Cross-Border Tax Effects on Affiliate Investment - Evidence from European Multinationals

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by

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Abstract

Several recent papers show that increases in the capital stock at one multinational affiliate tend to raise the capital stock at other locations, rather than to reduce it. In this paper, we theoretically and empirically explore the consequences of these findings for national corporate tax policy. Our main hypothesis is that domestic corporate taxation not only reduces *domestic* capital investment but also lowers capital stocks at *foreign* affiliates within a multinational group. The paper identifies several channels through which domestic taxation may exert such a cross-border effect on foreign capital. Using micro data on European multinational firms, we confirm the hypothesis showing that a ten percentage point increase in corporate tax rates is associated with a 5.5 percent decrease in the affiliate's capital stock. From a welfare point of view, this cross-border tax effect on capital investment gives rise to a negative fiscal externality of corporate taxation which is empirically shown to compensate a substantial fraction of the well-known positive profit shifting externality.

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1 Introduction

Recent empirical studies suggest that foreign investment of a multinational enterprise (MNE) does not reduce its domestic investment activity, it rather boosts it. Several papers demonstrate that an increase in foreign investment *causes* domestic investment to rise. These findings stand in sharp contrast to the standard model of tax competition which is based on the idea that foreign investment substitutes for domestic investment. The new empirical evidence instead suggests that if foreign taxes decrease foreign investment, they will consequently reduce domestic investment, too. To be precise, we expect taxes in one country to reduce the MNE's capital stocks at all locations. In the empirical public finance literature, these cross-border tax effects have been neglected so far.

In this paper, we identify different channels of cross-border tax effects on multinational investment, quantify them empirically and outline potential welfare implications. As a first step, we build a theoretical model to explain how taxes in one country affect investment in another country. Precisely, we consider tax rate changes at the MNE's headquarter location and investigate their effect on a foreign affiliate's capital investment. The second step is to empirically measure these cross-border tax effects on affiliate investment for a large panel of European MNEs and to test for the model predictions. As a third and final step, we explore some of the welfare implications. We show empirically that the fiscal externality caused by profit shifting behavior is considerably reduced if cross-border tax effects on affiliate capital stocks are taken into account.

In the standard literature on international investment, foreign investment is expected to substitute for domestic investment. Using aggregate investment data, Feldstein (1995) provides evidence that foreign investment replaces domestic investment "dollar for dollar". The tax competition literature rests on equivalent assumptions, see e.g. Zodrow and Mieszkowski (1986). Under perfect capital mobility, domestic taxes lower the domestic return to investment and drive capital out of the country. The interest rate falls which makes foreign capital stocks increase. Thus, national tax policies have positive externalities on other countries' tax revenue, which leads to inefficiently low tax rates in equilibrium.

Recent studies have challenged this view. Feldstein's (1995) finding is replicated

in Desai et al. (2005a) with respect to aggregate data, but the authors also find that US multinationals increase their domestic capital stock in response to investment abroad. In Desai et al. (2005b), they use firm-level data of US multinationals and show that foreign investment in plant, property and equipment (PPE) is associated with higher domestic PPE investment. Similarly, Egger and Pfaffermayr (2003) find that foreign investment increases domestic investment in tangible assets and does not decrease investment in intangibles. Castellani and Barba Navaretti (2004) and Jaeckle (2006) show that going abroad increases domestic productivity and competitiveness.[1]

An important implication of these empirical contributions is that the standard model of tax competition obviously misses some important aspects of international investment. Specifically, it cannot reproduce the empirically observed pattern that investment increases at one location cause investment at other affiliates to rise. The crucial question is what are potential driving forces behind this positive correlation and how do they relate to corporate taxation. In this paper, we consider three mechanisms. Firstly, following Nielsen et al. (2004), multinational firms may be assumed to use common inputs (e.g. marketing, trademarks, patents etc.) which increase the productivity of capital at all affiliates. The return of this input is generated at all of the MNE's locations. If taxes reduce the return of the common input at one of the affiliates, then real capital investment decreases at all affiliates. Secondly, if a multinational firm is credit constrained and has to finance new investment out of its own funds, increasing domestic taxes may reduce the available funds and therefore reduce foreign investment as well as domestic investment. Thirdly, following Grubert and Slemrod (1998), the cost of manipulating transfer prices may be related to a subsidiary's size of the capital stock. For example, large subsidiary capital stocks may 'legitimize' large trade flows between a subsidiary

[1]Lipsey (1995) analyzes a cross-section of American multinational firms, reporting a mild positive correlation between foreign production and domestic employment levels. Stevens and Lipsey (1992) analyze the investment behavior of seven multinational firms, concluding that investments in different locations substitute for each other due to costly external financing. Devereux and Freeman (1995) come to a different conclusion in their study of bilateral flows of aggregate investment funds between seven OECD countries, finding no evidence of tax-induced substitution between domestic and foreign investment. Desai et al. (2006) ask whether investment in tax havens diverts activity from non-havens and find that non-haven activity rises in response to tax haven investment activity.

and its parent (or other group affiliates respectively) which facilitates profit shifting behavior via transfer price distortions. Since changes in the domestic tax rate impact on the incentive to engage in profit shifting, they are predicted to affect the size of the foreign subsidiary's capital stock.

The central hypothesis derived from the theoretical model is that capital investment of multinational affiliates may decrease in the tax rate at foreign locations. Our estimation results support this prediction. Using a large set of European multinationals from the AMADEUS database, we regress the multinational affiliate's capital investment on the corporate tax rates at the subsidiary and the parent country and derive a robust negative relationship between both tax measures and the subsidiary's capital investment. Quantitatively, an increase in the foreign parent tax rate by 10 percentage points is estimated to reduce capital investment at the subsidiary level by 5.5%. Moreover, in line with our theoretical presumptions, the effect turns out to be especially prevalent if, firstly, the multinational headquarter owns intangible property and, hence, the use of common input goods tends to be important for the multinational firm and, secondly, if the MNE is small and earns low profits and is therefore most likely to be credit constrained, see Fazzari et al. (1988). Lastly, we also find evidence that investment at corporate subsidiaries tends to rise in the MNE's profit shifting opportunities.

