Corporate Taxes and Internal Borrowing within Multinational Firms

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Abstract

This paper develops a theoretical model of multinational firms with an internal capital market. Main reasons for the emergence of such a market are tax avoidance through debt shifting and the existence of institutional weaknesses and financial frictions across host countries. The model serves to derive hypotheses regarding the role of local versus foreign characteristics such as profit tax rates, lack of institutional quality, financial underdevelopment, and productivity for internal debt at the level of a given foreign affiliate. The paper assesses hypotheses in a panel data-set covering the universe of German multinational firms and their internal borrowing. Numerous novel insights are gained. For instance, the tax-sensitivity found in this paper is many times higher than previous research suggests. This accrues mainly to three things: the consideration of the boundedness of the internal debt ratio as a dependent variable in comparison to its treatment as an unbounded variable in most of the previous work; the coverage of all (small and large) multinationals here rather than a focus on large units in previous work; and the inclusion of endogenous characteristics in other countries multinationals are invested in (due to endogenous weights), while previous work did not consider such effects at all or assumed them to be exogenous. Moreover, local and foreign (at other locations of a given affiliate) market conditions matter more or less symmetrically and in the opposite direction. There is a nonlinear trade-off between institutional quality or financial development on the one hand and higher profit tax rates on the other hand, and the strength of this trade-off depends on the characteristics of one location relative to the other ones a multinational firm has affiliates (or the headquarters) in.

Key words: Internal capital market; Debt shifting; Multinational firms; Firm-level data; Microeconometrics

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1 Introduction

> *... in a credit-constrained setting [...] headquarters can create value by actively reallocating scarce funds across projects. For example, the cash flow generated by one division's activity may be taken and spent on investment in another division, where the returns are higher.*
>
> Jeremy Stein (1997, p. 111)

A recent literature in corporate finance explores how large corporations allocate scarce funds to different company divisions through an internal capital market (see Gertner and Scharfstein, 1994; Stein, 1997; Bolton and Scharfstein, 1998; Scharfstein and Stein, 2000). A prime example of such multi-unit companies are multinational enterprises (MNEs) which operate affiliated entities in different countries. In principal, each plant could operate as a separate unit and independently raise external funds to finance investment, just like any other local firm. Similar to other forms of multi-unit firms, productivity may differ across the units (affiliates) within MNEs. However, in contrast to domestic (single-country) multi-unit firms, MNEs are exposed to different corporate tax rates, institutional quality, or levels of financial development. Unit-specific productivity and local corporate tax rates determine the return on capital across units. Local institutional quality (such as legal, accounting, or governance standards) affect the accessibility of external capital markets. Similarly, the maturity of the financial sector (or its development) influence the loan rates charged at external capital markets and, hence, the cost of capital. In case of scarce resources, differences in these fundamentals (even in the absence of tax differentials) across countries and locations of units of an MNE then generate an incentive to reallocate capital across units to their most efficient use through an internal capital market. An important consequence of this procedure is that investments of different units within the same MNE then become interrelated.

This paper postulates a theoretical model of affiliates of MNEs which are financially constrained to different degrees. All units raise external funds at local capital markets and, in addition, borrow or lend at the MNE's internal capital market. The presence of financial constraints entails an excess return on investment. In our model, tighter constraints imply higher returns on investment. We illustrate as to how an MNE optimally allocates internal funds among units facing lesser constraints and ones with tighter constraints through an internal capital market. This internal borrowing and lending renders investment of units of an MNE different from stand-alone, but otherwise comparable, local firms which cannot rely on an internal capital market. By ignoring reasons for an internal capital market beyond the variability of profit tax rates, earlier research on the matter comes to the strong hypothesis that only the affiliate facing the lowest tax rate should lend and all others borrow internally to exploit the tax advantage of interest deductions.

The model proposed in this paper predicts a much richer pattern of internal capital flows that cannot be explained by standard models without capital market frictions. Differences in unit-specific productivity, local institutional quality, and financial institutions may amplify or offset differences in profit tax rates so that internal capital can flow in any direction. Empirical work ought to control for such fundamentals of the internal capital market to be able to identify the effect of corporate tax rates on internal borrowing and lending.

Furthermore, since an operative internal capital market renders investments across plants inherently interdependent, not only the lowest profit tax rate but the tax rates of all units are relevant.

We utilize the panel data-set *Microdatabase Direct Investment* (MiDi) provided by Deutsche Bundesbank (the German Central Bank) containing information about the universe of foreign affiliates of all German MNEs to shed light on both aforementioned aspects of internal capital markets: the dependence of the internal capital market on fundamentals beyond tax rates such as institutional quality and financial development at the location of units; and the relevance of profit tax rates, productivity, and (financial and other) institutions not only at the unit with the most favorable environment but also at other locations for internal borrowing and lending.

Using a fractional response model, our main results imply that a one-percentage point higher statutory tax rate in the host country is associated with a 0.92-percentage point higher internal-debt-to-capital ratio of the borrowing affiliate. At the same time, a one-percentage point increase in the (weighted) tax rate of the lending affiliates is associated with a 0.77-percentage point lower internal-debt-to-capital ratio of the borrowing affiliate. Other determinants of internal debt show the same qualitative pattern. While financial underdevelopment in the host country is positively related to the internal debt ratio of the borrowing affiliate, financial underdevelopment at other locations exerts a negative effect on the internal debt ratio of the borrowing affiliate. Financial weakness in the host country is associated with a higher internal debt ratio of the borrowing affiliate, but financial weakness at the lender locations leads to a lower internal debt ratio of the borrowing affiliate. A higher affiliate-level productivity of the borrowing affiliate relates positively to its internal debt ratio, but a higher productivity of the lenders exerts a negative impact on the internal debt ratio of the borrowing affiliate (it should be mentioned, however, that productivity measures are found to be statistically insignificant).

The next section sets out to portray the state of earlier theoretical and empirical work on internal capital markets and MNEs. Sections 3 and 4 introduce and analyze, respectively, the theoretical model. Section 5 describes the empirical approach taken and introduces the data. Section 6 summarizes and discusses the empirical results, and the last section concludes.

2 Previous Work on Debt Shifting

A substantial literature in public economics has investigated theoretically and empirically how tax rate differences induce international profit shifting via internal debt and other channels. MNEs with affiliates in different countries tend to exploit differences in tax rates to reduce consolidated tax payments. Devereux (2007) provides an overview of the literature. In Mintz and Smart (2004), for example, the subsidiary in the country with the lowest tax rate lends to other units subject to higher tax rates. This tax arbitrage is profitable since interest earnings in the tax haven country are only lightly taxed, while interest deductions in high-tax countries create large tax savings. Typically, the literature assumes reduced-form 'agency costs' of debt such that a deviation from a natural leverage ratio and a positive internal debt ratio create rising deadweight costs that eventually limit the amount of debt shifting (see

Fuest and Hemmelgarn, 2005; Huizinga et al. 2008; Buettner et al., 2009; Overesch, 2009; Egger et al., 2010; for example). Empirical results find that debt shifting is important, and undermines corporate tax revenue in high-tax countries (Huizinga et al., 2008) since MNE subsidiaries are much higher leveraged than autonomous national firms (Egger et al., 2010). On the positive side, the possibility of debt shifting can facilitate investment in high-tax countries (Overesch, 2009).

Desai et al. (2004) estimate that 10% higher local corporate tax rates are associated with 2.8% higher affiliate debt-to-asset ratios. One interesting result of their analysis is that the elasticity of external borrowing with respect to the tax rate is 0.19, while the elasticity of internal borrowing is 0.35. Mintz and Smart (2004) argue that income shifting has pronounced effects on provincial tax bases in Canada. They estimate the elasticity of taxable income with respect to tax rates for income shifting firms to be 4.9 and only 2.3 for other, comparable firms. Egger et al. (2010) find a substantial difference in the debt-to-asset ratios between foreign and domestically owned firms and report a strong interaction effect between plant operation mode and tax rates. An increase in the statutory corporate tax rate by one percentage point leads to an increase in the debt ratio by about 0.7 percentage points.

Some papers recognize more interaction of internal lending among affiliate units, as opposed to the unidirectional flow of debt from the unit with the lowest tax rate to all others with higher rates. Huizinga et al. (2008) find that debt financing of a subsidiary in a given country significantly depends on a weighted average of tax rate differentials to all other units.

Desai et al. (2004) point to the fact that internal debt not only responds to tax rate differentials but is also importantly influenced by financial market development and institutional quality. They find that multinational affiliates obtain less external debt in countries with underdeveloped capital markets and higher local borrowing costs. Internal debt substitutes for about three quarters of reduced external borrowing due to adverse local capital market conditions. Buettner et al. (2009) confirm this result using data on German multinationals. Antràs et al. (2009, p. 1208) argue, as does this paper, that 'the exploitation of technology is central to understanding MNE activity, but the critical constraint is the nature of capital market development and investor protection in host countries.' Their focus is, however, on the choice of arm's length trading relative to foreign direct investment (FDI), rather than tax-induced internal debt shifting. Like the present paper, they develop an MNE model with credit rationing of local production units in the spirit of Holmstrom and Tirole (1997) and explain how institutional and capital market variables determine the parent's decision to acquire a larger equity stake and thereby co-finance the local production unit rather than choosing an arm's length relationship. Their empirical analysis confirms that weak investor protection and adverse local capital market conditions in the host country limit the scale of MNE activity.

The recent empirical literature thus leads us to believe that MNEs operate internal capital markets not only to exploit tax rate differentials across countries but, perhaps more importantly, to overcome institutional and financial investment barriers in host countries. Our analysis of internal capital markets implies that firms tend to withdraw internal funds from less profitable units and reallocate them to operations with an above-average return on investment but limited access to external financing. Compared with the existing literature

on internal debt shifting, our analysis yields two central and novel results. First, investments in different units tend to be inherently interrelated. Second, the tax motive may reinforce or offset the economic motive of using internal debt, leaving no clear-cut pattern of internal debt flows. In spite of the tax disadvantage, internal funds may easily flow to high-tax countries for good economic reasons.

Similarly, albeit in a different context, Lamont (1997) provides evidence that investments are interrelated among different affiliates: when major oil companies' cash flows were hard-hit by the oil price decline of 1986, leaving them with much reduced own funds, they cut investment across the board, both in oil and non-oil related divisions.[1] Gopalan, Nanda, and Seru (2007) argue that intragroup loans are typically used to support financially weaker firms, e.g., to avoid default within the MNE with consequent negative spillovers to other affiliates. For example, a bankruptcy in a group causes a significant decline in external financing, investments and profits of other affiliates and an increase in their bankruptcy probability.

3 A Model of Internal Capital Markets

3.1 Definitions

Assume that there is an MNE with n subsidiaries in different countries. The total net value of the MNE is $V^H = \sum_j V_j$, where V_j refers to the value of a single, wholly-owned subsidiary in country j, and index H refers to the headquarters. The MNE is endowed with total equity or own funds $\sum_j A_j$ from previous operations. The distribution of equity across locations is historically pre-determined and exogenous. To finance investment in excess of own funds, each affiliated entity raises external debt from the local capital market. In addition, the MNE can operate an internal capital market and lend to subsidiaries with the largest need for investment funds. Internal debt may also be used to minimize the global tax bill by shifting profits to low-tax locations.

If investment I_j at plant j is successful, it yields an end-of-period value $I_j + Y_j$, where I_j is undepreciated capital, and $Y_j = \theta_j f(I_j)$ is the cash-flow function satisfying $f' > 0 > f''$ with θ_j denoting productivity. Assuming that investment opportunities exceed own funds, $I_j > A_j$, the subsidiary has to raise internal debt D_j and external funds. The latter consist of passive bank credit B_j and active, monitoring bank credit M_j. Hence, investment in location j is financed by $I_j = A_j + D_j + B_j + M_j$. Denote the loan rates charged by standard banks by i. Since monitoring is costly and might vary across countries, loan rates charged by active banks, i_j^M, could differ, despite of an integrated savings market with a common deposit rate.

The subsidiary is successful with probability p and fails with probability $1 - p$. If it fails, cash-flow is zero and no debt, neither internal nor external, is repaid. Accordingly, the

[1] Agency problems within firms could be of different nature, leading to underinvestment due to credit rationing or overinvestment due to self-serving managers and misuse of excess internal funds (Jensen, 1986). Lamont (1997) points out that interdependence of affiliate investments may result from either type of agency problems. Our key results do not essentially depend on which paradigm we adopt.

end-of-period value of the subsidiary is determined as

$$V_j = p\left[I_j + Y_j - (1+i)(B_j + D_j) - \left(1 + i_j^M\right) M_j - T_j\right] - RA_j. \tag{1}$$

Assets could earn a safe return $r \geqslant 0$ on the deposit market. For convenience, we utilize the acronym $R \equiv 1+r$. Active banks also incur monitoring costs cI_j proportional to investment, where c is a cost parameter. For lending to be profitable, expected repayment of internal debt and external debt from passive banks, respectively, must satisfy $p(1+i)D_j \geq RD_j$ and $p(1+i)B_j \geq RB_j$, while monitored lending requires $p\left(1+i_j^M\right)M_j \geq RM_j + cI_j$. Assuming competition, these participation (zero profit) constraints must hold with equality. Thus, the loan rate on risky debt is given by $p(1+i) = R$. To cover monitoring costs, informed banks must charge a higher rate, determined by $p\left(i_j^M - i\right)M_j = cI_j$, so that $i_j^M \geqslant i$. Using zero profit conditions, subsidiary value is equal to

$$V_j = p(I_j + Y_j - T_j) - (R+c)I_j, \tag{2}$$

which is repatriated to the parent as an end-of-period 'dividend'.[2]

The corporate tax liability owed in the source country is T_j. In line with common tax practice, interest on debt is deductible while the return on equity A_j is not, so that

$$T_j = \tau_j \cdot \left[Y_j - i(D_j + B_j) - i_j^M M_j\right]. \tag{3}$$

If $D_j > 0$, the subsidiary is a borrower and receives internal debt. If $D_j < 0$, it is a lender in the internal capital market. When a subsidiary in a low-tax country lends one dollar – creating a small tax liability $\tau_l i$ on interest earnings – to another affiliate in a high-tax country – yielding large tax savings $-\tau_h i$ from interest deductions there – the global tax is reduced by $-(\tau_h - \tau_l)i$. Differences in tax rates across countries introduce a tax motive to use internal debt in order to shift profits to low-tax locations. This tax motive may reinforce or offset other economic motives to use internal debt to allocate scarce capital to those units with the most profitable investment opportunities.

