

Similar to Keuschnigg and dietz (2004) or Keuschnigg (1991), we compute the percentage change in the cost of equity analogous to: $\widehat{re^f} \equiv \frac{d\, re^f}{re^f}$, where dre^f denotes the deviation from the initial value of re^f. The relative change in the particular tax rate is then defined as $\hat{\tau} \equiv \frac{d\,\tau}{1-\tau}$ to avoid division by zero. Therefore, taking r^V as given, we obtain in case a CBIT is applied:

$$re^f = \frac{r^V}{1-\tau^{G,f}} \qquad \Rightarrow \qquad \widehat{re^f} = \widehat{\tau^{G,f}}. \tag{18}$$

According to eq.(18), only the capital gains tax affects the cost of equity. Thus, in this case, since debt interest is not deductible, the change in the profit tax rate will not influence a firm's financing decision.

Figure 1 Effect of Introducing a CBIT on the Optimal Debt Asset Ratio



From Figure 1 we can see that abolishing the possibility to deduct debt interest from the profit tax base increases the cost of debt finance, while the cost of equity remains unchanged. If a preference of debt finance prevailed, this is now reduced, and the optimal debt asset ratio moves to the left to b^{*1}.

In case we opt for introducing an ACE, the cost of equity changes to

$$re^f_{t+1} - \frac{\gamma^{D,f}}{\Omega^f}\frac{\tau^{P,f}r}{\theta^{P,f}} = \frac{r^V}{1-\tau^{G,f}} - \tau^{P,f}r \tag{19}$$

We can see from eq. (19) that introducing the possibility to deduct an imputed return from the tax base lowers the cost of equity.

Figure 2 Effect of Introducing an ACE on the Optimal Debt Asset Ratio

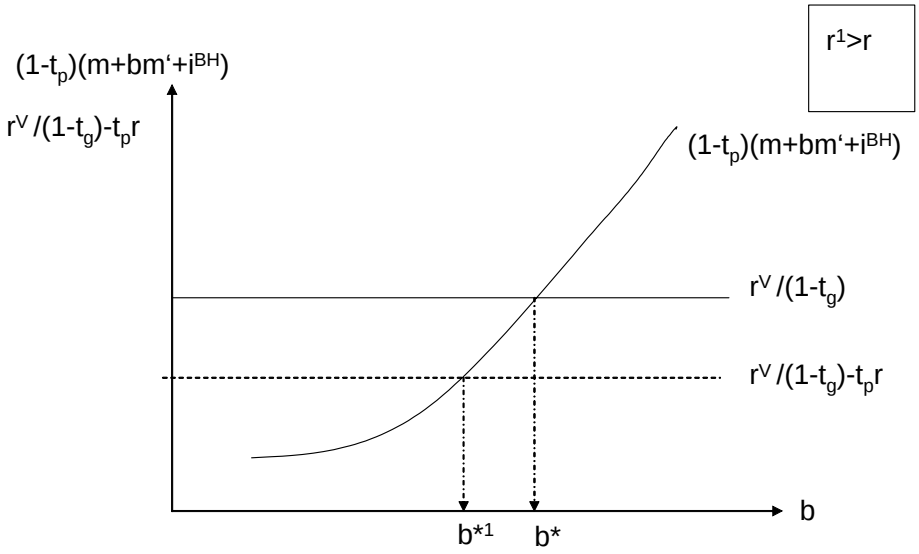
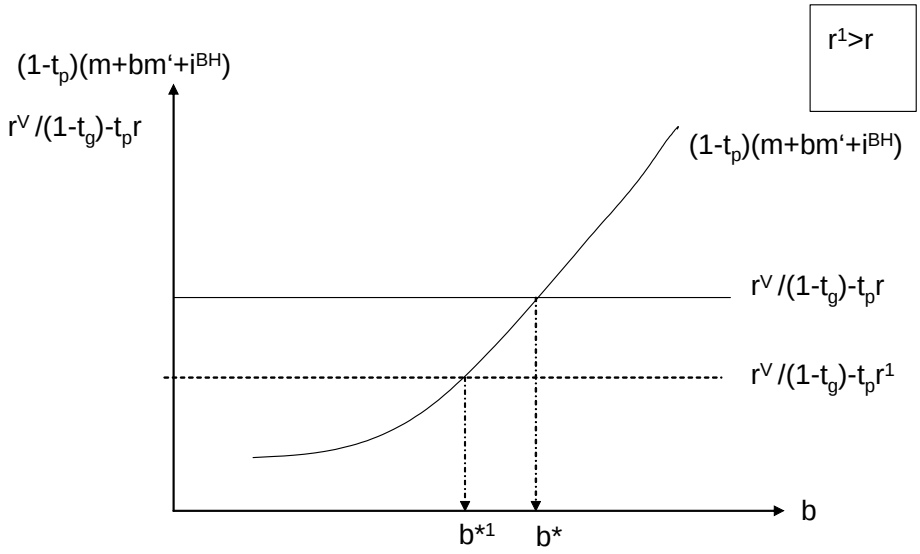


Figure 2 depicts the effects of introducing an ACE on the optimal debt asset ratio. As a result of the reform, the cost of equity (the horizontal line) shifts downwards while the cost of debt remains unchanged. Therefore, the optimal debt asset ratio declines to b^{*1}.