The existence of a negative cross-border tax effect on affiliate investment may have important implications for the thinking about international tax issues. The standard model ignores these cross–border effects and focuses on direct tax effects instead (for a recent survey of empirical studies, see Devereux, 2007). More recent studies concentrate on profit shifting activities within multinational firms and find quantitatively sizable effects.[2] These suggest that corporate taxation exerts a positive fiscal externality on the tax revenue and welfare of foreign countries which means that corporate taxes are set inefficiently low from a worldwide welfare perspective. Our cross-border investment effect obviously runs counter to this well-established positive externality due to profit shifting.[3] In other words, domestic taxes *ceteris paribus* increase foreign tax revenue and consequently for-

[2]See e.g. Hines and Rice (1994), Clausing (2003), Weichenrieder (2007), Buettner and Wamser (2007), Huizinga and Laeven (2008).

[3]The issue is explored in depth in a companion paper, see Becker and Riedel (2007).

eign welfare because reported foreign profits increase due to shifting activities but, at the same time, they *ceteris paribus* reduce foreign tax revenue because foreign investment is deterred. The question arises which of the two effects prevails. We empirically quantify the externalities and find that the profit shifting effect dominates. However, the negative investment externality is shown to compensate a substantial part of the profit shifting effect and thus is suggested to bring the economies closer to the efficient solution.

Besides the contribution to the literature on capital taxes and tax competition, our paper also adds to the work on investment activities within multinational firms, precisely to the question whether foreign and domestic investment levels are complements or substitutes. By using tax reforms, our approach provides a new solution to the often discussed endogeneity problem (see e.g. Desai et al. 2005b) that a simultaneous increase in foreign and domestic activity may be driven by unobservable factors like a new invention, a productivity shock etc. Since tax rate changes can be considered exogenous from the individual firm's point of view, our estimations provide additional evidence for the existence of a complementary relation between investment levels at different multinational locations without being exposed to the same methodological problems as previous studies (although there may be others).

The remainder of this paper is organized as follows. The next section outlines the theoretical model that underlies our analysis. Section 3 presents the estimation methodology. In section 4, we describe the data, provide descriptive statistics and report the results. Section 5 discusses some implications and concludes.

2 Model and hypotheses

2.1 Model setup

Consider a world with a large number of countries, among which there is a subset of two countries $j = A, B$ linked through multinational firm structures. The representative multinational enterprise (MNE) is headquartered in country A and runs a subsidiary in country B. It produces a single good at both of its locations using capital (K_A,K_B) and a common input S. Capital can be rented at rate

R from the world capital market. For simplicity reasons, we assume that the considered countries are small compared to the rest of the world and consequently, corporate tax rate changes do not affect the worldwide interest rate R.[4] The production technology in both locations is assumed to be the same[5]: $F(K_A, S)$ and $F(K_B, S)$, with $F_1, F_2 > 0 > F_{11}, F_{22}$.[6] Furthermore, we assume that the common input increases capital productivity and vice versa: $F_{12}, F_{21} > 0$. The input is common in the sense that the parent firm's use of it does not diminish its use by the affiliate, and vice versa. The world market for final goods is perfectly competitive, and changes in the MNE's output do not affect the world market price which is normalized to unity.

The headquarter produces the common input at a production price of 2 per unit. It charges a fee G to the affiliate. Tax authorities in both countries believe that a fair price is given by $G = 1$. However, since the arm's length price for the common input is hard to observe by national tax authorities, G may deviate from 1. Thus, the MNE can strategically make use of transfer pricing for tax planning reasons. In line with previous papers, e.g. Haufler and Schjelderup (2000), Nielsen et al. (2004), we assume that profit shifting activities incur concealment costs C which convexly increase in the deviation of the transfer price G from its true price 1 and which may depend on the affiliate's capital stock (which is clarified later on).[7] Formally, we define the concealment cost function $C = C(G-1, K_B)$ with $C(0) = 0$, $sign\ C_1 = sign\,(G-1)$ and $C_{11} > 0$.

Consequently, the MNE's total after-tax profits are given by

$$\begin{aligned}\Pi \;=\; & (1-t_A)\,(F(K_A,S) - (2-G)\,S) + (1-t_B)\,(F(K_B,S) - GS) \\ & -R\,(K_A+K_B) - C\,(G-1\,,K_B)S, \end{aligned} \tag{1}$$

with t_A and t_B representing the national corporate tax rates. Note that, whereas capital expenditures are not deductible from the tax base, the cost for the common

[4]The implications for empirical analysis will be discussed below.

[5]The results will not depend on this assumption which is mainly made for presentational ease.

[6]The subscripts denote derivatives to the first and second argument of the production function, e.g. $F_1^A \equiv \frac{\partial F}{\partial K_A}$ and $F_{12}^A \equiv \frac{\partial^2 F}{\partial K_A \partial S}$.

[7]Note that, due to the public good character of the common input, it is hard to determine the economically "true" charge. From the point of view of the MNE, it is only important, though, that it cannot set arbitrary levels of G without bearing concealment costs.

input good can be deducted. Note further, that for $G = 1$, the tax deductions for the common good S are equal in both locations.

Profit maximization implies that the MNE chooses K_A, K_B, S and G such that the partial derivatives are zero: $\Pi_{K_A} = 0$, $\Pi_{K_B} = 0$, $\Pi_S = 0$ and $\Pi_G = 0$. This set of first-order conditions implicitly defines the equilibrium quantities as functions of the exogeneously given parameters: $K_A = K_A(t_A, t_B, R)$, $K_B = K_B(t_A, t_B, R)$, $S = S(t_A, t_B, R)$ and $G = G(t_A, t_B, R)$.

In the following, we will consider the experiment of a tax rate change in country A. We are mainly interested in the cross-border effect of the tax policy change on investment behavior of the multinational affiliate in B, i.e. in dK_B/dt_A.

2.2 Cross-border tax effects

How do tax changes in country A affect affiliate investment in B? The most basic effect is the interest rate externality, as highlighted, among others, by Zodrow and Mieszkowski (1986). A tax rate increase in A reduces capital demand in A, which depresses the interest rate. As a consequence, capital investment in B rises. However, due to the assumption of a large world capital market, this effect does not occur in our model (the implications for the empirical work are discussed below).

Beside the standard externality via the interest rate channel, additional potential linkages between taxes and affiliate investment arise. We find it helpful to summarize them in three scenarios which are, for expositional reasons, based on different sets of assumptions. In each of these scenarios, the effect of a marginal increase of t_A on capital stocks K_A and K_B is considered.