In the internal capital market, lending and borrowing over all subsidiaries must balance and add up to zero. The total NPV of the MNE firm over all its operations is

$$V^H = \sum\nolimits_j V_j \quad s.t. \quad \sum\nolimits_j D_j = 0, \tag{4}$$

where $V_j = p\left[(1-\tau_j)(Y_j - iI_j) - (1-\tau_j)\left(i_j^M - i\right)M_j - \tau_j i A_j\right]$ results upon substituting (3) and zero-profit conditions together with $I_j = A_j + D_j + B_j + M_j$. We will emphasize the case $i_j^M = i$, implying $V_j = (1-\tau_j)p(Y_j - iI_j) - \tau_j ipA_j$, where the last term is due to the tax disadvantage of equity.

[2]There is a slight abuse of language. Strictly speaking, V_j is a surplus of end-of-period wealth over the opportunity cost RA_j. The expected dividend payment to the parent firm amounts to $p\left[Y_j - i(D_j + B_j) - i_j^M M_j - T_j\right]$. In addition, the parent gets expected interest payments piD_j.

3.2 Investment and External Borrowing

Timing: In maximizing the value in (4), the MNE makes a sequence of decisions. Given a pre-determined distribution of equity, it (i) allocates loans $D_j \gtrless 0$ on the internal capital market; (ii) raises external debt B_j and M_j from local banks and sets subsidiary investments I_j; (iii) induces managerial and monitoring efforts in all units; and (iv) pays back external funds and repatriates dividends. We solve backwards and begin with stage (iii).

Effort: We assume that the headquarters choose effort to manage n subsidiaries. The success probability p is high if managerial effort allocated to subsidiary j is high. It is low ($p_L < p$) if the headquarters neglect the subsidiary (low effort) and, instead, consume a private benefit $\Gamma_j I_j$ proportional to investment. The parent obtains the expected surplus of the subsidiary (income over opportunity cost of funds), consisting of the *sum* of repayment of internal debt and of repatriated dividends in (1),

$$v_j^h(p) \equiv p\left[I_j + Y_j - T_j - (1+i)B_j - \left(1+i_j^M\right)M_j\right] - R(A_j + D_j). \tag{5}$$

Except for the success probability, the value v_j^h in stage (iii) is fixed by the choice of contract terms in earlier stages. The incentive constraint to assure high effort (avoid private benefits) is $v_j^h(p) \geqslant v_j^h(p_L) + \Gamma_j I_j$. Substituting (5) yields

$$p\left[I_j + Y_j - T_j - (1+i)B_j - \left(1+i_j^M\right)M_j\right] \geqslant \gamma_j I_j, \quad \gamma_j \equiv \Gamma_j \cdot p/(p-p_L). \tag{6}$$

The subsidiary's success probability is high only when incentives are strong. The parent's *total* surplus must thus at least amount to $\gamma_j I_j$ to assure high effort. For this reason, the contract in stage (ii) must restrict external lending and not claim too high a repayment to keep the firm incentivized with high enough residual earnings.

When the financing contract is set in stages (i-ii), the active bank has already assigned resources cI_j to monitoring. After the contract is set, these resources might be diverted to other uses, i.e., monitoring is not contractible either. Its purpose is to reduce private benefits from a high Γ_j' to a low Γ_j. Suppose (6) is satisfied if both monitoring and managerial effort are high. The monitor keeps $v_j^m(p) = \left[p\left(1+i_j^M\right) - R\right]M_j$. If she diverts resources cI_j and fails to monitor, Γ_j rises to a high value Γ_j', thereby violating the incentive constraint (6) and discretely reducing the firm's success probability to a low $p_L < p$. With low effort, she would thus get a lower expected income $v_j^m(p_L) = \left[p_L\left(1+i_j^M\right) - R\right]M_j$ but obtain income cI_j from diverted resources. To assure monitoring, the contract must satisfy the incentive constraint $v_j^m(p) \geqslant v_j^m(p_L) + cI_j$, or

$$p\left(1+i_j^M\right)M_j \geqslant \mu_j I_j, \quad \mu_j \equiv c \cdot p/(p-p_L). \tag{7}$$

External Financing and Investment: Investment and borrowing in stage (ii) are governed by optimal contracts that specify the amount of external funds and the rates of interest. Formally, banks compete with contracts that maximize the MNE's surplus in (5) subject to incentive constraints for managerial and monitoring effort and participation (zero profit) constraints for active and passive banks. In the optimum, all constraints are binding. In

maximizing own value, the MNE fully extracts rents from external investors so that participation constraints must bind. A sufficient condition for the incentive constraint (6) to bind is that $p_L \to 0$. If the constraint were violated, low effort would reduce the success probability to zero. Either the bank could not break even and would not be willing to lend, or the firm would not want to invest. In principle, the MNE could do without active financing and exclusively rely on passive bank credit.[3] We state in (12) a condition that monitoring is valuable and firms demand informed capital. The MNE sets the minimum repayment in (7) that assures monitoring and, given this repayment, extracts a financing contribution until the monitor's participation constraint binds.

The financial contracts (i, B) and (i^M, M) for passive and active external financing are determined by the fact that all four constraints are binding in the optimum. The loan rate on passive debt is, thus, given by $p\,(1+i) = R$. The active bank's participation constraint together with (7) yields

$$M_j = \frac{\mu_j - c}{R} \cdot I_j = \frac{p_L}{p - p_L} \frac{c}{R} \cdot I_j, \quad 1 + i_j^M = (1+i)\,\frac{\mu_j}{\mu_j - c}. \tag{8}$$

In equilibrium, the firm raises a fixed fraction of investment as monitoring capital for which it pays $i_j^M > i$. Any need for further external funding must come from residual bank credit $B_j = I_j - A_j - D_j - M_j$. Substituting this and the monitor's zero-profit condition into the incentive constraint (6) shows how the firm can raise value by expanding investment. The firm optimally invests until the constraint becomes binding,

$$V_j = p\left[(1-\tau_j)\,(Y_j - iI_j) - \tau_j i A_j\right] - (1-\tau_j)\,cI_j \geq \gamma_j I_j - R\,(A_j + D_j)\,. \tag{9}$$

Given a level of own funds A_j and a level of internal debt D_j allocated by the MNE, scaling up investment is possible only if the subsidiary is able to raise additional external debt. When more debt-financed investment raises the r.h.s. of (9) at a faster rate than the l.h.s., see Assumption (A) below, the constraint eventually becomes binding. At that level of lending, the firm has exhausted its debt capacity. Banks cannot extend more credit since this would violate the incentive constraint and lead to a discrete reduction in the success probability. In this case, either the bank could not break even or the MNE would suffer a discrete loss in the joint surplus V_j. Hence, investment and external borrowing are implicitly determined by the binding constraint (9) as a function of internal debt, the tax rate, and other parameters. Figure 1 illustrates the solution for the case when the firm exclusively relies on standard bank credit ($c = 0$ and $i = i^M$). The curved line corresponds to the l.h.s., while the upward sloping, straight line stands for the r.h.s. of (9). In the absence of a financing constraint, subsidiary investment is at the first-best level that maximizes the expected value on the l.h.s., $\theta_j f'\left(I_j^{FB}\right) = i$, so that the marginal return is equal to the user cost of capital i. Taxes are not distorting the user cost since investment is financed with 100% debt *at the margin* with interest being fully deductible.

– Insert Figure 1 here –

[3] In fact, Section 4 analyzes a small introduction of active financing, starting with a level of zero.

If agency costs γ_j are sufficiently large, and since high agency costs reduce the firm's pledgeable income, investment becomes constrained and is no longer determined by user costs. When raising more external debt to expand investment, firms hit the financing constraint before reaching the first-best level. Being constrained, they earn an excess return on investment, $\rho_j > 0$. At the intersection point in Figure 1, the slopes satisfy $\gamma_j > \rho_j$. For this to be a well-determined equilibrium, we assume

$$R + \rho_j > \gamma_j > \rho_j \equiv (1 - \tau_j) \left[p \left(\theta_j f' \left(I_j \right) - i \right) - c \right] > 0. \tag{A}$$

Figure 1 illustrates how the parent can relax the subsidiary's financing constraint and expand investment in location j if it allocates more internal debt. Other determinants of investment are plant productivity θ_j, the profit tax rate τ_j, and agency costs $\gamma_j = \gamma \left(l_j, m_j \right)$. A firm's financing capacity depends positively on the quality of the legal and institutional environment (l_j) and on the monitoring effectiveness of active banks (m_j). Tighter accounting standards, for example, make management more accountable, narrow down the possibility to shirk and enjoy private benefits and are, thus, associated with a lower γ_j. Active oversight by informed intermediaries, captured by m_j, similarly reduces private benefits and boosts debt capacity. In other words, more monitoring or institutional improvements reduce private benefits by

$$\gamma_j = \gamma \left(l_j, m_j \right), \quad d\gamma_j / dl_j = -1, \quad d\gamma_j / dm_j = -\sigma. \tag{10}$$

To obtain analytical results, we need to take the total differential of (9),[4]

$$\begin{aligned} dI_j &= k_j R \cdot dD_j - k_j p \left(Y_j - i I_j + i A_j \right) \cdot d\tau_j \\ &+ k_j \left(1 - \tau_j \right) f \left(I_j \right) p \cdot d\theta_j + k_j I_j \cdot dl_j + k_j I_j \left[\sigma \cdot dm_j - \left(1 - \tau_j \right) \cdot dc \right], \end{aligned} \tag{11}$$

where $k_j \equiv 1 / \left(\gamma_j - \rho_j \right) > 0$. The concavity of $f \left(I_j \right)$ implies that investment is concave in internal funds, $d^2 I_j / dD_j^2 = k_j^2 R p \left(1 - \tau_j \right) \theta_j f_j'' \cdot dI_j / dD_j < 0$. The first inequality of assumption (A) implies $k_j R > 1$. Receiving a unit of debt from other affiliates boosts investment more than proportionately, i.e., internal debt is levered by additional external debt, $dB_j / dD_j = dI_j / dD_j - 1 = k_j R - 1 > 0$.

A higher local tax rate reduces subsidiary investment by eroding cash-flow and tightening the financing constraint, $dI_j / d\tau_j < 0$. In Figure 1, the profit curve would shift downwards in response, leading to a reduction of affiliate investment. When the subsidiary becomes more productive, it generates higher earnings at each level of investment which boosts pledgeable income, improves access to external financing and expands investment, $dI_j / d\theta_j > 0$. In Figure 1, the profit curve shifts up. Tighter accounting standards, associated with more corporate transparency and lower agency costs, boost investment, $dI_j / dl_j > 0$. Finally, we consider financial development in the sense that monitoring, given a constant cost c, becomes more effective and yields larger benefits. Financial development refers to an increase in active oversight by monitoring banks. A more active style of business finance, captured by an exogenous increase in monitoring productivity, reduces private benefits by $d\gamma_j / dm_j = -\sigma$.

[4]All derivatives for comparative static analysis are taken at a point of $c = 0$ so that $i^M = i$ is fixed by $p \left(1 + i \right) = R$ and $M_j = 0$.

It thereby raises pledgeable income, relaxes the financing constraint, and boosts investment by $dI_j/dm_j = \sigma k_j I_j$.

Financial development can affect investment only if firms demand informed capital in the first place. We must thus state a condition for monitored financing to exist. Monitoring is beneficial for firms since it raises the financing capacity by reducing private benefits and boosting pledgeable earnings (see above). However, monitoring also imposes extra costs and makes informed capital more expensive relative to standard credit. By adding costs, $dc_j = c \cdot dm_j$, it reduces investment in (11), giving $dI_j = [\sigma - (1-\tau_j)\, c]\, k_j I_j \cdot dm_j$ in total. For the *net* effect to be positive, we must assume that the benefits of monitoring exceed its cost, $\sigma > (1-\tau_j)\, c$. Firms attract informed capital only if it adds value. From (9), the introduction of monitored financing yields

$$dV_j = \rho_j \cdot dI_j - (1-\tau_j)\, I_j \cdot dc_j = [\rho_j \sigma - (1-\tau_j)\, c\gamma_j]\, k_j I_j \cdot dm_j. \tag{12}$$

We assume $\sigma > (1-\tau_j)\, c\gamma_j/\rho_j > (1-\tau_j)\, c$ for monitoring capital to be in demand. The last inequality is implied by (A). Given that firms rely on both sources of credit, we consider a productivity gain that makes monitoring more effective while the cost per unit of investment remains constant. In this sense, financial development unambiguously boosts investment and value by $dI_j = \sigma k_j I_j \cdot dm_j$ and $dV_j = \rho_j \cdot dI_j$, respectively.

3.3 Internal Capital Market

Value of a Subsidiary: We now show how the MNE, in stage (i), allocates funds on the internal capital market. Capital is moved to where it generates the highest return and adds the greatest value. Figure 1 illustrates how the subsidiary value depends on the level of internal capital received from other units. Allocating more internal debt relaxes the financing constraint and boosts investment. The larger scale increases subsidiary value in proportion to the excess return ρ_j. Differentiating (9) and using (11) yields

$$\begin{aligned} V_D^j &\equiv \frac{dV_j}{dD_j} = \rho_j \frac{dI_j}{dD_j} = \rho_j k_j R > 0, \\ V_{DD}^j &\equiv \frac{d^2 V_j}{dD_j^2} = (1+\rho_j k_j)\, k_j R \cdot p\,(1-\tau_j)\, \theta_j f_j'' \frac{dI_j}{dD_j} < 0. \end{aligned} \tag{13}$$

The derivative V_D^j represents the return on internal debt, showing by how much the value of subsidiary j rises if it receives more funds. The second equation shows that the subsidiary value is concave in the allocated level of internal debt.

Allocating Internal Debt: We assume that subsidiaries are historically endowed with an amount of equity or internally accumulated funds A_j. Affiliate value is a function of total capital provided internally. Using λ to denote the Lagrange-multiplier, the MNE's global optimization problem $V^H = \max_{D_j} \sum_j [V(D_j; \ldots) - \lambda \cdot D_j]$ leads to

$$V_D^j(D_j; \tau_j, \theta_j, l_j, m_j) = \lambda = V_D^i(D_i; \tau_i, \theta_i, l_j, m_j), \quad \sum\nolimits_j D_j = 0. \tag{14}$$

The MNE operates an internal capital market to allocate funds to those units where the return is highest. The internal capital allocation is optimal when returns are equalized. As noted in (13), the marginal value functions are downward sloping in the level of internal debt. Figure 2 shows how the allocation changes with a country-specific shock (see the next section) for the case of an MNE with two affiliates.

– Insert Figure 2 here –

Condition (14) includes tax and economic motives to use internal debt. Holding everything else constant, loading subsidiary i with more internal debt reduces the tax liability and raises its value in (2) by $dV_i = p\tau_i i \cdot dD_i$. If taxes are high in location i and low in j, i.e., $\tau_i > \tau_j$, internal lending from affiliate j to i ($dD_i = -dD_j$) boosts MNE value by an amount equal to global tax savings, $dV^H = p\left(\tau_i - \tau_j\right) i \cdot dD_i$. However, internal debt also serves economic functions and raises subsidiary value in location i by relaxing the financing constraint, see Figure 1. The need to do so depends on other fundamental country and plant characteristics which may reinforce or offset the tax motive.