Now, besides the capital gains tax, the profit tax and the level of the imputed return can also induce a preference for either debt or equity finance. Accordingly, not only a higher capital gains tax or a lower profit tax increase the cost of equity $\frac{d\,(re^f - \tau^{P,f} r)}{d\,\tau^{g,f}} > 0$, $\frac{d\,(re^f - \tau^{P,f} r)}{d\,\tau^{P,f}} < 0$ but also a reduction in the imputed return has a similar consequence $\frac{d\,(re^f - \tau^{P,f} r)}{d\,r} < 0$. Therefore, the higher the imputed return which can be deducted from the tax base, the lower the cost of equity and thus the higher the preference for equity finance will be. With the profit tax rate, the situation is a little bit ambiguous. On the one hand, the increase in the profit tax rate reduces the cost of equity, on the other hand, it also reduces the cost of debt since debt interest is also tax deductible. Therefore, the result will depend on the relative difference between the imputed return and the interest rate on firm debt. If both are equal, then both sources of finance are affected in the same way. However, if the imputed return is higher (lower) than the return on debt, there will be a preference for equity(debt) finance.

Figure 3 Effect of an Increase in the Imputed Return
on the Optimal Debt Asset Ratio in case of the ACE



In Figure 3, the initial debt asset ratio is denoted by b^*. If we allow for an increase in the imputed return which can be deducted from the tax base , $r^1 > r$, then the cost of equity declines (accordingly the horizontal line shifts downwards) and the optimal debt asset ratio shrinks to b^{*1}.

If the interest expenditures are tax deductible, an increase in the corporate tax rate will boost the tax advantage of debt finance in case there is no ACE in place. Here, $\frac{d\,b^C}{d\tau^{P,C}} = \frac{r^V/\left[(1-\tau^{G,C})(1-\tau^{P,C})^2\right]}{[2m'(b)+m''(b)]} > 0$ applies (see eq.(15)). For non-corporate firms, an increase in the personal tax rate will also increase the attractiveness of debt finance relative to external equity finance $\frac{d\,b^N}{d\,\tau^{P,N}} = \frac{r^V/(1-\tau^{P,N})^2}{[2m'(b)+m''(b)]} > 0$ (see eq.(15)). However, insofar as mentioned before an imputed return on equity is also deductible, it is not clear which source of finance will be preferred.

3.2.3 Investment Behavior

The shadow price of capital as given in eq.(14a) represents the value of an induced marginal profit. Adding one more unit of capital creates a marginal profit stream consisting of three different components: first, profits increase by the marginal product of capital; second,

due to lower adjustment costs future revenues increase; and third, the interest burden on debt is reduced, as the debt asset ratio decreases.

Combining eq.(14a) and (13b) we get the following expression for the cost of capital

$$F_K^f - \delta = re_t^f \frac{\gamma^{I,f}}{\gamma^{D,f}} - \frac{z_2 \tau^{P,f}}{\theta^{P,f}} r_t^f - m'_f b_f^2. \tag{20}$$

Integrating the last two eq.(20) and (15) the marginal product of capital can be expressed as the weighted sum of the cost of equity capital and external capital, where the debt asset ratio, b_f, serves as a weighting factor. The distinct and more concise formulae which clearly depict the difference between the cost of equity and the cost of debt for corporate and non-corporate firms respectively are found in eq.(22) and (27).

$$F_K^f - \delta = \underbrace{\left\{ \frac{re_t^f}{\gamma^{D,f}} \right\} (\gamma^{I,f} - \Omega^f b_f)}_{\text{cost of equity}} + \underbrace{\left\{ \frac{1 - z_1 \tau^{iP,f}}{\theta^{P,f}} i^{BH} + m_f \right\} b_f}_{\text{cost of debt}} - \underbrace{\frac{z_2 \tau^{P,f}}{\theta^{P,f}} (1 - b_f) r_t^f}_{\text{adv. of ACE}} \tag{21}$$

Without taxes, the investment must offer a rate of return at least equal to depreciation costs and interest so $F_K^f = i^{BH} + \delta$. With taxation, the cost of capital changes as shown in the above equation. The first term on the right hand side indicates the cost of equity finance. The second term, the cost of debt finance consists of interest payments plus the agency cost. The last term indicates the advantage of an a ACE in the case $z_2 > 0$. The propensity to invest also depends on the tax allowance for investments, z_3 , which is included in $\gamma^{I,f}$ and reduces the actual tax burden if $z_3 > 0$.