The first scenario follows the analysis in Nielsen et al. (2004), where it is assumed that MNEs are characterized by the use of common input goods, like patents, trademarks or management services. The common input is assumed to be a public good within the firm, i.e. the input used in one location does not prevent its use in another location. The scenario can be summarized by the following

Hypothesis 1 (Common input): *Assume that the firm chooses K_A, K_B and S optimally and that there are no profit shifting opportunities, $G = 1$. Then a corporate tax increase at the headquarter location reduces capital investment at the subsidiary level.*

Profit maximizing behaviour is implied by the following first-order conditions:

$$\frac{\partial \Pi}{\partial K_j} = (1-t_j)F_1^j - R = 0 \quad \text{for } j = A, B, \tag{2}$$

$$\frac{\partial \Pi}{\partial S} = (1-t_A)\left(F_2^A - 1\right) + (1-t_B)\left(F_2^B - 1\right) = 0. \tag{3}$$

Now consider an increase in the corporate tax rate of country A. It can easily be shown that a rise in t_A has a negative impact on capital investment in country A, as expected, and thus, $dK_A/dt_A < 0$. How does the affiliate in country B react to a change in the tax rate t_A? We derive that

$$dK_B = \frac{F_{12}^B F_{21}^A F_1^A - F_{12}^B F_{11}^A \left(F_2^A - 1\right)}{F_{11}^B \left(F_{11}^A F_{22}^A - F_{21}^A F_{12}^A\right)(1-t_A) + F_{11}^A \left(F_{11}^B F_{22}^B - F_{12}^B F_{21}^B\right)(1-t_B)} dt_A. \tag{4}$$

The denominator is unambiguously negative. The first term in the numerator is positive, and the second is zero if tax rates are equal, see (3). In this case, an increase in t_A decreases affiliate investment, $\frac{dK_B}{dt_A} < 0$.[8] The intuition behind the result is the following: The larger the firm's overall capital stock, the more productive is the common input. If corporate taxes in A depress the parent company's capital stock, the common input is reduced as well, which negatively affects the size of the affiliate capital stock in country B.

Scenario 2 is characterized by the assumption that investors are credit constrained. This implies that taxes may determine the allocation of capital across different locations but may also affect the available funds and thus the size of the firm's overall stock of capital. This scenario can be summarized as follows:

Hypothesis 2 (Credit constraints): *Assume that the MNE neither decides on* S, i.e. $S = \bar{S}$, *nor on* G, i.e. $G = 1$. *It observes retained earnings of* E *from previous periods and has no access to the world capital market. Then, an increase in the corporate tax rate at the parent location may lead to a reduction or increase in subsidiary capital investment.*

Retained earnings at the parent firm in country A are taxed at the domestic rate

[8] If tax rates differ much, some interferences with the deductibility of the common input occur. Then, the second term in the numerator can take positive and negative values. For purpose of illustration, we abstract from this effect.

t_A. These funds are invested in the headquarter and the affiliate's capital stocks, K_A and K_B, or, alternatively, in the world capital market at the interest rate R. An effective credit constraint is given if $F_1^A(1-t_A) > R$ and $F_1^B(1-t_B) > R$ which implies that no capital is invested in world market bonds and hence

$$(1-t_A)\,E = K_A + K_B. \tag{5}$$

The optimal choices of K_A and K_B are implied by

$$(1-t_A)\,F_1^A = (1-t_B)\,F_1^B. \tag{6}$$

Now, we again consider the effect of a change in the corporate tax rate of country A, t_A, on capital investment. A comparative static analysis with respect to equations (5) and (6) yields the following effects of t_A on capital investment in the parent company and the affiliate:

$$dK_A = \frac{F_1^A - (1-t_B)\,EF_{11}^B}{(1-t_A)\,F_{11}^A + (1-t_B)\,F_{11}^B}dt_A < 0, \tag{7}$$

$$dK_B = \frac{-F_1^A - (1-t_B)\,EF_{11}^B}{(1-t_A)\,F_{11}^A + (1-t_B)\,F_{11}^B}dt_A \lessgtr 0. \tag{8}$$

The sign of equation (7) is unambiguously negative indicating that a rise in the tax rate t_A lowers capital investment at the parent firm. This result is driven by two effects: The first term in the numerator can be interpreted as the substitution effect; an increasing tax rate shifts production from A to B. The second term can be interpreted as the income effect: The tax rate increase reduces available funds and thus reduces investment in both countries. Both effects lead to reduced capital investment in country A. The effect of tax rate changes in A on capital investment in B, as given by equation (8), is ambiguous in turn. Here, the substitution effect tends to increase investment at the affiliate in B while the income effect reduces available funds and thus also reduces investment in country B.

The third scenario captures the idea that firms increase their subsidiary investment to facilitate profit shifting activities between multinational locations, see e.g. Grubert and Slemrod (1998). The underlying rationale is that high capital

stocks justify large trade interactions between the affiliates that give rise to profit shifting possibilities via the distortion of intra-firm transfer prices. The scenario can be summarized in

Hypothesis 3 (Profit shifting): *Assume that the MNE does not decide on* S, i.e. $S = \bar{S}$. *Concealment costs* $C = C(G-1, K_B)$ *are convex in the level of profit shifting, i.e. sign* $C_1 = sign(t_B - t_A)$ and $C_{11} > 0$. *Furthermore, concealment costs depend negatively on the size of the affiliate's capital stock, i.e.* $C_2 < 0 < C_{22}$. *Cross-derivatives are given by: sign* $C_{12} = sign(t_A - t_B)$, *sign* $C_{21} = sign(t_A - t_B)$.[9] *Then, an increase in the absolute corporate tax rate differential between the two locations increases subsidiary investment.*

Differentiating (1) with respect to K_A, K_B and G under the assumptions of Hypothesis 3 yields

$$\frac{\partial \Pi}{\partial K_A} = (1 - t_A)F_1^A - R = 0, \tag{9}$$

$$\frac{\partial \Pi}{\partial K_B} = (1 - t_B)F_1^B - R - C_2\bar{S} = 0, \tag{10}$$

$$\frac{\partial \Pi}{\partial G} = (t_B - t_A) - C_1 = 0. \tag{11}$$

The level of profit shifting is determined by equation (11) which equates the marginal gain from shifting one unit of profits, $t_B - t_A$, to the marginal shifting cost C_1. If $t_B > t_A$ then profit is shifted from country B to country A which implies $G > 1$, and vice versa. Moreover, it follows from equation (11) that the larger the absolute tax rate differential between countries A and B, the larger is the profit shifting volume.