4 Determinants of Internal Debt

We start from a symmetric situation where A_j and all other parameters are identical. Initially, there is no reason, neither tax nor economic, to use internal debt, i.e., $D_j = 0$. The comparative static analysis reveals how certain structural changes make subsidiary establishments different from local firms. Intuition suggests that those subsidiaries which face the tightest financing constraints (due to high taxes τ_j, inefficient capital markets with ineffective monitoring m_j, bad legal environment reflected in low l_j, and high factor productivity θ_j creating large investment opportunities, etc.), have the highest excess return and should attract the largest internal credit. In the following analysis we start with $M_j = c = 0$, leaving $\rho_j = \left(1 - \tau_j\right) p\left(\theta_j f_j' - i\right)$, and often assume that financial constraints are not too tight and excess returns are small.

Corporate Tax: Suppose that country 1 raises the tax rate and becomes a high-tax location. Standard reasoning suggests that local subsidiaries should attract internal debt to save taxes. In addition, the higher tax reduces firms' pledgeable income and makes them more constrained relative to plants in other regions, creating yet another reason to shift internal funds towards the high-tax country. Altogether, a higher tax rate should raise the return to internal debt in that country. The derivative of (13) yields

$$V_{D\tau}^j \equiv \frac{d^2 V_j}{dD_j d\tau_j} = \left(1 + \rho_j k_j\right) k_j R \left[-p\left(\theta_j f_j' - i\right) + \left(1 - \tau_j\right) p\theta_j f_j'' \frac{dI_j}{d\tau_j}\right] > 0. \tag{15}$$

The term in square brackets reflects the change in excess return, $d\rho_j/d\tau_j$. The tax directly reduces the return, giving rise to a negative first term. The second term is positive since lower investment yields a higher excess return. If the financing constraint is not too tight and the excess return is small in the outset, the first term is close to zero, leaving an overall

positive effect. The return on internal debt rises when subsidiary j gets taxed more heavily, $V^j_{D\tau} > 0$. In Figure 2, the schedule V^1_D shifts upwards in response.

Since a higher tax diminishes the subsidiary's external financing capacity, the MNE gets more constrained at location 1. Given a higher return on internal debt, the MNE makes plant 1 borrow internally ($dD_1 > 0$) from other subsidiaries which become lenders, $dD_j < 0$. Analytically, the differential of (14) when only country 1 raises the tax rate gives $V^1_{DD} \cdot dD_1 + V^1_{D\tau} \cdot d\tau_1 = d\lambda$ and $V^j_{DD} \cdot dD_j = d\lambda$. Summing over all plants and using $\sum_j D_j = 0$ together with symmetry, $V^j_{DD} = V_{DD}$, yields

$$\frac{d\lambda}{d\tau_1} = \frac{V^1_{D\tau}}{n} > 0, \quad \frac{dD_j}{d\tau_1} = \frac{V^1_{D\tau}}{nV_{DD}} < 0, \quad \frac{dD_1}{d\tau_1} = -(n-1)\frac{V^1_{D\tau}}{nV_{DD}} > 0. \tag{16}$$

Starting from symmetry, the higher tax makes the plant in country 1 more constrained so that the excess return becomes larger than at other locations. Internal borrowing makes the MNE more constrained in other locations as well so that the marginal value of a unit of debt rises by a common factor $dV^j_D = d\lambda$. This is illustrated in Figure 2.

Factor Productivity: Turning to economic fundamentals, we argue that MNEs shift capital towards more productive plants. Higher productivity affects the return to internal debt only via its impact on the excess return which is proportional to $d\left(\theta_j f'_j\right)/d\theta_j = f'_j + \theta_j f''_j \frac{dI_j}{d\theta_j}$. The productivity shock directly boosts the excess return but the induced investment brings it down again. If the technology is not too concave (f'' small),[5] the second term is small which establishes the positive sign in (17). When investment in location j gets more profitable compared to elsewhere, the return to internal debt rises:

$$\begin{aligned} V^j_{D\theta} &= (1+\rho_j k_j)\, k_j R \cdot p\,(1-\tau_j)\left[f'(I_j) + \theta_j f''(I_j)\frac{dI_j}{d\theta_j}\right] > 0, \\ \frac{dD_1}{d\theta_1} &= -(n-1)\frac{V^1_{D\theta}}{nV_{DD}} > 0, \quad \frac{dD_j}{d\theta_1} = \frac{V^1_{D\theta}}{nV_{DD}} < 0. \end{aligned} \tag{17}$$

The same steps as in (16) show that MNEs allocate funds towards more productive units. Starting from symmetry, a higher productivity boosts the return on capital and makes the firm more constrained. A more productive plant has a larger excess return than other ones and, therefore, offers a higher return on internal funds. For this reason, the MNE makes plant 1 borrow internally from other, less productive units. The borrowing makes the MNE more constrained in other locations so that the marginal value of a unit of debt rises by a common factor $dV^j_D = d\lambda$. Figure 2 illustrates this argument when replacing τ_1 by θ_1.

The literature in public economics predominantly uses reduced-form models of internal debt, predicting that internal lending should flow only from low- to high-tax jurisdictions. In our model, the internal lending pattern is more complex. Consider a situation where location

[5] Assume $f(I) = I^\alpha$, so that $f''f/f' = -\frac{1-\alpha}{\alpha}f'$. Substitute $dI/d\theta = k(1-\tau)fp$ and get $d(\theta f')/d\theta = \left[1 - \theta f' \cdot \frac{1-\alpha}{\alpha} k(1-\tau)p\right] f'$. With $\theta f' \sim i$ and the multiplier k not much larger than one (consistent with a realistic leverage factor $dI/dD = kR$), the term in square brackets is positive for values $\alpha > 1/2$.

1 faces a low tax rate and lends to other units. Starting from a symmetric equilibrium as in the preceeding subsection, this situation is created by a negative tax shock $d\tau_1 < 0$. All other units face relatively higher tax rates and take on internal debt. Suppose now that plant 1 becomes more productive, $d\theta_1 > 0$. Given capital market frictions, it cannot raise enough funds on the external capital market and needs to borrow internally to accommodate the increased investment opportunities. Obviously, if the productivity difference to other units is large enough, plant 1 becomes a net internal borrower in spite of being located in a low-tax country. One can easily compute an 'exchange rate' (reflecting the respective trade-off), giving the size of the compensating productivity differential required to offset the tax rate differential such that the level of internal debt remains unchanged. Using (16) and (17) yields

$$\left.\frac{d\theta_1}{d\tau_1}\right|_{dD_1=0} = -\frac{\partial D_1/\partial \tau_1}{\partial D_1/\partial \theta_1} = -\frac{V^1_{D\tau}}{V^1_{D\theta}} < 0. \tag{18}$$

The upshot is that the pattern of internal debt not only depends on tax rate differentials but also on other firm and country-specific characteristics so that the flow of internal debt cannot be predicted by looking at tax rate differentials alone.

Institutional Development: A country's institutional environment may be an important determinant of capital market frictions. MNEs might then use internal debt to offset the negative influence. For example, better accounting standards and corporate governance rules make management more accountable to outside stakeholders and reduce the moral hazard problem. This improves access to the local, external capital market and reduces the reliance on scarce internal funds. Better institutions should thus lead the MNE to release internal resources to other affiliates operating in countries with a less developed legal system.[6] Institutional improvement reduces the return on internal debt. More formally, $V^j_{Dl} = \rho_j k_j^2 R + (1+\rho_j k_j)\, k_j R \cdot \frac{d\rho_j}{dI_j}\frac{dI_j}{dl_j}$. With good governance, managerial incentive problems are less severe, $d\gamma_j = -dl_j$ in (10), and pledgeable income is higher. In allowing for more externally financed investment, a better legal system would actually raise the return on internal debt, because the plant can earn the excess return on a larger investment scale, see the term $\rho_j k_j^2 R$. However, this effect is small if the excess return ρ_j is small. More importantly, the additional investment erodes the return on capital and, thereby, the return on internal debt. This negative effect is non-negligible ($\rho_j \to 0$ leaves $V^j_{Dl} = k_j R \frac{d\rho_j}{dI_j}\frac{dI_j}{dl_j} < 0$). On net,

$$\begin{aligned} V^j_{Dl} &\equiv \frac{d^2 V_j}{dD_j dl_j} = \rho_j k_j^2 R + (1+\rho_j k_j)\, k_j R \cdot p\,(1-\tau_j)\,\theta_j f''(I_j)\,\frac{dI_j}{dl_j} < 0, \qquad (19)\\ \frac{dD_1}{dl_1} &= -(n-1)\,\frac{V^1_{Dl}}{nV_{DD}} < 0, \quad \frac{dD_j}{dl_1} = \frac{V^1_{Dl}}{nV_{DD}} > 0. \end{aligned}$$

By improving access to local finance, institutional development reduces the return on internal debt, i.e., shifts down the return schedule V^1_D in Figure 2, and triggers a flow of internal debt

[6] The excess return should be high in a country with bad institutions. Antràs and Caballero (2009) show that capital does not flow from rich to poor countries, although the return on investment there is high. They do not address the role of MNEs to overcome local capital market problems.

Table 1: Allocating internal debt

Shocks to country 1		dD_1	dD_j
Corporate income tax	$d\tau_1 > 0$	$(+)$	$(-)$
Firm level productivity	$d\theta_1 > 0$	$(+)$	$(-)$
Institutional weakness	$dl_1 < 0$	$(+)$	$(-)$
Financial underdevelopment	$dm_1 < 0$	$(+)$	$(-)$

towards other countries with less developed institutions.

Financial Development: We study financial development in the sense that local intermediaries become more productive in exercising oversight and control. More effective monitoring reduces private benefits, $d\gamma_j = -\sigma \cdot dm_j$, which, in turn, raises a firm's pledgeable income and financing capacity. It thus boosts investment by $dI_j = \sigma k_j I_j \cdot dm_j$ as in (11), and raises affiliate value by (12). With better access to the local capital market, there is less need for internal debt. The return on internal debt in (13) declines by

$$V_{Dm}^j \equiv \frac{d^2 V_j}{dD_j dm_j} = \sigma\rho k^2 R + (1+\rho k)\, kR \cdot \frac{d\rho_j}{dm_j} < 0. \tag{20}$$

The first term is positive and arises because monitoring directly reduces agency costs which boosts the investment multiplier. The second, negative term results as monitoring increases investment, which reduces the excess return via the negative impact on the return on capital f', $d\rho_j/dm_j = (1-\tau_j)\, p\theta f'' \cdot dI_j/dm_j < 0$. If credit constraints are not too tight, the total effect is negative. Letting $\rho \to 0$ leaves $V_{Dm}^j = kR \cdot d\rho_j/dm_j < 0$. Repeating the steps in (16) yields

$$\frac{dD_1}{dm_1} = -(n-1)\,\frac{V_{Dm}^1}{nV_{DD}} < 0, \quad \frac{dD_j}{dm_1} = \frac{V_{Dm}^1}{nV_{DD}} > 0. \tag{21}$$

Financial development relaxes the financing constraint and makes it less profitable to allocate funds to an affiliate with better access to external funds. Financial development in country 1 reduces the return on internal debt and makes affiliate 1 an internal lender. Funds flow to affiliates in other regions, turning them into borrowers.

Empirical Implications: Table 1 summarizes the most important results. Internal debt is used to equate the marginal value of a dollar of internal funds across locations when there are constraints on external debt. The flow of internal debt is thus driven by tax *and other* economic considerations. In particular, there is no clear-cut pattern any more between tax rates and profit shifting via internal debt when countries not only differ by tax but also along other economic fundamentals. Suppose that country 1 is a *high-tax* country and also has a well *developed* financial sector, $\tau_1 > \tau_j$ and $m_1 > m_j$. Clearly, the higher tax creates positive internal debt, $dD_1 > 0$, while financial development ($dm_1 > 0$ in Table 1) leads to

less internal debt, $dD_1 < 0$. It improves access to external funding which allows MNEs to economize on scarce internal funds and reallocate them to other units operating under more constrained conditions. Obviously, these two country differences can offset each other.

5 Data and Empirical Approach

In what follows, we seek to identify how internal borrowing responds to both local incentives and global incentives created within an MNE that holds affiliates in different countries. The above model suggests that incentives to lend or borrow among units within MNEs arise from differences in productivity, corporate income taxation, institutional quality, and financial development across locations. In this section, we introduce the data and empirical approach utilized to infer how local versus global aspects matter and illustrate that not only features of the most-favorable market (within the firm) but also those of other locations matter for the internal capital market.

5.1 Specification of Country-specific and Affiliate-specific Fundamentals of the Internal Capital Market

Let us use θ_{it}, τ_{it}, l_{it}, and m_{it} to denote productivity, the corporate profit tax rate, institutional quality, and the level of financial development, respectively, at the location of affiliate i in year t. Let us refer to any of these fundamentals by $\iota_{it} \in \{\theta_{it}, \tau_{it}, \phi_{it}, \kappa_{it}\}$, where, to simplify matters, l (institutional quality) and m (financial development) as used in Sections 3 and 4 have been replaced by $\phi = |l - \max\{l\}|$ and $\kappa = |m - \max\{m\}|$ measuring *institutional weakness* and *financial underdevelopment*, respectively, so that ι_{it} is defined such that a higher level thereof ceteris paribus raises the incentive towards internal debt for affiliate i in t. According to the theoretical model, affiliate j then has ceteris paribus an incentive to provide internal debt to affiliate i whenever $\iota_{it} > \iota_{jt}$ (see Table 1 for the individual comparative static effects).

Let us describe informally how we will account for the incentives of the lending entities with regard to fundamental ι_{it}. Affiliate i may borrow from other affiliates in different countries within the same MNE according to Sections 3 and 4. For the sake of simplicity, we analyzed the case of a firm with symmetric affiliates in Sections 3 and 4. This was sufficient to make the general channels of influence transparent. The data on multinational firm networks are of course much more complex than a model could and should be. In particular, there is a general heterogeneity about affiliates and host countries. However, some general features of the analysis in Section 4 should prevail. For instance, in case that affiliates are attractive lenders to other units of a firm because of fundamentals (affiliate-level productivity, financial underdevelopment, or institutional weakness), the incentive to borrow from those "natural lender" affiliates for a "natural borrower" affiliate (because of the same fundamentals) should rise if the tax rate of the "natural borrowers" declines absolutely and relatively compared to the "natural lenders". Hence, the argument that not only local tax policy and other fundamentals at the borrower's site but ones at the lenders' sites matter remains intact. To capture this argument, we account for the affiliate-i-specific incentive to

borrow internally in relation to fundamental ι_{it} by considering the weighted (indicated by superscript w) average level of that fundamental over all affiliates j of the same MNE *with at most as favorable an environment w.r.t. that fundamental* towards internal debt financing, ι_{it}^{w}.[7] This average fundamental ι_{it}^{w} involves weights that are based on the lending capacity each affiliate of an MNE exhibits.[8] With this strategy, both local borrowing incentives and global lending incentives to the firm matter jointly for a given affiliate's internal debt ratio as in Sections 3 and 4. Moreover, even though countries are symmetric, there are only two parameters to be estimated on each fundamental variable: one for local borrowing conditions and one for global lending conditions to the firm.