(a) Corporate firms Inserting the relevant parameters for corporate firms into eq. (20) we can derive the following cost of capital formula for firms belonging to the corporate sector under the present tax schedule prevailing in Germany[19].

$$F_K^C - \delta = \frac{r^V}{\theta^{G,C} \theta^{P,C}} (1 - b_C) + (i^{BH} + m_C) b_C \tag{22}$$

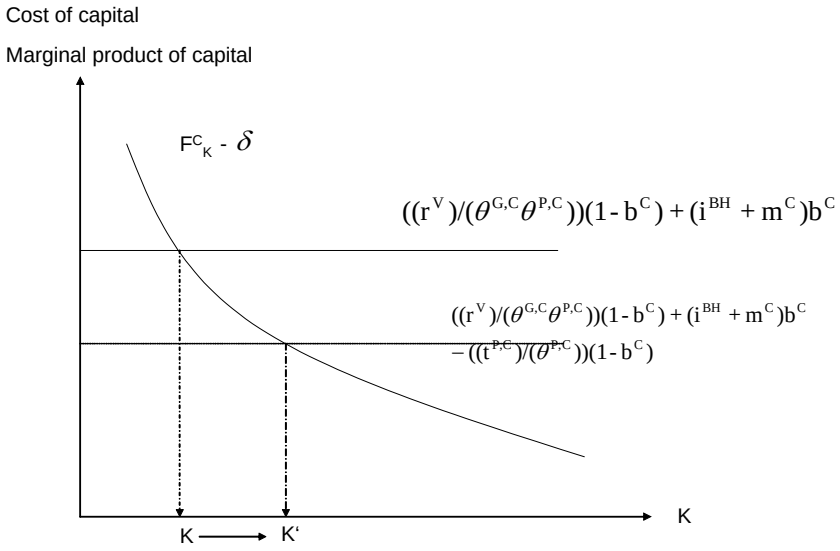
[19]Remember that $\gamma^{D,C} = \frac{\theta^{D,C} \theta^{P,C}}{\theta^{G,C}}$ and $\gamma^{I,C} = \frac{\theta^{D,C}}{\theta^{G,C}}$ as well as $\Omega^C = \frac{\theta^{D,C}}{\theta^{G,C}}$. Moreover we assume $\beta = 0$ indicating that there are no new share issues and that depreciation follows economic depreciation, $z_3 = 0$. Furthermore, we allow for the debt interest deductibility so $z_1 = 1$ and we disregard any allowance for corporate equity so $z_2 = 0$:

If we introduce an ACE, the cost of capital changes to

$$F_K^C - \delta = \frac{r^V}{\theta^{G,C}\theta^{P,C}}(1 - b_C) + (i^{BH} + m_C)b_C - \frac{\tau^{P,C}}{\theta^{P,C}}(1 - b_C)r_t \tag{23}$$

and accordingly declines by the amount of $\frac{\tau^{P,C}}{\theta^{P,C}}(1 - b_C)r_t$.

Figure 4 The Effect of Introducing an ACE on Corporate Firms



In Figure 4 the optimal capital stock is given by the intersection of the downward sloping marginal product curve with the cost of capital represented by the horizontal line. In case we introduce an ACE, the cost of capital line is shifted downwards and accordingly the capital accumulation will increase to K'.

If we apply a CBIT, the cost of capital changes to

$$F_K^C - \delta = \frac{r^V}{\theta^{G,C}\theta^{P,C}}(1 - b_C) + (\frac{1}{\theta^{P,C}}i^{BH} + m_C)b_C \tag{24}$$

and thus the cost of capital increases since the interest on debt is no longer tax deductible.

Figure 5 The Effect of introducing a CBIT on Corporate Firms

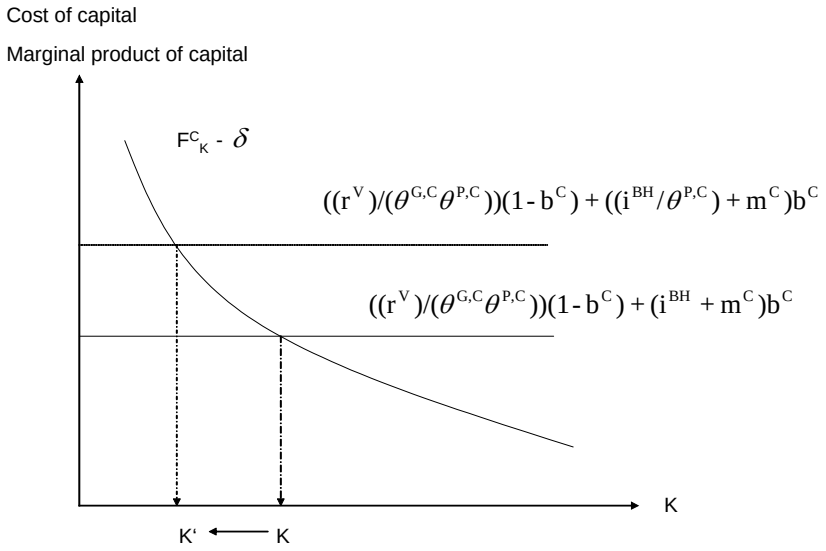


Figure 5 depicts the above described effect on the development of capital. Introducing a CBIT, the capital cost line is shifted upwards such that we will have capital decumulation in the economy.