Again, we consider the effect of a marginal increase of t_A. It is straightforward to show that $dK_A/dt_A < 0$. Moreover, t_A impacts on K_B by affecting the tax rate differential between the entities and hence, the MNE's profit shifting incentive.

[9] The assumption on cross-derivatives reflects that a marginal increase in the affiliate's capital stock lowers the marginal profit shifting costs. Similarly, the marginal effect of an increase in the capital stock on concealment cost is larger, the larger the level of profit shifting. An example of such a concealment cost function is $C = (G-1)^2/K_B$.

Formally, the effect on the size of the affiliate B's capital stock is given by:

$$dK_B = \frac{C_{21}\bar{S}}{C_{11} \cdot F_{11}^B (1 - t_B) - (C_{11}C_{22} - C_{12}C_{21})\bar{S}} d(t_B - t_A). \quad (12)$$

With $C_{11}, C_{22} > 0$ and $C_{22}C_{11} > C_{12}C_{21}$, the denominator is unambiguously negative. In order to interpret equation (12), we have to differentiate between two cases. If country B is the high-tax country, i.e. $t_B > t_A$, an increase in t_A decreases the absolute tax rate differential between the affiliates. As a consequence, less profits are shifted and, with $C_{21} < 0$, the affiliate's capital stock K_B is decreased. However, if country B is the low-tax country, i.e. $t_B < t_A$, an increase in t_A widens the absolute tax differential and increases the level of profit shifting. With $C_{21} > 0$, investment in the affiliate's capital stock K_B rises. Taken together, we can conclude that the capital investment at affiliate B is predicted to positively depend on the the *absolute* tax rate differential between the locations.

2.3 Implications for tax competition

In the previous section, we identified several channels through which corporate taxes may exert a cross-border effect on foreign investment. Hypothesis 1 predicts the effect to be unambiguously negative whereas hypotheses 2 and 3 suggest a potentially negative relation. In the following, we will determine the implication of this finding for international tax competition and worldwide welfare.

In the standard model of corporate tax competition and multinational firms, domestic tax policy exerts a positive fiscal externality on the foreign country's tax revenue. A tax rate increase enhances the profit that the multinational firm shifts to the foreign location and, thus, raises foreign corporate tax revenues. In the tax competition equilibrium, this externality translates into inefficiently low corporate taxes. However, in the previous section, we also identified various channels through which corporate taxation may exert a *negative* impact on foreign *investment* levels. These cross-border effects give rise to a negative fiscal externality and inefficiently high tax rates. Consequently, the question arises which of these externalities prevails.

To investigate that in a formal framework, consider the effect of an increase

of t_A on the tax revenue in country B, denoted by R_B, which is given by $R_B = t_B \cdot (F^B - GS)$, see equation (1). Assuming multinational profit shifting possibilities and cross-border tax effects on capital investment, the externality of corporate tax setting in A on tax revenue in country B is derived as

$$\frac{\partial R_B}{\partial t_A} = t_B \cdot \frac{\partial (F^B - GS)}{\partial t_A} = t_B \left[-S \frac{\partial G}{\partial t_A} + F_1^B \frac{\partial K_B}{\partial t_A} \right]. \tag{13}$$

The first term in square brackets captures the direct effect of t_A on the level of profit shifting, $\partial G / \partial t_A < 0$, which follows from equation (11). Note that the direction and volume of profit shifting is critically determined by the tax rate differential between the locations as clarified by equation (11). The second term captures the cross border tax effect on affiliate investment. In accordance with the previous section, each of the three channels can be the driving force behind $\partial K_B / \partial t_A < 0$. Thus, equation (13) captures two fiscal externalities, a positive externality due to profit shifting and a negative externality due to cross-border tax effects on affiliate investment. The sign of the sum of these two externalities is crucial for the welfare implications of tax competition. Equation (13) does not provide a clear-cut answer to the question which of the two externalities prevails. Therefore, empirical work is needed to quantify the two effects. Among other aspects, this will be addressed in the subsequent sections.

2.4 From theory to empirical analysis

In section 2.2 we identified four channels through which taxes in A may affect investment in B: the interest rate externality, common inputs (scenario 1), credit constraints (scenario 2) and profit shifting (scenario 3). Whereas the interest rate channel affects all firms in country B, not only those owned by parents in country A but also those owned by parents who reside in other countries, the three remaining channels are based on the specific relationship between the parent company and the affiliate. This setting allows for identifying the role of common ownership by comparing the behavior of affiliates owned by parents in A to the behavior of affiliates owned by parents in other countries. In the context of our

empirical model, the former represent the treatment group while the latter serve as the control group. This structure has the advantage that the subsidiaries are located in the *same* country B and only differ in exposure to tax policy changes at their parent location. In the empirical framework, we control for country-year fixed effects and consequently for the impact of unobserved policy changes in country B on subsidiary capital investment and may still identify the effects of corporate tax rate changes at the parent location on the subsidiary's investment level. The country-year fixed effect also captures potential policy-driven interest rate changes which are equal for all firms.

How do we distinguish between the channels described in scenarios 1 to 3? Unfortunately, the theory does not provide clear-cut criteria to separate the specific scenarios from each other. However, we can define groups of firms which we consider to be characterized by common input issues, credit constraints or profit shifting. In scenario 1 (common inputs), we consider firms with stocks of intangible assets since common inputs are mostly intangible in nature (e.g. patents). With regards to scenario 2 (credit constraints), previous studies suggest that credit constraints are most likely a good description for firms which are small and have low profits. In addition, by controlling for the absolute tax rate differential we can capture the role of profit shifting (scenario 3). Although not providing us with a thorough test with which we can fully separate the individual impact–channels from one another, this may suffice to get an idea about what happens.