For a formal treatment, let us define a binary variable

$$b_{\iota,ijt} = \begin{cases} 1, & \text{if } \iota_{it} > \iota_{jt}, \\ 0 & \text{otherwise,} \end{cases} \tag{22}$$

which, in words, is unity if fundamental ι is more favorable to internal debt financing at i's location than at j's in year t and zero otherwise. Furthermore, let us define the set of affiliates I_{it}, which consists of all units that belong to the same MNE as i in year t, except for ones in the same country as i. Let us denote the internal lending carried out by unit j in t with f_{jt}. Then, we may define the relevant share or weight of j in the lending capacity i has access to within the same MNE among all affiliates in year t as

$$w_{\iota,ijt} = \begin{cases} \frac{b_{\iota,ijt} f_{jt}}{\sum_{j \in I_{it}} b_{\iota,ijt} f_{jt}}, & \text{if } b_{\iota,ijt} f_{jt} > 0, \\ 0 & \text{otherwise.} \end{cases} \tag{23}$$

The incentive of any affiliate i of an MNE in year t to use internal debt financing arises (ceteris paribus) from the fundamentals, ι_{it}, and the fundamentals at other locations of the same firm, ι_{it}^{w}, where the latter are defined as

$$\iota_{it}^{w} = \begin{cases} \iota_{it}, & \text{if } \iota_{it} = \min_j(\iota_{jt}), \\ \sum_{j \in I_{it}} w_{\iota,ijt} \iota_{jt} & \text{otherwise.} \end{cases} \tag{24}$$

To acknowledge the lending capacity within each MNE comprehensively, $\sum_{j \in I_{it}}$ runs over all units, including the German parent, even though the parent does not surface in the affiliate-level data on internal debt below. Suppose affiliate i faces the least favorable fundamental ι_{it} in the group in year t for internal debt financing. Then, by design of (24), $\iota_{it}^{w} = \iota_{it}$. Hence, the differential $\iota_{it} - \iota_{it}^{w} \geq 0$ is a compact measure of the (ceteris paribus) incentive to use cross-border internal debt according to ι_{it}.[9] Notice that all fundamentals ι_{it} and ι_{it}^{w} vary over time for the average affiliate which permits conditioning on affiliate-specific fixed effects and to identify the parameters on ι_{it} and ι_{it}^{w} from the time dimension within affiliates.

[7] Recall that one specific aspect of the above model is that, from a specific fundamental's point of view, there is an incentive to use cross-border internal debt from affiliates in countries with a less favorable environment, depending on the configuration of other fundamentals. We will come back to this issue below.

[8] Internal lending of all German affiliates and the headquarters is observed in the data (see Section 5.3).

[9] Of course, other fundamentals may generate incentives for internal borrowing or lending beyond a specific ι_{it} in the theoretical model in Sections 3 and 4.

5.2 Capturing Incentives for Internal Debt with Several Fundamentals

If countries or, generally, units within a firm differed only in one dimension – say, the corporate profit tax rates they face – the internal capital market would be determined by a bivariate model where only affiliate i's and the minimally taxed affiliate's tax rate (within an MNE) would matter. With several fundamentals for the internal capital market as in the theoretical model outlined in Sections 3 and 4, we arrive at a multivariate empirical model. Moreover, there is a trade-off between more favorable market conditions in some dimensions (profit taxes, institutions, financial development, or productivity) and less favorable ones in other dimensions. Hence, the sharp rules for relevant borrowing or lending relationships for the fundamentals $\iota_{it} \in \{\theta_{it}, \tau_{it}, \phi_{it}, \kappa_{it}\}$ in (22) do not have to hold at the stated precision. This is in line with the model in Sections 3 and 4.

There are several options to relax those conditions, and we chose to implement heuristic degrees of imprecision by modifying (22) to

$$b_{\iota,ijt} = \begin{cases} 1, & \text{if } \iota_{it} > \iota_{jt} - r\sigma_{\iota,i}, \\ 0 & \text{otherwise,} \end{cases} \tag{25}$$

where $\sigma_{\iota,i}$ is the standard deviation of fundamental ι_{it} calculated across all observations for the MNE that affiliate i belongs to, and $r \in \{0.1, 0.5, 1.0\}$ is a heuristic scaling factor. We relax the sharp conditions for internal debt financing in (22) by up to one standard deviation of the respective fundamental for each affiliate i in year t. Notice that, in line with the model in Sections 3 and 4, the approach in (25) implies that units in a firm may not only borrow from ones with, say, a less favorable (lower) tax rate but also from ones with a more favorable (higher) tax rate, as long as the disincentive to borrow entailed by the tax rate alone is compensated by other favorable characteristics.

5.3 Data

The empirical investigation relies on the MiDi database (Microdatabase Direct Investment) collected by Deutsche Bundesbank. Two aspects of MiDi are particularly noteworthy. First, above a minimum reporting threshold, we observe all foreign affiliates held by German MNEs.[10] The fact that MiDi reports the universe of German MNEs is especially important for our analysis, as it allows determining tax and other incentives to use internal debt in a comprehensive way across all units, taking into account MNEs' activities in almost all countries of the world, including all affiliates and the German parent firm. Second, MiDi does not only provide information about the affiliates' *total* debt but also about *internal* borrowing. Specifically, firms have to report *liabilities to affiliated enterprises linked with the*

[10] All German firms and households which hold 10% or more of the shares or voting rights in a foreign enterprise with a balance-sheet total of more than 3 million Euros are required by law to report balance-sheet information to Deutsche Bundesbank. Indirect participating interests have to be reported whenever foreign affiliates hold 10% or more of the shares or voting rights in other foreign enterprises. The reporting requirements are set by the Foreign Trade and Payments Regulation. For details and a documentation of MiDi, see Lipponer (2009).

party required to report through participating interests (see Lipponer, 2009). We are particularly interested in the determinants of *cross-border* internal borrowing and lending, which is supposedly used by MNEs to shift profits. Hence, we focus on cross-border transactions among units (affiliates and the parent company) excluding all debt from affiliated entities that are located in the same country as the borrowing entity.[11] The data-set available to us comprises 45,608 affiliates of German MNEs over the period 1996 to 2007. Altogether, our empirical analysis is based on 227,558 observations over this time span.

According to the theoretical model, the aforementioned fundamental determinants of the internal capital market should be included in an empirical model of internal debt financing. Our empirical analysis includes the following variables as determinants of internal debt of affiliate i: (i) *corporate income tax (host)* denotes the statutory income tax rate faced by affiliate i in year t, τ_{it}; (ii) *weighted corporate income tax (other locations)* is the lending capacity-weighted corporate income tax rate as defined in equation (24), τ_{it}^{w}; (iii) *financial underdevelopment (host)* is a variable that captures the financial underdevelopment at the location of i in year t, κ_{it}; (iv) *weighted financial underdevelopment (other locations)* is the lending capacity-weighted financial underdevelopment as defined in equation (24), κ_{it}^{w}; (v) *institutional weakness (host)* is a variable that captures the institutional weakness of the host country of i in year t, ϕ_{it}; (vi) *weighted institutional weakness (other locations)* is the lending capacity-weighted institutional weakness at the other locations as defined in equation (24), ϕ_{it}^{w}; (vii) *affiliate-level productivity OP (host)* is affiliate i's productivity as estimated by the method of Olley and Pakes (1996), θ_{it}; (viii) *weighted affiliate-level productivity (other locations)* is the lending capacity-weighted productivity (Olley and Pakes, 1996) from other affiliates within the MNE that affiliate i belongs to in year t as defined in equation (24), θ_{it}^{w}.[12]

Beyond the variables suggested by our theoretical model, some other factors might affect

[11] In the context of our model, reasons for internal borrowing from other affiliates in the same market could only be productivity differences, since other aspects (profit taxation, institutional standards, financial development) are similar for such units.

[12] Note that in robustness tests we use alternative specifications for the productivity variable. The estimator of Olley and Pakes (1996) accounts for three salient features of technology: endogenous input choice by firms; dynamics (sluggish adjustment of productivity); and selection (variability of total factor productivity of stayers versus exiters with selection of inefficient firms into exiting). We utilize (i) affiliate-level log turnover (value added is not reported in the data) as the dependent variable, (ii) log number of employees and log financial and other assets as inputs (intermediate goods are not recorded in the data), (iii) affiliate age and log fixed assets as state variables, (iv) log net investment (the first difference of fixed assets) as the proxy variable which is monotonically related by assumption to the unobserved total factor productivity state variable. Throughout, we condition on a time trend as an additional control variable. The estimator involves three steps. In a first step, the decision to exit (versus remaining in) the market is estimated for an affiliate, conditional on affiliate-level productivity to be lower (equal to or greater than) some threshold level, and conditional on the (log) fixed assets and age of the foreign affiliate. The exit rule follows a dynamic process (where we assume a first-order Markov process) about the latent productivity state variable. We employ a probit model to estimate this selection equation. In a second step, investment is determined as a function of productivity, fixed assets (i.e., the capital stock), age, and a time trend. The inverted investment function allows solving for the productivity state variable. In a third step, assuming some production function (in our case, as is customary in the literature, a Cobb-Douglas production function), output is related to production factors (employment and fixed assets), age, a time trend, and the latent productivity state variable.

internal debt. For some affiliates, the costs of external borrowing, i.e., issuing bonds or borrowing from banks, might be comparatively low. One explanation for the better access to external debt may be that affiliates differ in their opportunities to borrow against collateral. Therefore, we include the variable *Tangibility* which reflects the fixed-to-total-asset ratio of affiliate i in year t. Asset tangibility is associated with higher liquidation values and can facilitate debt financing since a possible liquidation of a firm gets less costly for shareholders as well as for debt holders. Higher liquidation values may also facilitate more effective management control since a liquidation threat becomes more credible.[13] Harris and Raviv (1990) find a positive correlation between companies' liquidation value (proxied by the fraction of tangible assets) and the optimal debt level. A positive effect of tangibility on leverage is also confirmed by Rajan and Zingales (1995), who investigate the determinants of capital structure of public firms in G-7 countries. Bernardo, Cai, and Luo (2001) emphasize another case that might explain a positive relationship between tangibility and internal debt. They argue that clear repayment and interest rules can solve information problems associated with long-term investment projects. A high share of fixed assets (high tangibility) may indicate that the share of long-term investment projects is high and, therefore, internal debt – associated with regular interest payments – may be the preferred source of finance. Tangibility may as well capture another aspect that generally affects the use of debt. De Angelo and Masulis (1980) point out that non-debt tax shields – such as depreciation allowances or investment tax credits associated with fixed assets – may crowd out the value of interest deduction. Accordingly, tangibility may also negatively affect the internal-debt-to-capital ratio of a firm since alternative opportunities to reduce the corporate tax burden apart from debt are available.

Furthermore, we include the variable *Loss carryforward*, which is defined as a binary variable that is unity if affiliate i carries forward losses in period t and zero otherwise. Since taxable profits in the current period can be credited against losses carried forward, the benefits of additional interest deductions may be crowded out as additional interest payments only result in new losses that can be carried forward into consecutive periods (see, e.g., MacKie-Mason, 1990). For this reason, we may expect that *Loss carryforward* is negatively related to internal debt. If, however, a loss carryforward indicates that the affiliate is financially distressed, more internal debt might be provided by the parent or other affiliated entities to support the firm (see Gopalan, Nanda, and Seru, 2007).

We also use *Sales* to capture the size and cash flow of affiliate i in year t. With either interpretation, higher sales are associated with more favorable lending conditions in terms of external debt (see Graham and Harvey, 2001). In addition, higher sales may also imply that a firm is more capable to retain earnings. Both arguments suggest a negative impact on internal debt.

The fact that MiDi provides panel data allows us to control for aggregate common year-specific effects. This captures not only simultaneous aggregate shocks in host countries but also changes in German taxing and lending conditions as all parent firms are based in

[13] At the cost of complexity, one might include a liquidation value βI, $\beta < 1$, in the model which can be accessed by creditors in case of failure and therefore allows additional debt financing. Higher tangibility would be associated with a higher β.

Germany. Another advantage of panel data is that we can use affiliate-specific fixed effects to control for all unobservable time-invariant factors of influence on an affiliate's internal debt. This might be important as different affiliates can have different optimal internal debt ratios, depending on affiliate-specific unobservable costs and benefits.

The first and second moments of all dependent and independent variables used in the regressions with the lending capacity or the internal debt ratio as dependent variables are summarized in Table 2.

– Include Tables 2 and 3 here –

As already emphasized above, the unique features of the MiDi data allow us to identify virtually all relevant activities of German MNEs abroad. Table 3 provides some information about the geographical distribution of foreign affiliates of German MNEs. In terms of the total number of observations, the table shows that the USA, France, and the United Kingdom are the most important host countries to German MNEs.

5.4 The Internal Debt Ratio as a Fractional Response Variable

An affiliate's internal debt ratio is necessarily bounded between zero and one. A linear regression model will not generally obey those bounds and involve similar problems as linear probability models do. This calls for an appropriate estimation technique, where the marginal effect of any explanatory variable is not constant over the support region (see Papke and Wooldridge, 1996, for further discussion). We follow Papke and Wooldridge (2008) in estimating a panel-data fractional response model with the debt ratio as the dependent variable, first assuming strict exogeneity of all regressors, and then allowing lending capacity – which is used in the weights $w_{\iota,ijt}$ in (23) – to be endogenous.

The response variable is the cross-border internal-debt-to-total-capital ratio for affiliate i at time t, denoted by $ID_{it} \in [0,1]$.[14] We assume the conditional expectation of ID_{it} to be

$$E[ID_{it}|\mathbf{x}_{it}, c_i] = \Phi(\mathbf{x}'_{it}\boldsymbol{\beta} + c_i), \tag{26}$$

where $\Phi(\cdot)$ is the standard normal cumulative distribution function, $\mathbf{x}_{it}$ is a column vector of explanatory variables, $\boldsymbol{\beta}$ is the corresponding column vector of parameters to be estimated, and c_i is a time-constant affiliate-specific unobserved effect which is allowed to be correlated with all explanatory variables. $\mathbf{x}_{it}$ includes the fundamentals ι_{it} and ι^w_{it} for all $\iota \in \{\theta, \tau, \phi_{it}, \kappa_{it}\}$ as introduced in Subsection 5.1. $\mathbf{x}_{it}$ also includes affiliate-specific control variables as introduced at the end of Subsection 5.3 and time dummy variables.