It is straightforward since we assumed the 'New View' of dividend taxation to apply, that only the capital gains and the profit tax rate affect the cost of capital.

Differentiating (22) with respect to the tax rate under consideration, we find that reducing the corporate income tax has a positive impact on investment, because in each case the cost of capital declines with the effect being highest in case a CBIT is applied. [2021]:

$$\begin{aligned} ACE \quad &: \quad \frac{d\,(F_K^C - \delta)}{d\,\tau^{P,C}} = \frac{r^V}{(1-\tau^{G,C})(1-\tau^{P,C})^2}(1-b_C) - \frac{r}{(1-\tau^{P,C})^2}(1-b_C) > 0, \\ CBIT \quad &: \quad \frac{d\,(F_K^C - \delta)}{d\,\tau^{P,C}} = \frac{r^V}{(1-\tau^{G,C})(1-\tau^{P,C})^2}(1-b_C) + \frac{\tau^{P,C} i^{BH}}{(1-\tau^{P,C})^2} b_C > 0 \end{aligned} \tag{25}$$

The economic implication of an increase in the corporate tax rate is obvious. If the corporate tax rate increases, returns stemming from real investments are more heavily

[20] For the ACE we assume that $r^V > r$ such that the imputed return is lower than the net return on equity (assumed here to be eight per cent).

[21] Since we also assume that the debt asset ratio is optimally chosen, a marginal change in a tax rate has no influence on the optimal debt asset ratio which enters the cost of capital formula.

taxed compared to those from a financial investment which is not subject to the corporate tax rate. Hence, the cost of capital increases resulting in less real investments. The size of this effect will be larger for firms endowed with much equity and smaller for highly indebted firms.

Moreover, under an ACE type of tax system, the cost of capital also depends on the size of the imputed interest. Therefore, the higher the chosen rate, the lower the cost of capital will be since the tax base is narrowed.

$$ACE: \frac{d\ (F_K^C - \delta)}{d\ r} = -\frac{\tau^{P,C}}{\theta^{P,C}}(1 - b_C) < 0 \tag{26}$$

(b) Non-corporate Firms Similarly, inserting the relevant tax factors and parameters for non-corporate firms, we can compute the following cost of capital formula for firms belonging to the non-corporate sector[22]:

$$F_K^N - \delta = \frac{r^V}{\theta^{P,N}}(1 - b_N) + (i^{BH} + m_N)b_N \tag{27}$$

If we introduce an ACE, the cost of capital formula changes to

$$F_K^N - \delta = \frac{r^V}{\theta^{P,N}}(1 - b_N) + (i^{BH} + m_N)b_N - \frac{\tau^{P,N}}{\theta^{P,N}}(1 - b_N)r_t \tag{28}$$

and with a CBIT in place

$$F_K^N - \delta = \frac{r^V}{\theta^{P,N}}(1 - b_N) + (\frac{1}{\theta^{P,N}}i^{BH} + m_N)b_N \tag{29}$$

The striking difference to the cost of capital for corporate firms is the fact that the capital gains tax rate does not appear in this formula. This is so because non-corporate firms can not draw on retained earnings as a marginal source of finance, and accordingly the capital gains tax rate does not influence the investment decision.

The differentiation of eq. (27) with respect to the tax rate under consideration, shows that increasing the personal income tax has a negative impact on investment, because the cost of capital increases.

[22]Remeber here that $\gamma^{D,N} = \frac{\theta^{P,N}}{\theta^{G,N}}$ and $\gamma^{I,N} = 1 - \frac{\tau^{P,N} z_3}{\theta^{G,N}}$ as well as $\Omega^N = 1$. Moreover $z_1 = 1$, $z_2 = 0$, $z_3 = 0$.

$$\text{ACE} \quad : \quad \frac{d\ (F_K^N - \delta)}{d\ \tau^{P,N}} = \frac{r^V}{(1-\tau^{P,N})^2}(1-b_N) - \frac{r}{(1-\tau^{P,N})^2}(1-b_N) > 0 \qquad (30)$$

$$CBIT \quad : \quad \frac{d\ (F_K^N - \delta)}{d\ \tau^{P,N}} = \frac{r^V}{(1-\tau^{P,N})^2}(1-b_N) + \frac{\tau^{P,N} i^{BH}}{(1-\tau^{P,N})^2} b_N > 0 \qquad (31)$$

Here again, a higher imputed return will decrease the cost of capital and thus boost investments.