3 Estimation methodology

The previous sections suggest that the capital stock of subsidiary i at time t depends on the host country's corporate tax rate, $\tau_{i,t}$, as well as on the corporate tax rate at the foreign headquarter location, $\tau_{hi,t}$. Hypotheses 1, 2 and 3 offer alternative explanations why $\tau_{hi,t}$ may exert a negative impact on the affiliate's capital stock, $k_{i,t}$. In addition, Hypothesis 3 can be tested precisely by regressing capital investment on the absolute difference between the subsidiary and parent

tax $|\tau_{i,t} - \tau_{hi,t}|$. Our estimation approach is described by the following equation

$$\begin{aligned} \Delta \log k_{i,t} &= \beta_1 \Delta \log k_{i,t-1} + \beta_2 \Delta \tau_{i,t} + \beta_3 \Delta \tau_{hi,t} + \beta_4 \Delta |\tau_{i,t} - \tau_{hi,t}| \\ &\quad + \beta_5 x_{i,t} + \beta_6 \Delta x_{hi,t} + \Delta \mu_t + \Delta \epsilon_{i,t} \end{aligned} \tag{14}$$

where we expect $\beta_2, \beta_3 < 0$ and $\beta_4 > 0$, according to the theory. We made several choices on estimation methodology which are discussed in turn.

Since the distribution of fixed assets is rather skewed, we employ the logarithm of fixed assets as the endogeneous variable. To control for time-constant subsidiary, country and parent characteristics, we employ a first-difference approach. (Δ denotes the first difference of a variable).[10] Moreover, we include a full set of year dummies μ_t to control for time-varying effects which are common to all subsidiaries in our data set, e.g. changes in the world market interest rate over time. Additionally, we include time-varying locational and industry characteristics $x_{i,t}$, as well as time-varying characteristics of the parent country $x_{hi,t}$. Moreover, we add country-year fixed effects that fully absorb the impact of policy variable changes at the subsidiary location. This implies that the effect of the host country tax rate on capital investment cannot be identified separately, but we still may determine the effect of the parent tax on subsidiary capital. Hence, we compare capital investment of subsidiaries in the same country that only differ in (the tax policy at) their parent's location (see also section 2.4).

Since changes in the subsidiary's capital investment are likely associated with relevant adjustment costs, it is reasonable to employ a dynamic panel estimation approach that takes into account that subsidiary capital investment today is determined by the level of subsidiary capital investment in the previous period $k_{i,t-1}$. We use a General Method of Moments (GMM) approach which is a generaliza-

[10] Since we employ panel data that is available for more than two time periods, it is not equivalent to apply a fixed effect and first-differencing approach to control for unobserved subsidiary heterogeneity. Both models give unbiased and consistent estimates although the relative efficiency of the estimators may differ, depending on the model structure. Precisely, the fixed effect estimator is less sensitive against the violation of strict exogeneity of the regressors while the first-differencing estimator is less sensitive against the violation of serially uncorrelated error terms. Since we will account for dynamic investment effects as explained below, we will follow the literature on dynamic investment models and estimate a first-difference model. However, we equally experimented with fixed effect equations which led to qualitatively equivalent results.

tion of Anderson and Hsiao (1982) to estimate the model in first differences. We instrument for the differenced lag of the dependent capital investment variable with the level of deeper lags. Because the model is estimated in first differences, the equation will be characterized by the presence of first-order serial correlation. However, the validity of the estimator relies on the absence of second-order serial correlation. The test for first-order and second-order serial correlation by Arellano and Bond (1991) will be reported at the bottom of the result tables. The approach provides a means to derive consistent estimates for dynamic models and to circumvent the well-known dynamic panel bias in estimation of dynamic fixed effects models. More precisely, we employ the second and third lag of subsidiary capital investment to instrument for the first lag of the dependent capital investment variable. To test for the relevance of our instrument set, we employ the Kleibergen and Paap (2006) statistic which requires a rejection of the null hypothesis. Moreover, we test for the validity of the instruments by using a Sargan/Hansen test of overidentifying restrictions which requires an acceptance of the null hypothesis.[11]

A major implication of cross-border tax effects on affiliate investment concerns the fiscal externality of corporate taxation. If cross-border effects are accounted for, there are two externalities, namely the profit shifting and the investment externality (see section 2.3), which may compensate each other. To quantify the externalities, we will estimate the following equation

$$\Delta \log b_{i,t} = \alpha_1 \Delta \left(\tau_{i,t} - \tau_{hi,t}\right) + \alpha_2 \Delta \log k_{i,t} + \alpha_3 x_{i,t} + \alpha_4 x_{hi,t} + \Delta\mu_t + \Delta\upsilon_{i,t}, \quad (15)$$

whereas $b_{i,t}$ represents subsidiary i's pre-tax profit at time t. As explained in Section 2.3, the profit shifting externality on foreign pre–tax profits (and consequently the foreign tax base) depends on the tax rate *difference* $\tau_{hi,t}-\tau_{i,t}$. Hence, in line with previous empirical studies (e.g. Devereux, 2007), we interpret α_1 to capture the profit shifting externality. The coefficient α_2 measures the effect of the capital stock $k_{i,t}$ on pre-tax profit which, in turn, is affected by the parent tax rate via the

[11] The estimation method we follow here, is a generalization of Anderson and Hsiao (1982). Arellano and Bond (1991) generalize this method by using a more detailed set of moment conditions to derive the appropriate instruments. However, we do not use the Arellano and Bond GMM estimation since we found the expanded set of instruments from this method to be weak in some of our estimation equations. Nevertheless, the results from this approach generally lead to qualitatively equal results.

investment externality. Thus, taking into account the coefficient estimates α_1, α_2 and β_3 allows us to quantify the two fiscal externalities and compare them against each other. Moreover, the approach controls for firm and country characteristics $x_{i,t}$ and $x_{hi,t}$ as defined above.

Again, first differencing accounts for time-constant subsidiary characteristics. To avoid endogeneity biases requires valid instruments for the subsidiary assets $k_{i,t}$. The coefficient estimate for α_2 may otherwise be biased due to reverse causality problems: high profits may equally trigger high capital investment. Therefore, we again employ an GMM approach based on Anderson and Hsiao (1982). If there is no serial correlation, lagged fixed assets are not correlated with the differenced error term and are therefore valid instruments for the current fixed assets. Additionally, we include the corporate tax rates at the affiliate and parent location as instruments for affiliate fixed assets. To test the validity of these instruments we again make use of a Sargan test of overidentifying restrictions.[12]

4 Data, descriptive statistics and results

In this section, we describe the data base, give some descriptive statistics (4.1) and report the result of the estimation approach outlined above (4.2).