With regard to the modeling of c_i, we follow the so-called Mundlak-Chamberlain-Wooldridge device (see Mundlak, 1978, Chamberlain, 1982, 1984, and Wooldridge, 2002) as in Papke and Wooldridge (2008) and assume that c_i is normally distributed conditional on $\mathbf{x}_{it}$. They define

$$c_i = \psi + \overline{\mathbf{x}}'_i\boldsymbol{\xi} + a_i, \qquad a_i|\overline{\mathbf{x}}_i \sim \text{Normal}(0, \sigma_a), \tag{27}$$

[14] Note that the data allow us to focus on cross-border internal borrowing. Hence, ID_{it} does not include internal borrowing from affiliates active in the same country.

where $\overline{\mathbf{x}}_i \equiv T^{-1}\sum_{t=1}^{T} x_{it}$ is a column vector of the time-averaged explanatory variables for affiliate i and σ_a is the conditional variance of c_i. Plugging this expression into (26), we obtain

$$E[ID_{it}|\mathbf{x}_{it}, c_i] = \Phi(\psi + \mathbf{x}'_{it}\boldsymbol{\beta} + \overline{\mathbf{x}}'_i\boldsymbol{\xi}/(1+\sigma_a)^{1/2}) \quad (28)$$

$$\equiv \Phi(\psi_a + \mathbf{x}'_{it}\boldsymbol{\beta_a} + \overline{\mathbf{x}}'_i\boldsymbol{\xi_a}), \quad (29)$$

and see that $\boldsymbol{\beta}$ is identified up to the positive scalar $(1+\sigma_a)^{1/2}$ (see Papke and Wooldridge 2008, p. 123, for details). Average partial effects can then be estimated by taking derivatives of $N^{-1}\sum_{i=1}^{N}\Phi(\hat{\psi}_a + \mathbf{x}'_{it}\hat{\boldsymbol{\beta}}_{\boldsymbol{a}} + \overline{\mathbf{x}}'_i\hat{\boldsymbol{\xi}}_{\boldsymbol{a}})$ with respect to the variable of interest. In general (and with the only exception of one sensitivity check where we account for country-year clustering of the disturbances), we apply a panel bootstrapping procedure (see Fitzenberger, 1998; Papke and Woolrdidge, 2008).

5.5 Allowing for Endogenous Lending Capacity Weights

Since internal lending and borrowing within MNEs are simultaneously determined, $w_{\iota,ijt}$ for $\iota \in \{\theta, \tau, \phi_{it}, \kappa_{it}\}$ and, in turn, ι^w_{it} are likely endogenous to the internal debt ratio of affiliate i at time t. To solve this problem, we project *actual lending*, f_{jt}, on characteristics thereof (including affiliate-specific fixed effects) to obtain a measure of *predicted lending capacity*, $\hat{f}_{jt}$, yielding predicted weights, $\hat{w}_{\iota,ijt}$.

Notice that f_{jt} is a non-negative variable which may be zero. Therefore, we use an exponential regression model to estimate $\hat{f}_{jt}$, conditional on affiliate-specific and market-specific time-variant variables collected in the vector $\mathbf{z}_{jt}$ and an affiliate-specific effect α_j,

$$E(f_{jt}|\mathbf{z}_{jt}, \alpha_j) = exp(\mathbf{z}'_{jt}\boldsymbol{\theta})\alpha_j, \quad (30)$$

where $\boldsymbol{\theta}$ is a vector of unknown parameters on $\mathbf{z}_{jt}$. We again follow the Mundlak-Chamberlain-Wooldridge device to specify $E(\alpha_j|\mathbf{z}_{jt}) = exp(\overline{\mathbf{z}}'_j\boldsymbol{\pi})$, where $\overline{\mathbf{z}}'_j$ are the affiliate-level means of the regressors and $\boldsymbol{\pi}$ is a corresponding vector of unknown parameters. Then, we substitute f_{jt} in (23) by $\hat{f}_{jt}$ to calculate lending capacity weights and weighted fundamentals $\hat{\iota}^w_{it}$ for $\iota \in \{\theta, \tau, \phi_{it}, \kappa_{it}\}$ as defined in (24).

Below, we will make use of $\hat{\iota}^w_{it}$ to instrument ι^w_{it}.[15] We follow Papke and Wooldridge (2008) and estimate a reduced form for ι^w_{it} using the instrument $\hat{\iota}^w_{it}$ along with the exogenous explanatory variables in (26). We then include the predicted residuals of this regression, denoted as $\hat{v}_{it}$, to control for the potential endogeneity of ι^w_{it} in the fractional response model (26).[16]

[15] Note that $\hat{\iota}^w_{it}$ carries the information of the exogenous variables $\mathbf{z}_{jt}$ which capture conditions at the lending affiliates.

[16] See Papke and Wooldridge (2008, p. 125) for a detailed discussion of the procedure.

6 Results

6.1 Baseline Results for Exogenous versus Endogenous Lending Capacity

Table 4 shows the baseline results for a fractional response model on the internal debt ratio ID_{it} as in (26). In the first four columns, we assume that all (lending capacity-) weighted fundamentals are strictly exogenous. In the last two columns, we allow the (lending capacity-) weights to be endogenous. The fractional response model is estimated by pooled quasi maximum-likelihood estimation (QMLE).[17] Note that all regressions include time- and affiliate-specific fixed effects.

– Include Table 4 here –

The first column of the table confirms results of earlier studies, suggesting that the local statutory tax rate positively relates to the share of internal cross-border debt of affiliate i. The columns labeled *Coeff.* contain the estimated coefficients (and standard errors in parentheses), while the columns labeled *APE* display the re-scaled coefficients as average partial effects, which may be compared to the coefficients of a linear model. Once we include the weighted tax rate of the lending part of an MNE, the coefficient of the local tax effect becomes slightly smaller but remains positive and significantly different from zero.

Note that the point estimates on all other incentive variables (or fundamentals) suggested by our model have the expected sign. According to our definition of those variables, the local incentive to internal debt financing should increase with a higher value of the respective variable (ι_{it}). Consistent with that, the weighted foreign fundamentals (in other affiliates and countries than i; ι^w_{it}) should exert a negative effect. While the estimate for the (exogenously) *weighted corporate income tax (other locations)* is not significantly related to internal debt, we do not want to overemphasize the findings based on exogenous lending capacity weights in Table 4, as the estimates are likely biased as indicated in Subsection 5.5.

The last two columns of Table 4 allow for endogenous weighted regressors, using the approach suggested by Papke and Wooldridge (2008) and described in Subsection 5.5. Other than that, the specification underlying those columns is identical to the one in the two columns in the center of Table 4. One interesting finding in comparison to the earlier results is that the magnitudes of the *host* coefficients (on ι_{it}) and the *other-location* coefficients (on ι^w_{it}) are similar in the last two columns of Table 4 for all fundamentals ι. In comparison, the corporate tax effects were much more asymmetric when assuming exogeneity of lending capacity weights in the center of Table 4. Moreover, internal cross-border debt seems to be much more strongly determined by differences in corporate taxes across locations when allowing for endogenous lending weights rather than assuming exogeneity.

The average partial effect (APE) of the corporate income tax in the host country (τ_{it}), which is displayed in the last column of Table 4, implies that a ten percentage point higher local corporate income tax rate leads to a 9.2 percentage point higher internal-debt-to-capital ratio. This is almost four times as large as the comparable effect in the fourth column of

[17] For a discussion on different estimation methods see Papke and Wooldridge (2008, p. 124).

Table 4. We may compare this estimate to the findings of a meta-study by Feld, Heckemeyer, and Overesch (2011), investigating 46 studies on the impact of taxes on debt-to-capital ratios. Their results suggest a marginal tax effect on debt of about 0.3. Hence, the marginal effect identified in the underlying census-type data-set is much larger than in other studies which mainly focus on larger firms. A ten percentage point higher corporate income tax rate at other relevant lending locations of the same MNE leads to an almost symmetric negative effect of the same magnitude on affiliate i's debt-to-capital ratio in the same year.

The regressions based on exogenous lending weights in Table 4 suggested that all of the fundamentals postulated by the above theoretical model matter for an affiliate's internal debt ratio. With the exception for productivity, the same conclusions apply when considering the endogeneity of lending capacity.[18] A more severe financial underdevelopment and institutional weakness in the host country lead to a significantly higher internal-debt-to-capital ratio. Consistent with the incentives described in Subsection 5.1, the weighted averages of these two measures across other locations within the same firm have a negative effect on the share of internal debt of a given affiliate.

Two of the affiliate-specific control variables included in the estimations are also significantly related to internal debt financing. First, a higher share of tangible (fixed) assets (*Tangibility*) implies a higher internal-debt-to-capital ratio. Since a high tangibility is a proxy for the importance of long-term investment projects in a firm, this finding might reflect that monitoring problems associated with investment projects are partly solved by using internal debt (see Bernardo, Cai, and Luo, 2001). The positive coefficient of the *Loss carryforward* indicator variable confirms that internal debt is a flexible source of finance that can be provided by affiliated entities (see Gopalan, Nanda, and Seru, 2007). Beyond the mentioned variables, firm size in terms of foreign affiliate sales does not enter significantly as a driver of internal debt.

6.2 Sensitivity Analysis with Regard to the Incentives to Use Internal Debt

The results in Table 4 do not allow for a trade-off between the different fundamentals determining the incentives to use cross-border internal debt. There, the (ceteris paribus) incentive to use internal debt according to fundamental $\iota_{it} \in \{\theta_{it}, \tau_{it}, \phi_{it}, \kappa_{it}\}$ is given by the differential $\iota_{it} - \iota_{it}^{w} \geq 0$, where ι_{it}^{w} is the weighted-average over all affiliates j with $\iota_{it} > \iota_{jt}$. This ignores that there is a trade-off between more favorable conditions in some fundamentals (profit taxes, institutional weakness, financial underdevelopment, or productivity) and less favorable ones in others.

Table 5 presents results using weighted foreign fundamentals constructed as described in (25). Here, we allow the incentives in each dimension to become negative by building ι_{it}^{w} over a larger set of affiliates j with $\iota_{it} > \iota_{jt} - r\sigma_{\iota,i}$, where $\sigma_{\iota,i}$ is the standard deviation of a

[18] However, affiliate-level productivity at affiliate i, and even more so at (weighted) other locations within the same firm, displays a low degree of variation over short periods of time. Hence, it is hard to discern the productivity variables' effects on the debt ratio from the one of affiliate-specific time-invariant effects on the one hand and from common time effects on the other hand.

fundamental ι_{it} calculated across all observations within the MNE affiliate i belongs to, and r takes on the values 0.1, 0.5, and 1.0 in Cases I, II, and III, respectively, in Table 5. That is, we relax the sharp conditions for internal debt financing in (22) alternatively by one tenth of, one half of, and one standard deviation of the respective fundamental for each affiliate i in year t.

The magnitude of the effects across Cases I-III in Table 5 is very similar to those for endogenous lending capacity weights in Table 4 and the levels of significance are somewhat higher. The APEs of the corporate income tax and institutional weakness in the host country are smaller and higher, respectively, than in the comparable columns of Table 4. For example, the APEs reported for Case III in Table 5 imply that a ten percentage points higher local corporate income tax rate leads to a 7.2 points higher internal-debt-to-capital ratio, while an increase in the index of institutional weakness of one standard deviation (1.7) increases the internal-debt-to-capital ratio by about 3.5 percentage points.

– Include Table 5 here –

6.3 Sensitivity Analysis with Regard to Affiliate-Productivity Measurement

While all results presented in Table 4 to 5 use the method suggested by Olley and Pakes (1996) to estimate total factor productivity of an affiliate, we may investigate the sensitivity of our findings with respect to other productivity measures. Table 6 shows that our main results are not affected at all when doing so.

In columns 1 and 2 we estimate affiliate-level productivity by using the method of Levinsohn and Petrin (2003).[19] For both estimated coefficients (for the host-country productivity and for the weighted productivity at other locations), we cannot find a significant impact on the internal debt ratio of affiliates. In columns 3 and 4 we use an alternative, less accurate measure for productivity calculated as affiliate sales divided by the average change in the total assets of an affiliate.[20] Again, we cannot confirm that this alternative measure is significantly related to the internal debt ratio of the foreign affiliates.

– Include Table 6 here –

6.4 Further Sensitivity Analysis

We have conducted further sensitivity checks regarding (i) the treatment of location choice of affiliates as endogenous, (ii) an alternative treatment of standard errors by using country-

[19] In contrast to Olley and Pakes (1996), Levinsohn and Petrin (2003) suggest using intermediate inputs (materials) as a proxy variable instead of investment. As said above, materials are not recorded in the affiliate statistics at hand. Therefore, we use financial and other assets – which is also more stable than net investment – as a proxy variable, which is monotonically related by assumption to the unobserved total factor productivity state variable. In other regards, the adopted estimation procedure is similar to the one of Olley and Pakes (1996).

[20] In contrast to the estimates based on Olley and Pakes (1996) and Levinsohn and Petrin (2003), this proxy variable does not account for the endogeneity of some of the inputs, nor does it account for selectivity.

year clustering instead of a panel bootstrap procedure, (iii) effects on small versus large firms, (iv) the relative importance of conditioning on other fundamentals than corporate profit tax rates, (v) the role of estimating nonlinear models (which respect to the boundedness of the dependent variable) relative to linear (OLS) models, (vi) the consideration of interaction terms of the fundamental variables so that their nonlinear effects on internal borrowing do not only accrue to the nonlinear functional form of the estimator for fractional dependent variables, and (vii) the consistency of internal borrowing within a country with firm-level productivity differences across all units of a firm in that country and year.

A detailed presentation of the associated results is provided in a separate online appendix for the sake of brevity of the manuscript. The main conclusions drawn from this analysis are the following. First, a control function approach to control for endogenous affiliate location choice does not lead to qualitatively or quantitatively different results from the ones presented above. Country-year clustering of the standard errors does not lead to a big difference in standard errors relative to the panel bootstrap.

The inclusion of small firms, the treatment of fundamentals of other affiliates than i for i's internal borrowing as endogenous, and the treatment of the internal borrowing (share) as a bounded dependent variable are major reasons for the identification of much larger tax semi-elasticities in this paper compared to previous work. The consideration of interaction effects of fundamentals beyond the nonlinear functional form of the econometric model does not add much in terms of nonlinearity of the effects of fundamentals on internal borrowing in the support region of the data (this is aligned with our expectations; see Greene, 2010). Finally, within-country productivity differences are of a similar importance for internal borrowing as productivity differences across countries.