The remaining buildings blocks of a CGE model, in particular the household as well as the rest of the world, are not considered in detail here, since they are only of minor importance for the theoretical underpinning or the interpretation of the simulation results. Just the next section presents the building block representing the government sector since the way in which we model the tax system, so by providing interest deductibility or not will affect government revenues.

3.2.4 Public Accounts

Via taxation the domestic government introduces various distortions on the behavioral margins of the economic agents. The government total tax revenue TTR_t consists of revenue from the tax levied on corporate and personal income of corporate and non-corporate firms T^P, interest income taxation T^i, labor income taxation T^L, and the taxation of dividend income T^D as well as capital gains T^G.

$$TTR_t = T^P + T^I + T^C + T^L + T^D + T^G + TTIA$$

where

$$
\begin{aligned}
&\text{(a)} \quad T^P &&= T^{P,C} + T^{P,N} \text{ ,}^{23} \\
&&&= \tau^{P,f}[Y^f - J^f - w^f L^f - z_2 r^f (K^f - B^f) - \delta K^f - (z_1 i^{BH} + m^f) B^f - z_3 IN^f] \\
&\text{(b)} \quad T^i &&= \tau^i \left[i^{BH} A^{B,H} + i^H A^{DH,H} + i^F A^{DF,H} \right], \\
&\text{(c)} \quad T^C &&= \tau^C C \text{ ,} \\
&\text{(d)} \quad T^L &&= \tau^L (w_t L_t^S - LTA) \text{ ,} \\
&\text{(e)} \quad T^D &&= \tau^D Div^C \text{ ,} \\
&\text{(f)} \quad T^G &&= \textstyle\sum_{f=C,\ N}^{2} \tau^{G,f} \left[GV_{t+1}^f - V_t^f - VN^f \right] . \\
&\text{(g)} \quad TTIA &&= \tau^i r^f (K^f - B^f)
\end{aligned}
\tag{32}
$$

Business income taxes consist of corporate and personal income tax of domestic corporate and personal firms $T^{P,C} + T^{P,N}$. We can thus see that in case $z_1 = z_2 = 1$ so when both debt interest and the imputed return on equity are tax deductible, the profit tax base shrinks and accordingly also government revenue. Dividend taxes are paid only on dividends of corporate firms. Firms pay the interest on debt plus an agency cost $(i^{BH} + m^f)B^f$ while private households just receive the gross interest on the $i^{BH} A^{B,H}$. Therefore the interest tax can just be levied and the tax revenue from interest taxation includes revenues from interest taxes on domestic firm bonds $A^{B,H}$ as well as on domestic and foreign government bonds accruing to domestic investors $A^{DH,H}$ and $A^{DF,H}$. Here $i^H(i^F)$ denotes the gross interest on domestic (foreign) government bonds. Capital gains taxes contribute to public revenues as noted in eq.(32f) and the labor tax is levied on labor income less a labor tax allowance.

The accumulation of public debt has to cover public consumption C_t^G, the primary deficit and the interest spending on public debt $(1+i^H)D_t^G$. The primary deficit is defined as the difference between lump-sum transfers T_t^H and total tax revenue TTR_t.

$$
GD_{t+1}^G = (1 + i^H) D_t^G + C_t^G + T_t^H - TTR_t \text{ .} \tag{33}
$$

The government debt accumulation is intertemporally constrained. It rules out ex-

[23] The profit tax levied on corporate/non corporate firms is according to equation (3)

penditure increases to finance a budget deficit. A present imbalance has to be offset by a future compensating action. To finance a tax reform that envisages lower income taxes, a scenario which envisages a reduction a change in the VAT to compensate for the revenue loss is considered.

4 Simulation Results

Table 1 summarizes the Status Quo effective German tax rates as well as the main parameters used in the calibration. The behavioral parameters confirm the empirical findings found in the literature.

Table 1 Status Quo Tax Rates

	Status Quo (2004)
Profit Tax, $\tau^{P,C}/\tau^{P,NC}$	0.383/0.454
Labor Tax, τ^{L}	0.295
Tax on Interest Income, τ^{i}	0.443
Dividend Tax, τ^{D}	0.221
Capital Gains Tax, τ^{G}	0.00
VAT, τ^{C}	0.16
Elasticity of Debt-Asset Ratio[a)] (GORDON and LEE 2001)	0.36
Intertemporal Elasticity of Substitution (FLAIG 1988)	0.4
Economic Depreciation Rate	0.1
Elasticity of Factor Substitution (GERMAN CENTRAL BANK 1995)	0.8
Labor supply elasticity (weighted average of FENGE et al. 2002)	0.37
Notes: Elasticity with respect to: [a)] profit tax	
Source: German Ministry of Finance, own calculations	

In the German tax system prevailing in 2004, the statutory corporate tax rate amounts to 25 per cent, but adding the local trade tax and the solidarity surcharge the effective

corporate tax rate comes to 38.3 per cent. On the household level, the progressive labor tax rate reaches a top marginal tax rate of 42 per cent and including the solidarity surcharge amounts to 44.3 per cent.[24] This tax rate also applies to interest income. Taking an average annual income of about € 20,814 as given, the representative individual, according to the prevailing tax bracket, is liable to a marginal income tax of 28 per cent, which, if we add the solidarity surcharge, reaches 29.5 per cent. Moreover, according to the German half income principle, income derived from dividends (distributed profits) is subject to half of the personal income tax rate, while capital gains remain untaxed.