4.1 Data and sample statistics

Our empirical analysis relies on the AMADEUS data base (Bureau van Dijk) which contains detailed accounting and firm structure information for 1.6 million corporations in 38 countries. The data is available from 1995 to 2005, but unbalanced in structure. Our analysis comprises data on multinational subsidiaries from EU-25 countries whose direct immediate owner equally resides within EU 25 for the years 1995 to 2005. We restrict our sample to subsidiaries which are directly owned by a foreign parent company with at least 90% of the ownership shares. Apart from this, we exclude companies for which essential information needed for our analysis

[12] Following the empirical literature on corporate taxes and affiliate productivity, we decided to estimate a static instead of a dynamic profit equation since corporate profitability is not found to be (strongly) persistent over time.

(fixed assets, corporate tax rate at affiliate and parent location, parent information) is not available and those, for which unconsolidated accounting information is unavailable.

The ownership information in our data refers to the last reported date which is the year 2005 for most corporations in our data set. Thus, the ownership information has a cross-sectional dimension only. However, in line with previous work based on the same data, we are not too concerned about this assumption. To the extent that we are potentially including a few affiliates which were not affiliated in earlier years, we are introducing a measurement error that biases our results towards zero, see Budd et al. (2005), Barba Navaretti et al. (2003).

Matching parent companies to foreign affiliates gives an unbalanced panel with 5,048 affiliates and 2,564 parent corporations over 10 years. In total, our data contains 23,438 affiliate-year observations. Thus, the accounting information is available for 4.6 years on average. Table 1 exhibits the country distribution which is basically consistent with patterns of multinational firms in Europe. Most of the parent firms are concentrated in Western European countries like France, Germany and the United Kingdom. In contrast, many subsidiaries are located in the European South (Spain and Italy) as well as in new EU member states like the Czech Republic and Poland.

Since our analysis investigates corporate tax effects on capital investment and pre-tax profit, we additionally merge data on the statutory corporate tax rates for EU-25 countries, taken from European Commission (2006), as well as data on the effective marginal corporate tax rates, taken from Loretz (2008). Data on other country characteristics like GDP per capita, the population size and the country's unemployment rate which serve as proxies for the degree of development, market size and the economic situation are retrieved from Eurostat.

Basic sample statistics are summarized in Table 2. The average amount of fixed assets in the sample of our subsidiaries is 64 million US Dollar.[13] The average number of employees is 282 and the average pre-tax profit is calculated with 5.2 million US dollars. Not surprisingly, the corresponding accounting numbers at

[13]Note that we employ the subsidiaries' fixed asset *stock* as dependent variable in our regression analyses. In the following, we refer to this variable as fixed assets (stock), capital (stock), capital investment and fixed asset investment interchangeably.

the parent location are substantially larger. Moreover, 63.7% of the subsidiaries belong to a parent firm that owns intangible property. With regard to country characteristics, the average corporate tax rate at the parent location is 0.34 and hence slightly higher than the corporate tax rate at the subsidiary location which is 0.32. This observation is in line with the common perception that headquarters are mainly located in western European high-tax countries while production is also undertaken at subsidiaries in Eastern and Southern European countries with lower corporate tax rates.

4.2 Estimation results

The following section presents our estimation results. Throughout the whole analysis, the unit of observation will be the multinational subsidiary as described in section 3. All specifications include a full set of year dummies and robust standard errors are calculated and displayed below the coefficient estimates in the result tables. Following our argumentation in the methodology section, we will firstly investigate the effect of corporate taxes at the parent location on foreign subsidiary fixed assets investment. In a second step, we then determine the impact of parent corporation tax on subsidiary *pre-tax profits* distinguishing between the investment and the profit shifting externality.

4.2.1 Baseline results

Table 3 displays the results of the dynamic capital investment model outlined in section 3. The specifications regress the subsidiary's fixed asset investment on the statutory corporate tax rates at the subsidiary and the parent country. In specification (1), we find a significantly negative effect of both variables, the domestic and the foreign parent corporate tax rate, on fixed assets. The semi-elasticities are calculated with -1.4210 and -0.6040 respectively. Specification (2) additionally accounts for various country characteristics (GDP per capita, population size and unemployment rate) at the affiliate and parent location to make sure that our results are not driven by unobserved time-varying factors that are correlated

with the corporate tax rate and capital investment.[14] The inclusion of the additional country controls slightly increases the coefficient estimates for the tax rate variables at the subsidiary and the parent location. Specification (3) re-estimates the relationship including a full set of industry-year dummies which does neither qualitatively nor quantitatively affect our results. Last, in specification (4) we add country-year effects which absorb all country-specific shocks to the subsidiary including the domestic corporate tax effect on subsidiary investment (consequently, there is no coefficient estimate reported for this effect). The estimated coefficient for the parent corporate tax slightly drops in size but remains statistically significant at the 5% level. It suggests that an increase in the parent tax by 10 percentage points on average reduces affiliate fixed asset investment by 5.6%. Moreover, note that the test statistics reported at the bottom of the table indicate our estimation model to be valid. The Kleibergen-Paap statistic rejects the null hypothesis that the instruments are weak while the Sargan-Hansen statistic does not reject the null hypothesis that the instruments are exogeneous to the error term. Furthermore, the Arellano-Bond test indicates the absence of second-order autocorrelation.

4.2.2 Manufacturing firms and EMTR

In order to reduce the heterogeneity in our sample, we re-estimate our baseline equation restricting the sample to manufacturing firms only, see specifications (1) and (2) of Table 4. While specification (1) controls for industry-year effects and time-varying country characteristics, specification (2) additionally adds a full set of country-year effects. Interestingly, for manufacturing firms we find a substantially stronger effect of the parent corporate tax on subsidiary capital investment while the host country tax is found to exert a slightly weaker influence than in the overall sample of firms. A similar result is derived in specification (2).