6.5 Quantification of Tax Effects and Their Discussion in the Light of the Literature

The novel aspect of our investigation is that we allow MNEs to use their internal capital markets to reallocate capital to entities facing constraints in general, and high taxes, weak institutions, an underdeveloped financial market, and a high productivity in host-countries in particular. An important advantage of our study over existing empirical work is that the data allow us to observe lending and borrowing among affiliates of MNEs in a comprehensive way, because German MNEs are required to report their capital links to Deutsche Bundesbank so that we may gain a virtually complete picture of the internal capital market of a group.

Since the literature has devoted much attention on tax incentives for internal debt, let us compare our findings to previous estimates for the impact of taxes on debt. Feld, Heckemeyer, and Overesch (2011) identify in a meta-study, synthesizing evidence from 46 studies, a typical semi-elasticity of 0.313 of total debt. Our estimated host-country tax coefficient of .918 (see the last two columns of Table 4) translates into a semi-elasticity of 5.02, which exceeds the typical semi-elasticity found in the meta-study by a factor of more than 16. If only internal debt is considered, the meta-analysis finds a typical semi-elasticity of 0.47, which is still less than a tenth of our estimate. As indicated in Subsection 6.4, there are three likely reasons for the big difference between the estimated semi-elasticity in this paper and the ones in

earlier work. First, while other data-sets often include large MNEs only, we consider also relatively small MNEs with rather modest internal debt ratios in our census of data. Second, while earlier work often used linear models we resort to a nonlinear framework which pays attention to the limited dependent variable nature of internal-debt-to-capital ratios employed as the dependent variable. Third, unlike earlier work, we consider a more complete array of incentives to internal borrowing, where multiple units in a firm may act as lenders and borrowers simultaneously. In view of several papers speculating about why the tax-sensitivity of debt is so low (see, e.g., Ruf, 2011), our results suggest that internal debt is highly tax-responsive and that the tax rate is an important determinant of the internal-debt-to-capital ratio. Tables 7 and 8, respectively, shed light on the relative importance of the inclusion of small versus large firms in the sample for the data at hand, and on the relevance of allowing for non-linear effects when considering a dependent variable which is bounded in particular from below by zero and also from above by unity.

– Include Tables 7 and 8 here –

To assess the potential relevance of firm size (and selectivity bias in previous research) for the results, we run the regressions in the last four columns of Table 4 for two alternative subsamples: one that contains firms that are smaller than the firm at the 25th centile and one that contains firms that are larger than the firm at the 75th centile. The corresponding results are summarized in Table 7. If anything, Table 7 suggests that utilizing a subsample of large firms leads to somewhat smaller coefficients and average partial effects than utilizing a subsample of small firms. Hence, we conclude that – to some (though not an overwhelming) extent – the difference in magnitude of tax effects for internal borrowing between this study and previous research may accrue to the selective reliance on larger firms in some of the earlier work.

The linear fixed effects and two-stage least squares linear fixed effects models in Table 8 suggest that assuming a linear regression model (which is inadequate since it does not pay attention to the boundedness of the dependent variable) leads to much smaller coefficients and average partial effects (which in linear models are identical to coefficients) of the statutory income tax variable. To see this, compare the first column of Table 8 with its nonlinear counterpart in the two columns in the center of Table 4. It turns out that the corporate tax parameter (and the average partial effect) is much smaller in the linear model with exogenous weighting than in the nonlinear model as reported in the center of Table 4. The parameters of the tax variables even turn (and take on implausible signs) in case of (inadequate) linear two-stage least-squares estimation relative to the nonlinear two-stage least-squares model in the last two columns of Table 4. This suggests that the inadequate linear modeling of internal lending (in levels or as a ratio) is identified as one potentially fundamental problem with the data at hand.

The non-linear fractional response model used in our analysis suggests that marginal effects vary with the levels fundamental determinants of the internal debt ratio take on. Hence, MNEs with certain characteristics may respond even more to variations in taxes than others. Figures 1 and 2 in the online Appendix emphasize this aspect by showing how predicted internal debt ratios vary according to variations in host-country characteristics.

Tables 9 and 10 present the respective estimates for some countries that exhibit extreme values of these characteristics in view of the distribution of these variables across countries. In those tables (and the figures in the online Appendix), we assume that countries and affiliates vary only in terms of characteristics as indicated in the tables (or on the axes of the figures) but are identical to the average otherwise. Comparing Greece with the United States, for example, shows that we would predict about the same internal debt ratio, even though the statutory tax rate in the United States is about 10 percentage points higher. Another interesting comparison between Greece and the United States shows that the institutional environment faced by foreign affiliates in Greece ought to be improved by 0.36 (to 6.3) to predict ceteris paribus the same internal debt ratio for the average affiliate located in Greece or the United States. With respect to capital market development, Japan, for example, would have to improve its capital market development index to a value of 32 (from about 125) for affiliates located in Japan to exhibit the same predicted internal debt ratio as affiliates located in the United States. A comparison between affiliates in Hong Kong and affiliates in Singapore, on the other hand, shows that capital market conditions may become 2.5 times worse (from 168 to 434) in Hong Kong until the lower tax rate in Hong Kong is offset and the affiliates rely on the same amount of internal debt financing as in Singapore. The non-linearity of the relationship between tax and institutional components in determining ID_{it} is also reflected in different gradients with respect to fundamentals, which depend on where a country is located in tax-institution space. The last columns of Tables 9 and 10 demonstrate that the effect of a marginal increase in the host-country tax rate differs a lot across locations.

– Include Tables 9 and 10 here –

Moreover, Section (iii) of the online Appendix illustrates that controlling for fundamental determinants of internal debt ratios beyond taxation (i.e., for financial underdevelopment, institutional weakness, and productivity) is not responsible for the bigger effects identified here relative to earlier research. Altogether, this suggests the following conclusions. Data on internal debt ratios represent an equilibrium between financial demand at a location and, given external financial supply, financial supply within the firm as a whole. Not only demand for internal finance but also its supply are endogenous. The latter is typically ignored. The (endogenous) lending capacity of other units in a firm makes fundamental determinants at those sites relevant for the internal debt ratio of a given unit. In this way, aspects of taxation, financial underdevelopment, institutional weakness, or productivity do not only matter locally but globally to each unit in a firm. To which extent global characteristics matter for a local unit depends on the "natural" lending capacity in other units and the fundamentals at those sites. This is typically ignored as well. Moreover, internal debt (in levels or relative to other variables) is a bounded variable which should not be (log-)transformed. The misspecification of the functional form of the relationship between fundamental determinants and internal debt may lead to bias (see Papke and Wooldridge, 1996; Santos Silva and Tenreyro, 2006). This is almost always ignored. Altogether, according to the evidence provided here, three main reasons for relatively small effects of taxation in earlier research relative to this study are the following (ordered such that most important reasons come first): the

ignorance of endogenous lending capacity in the firm and its interaction with global determinants of internal finance; the ignorance of the bounded-variable character of internal debt; the focus on selected samples (containing mainly large firms).

Let us finish with illustrating the nonlinear (and, hence, heterogeneous) impact of taxation on internal debt ratios. Suppose that we observe an MNE that consists of just two entities. The borrowing entity is located in a low-tax country and the lending entity is located in a high-tax country. At the same time, the borrowing entity is located in a country with bad institutions and an underdeveloped capital market, while the lending entity is located in a country with sound institutions and a well developed capital market. Let us assume values for the respective fundamentals of the borrowing (lending) affiliate that refer to the 95th percentile (5th percentile) of the respective distribution of ϕ and κ, and a corporate profit tax rate at the lending location of 40%. We may compare the predicted internal debt ratio of this MNE to the *average* MNE in our sample and determine the (negative) tax rate differential for this example which the firm would be willing to accept to end up with the same predicted share of internal debt. For the average MNE, our model predicts an internal-debt-to-capital ratio of 0.18. Note that from a pure taxation point of view, affiliates in low-tax countries would not borrow from affiliates in high-tax countries. In our example, however, given other fundamentals of the internal capital market, the borrowing affiliate would be willing to accept a negative tax rate differential of 11 percentage point (i.e., a host-country tax rate of 29%) and still choose an internal debt ratio of 0.18. Figure 3 in the online Appendix illustrates how the local and foreign tax incentives interact in determining a local affiliate's internal debt ratio for countries (and affiliates) that are identical to the average in all other respects.

7 Conclusions

This paper has shown how multinational firms allocate internal financing by means of an internal capital market not only to shift profits but also to avoid constraints faced by affiliates in foreign countries. Similar to a high productivity of these affiliates, constraints associated with a weak institutional environment or an underdeveloped capital market lead to an excess return on investment. In this sense, the internal capital market is used to allocate financing to affiliates with investment opportunities that entail the highest return.

Earlier work has mainly focused on tax responses of internal borrowing from the unit where the incentive is maximal. We illustrate that internal capital markets render predictions concerning tax effects more complex than portrayed before. In particular, differences in incentives given by fundamentals such as institutional weakness, financial underdevelopment or productivity can offset tax incentives so that affiliates in high-tax countries may lend to affiliates in low-tax countries. For the empirical analysis we use the Microdatabase Direct Investment (MiDi) provided by Deutsche Bundesbank, which is a unique data-set of German multinational firms and their foreign affiliates. Since German law requires mandatory reporting to Deutsche Bundesbank, MiDi includes the universe of German multinational firms. This feature of the data allows us to capture tax, institutional, capital market, and productivity incentives in a comprehensive way, since not only the borrowing parties within

a group but also the lending parties are observed.

Using a fractional response model, our main results imply that a one percentage point higher statutory tax rate in the host country is associated with a 0.92 percentage point higher internal-debt-to-capital ratio of the borrowing affiliate. At the same time, a one percentage point increase in the (weighted) tax rate of the lending affiliates is associated with a 0.77 percentage point lower internal-debt-to-capital ratio of the borrowing affiliate. Other determinants of internal debt show the same qualitative pattern. While financial underdevelopment in the host country is positively related to the internal debt ratio of the borrowing affiliate, financial underdevelopment at other locations exerts a negative effect on the internal debt ratio of the borrowing affiliate. While financial weakness in the host country is associated with a higher internal debt ratio of the borrowing affiliate, financial weakness at the lender locations leads to a lower internal debt ratio of the borrowing affiliate. While a higher affiliate-level productivity of the borrowing affiliate relates positively to its internal debt ratio, a higher productivity of the lenders exerts a negative impact on the internal debt ratio of the borrowing affiliate (it should be mentioned, however, that productivity measures are found to be statistically insignificant).

Since this paper shows that internal debt within multinational firms is not only used to avoid taxes but also to compensate differences in other fundamentals, tax policy must consider that anti-tax avoidance measures designed to restrict profit shifting of multinational firms (e.g. thin-capitalization rules) might aggravate financing constraints caused by non-tax fundamentals. Given our findings, such policies would have significant effects on real investment decisions of multinational firms, which go beyond their actual purpose.

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Appendix – Prediction of Lending Capacity

Figure 7 shows the world map of actual lending from all countries affiliates of German multinationals are located in. The problem of using actual lending in $w_{\iota,ijt}$ as defined in (23) is that borrowing at one location and lending elsewhere are jointly determined by a common set of firm-specific (and country-specific) characteristics at any time t. The latter leads to a potential endogeneity bias in the parameters on the determinants of the internal debt ratio.

For the sake of the instrumental variable approach, we use yearly poisson regressions to predict the potential lending of each affiliate. The yearly regressions to predict lending include the following variables: corporate income tax rate, financial underdevelopment, and institutional weakness of the lender's country, the affiliate-level productivity, tangibility, loss carryforward, and the sales of the lending affiliate. The regressions also include the affiliate-specific means of all variables. Formally, the predictions read

$$\hat{f}_{jt} = \exp(Z_{jt}\hat{\delta}), \tag{31}$$

where Z_{jt} are the aforementioned observable characteristics determining j's lending at time t including their time averages, and $\hat{\delta}$ are the corresponding estimated parameters on them. An advantage of this approach is that it can be made robust to heteroskedasticity of unknown form (see Santos Silva and Tenreyro, 2006), and it can accommodate zeros of the dependent variable; unlike log-linear models.

The predicted values $\hat{f}_{jt}$ of these regressions are then used to weight the fundamentals of the lending countries by $\hat{w}_{\iota,ijt}$ (the predicted counterpart to $w_{\iota,ijt}$) as outlined in equation (23). Notice that this approach is similar in spirit to the one taken by Frankel and Romer

(1999), who estimate a bilateral gravity model of international trade and employ the (aggregated) predictions of that model to instrument observed (unilateral) trade as a determinant of economic growth. Recently, Kelejian and Piras (2012) have provided econometric foundations for such problems. In our case, predicted lending serves as an instrument for observed lending which then is used to aggregate up all non-i affiliate fundamentals as weighted averages, where the weights are allowed to be endogenous as in Frankel and Romer (1999) and Kelejian and Piras (2012).

This approach leads to a just-identified instrumental variables approach akin to Wooldridge (2002; chapter 18) so that we can not apply over-identification tests, since each weight is instrumented by a single predicted weight. However, since lending is predicted by fundamentals that can not easily be changed by an affiliate from year to year (e.g., the affiliate-level productivity, tangibility, loss carryforward, and sales of the lending affiliate are predetermined) and we condition on time-specific effects through fixed effects, it is plausible to assume that the instruments are exogenous. In any case, the predicted weighted affiliate fundamentals turn out to be jointly highly relevant determinants of observed weighted affiliate fundamentals as is indicated by the F-statistics reported in the respective table footnotes.