The following Tables depict the simulation results assuming revenue neutrality is achieved by a change in the VAT. We assume the imputed return on equity equals debt interest of six per cent to ensure neutrality with respect to the source of finance. We can see that, given the present tax constellation, introducing an allowance for both corporate and non-corporate equity achieves better results compared to the implementation of a CBIT. Contrary to the usual assumptions made in the literature, we do not apply an alteration in the profit tax to ensure revenue neutrality since there are also other taxes at hand, such as the consumption tax, which can be increased(decreased) in case the tax revenue shrinks(rises) after the policy shock.

[24] The income tax rate applying to non-corporate firms is 45.4 per cent since it also includes part of the local trade tax.

Table 2 Key Economic Figures ACNE (Long Run Change in %)	
GDP	9.1
Capital Stock	20.5
Gross Wage	9.4
Labor Supply	1.7
Current Real Wage	4.7
Disposable Income	6.5
Increase in VAT %-points	5.1
Domestic Consumption	4.6
Welfare in % of Life Time Inc.	0.1
Welfare in % of GDP	0.08
Source: Own calculations	

Table 3 Key Economic Figures CBIT (Long Run Change in %)	
GDP	-5.3
Capital Stock	-10.2
Gross Wage	-4.8
Labor Supply	-1.4
Current Real Wage	-3.7
Disposable Income	-4.3
Change in VAT %-points	-1.3
Domestic Consumption	-4.7
Welfare in % of Life Time Inc.	-1.2
Welfare in % of GDP	-0.7
Source: Own calculations	

Due to the possibility to deduct an imputed return from the profit tax base the cost of capital decreases and accordingly also investments and capital accumulation. The capital stock increases by around 20 per cent for the whole economy inducing an increase in labour demand of five per cent of corporate firms and an increase in aggregate labour supply of 1.7 per cent. The results are driven by the reduction in the cost of capital which decreases by 6.3 per cent and 4.3 per cent for the corporate and non-corporate sector respectively. As opposed to this, the simulation results of the CBIT do not look that good. Since the advantage of being able to deduct debt interest from the profit tax base does not exist anymore, the cost of capital increases by around 10 per cent for corporate firms and by around 22 per cent for non-corporate ones. As a result, the capital stock decumulates for the entire economy by ten per cent. As a result GDP also shrinks by 5.3 per cent, labour demand declines and accordingly gross wages and consumption. Therefore, this reform even induces a decline in welfare by 1.2 per cent in terms of life-time income or 0.7 per cent of GDP. This negative outcome occurs even though as a result of the increased profit tax revenue, a lower VAT of namely 14.7 per cent compared to the former 16 per cent is sufficient to ensure revenue neutrality. The negative impact on the accumulation of

capital and accordingly on gross wages (assuming the same profit tax rate prevails after the reform as well) is so large that it can not be compensated by a lower consumption tax.

Table 4 Anticipated Effects of Introducing an ACE		
	C-Firm	NC-Firm
Cost of Capital	10.6	9.9
EMTR	35.5	37.0
Cost of Capital	9.9	9.5
EMTR	30.1	31.8
Long Run Change in %		
Capital Stock	25	12.6
Labor Demand	5	-4.3
Cost of Capital	-6.3	-4.3
EMTR	-15.5	-14.2
Source: Own calculations		

Table 5 Anticipated Effects of Introducing a CBIT		
	C-Firm	NC-Firm
Cost of Capital	10.6	9.9
EMTR	35.5	37.0
Cost of Capital	11.6	12.0
EMTR	42.4	50
Long Run Change in %		
Capital Stock	2.7	-33.3
Labor Demand	11.1	-24.7
Cost of Capital	9.7	21.8
EMTR	19.3	35
Source: Own calculations		

Given the above results it is interesting to see how such a policy shock would affect economic aggregates if we start from a comparatively lower tax rate instead of the present effective tax rate of 38.3 per cent.

Thus for instance, starting from a tax rate on corporate profits of 25 per cent the picture changes as depicted in Tables 6 to 9. In this case, even under an ACNE welfare decreases by around 0.3 per cent of GDP because the additional advantage of being able to deduct an imputed return from the profit tax base is more than offset by the disadvantage of the higher VAT of 21.5 per cent required to finance the reform. The overall capital stock still increases by around 13 per cent however, labour demand even decreases in the corporate sector.