In specifications (3) and (4), we reestimate the relation between corporate taxes and capital investment for the subset of manufacturing firms employing the effective marginal corporate tax rate (EMTR) as explanatory variable instead

[14] All country control variables enter the estimation equation in log form. This specification is chosen since it fits the data slightly better than an inclusion in levels. Note, however, that the estimated corporate tax coefficient are neither qualitatively nor quantitatively sensitive to the specification of the controls.

of the statutory corporate tax rate. The EMTR is a summary measure which includes depreciation allowances for capital goods, which is especially important in the manufacturing industry. The results for the EMTR estimations for the subgroup of manufacturing firms are displayed in columns (3) and (4) of Table 4. Both the subsidiary and the parent tax rate are confirmed to exert a negative and significant effect on subsidiary capital investment whereas the coefficient estimates are quantitatively comparable to the results found based on statutory corporate rate measures (cf. columns (1) and (2)).

4.2.3 Transmission channels

In the theory section, we established three alternative transmission channels through which taxes at the parent company location may affect subsidiary capital investment: common inputs, credit constraints and profit shifting.

Firstly, in the common input scenario, taxes on the parent company reduce the use of the common input and, thus, render capital investments at the subsidiaries less productive. In order to explore the relevance of this scenario, we split our data in two group: subsidiaries that belong to parent firms that hold intangible assets and subsidiaries that belong to parent firms that do not hold intangible assets. From our point of view the ownership of intellectual property is plausibly a good proxy for whether the parent provides common input goods to its subsidiaries or not since many public inputs are intangible in nature, see e.g. Markusen (1995) and Gattai (2005). The results are presented in Table 5 and confirm the role of common inputs in explaining cross-country tax effects on affiliate investment. Specifications (1) and (3) show the results for the subsample of firms that belong to parents with intangible property. For these firms, we find a strong negative effect of the parent tax rate on subsidiary capital investment. On average, an increase in the corporate tax rate by 1 percentage point is estimated to lower capital investment at the subsidiary by 0.84% (specification (1)) and 0.76% (specification (3)) respectively. In contrast, specifications (2) and (4) exhibit regressions for the subgroup of subsidiaries that belong to parents that do not own intellectual property. The results indicate a strong negative impact of the subsidiary's corporate tax rate on subsidiary investment whereas - in line with the presumption - the

parent tax does not exhibit a statistically significant influence.[15]

Secondly, MNEs may be restricted with respect to borrowing on the capital market and therefore, their investment volumes depend on the after-tax profit earned which then may be re-invested in the corporation. Raising the corporate tax rate at the parent location thus reduces the parents' after-tax profit and thus the funds available for investment at the subsidiary. Thus, we would like to split our sample in sub-groups of firms that are likely to be credit-constraint and non-credit-constraint respectively. In this context, empirical studies have shown that especially small firms and firms with a low-profit tend to suffer from borrowing constraints, see Fazzari et al. (1988). Therefore, we divide our sample in two subgroups of subsidiaries that belong to parent firms which earn a high and low pre-tax profit respectively. For this purpose, we determine the median pre-tax profit of our sample which is slightly above 16 million US dollars. The estimation results are presented in Table 6. Specifications (1) and (3) present estimations for the subsample of subsidiaries that belong to parent firms with a low pre-tax profit while specifications (2) and (4) present estimations for the subsample of subsidiaries that belong to parent firms with a high pre-tax profit.[16] The results are in line with our presumptions indicating that subsidiaries which belong to high-profit parents do not observe effects of the headquarter's corporate tax rate on its investment level while the fixed asset investment of subsidiaries which belong to low-profit parents are strongly affected by changes in the headquarter tax.[17]

[15]Strictly speaking, the coefficient estimates for the parent tax variable do not differ in a statistical sense for the two subgroups of subsidiaries due to rather large standard errors. The large standard error for the parent tax coefficient estimates in the subgroup of subsidiaries whose parents do not hold intangible property may be driven by a misclassification of some MNEs. First, parents in the subgroup of no-intangibles holding firms may nevertheless provide common input goods or common services to their affiliates that are not captured by the balance sheet item intangible assets. This might refer to e.g. management or administration services. Second, accounting law generally regulates that if a firm develops intangible property this might only be capitalized in the balance sheet at a late production stage, e.g. with the file of a patent or alternatively if the intangible property is bought from another firm. That implies that some of the no-intangibles holding firms de facto own intangible property and hence the mechanism sketched in our theoretical section applies.

[16]Note that although we split the sample at the median value, the two subsamples must not necessarily contain the identical number of observation since inclusion in the regression analysis implies that the first to third lag of the capital investment variable to be non-missing to apply the Anderson and Hsiao (1982)-estimator which is not the case for every observation in our sample.

[17]We understand these results as an indication that credit constraints play a role in determining

Thirdly, the subsidiaries' investment level may be affected by profit shifting considerations. The larger the absolute tax rate differential between a subsidiary and its parent firm, the larger are potential profit shifting possibilities. Thus, we expect the subsidiary's capital stock to depend positively on the absolute value of the tax difference. We re-estimate our dynamic subsidiary investment model and additionally include the absolute tax rate differential as explanatory variable. The results are presented in Table 6. Specification (1) includes year dummies and suggests a strong negative effect of both, the subsidiary corporate tax rate as well as the parent corporate tax rate, on subsidiary investment. Moreover, in line with our presumption, increases in the absolute tax rate differential tend to increase subsidiary investment although the coefficient estimate does not fully reach statistical significance. Specifications (2) and (3) additionally include controls for country characteristics and industry-year dummies respectively which derives similar coefficient estimates for our tax variables as in Specification (1) whereas the coefficient estimate of the absolute tax difference variable gains significance at the 5% level. These results may be interpreted as evidence in favor of shifting induced fixed-asset investment.[18]

4.2.4 External effects on the foreign tax base

The previous section provided evidence for a negative and significant impact of home country taxes on host country activity. This generates a potentially important negative externality of domestic tax policy on the foreign country's tax revenue and is thus related to another hotly debated question: the inefficiencies caused by the positive profit shifting externality. Following the methodology outlined in section 3, we quantify the two externalities against each other.

the observed cross-border tax effects. However, it must also be stressed that the coefficient estimates for the parent tax variable in the subgroups of high-profit and low-profit firms are again not statistically different from each other. Moreover, the coefficient estimates in the two subgroups turn out to be somewhat sensitive against the profit cut-off values used to define the subgroups. In our view, this may again be referred to the somewhat bold definition of the groups of credit-constrained and not credit-constrained firms.