Appendix – Figures

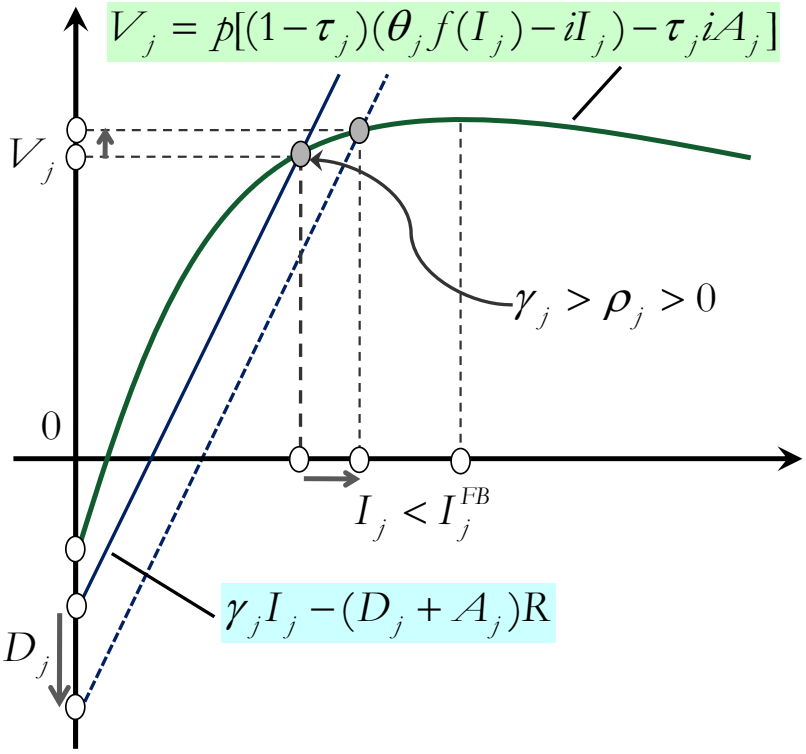

Figure 1: Investment and Internal Debt

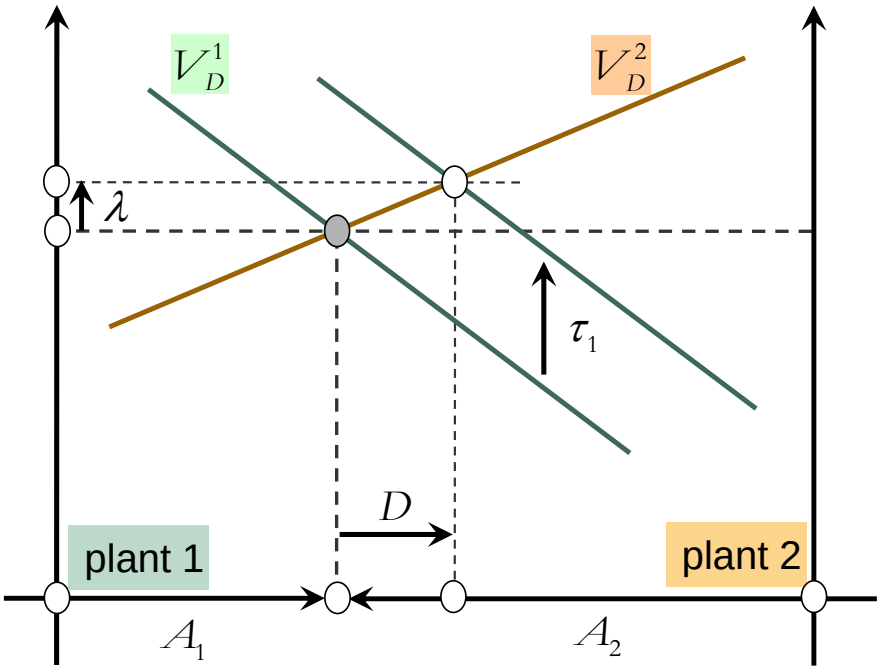

Figure 2: Internal Capital Market

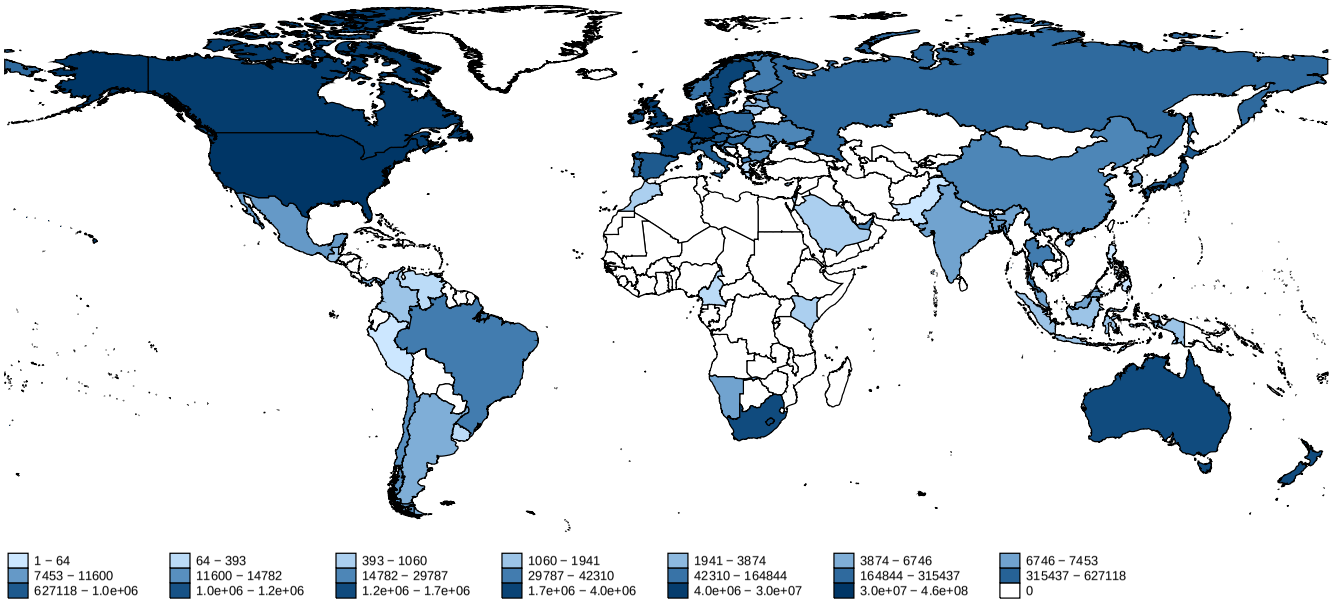

Figure 3: Lending by countries in 2005

Notes: Sum of lending in the year 2005 over all affiliates in a country. Information on lending is taken from MiDi. The ten most important lender countries are (in decreasing importance): Germany, USA, Netherlands, UK, Luxembourg, Cayman Islands, Canada, France, Netherlands Antilles, Belgium.

Appendix – Tables

Table 2: Descriptive statistics

Variable	Acronym	Mean	Std. Dev.
Internal-debt ratio	ID_{it}	.1827	.2564
Corporate income tax (host)	τ_{it}	.3235	.0724
Weighted corporate income tax (other locations)	τ_{it}^{w}	.3062	.0743
Financial underdevelopment (host)	κ_{it}	211.2420	53.5578
Weighted financial underdevelopment (other locations)	κ_{it}^{w}	196.4351	52.5706
Institutional weakness (host)	ϕ_{it}	3.8210	1.6974
Weighted institutional weakness (other locations)	ϕ_{it}^{w}	3.3883	1.7441
Affiliate-level productivity OP (host)	θ_{it}	-21.5328	2.7130
Weighted affiliate-level productivity OP (other locations)	θ_{it}^{w}	-22.4540	3.0385
Affiliate-level productivity LevPet (host)	θ_{it}	.3505	5.9113
Weighted affiliate-level productivity LevPet (other locations)	θ_{it}^{w}	.1675	4.0388
Affiliate-level productivity Alt (host)$^{(a)}$	θ_{it}	.1928	9.3171
Weighted affiliate-level productivity Alt (other locations)$^{(a)}$	θ_{it}^{w}	-.0554	8.7226
Tangibility		.2490	.2731
Loss carryforward		.3123	.4635
Sales		.0619	.5536

Notes: 227,558 observations ($^{(a)}$ 217,103 observations). All affiliate-level variables are taken from the MiDi database provided by Deutsche Bundesbank. Internal-debt ratio is the cross-border-internal-debt-to-total-capital ratio, where total capital consists of registered capital, capital reserves and profit reserves, as well as internal and external debt. *Corporate income tax (host)* is the statutory tax rate of the country hosting the borrowing affiliate i. *Weighted corporate income tax (other locations)* is the lending-weighted corporate income tax rate as defined in (24). The tax data is collected from databases provided by the International Bureau of Fiscal Documentation (IBFD) and tax surveys provided by Ernst&Young, PwC, and KPMG. *Financial underdevelopment (host)* is a variable that captures the financial underdevelopment of the host country. To measure financial underdevelopment, we have taken a statistic for *domestic credit to private sector* relative to a country's GDP, provided by the World Bank's World Development Indicators (WDI) database. We define *Financial underdevelopment (host)* as $(|\frac{DomesticCredit}{GDP} - max\{\frac{DomesticCredit}{GDP}\}|)$. *Weighted financial underdevelopment (other locations)* is the lending-weighted financial underdevelopment as defined in (24). *Institutional weakness (host)* captures the institutional weakness of the host country. Also from the WDI database, to measure institutional weakness, we use an index on the strength of investor protection. We define the index such that it ranges from 0 (strong investor protection) to 9 (weak investor protection). Accordingly, *weighted institutional weakness (other locations)* is the lending-weighted institutional weakness as defined in (24). *Affiliate-level productivity OP (host)* captures the productivity of affiliate i. We use the method suggested by Olley and Pakes (1996) to estimate productivity. *Weighted affiliate-level productivity OP (other locations)* is lending-weighted productivity as defined in (24). *Tangibility* is the affiliate-specific fixed-asset-to-total-asset ratio. *Loss carryforward* is a binary variable taking the value one if an affiliate reports a loss carryforward. *Sales* are the annual sales of an affiliate in bill. €.

Table 3: Countries in the sample

Country	*Obs.*	*Country*	*Obs.*	*Country*	*Obs.*
Albania	12	Haiti	.	Panama	99
Algeria	52	Honduras	37	Papua New Guinea	.
Angola	9	Hong Kong	2,866	Paraguay	29
Argentina	1,303	Hungary	5,615	Peru	227
Armenia	.	Iceland	18	Philippines	497
Australia	3,577	India	2,082	Poland	8,754
Austria	12,580	Indonesia	755	Portugal	2,677
Azerbaijan	22	Iran	88	Qatar	6
Bahrain	18	Ireland	2,482	Romania	1,237
Bangladesh	53	Israel	300	Russian Federation	2,172
Belarus	50	Italy	11,909	Saudi Arabia	143
Belgium	6,301	Jamaica	8	Senegal	12
Bolivia	35	Japan	3,732	Sierra Leone	.
Brazil	4,398	Jordan	11	Singapore	2,909
Bulgaria	513	Kazakhstan	87	Slovak Republic	1,707
Cameroon	33	Kenya	105	Slovenia	543
Canada	1,133	Korea, Rep. of	1,501	South Africa	2,470
Chile	791	Kuwait	12	Spain	11,206
China	6,437	Kyrgyzstan	8	Sri Lanka	.
Columbia	459	Latvia	255	Swaziland	.
Costa Rica	117	Lebanon	16	Sweden	3,821
Côte d'Ivoire	34	Lithuania	264	Switzerland	12,050
Croatia	592	Luxembourg	2,822	Syria	15
Czech Republic	7,592	Macedonia	51	Tanzania	24
Dem. Rep. Congo	7	Malawi	5	Thailand	1,002
Denmark	2,930	Malaysia	1,490	Trinidad & Tobago	31
Dominican Rep.	.	Mauritius	82	Tunisia	194
Ecuador	157	Mexico	2,566	Turkey	2,019
Egypt	393	Moldova	42	Uganda	22
El Salvador	59	Morocco	225	Ukraine	425
Estonia	235	Mozambique	6	Unit. A. Emirates	180
Ethiopia	.	Namibia	.	United Kingdom	17,968
Finland	1,336	Nepal	.	Uruguay	164
France	19,167	Netherlands	12,232	USA	28,756
Gabon	8	New Zealand	574	Venezuela	428
Gambia	.	Nicaragua	28	Vietnam	107
Georgia	10	Nigeria	150	Zambia	6
Ghana	25	Norway	949	Zimbabwe	20
Greece	1,392	Oman	12		
Guatemala	105	Pakistan	184	*All (118) Countries*	*227,558*

Notes: Obs. refers to the total number of observations (affiliates) from 1996 to 2007 in 118 host countries. "." denotes data, where reporting is not allowed due to confidentiality reasons.

Table 4: Determinants of internal debt – exogenous vs. endogenous incentives

	Exogenous incentives				Endogenous incentives	
	Coeff.	APE	Coeff.	APE	Coeff.	APE
Corporate income tax (host)	1.0315***	.2687***	1.0094***	.2615***	3.5471***	.9176***
	(.1032)	(.0270)	(.1180)	(.0306)	(.4650)	(.1202)
Weighted corporate income tax (other locations)			-.0361	-.0094	-2.9818***	-.7714***
			(.0633)	(.0164)	(.5304)	(.1370)
Financial underdevelopment (host)	.0006***	.0002***	.0008***	.0002***	.0010**	.0003**
	(.0002)	(.0000)	(.0002)	(.0000)	(.0004)	(.0001)
Weighted financial underdevelopment (other locations)			-.0004***	-.0001***	-.0007	-.0002
			(.0001)	(.0000)	(.0005)	(.0001)
Institutional weakness (host)	.0147	.0038	.0221	.0057	.0625**	.0162**
	(.0178)	(.0046)	(.0177)	(.0045)	(.0275)	(.0071)
Weighted institutional weakness (other locations)			-.0105***	-.0027***	-.0653***	-.0169***
			(.0032)	(.0008)	(.0233)	(.0060)
Affiliate-level productivity OP (host)	.0081***	.0021***	.0121***	.0031***	.0088	.0023
	(.0013)	(.0003)	(.0016)	(.0004)	(.0059)	(.0015)
Weighted affiliate-level productivity OP (other locations)			-.0056***	-.0014***	-.0018	-.0005
			(.0014)	(.0004)	(.0072)	(.0019)
Tangibility	.0528**	.0138**	.0490**	.0127**	.0531**	.0137**
	(.0244)	(.0064)	(.0243)	(.0063)	(.0242)	(.0063)
Loss carryforward	.1011***	.0263***	.1015***	.0263***	.1019***	.0264***
	(.0059)	(.0015)	(.0059)	(.0015)	(.0060)	(.0015)
Sales	.0035	.0009	.0047	.0012	.0107	.0028
	(.0112)	(.0029)	(.0115)	(.0030)	(.0118)	(.0030)

Notes: 227,558 Observations. Fractional response model estimated by Pooled QMLE. The dependent variable refers to internal cross-border debt. All regressions include time dummies and affiliate-specific fixed effects. Robust standard errors reported in parentheses are based on panel bootstrapping. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively. Tests on the joint significance of the instruments yield the following robust F-statistics (in the order of the endogenous variables instrumented): 171.06, 219.17, 443.83, 618.25, respectively. Estimated coefficients of the control function: $\hat{v}_{it}^{\tau}$: 3.0073*** (.5404); $\hat{v}_{it}^{\kappa}$: .0004 (.0005); $\hat{v}_{it}^{\phi}$: .0557** (.0238); $\hat{v}_{it}^{\theta}$: -.0030 (.0073).