Table 6 Key Economic Figures ACE

(Long Run Change in %)

GDP	5.5
Capital Stock	12.9
Gross Wage	6.4
Labor Supply	0.6
Current Real Wage	1.5
Disposable Income	6.8
Increase in VAT %-points	5.5
Domestic Consumption	2.9
Welfare in % of Life Time Inc.	-0.45
Welfare in % of GDP	-0.26

Source: Own calculations

Table 7 Key Economic Figures CBIT

(Long Run Change in %)

GDP	-3.9
Capital Stock	-6.5
Gross Wage	-3.5
Labor Supply	-1.0
Disposable Income	-3.1
Change in VAT %-points	-1.3
Domestic Consumption	-3.4
Welfare in % of Life Time Inc.	-1.1
Welfare in % of GDP	-0.6

Source: Own calculations

For the CBIT the results are slightly better than in the base case. Due to the fact that we start from a lower corporate tax, the disadvantage from the lack of debt interest deductibility is now lower. The cost of capital increases by about 5 and 21 per cent respectively for corporate and non-corporate firms inducing a decline in the overall capital stock of 6.5 per cent. Gross wages and thus disposable income and consumption decline resulting in a decrease in welfare by 0.6 per cent in terms of GDP.

Table 8 Anticipated Effects of the Introducing an ACE		
	C-Firm	NC-Firm
Pre-Reform Cost of Capital	9.1	9.9
Pre-Reform EMTR	25.1	37.0
Post-Reform Cost of Capital	8.9	9.4
Post-Reform EMTR	21.7	31.3
Long Run Change in %		
Capital Stock	-2	41.5
Labor Demand	-11.4	22.9
Cost of Capital	-2.6	-4.7
EMTR	-13.4	-15.5
Source: Own calculations		

Table 9 Anticipated Effects of Introducing a CBIT		
	C-Firm	NC-Firm
Pre-Reform Cost of Capital	9.1	9.9
Pre-Reform EMTR	25.1	37.0
Post-Reform Cost of Capital	9.6	12.0
Post-Reform EMTR	29.8	49.8
Long Run Change in %		
Capital Stock	11.1	-40.2
Labor Demand	16.4	-33.4
Cost of Capital	5.0	21.5
EMTR	18.7	34.5
Source: Own calculations		

An additional question to be asked is what happens in case the imputed return differs from the interest rate paid on debt. In case this presumptive return equals the risk-free interest rate on government debt of three per cent for instance, thus being lower than the

interest paid on firm debt, the results change in the following way.

Table 10 Key Economic Figures ACNE (Long Run Change in %)

GDP	3.5
Capital Stock	7.5
Gross Wage	3.5
Labor Supply	0.7
Current Real Wage	2.0
Disposable Income	3.4
Increase in VAT %-points	1.7
Domestic Consumption	2.6
Welfare in % of Life Time Inc.	0.3
Welfare in % of GDP	0.1

Source: Own calculations

Table 11 Anticipated Effects of the Introducing an ACE

	C-Firm	NC-Firm
Pre-Reform Cost of Capital	10.6	9.9
Pre-Reform EMTR	35.5	37.0
Post-Reform Cost of Capital	9.6	9.0
Post-Reform EMTR	28.5	30.1
Long Run Change in %		
Capital Stock	8.9	5.0
Labor Demand	1.9	-1.4
Cost of Capital	-9.3	-8.7
EMTR	-19.9	-18.8

Source: Own calculations

Even though this alternative might not equalize the cost of capital across the different sources of finance, the overall induced macroeconomic effects are better than in the previous case. Since a lower return can be deducted from the tax base, the revenue loss turns out to be smaller and thus the required increase in the VAT rate to balance the government budget is lower, thus leading to positive welfare results.

For the CBIT such a reform alternative does nor influence the results since no imputed return on equity can be deducted.

Now, the question which can be asked refers to the alternative of financing the reform by an exogeneous change in the tax rates on corporate and non-corporate profits.

If we try to simulate a reform which envisages the introduction an ACE which is financed by an exogeneous increase in the profit tax rate we can see that this rate can not be high enough to compensate for the costs of the reform since even at vary large values transfers to households still decrease. This result occurs since our dynamic general equilibrium model captures a wide range of effects and economy-wide repercussions and a

high profit tax rate will have a substantial negative effect on investments, capital accumulation, GDP and labour demand thus shrinking the tax base of the other taxes as well and requiring an adjustment in transfers to finance such a reform. If we performed our analysis in a two-period framework, in which only the second period budget needs to be balanced, the simulations show that the introduction of the ACE needs to be accompanied either by an increase in the corporate tax rate to 53.5 per cent so by 15.2 percentage points or by a simultaneous increase in the tax rate on corporate profits from 38.3 to 46.5 per cent and in the tax rate on non-corporate profits from 45.4 to 54.5 per cent other things being equal. However, such a calculation does not account for the negative outcome such an increase brings about for other macroeconomic variables.

In case a CBIT is implemented in a two period framework, the possible reduction in tax rates which assure in the second period a balanced budget is tremendous. Accordingly, for instance a reduction of almost ten percentage points in both tax rates, leading to a corporate tax of 27.5 per cent and a tax on non-corporate profits of 35.5 per cent lead to the same overall tax revenue as before the reform where debt interest was still tax deductible. The same result is achieved if just the corporate tax rate is reduced to 20.5 per cent other things being equal. Nevertheless, once again such a computation neglects the economy-wide repercussions which can be captured by our dynamic general equilibrium model whose strength is just this particular computation and evaluation of overall effects of a tax reform.

If we perform a simulation where an exogeneous change in the profit tax rates assure that the long-run steady state transfers do not have to adjust, we can see that a corporate tax rate of 31 per cent and a tax rate on non-corporate profits assure in case of a CBIT a balanced budget. Removing the advantage of debt interest deductibility accompanied by reduced tax rate on corporate profits brings about the following

results:

Table 12 Key Economic Figures CBIT (Long Run Change in %)	
GDP	-1.4
Capital Stock	-0.02
Gross Wage	-1.1
Labor Supply	-0.4
Current Real Wage	-1.6
Disposable Income	-1.0
Domestic Consumption	-1.1
Welfare in % of Life Time Inc.	-0.6
Welfare in % of GDP	-0.3
Source: Own calculations	

Table 13 Anticipated Effects of Introducing a CBIT		
	C-Firm	NC-Firm
Pre-Reform Cost of Capital	10.6	9.9
Pre-Reform EMTR	35.5	37.0
Post-Reform Cost of Capital	10.6	10.9
Post-Reform EMTR	36.0	43.8
Long Run Change in %		
Capital Stock	10.1	-25.2
Labor Demand	11	-21.6
Cost of Capital	-0.2	10
EMTR	1.4	18.2
Source: Own calculations		

Of course, these results may change if a CBIT is accompanied c.p. just by a reduction in the corporate tax or just in the tax rate on non-corporate profits. However, the overall message is clear: Even though the usual line presented in the literature states that a CBIT might have positive effects because of the lower profit tax rates which apply and which constitute a positive signal for investors, the simulation results show that the overall effect on the cost of capital is negative, thus inducing a negative outcome on investments, capital accumulation and welfare.

5 Conclusion

The aim of this paper was to discuss two main reform alternatives of corporate income taxation. On the one hand, the ACE as suggested by the IFS Capital Taxes Group which provides for the reduction of an imputed return on equity from the profit tax base and on the other hand the CBIT which abolishes the preferential debt treatment by eliminating debt interest deductibility. Both policy scenarios align the cost of capital for investments financed by debt or equity. Under the ACE the tax base the profit tax base becomes narrower such that opponents of this reform argue a higher corporate tax rate is necessary

to finance a certain tax revenue; this outcome is however not desirable for a small open economy in a world of high capital economy where the profit tax rate acts as a signalling device. Nevertheless, if we assume the reforms are financed by a change in the VAT rate and not in the profit tax rate, our simulation results show that introducing an ACE leads to better results for investment, capital accumulation and welfare. This outcome occurs since the CBIT raises the cost of capital and induces negative consequences for investment. Firms will reduce their labour demand, gross wages will decrease and even though a lower VAT rate applies this is not enough to compensate the negative effects of the reform. Moreover, if the imputed return on equity is lower than the interest on firm debt, the reform leads to an even higher increase in welfare since the required increase in the VAT to finance the reform is smaller. Therefore, in our model of two open economies with capital flows which interact with each other the ACE achieves welfare improving results and is to be preferred relative to a CBIT.

If we perform simulations which provide for a change in the profit tax rate to assure revenue neutrality, we can see that the in case of the ACNE, these taxes cannot be high enough to finance such a reform in a dynamic general equilibrium framework. This outcome occurs since in such a model, the higher profit tax rates have negative effects on capital accumulation and thus labor demand and other macroeconomic variables. These substantial negative economy-wide repercussions make just the change in the profit tax rate insufficient; this must be accompanied either by a change in transfers or in the VAT to ensure the government's budget is balanced.

For a CBIT, things look different. Even though the reform proposal envisages to abolish the possibility of deducting debt interst, the accompanying substantial exogeneous reduction in profit tax rates has better results than when the reform is financed by an endogeneous change in the VAT.

Nevertheless, the performed simulations show that the ACNE leads to better welfare improving results in case the reform is financed by a change in the VAT and it is not advisable to finance such a reform by an increase in the tax rates on corporate or non-corporate profits since these would have considerable negative economy-wide repercussions.

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