Table 5: Allowing for wider (endogenous) incentives

	Case I		Case II		Case III	
	Coeff.	APE	Coeff.	APE	Coeff.	APE
Corporate income tax (host)	3.0949***	.8009***	2.1240***	.5501***	2.8036***	.7254***
	(.4162)	(.1077)	(.3718)	(.0963)	(.4307)	(.1113)
Weighted corporate income tax^{Case} (other locations)	-2.4556***	-.6355***	-1.3198***	-.3418***	-2.0906***	-.5409***
	(.4722)	(.1221)	(.4178)	(.1081)	(.4965)	(.1284)
Financial underdevelopment (host)	.0011***	.0003***	.0010***	.0003***	.0009**	.0002**
	(.0004)	(.0001)	(.0003)	(.0001)	(.0004)	(.0001)
Weighted financial underdevelopment^{Case} (other locations)	-.0008*	-.0002*	-.0007*	-.0002*	-.0004	-.0001
	(.0005)	(.0001)	(.0004)	(.0001)	(.0005)	(.0001)
Institutional weakness (host)	.0746***	.0193***	.0824***	.0214***	.0808***	.0209***
	(.0259)	(.0067)	(.0258)	(.0067)	(.0152)	(.0039)
Weighted institutional weakness^{Case} (other locations)	-.0763***	-.0197***	-.0854***	-.0221	-.1067***	-.0276***
	(.0213)	(.0055)	(.0197)	(.0051)	(.0196)	(.0050)
Affiliate-level productivity OP (host)	.0090	.0023	.0159***	.0041***	.0088	.0023
	(.0058)	(.0015)	(.0057)	(.0014)	(.0056)	(.0014)
Weighted affiliate-level productivity^{Case} OP (other locations)	-.0024	-.0006	-.0107	-.0028	-.0016	-.0004
	(.0071)	(.0018)	(.0069)	(.0017)	(.0065)	(.0017)
Tangibility	.0533**	.0138**	.0518**	.0134**	.0561***	.0145***
	(.0242)	(.0063)	(.0243)	(.0063)	(.0203)	(.0053)
Loss carryforward	.1015***	.0263***	.1010***	.0261***	.1009***	.0261***
	(.0059)	(.0015)	(.0059)	(.0015)	(.0064)	(.0017)
Sales	.0099	.0026	.0061	.0016	.0112	.0029
	(.0118)	(.0031)	(.0118)	(.0031)	(.0098)	(.0025)

Notes: 227,558 Observations. Fractional response model estimated by Pooled QMLE. The dependent variable refers to internal cross-border debt. All regressions include time dummies and affiliate-specific fixed effects. Robust standard errors reported in parentheses are based on panel bootstrapping. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

Case I: Tests on the joint significance of the instruments yield the following robust F-statistics (in the order of the endogenous variables instrumented): 276.89, 174.91, 612.16, 765.75, respectively. Estimated coefficients of the control function: $\hat{v}_{it}^{\tau}$: 2.4570*** (.4826); $\hat{v}_{it}^{\kappa}$: .0005 (.0005); $\hat{v}_{it}^{\phi}$: 0.0666*** (.0219); $\hat{v}_{it}^{\theta}$: -.0023 (.0073). Note that the incentives arising from other locations are defined such that differentials between the host and other variables may become negative. All variables denoted with "$Case$" are defined according to Equation (25), where we apply the less strict condition $b_{\iota,ijt} = 1$ if $\iota_{it} > \iota_{jt} - 0.1\sigma_{\iota,i}$.

Case II: Tests on the joint significance of the instruments yield the following robust F-statistics (in the order of the endogenous variables instrumented): 181.77, 187.38, 498.91, 735.22, respectively. Estimated coefficients of the control function: $\hat{v}_{it}^{\tau}$: 1.2584*** (.4291); $\hat{v}_{it}^{\kappa}$: .0005 (.0004); $\hat{v}_{it}^{\phi}$: .0778*** (.0201); $\hat{v}_{it}^{\theta}$: .0068*** (.0073). All variables denoted with "$Case$" are defined according to Equation (25), where we apply the less strict condition $b_{\iota,ijt} = 1$ if $\iota_{it} > \iota_{jt} - 0.5\sigma_{\iota,i}$.

Case III: Tests on the joint significance of the instruments yield the following robust F-statistics (in the order of the endogenous variables instrumented): 160.40, 217.68, 442.72, 663.07, respectively. Estimated coefficients of the control function: $\hat{v}_{it}^{\tau}$: 2.1495*** (.5059); $\hat{v}_{it}^{\kappa}$: .0002 (.0005); $\hat{v}_{it}^{\phi}$: .0958*** (.0198); $\hat{v}_{it}^{\theta}$: -.0032 (.0066). All variables denoted with "$Case$" are defined according to Equation (25), where we apply the less strict condition $b_{\iota,ijt} = 1$ if $\iota_{it} > \iota_{jt} - \sigma_{\iota,i}$.

Table 6: Alternative productivity measures – endogenous incentives

	Coeff.	APE	Coeff.	APE
Corporate income tax (host)	3.3965***	0.8811***	3.3426***	.8638***
	(.4329)	(.1122)	(.4435)	(.1144)
Weighted corporate income tax (other locations)	-2.7980***	-.7258***	-2.7039***	-.6988***
	(.4930)	(.1277)	(.5253)	(.1356)
Financial underdevelopment (host)	.0009**	.0002**	.0008*	.0002*
	(.0004)	(.0001)	(.0004)	(.0001)
Weighted financial underdevelopment (other locations)	-.0005	-.0001	-.0004	-.0001
	(.0005)	(.0001)	(.0005)	(.0001)
Institutional weakness (host)	.0658**	.0171**	.0691**	.01787**
	(.0275)	(.0071)	(.0286)	(.0074)
Weighted institutional weakness (other locations)	-.0711***	-.0184***	-.0749***	-.0193***
	(.0231)	(.0060)	(.0236)	(.0061)
Affiliate-level productivity LevPet (host)	-.0074	-.0019		
	(.0084)	(.0022)		
Weighted affiliate-level productivity LevPet (other locations)	.0239	.0062		
	(.0180)	(.0047)		
Affiliate-level productivity Alt (host)			.0052	.0014
			(.0071)	(.0018)
Weighted affiliate-level productivity Alt (other locations)			-.0060	-.0016
			(.0074)	(.0019)
Tangibility	.0556**	.0144**	.0491**	.0127**
	(.0249)	(.0065)	(.0250)	(.0065)
Loss carryforward	.1024	.0265	.1029***	.0266***
	(.0060)	(.0016)	(.0058)	(.0015)
Sales	.0172	.0044	.01672	.0043
	(.0114)	(.0029)	(.0107)	(.0028)

Notes: Results reported in the first and second (third and fourth) columns based on 227,558 (217,103) observations. Fractional response model estimated by Pooled QMLE. The dependent variable refers to internal cross-border debt. All regressions include time dummies and affiliate-specific fixed effects. Robust standard errors reported in parentheses are based on panel bootstrapping. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively. Tests on the joint significance of the instruments yield the following robust F-statistics (in the order of the endogenous variables instrumented): 160.40, 217.68, 442.72, 663.07, respectively. Estimated coefficients of the control function for the Levinsohn and Petrin specification: $\hat{v}_{it}^{\tau}$: 2.7981*** (.5035); $\hat{v}_{it}^{\kappa}$: .0001 (.0005); $\hat{v}_{it}^{\phi}$: .0602** (.0236); $\hat{v}_{it}^{\theta}$: -.0000 (.0000). Estimated coefficients of the control function for the Alt specification: $\hat{v}_{it}^{\tau}$: 2.7055*** (.5320); $\hat{v}_{it}^{\kappa}$: -.0001 (.0005); $\hat{v}_{it}^{\phi}$: .0644*** (.0234); $\hat{v}_{it}^{\theta}$: .0000 (.0001).

Table 7: Determinants of internal debt – exogenous and endogenous incentives for small vs. large firms

	Exog. incentives				Endog. incentives			
	Small firms		Large firms		Small firms		Large firms	
	Coeff.	APE	Coeff.	APE	Coeff.	APE	Coeff.	APE
Corporate income tax (host)	.8430***	.2280***	.6042***	.1624***	3.1111***	.8407***	2.8916***	.7750***
	(.2566)	(.0693)	(.2161)	(.0579)	(.9007)	(.2427)	(.7242)	(.1944)
Weighted corporate income tax (other locations)	.2425	.0656	-.0786	-.0211	-2.3021**	-.6221**	-2.8829***	-.7726***
	(.1755)	(.0475)	(.1058)	(.0284)	(.9782)	(.2639)	(.8880)	(.2386)
Financial underdevelopment (host)	.0008*	.0002*	.0006	.0002	.0007	.0002	-.0002	-.0000
	(.0005)	(.0001)	(.0004)	(.0001)	(.0009)	(.0002)	(.0008)	(.0002)
Weighted financial underdevelopment (other locations)	-.0001	-.0000	-.0003	-.0001	-.0002	-.0001	.0007	.0002
	(.0003)	(.0001)	(.0002)	(.0001)	(.0010)	(.0003)	(.0010)	(.0002)
Institutional weakness (host)	0.0681*	.0184*	.0261	.0070	.1043**	.0282**	.0785*	.0210*
	(.0372)	(.0100)	(.0367)	(.0098)	(.0517)	(.0140)	(.0474)	(.0127)
Weighted institutional weakness (other locations)	-.0186**	-.0050**	-.0095	-.0026	-.0696	-.0188	-.0699**	-.0187**
	(.0077)	(.0021)	(.0066)	(.0018)	(.0429)	(.0116)	(.0356)	(.0095)
Affiliate-level productivity OP (host)	.0104*	.0028*	.0084***	.0022***	.0108	.0029	.0389***	.0104***
	(.0057)	(.0015)	(.0028)	(.0008)	(.0130)	(.0035)	(.0094)	(.0025)
Weighted affiliate-level productivity OP (other locations)	.0055	.0015	-.0066***	-.0018***	.0047	.0013	-.0456***	-.0122***
	(.0044)	(.0012)	(.0026)	(.0007)	(.0142)	(.0038)	(.0119)	(.0032)
Tangibility	.0537	.0145	-.0073	-.0020	.0532	.0144	-.0030	-.0008
	(.0502)	(.0136)	(.0532)	(.0143)	(.0502)	(.0136)	(.0536)	(.0144)
Loss carryforward	.1368***	.0370***	.0808***	.0217***	1.1359***	.0367***	.0810***	.0217***
	(.0140)	(.0038)	(.0124)	(.0034)	(.0142)	(.0038)	(.0127)	(.0034)
Sales	-6.2526***	-1.6912***	-.0042	-.0011	-6.1096***	-1.6510***	.0019	.0005
	(1.0966)	(.2969)	(.0119)	(.0032)	(1.0662)	(.2885)	(.0118)	(.0032)
Observations	56,880		56,903		56,880		56,903	

Notes: Fractional response model estimated by pooled QMLE. The dependent variable refers to internal cross-border debt. All regressions include time dummies and affiliate-specific fixed effects. Robust standard errors reported in parentheses are based on panel bootstrapping. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively. Estimated coefficients of the control function for small firms: $\hat{v}^{\tau}_{it}$: 2.5857*** (.9876); $\hat{v}^{\kappa}_{it}$: .0522 (.0409); $\widehat{v}^{\phi}_{it}$: .0001 (.0010); $\widehat{v}^{\theta}_{it}$: .0017 (.0145).

Estimated coefficients of the control function for large firms: $\hat{v}^{\tau}_{it}$: 2.8972*** (.9098); $\hat{v}^{\kappa}_{it}$: .0628* (.0358); $\widehat{v}^{\phi}_{it}$: -.0009 (.0010); $\widehat{v}^{\theta}_{it}$: .0419*** (.0119).

Table 8: Determinants of internal debt – exogenous vs. endogenous incentives using linear fixed effects models

	Exog. incentives	Endog. incentives
Corporate income tax (host)	.1549***	-.1199
	(.0301)	(.1205)
Weighted corporate income tax (other locations)	-.0169	.3106**
	(.0189)	(.1409)
Financial underdevelopment (host)	.00003	.00003
	(.0001)	(.0001)
Weighted financial underdevelopment (other locations)	-.0001***	-.0001
	(.00002)	(.0002)
Institutional weakness (host)	.0021	.0025
	(.0046)	(.0078)
Weighted institutional weakness (other locations)	-.0024***	-.0019
	(.0008)	(.0075)
Affiliate-level productivity OP (host)	.0030***	.0080***
	(.0005)	(.0016)
Weighted affiliate-level productivity OP (other locations)	-.0018***	-.0079***
	(.0004)	(.0019)
Tangibility	.0058	.0052
	(.0062)	(.0062)
Loss carryforward	.0276***	.0276***
	(.0016)	(.0016)
Sales	.0037	.0026
	(.0035)	(.0036)

Notes: 227,558 Observations. Linear fixed effects models (disregarding the boundedness of the dependent variable). The dependent variable refers to internal cross-border debt. The first column represents a standard fixed effects model while the second column represents a fixed effects two-stage least squares model. Due to the imposed linearity, the coefficients reflect partial (and average partial) effects, unlike in Tables 4 and 5. All regressions include time dummies and affiliate-specific fixed effects. Robust standard errors reported in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

Table 9: Selected marginal tax effects evaluated at grand means except for fundamentals as in the table

Host Country	Institutional Weakness (host)	Corporate Income Tax Rate (host)	Predicted Internal Debt Ratio	Marginal Effect of $\Delta\tau$
Bahamas	5.0000	.0000	.0228	.0172
China	5.2133	.3186	.1960	.0881
Greece	6.6600	.3221	.2258	.0957
Hong Kong	.92000	.1661	.0479	.0318
Ireland	1.4000	.1125	.0340	.0240
Japan	2.7000	.4389	.2788	.1070
Mexico	5.3967	.3229	.2033	.0901
Singapore	.39999	.2293	.0703	.0430
USA	1.4000	.4084	.2190	.0941

Notes: The predicted internal debt ratio (and the marginal tax effect in column 5) is evaluated at sample means of the explanatory variables and the country-specific averages of the institutional weakness indicator and the corporate income tax rate of the host countries listed.

Table 10: Selected marginal tax effects evaluated at grand means except for fundamentals as in the table

Host Country	Capital Market Underdevelopment	Corporate Income Tax Rate (host)	Predicted Internal Debt Ratio	Marginal Effect of $\Delta\tau$
Bahamas	242.7126	.0000	.0206	.0158
China	208.8015	.3186	.1722	.0813
Greece	259.5229	.3221	.1889	.0861
Hong Kong	168.3227	.1661	.0634	.0396
Ireland	191.2044	.1125	.0451	.0303
Japan	124.8518	.4389	.2734	.1060
Mexico	300.3724	.3229	.2008	.0894
Singapore	209.5045	.2293	.1036	.0574
USA	140.3398	.4084	.2435	.0998

Notes: The predicted internal debt ratio (and the marginal tax effect in column 5) is evaluated at sample means of the explanatory variables and the country-specific averages of the institutional weakness indicator and the corporate income tax rate of the host countries listed.