[18]Note that we do not control for country-year characteristics here as the rather pronounced correllation between the parent tax rate and the absolute tax rate difference between subsidiary and parent country avoids a separate identification if we absorb much of the variation in the tax variables by including country-year effects.

Table 8 presents several model specifications. Specification (1) regresses the subsidiaries' pre-tax profit on fixed asset investment and the tax rate differential between the subsidiary and the parent firm. The tax rate differential enters with a negative sign, as expected, the semi-elasticity is estimated with -0.84. Thus, a larger difference between the statutory tax rates at the subsidiary and parent location reduces the MNE's pre-tax profit. This observation is in line with profit shifting behavior. The coefficient estimate on fixed assets indicates that an 1% increase in fixed assets raises pre-tax profits by 0.45% on average. Specifications (2) and (3) additionally control for time-varying country characteristics and industry-year dummies respectively. The inclusion of these additional country control variables leads to a slight drop in the absolute size of both coefficient estimates, the coefficient for the fixed asset investment as well as the coefficient for the difference in statutory tax rates. Specification (3) suggests that an 1% increase in fixed asset investment raises the subsidiary's pre-tax profit by 0.35% on average and that the semi-elasticity of pre-tax profit with respect to the tax rate differential is -0.71 on average.

This allows us to compare the tax base effects caused by the two opposing externalities presented in the theoretical section of this paper: firstly, the profit shifting externality formally captured by the tax rate differential in the pre-tax profit equation is quantified with a semi-elasticity of -0.71 (cf. Table 8, column (3)); secondly, the negative externality of parent taxes on subsidiary capital investment is measured with a semi-elasticity of $0.20 = 0.56 \cdot 0.35$ (cf. Table 3, column (4) and Table 8, column (3)). Thus, almost one third of the positive profit shifting externality on the foreign subsidiary country's tax base is compensated by the negative parent tax externality on subsidiary capital investment. This result implies that if a country decreases its corporate tax rate, it attracts foreign paper profits and therefore reduces the corporate tax base of foreign countries. However, this effect is partly mitigated as the corporate tax reduction also implies that capital investment at foreign subsidiaries is increased which, in turn raises the corporate tax base of foreign countries.

5 Discussion and concluding remarks

In this paper, we used a large firm-level data set to test for cross-border tax effects within multinational firms. Our results show that tax increases at the parent location have a significant and robust negative effect on foreign subsidiary capital stock. We identified three different channels (apart from interest rate effects at the world capital market) through which these cross-border tax effects may emerge: the use of common inputs (like patents, trademarks etc.), credit constraints and profit shifting. We find support for the importance of all three transmission channels.

Our findings are also in line with recent studies showing that, within multinational firms, domestic investment increases in response to foreign investment. They may even be read as additional indirect evidence for such a complementary relation. An important question in this literature is whether the observed positive correlation of investment levels can be interpreted as a *causal* effect of foreign investment on domestic capital stocks, or if it is due to some unobservable effect driving both foreign and domestic investment. By considering tax effects, we offer a new identification strategy. Since it seems plausible to assume that foreign tax rate changes are exogenous from the viewpoint of the multinational firm's investment behavior, our results support the notion of a causal effect.

Additionally, the paper shows that the derived cross-border tax effect on subsidiary investment gives rise to a so far neglected negative fiscal externality on foreign tax revenues. We contrast this effect with the well-established positive externality due to profit shifting and find that the shifting externality is considerably compensated by up to one third. Hence, we conclude that countries are not as much harmed by tax rate decreases in foreign economies as is usually assumed. Moreover, we believe that the estimation of one third is a conservative guess for the following reason. We can (more or less) precisely measure the impact of tax rate differences on profits, but there may be more real activity responses to parent company taxation than we considered here. For example, additional foreign investment may imply an increase in foreign employment. If an increase in employment increases welfare (e.g. in the presence of labor taxes, unemployment etc.), the externality due to cross-border tax effects on capital becomes stronger.

Therefore, we consider the cross-border investment effect to be an important

counter-balance for the well-known profit shifting externality. As a consequence, our results may change the perspective from which multinational enterprises are considered. An often cited view is that multinational firms, as opposed to nationally operating firms, accelerate tax competition. Our analysis shows that multinational firms "export" the tax burden on the headquarter to its foreign affiliates. That means, if real economic activity and not accounting profits are concerned, the existence of multinational firms may dampen the pressure from tax competition.

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Table 1: Country Statistics

Country	*Subsidiary*	*Parent*
Austria	20	75
Belgium	470	177
Cyprus	0	3
Czech Republic	133	2
Germany	122	366
Denmark	299	185
Estonia	93	6
Spain	465	100
Finland	203	98
France	705	251
United Kingdom	827	397
Greece	51	7
Hungary	63	3
Ireland	155	64
Italy	336	193
Lithuania	10	2
Luxembourg	10	35
Latvia	37	1
Netherlands	322	261
Poland	247	14
Portugal	55	21
Sweden	403	298
Slovenia	2	4
Slovakia	20	1
Sum	5,048	2,564

Table 2: Descriptive Statistics

Variable	*Obs.*	*Mean*	*Std. Dev.*	*Min.*	*Max.*
Subsidiary Level:					
Statutory Corporate Tax Rate	23,428	.3249	.0586	.1	.5601
Effective Marginal Tax Rate	23,428	.1134	.0585	-.4350	.4011
Fixed Assets★	23,428	64,556.9	724,387.2	1	4.81e+07
Number of Employees	19,448	282.0	1,065.0	1	24,561
Pre-tax Profit★	22,490	5158.5	80,093.0	-3,930,011	6,395,743
GDP per Capita♦	23,428	23,903.3	7,534.7	2,484.6	60,311.2
Population	23,428	3.52e+07	2.42e+07	422,050	8.25e+07
Unemployment Rate	20,625	.0796	.0339	.0210	.1980
Parent Level:					
Statutory Corporate Tax Rate	23,428	.3412	.0658	.1	.5601
Effective Marginal Tax Rate	23,428	.1136	.0416	-.4350	.4011
Fixed Assets★	12,118	4,423,212	1.20e+07	3	1.36e+08
Number of Employees	10,438	7,465.6	29,432.4	1	323,298
Profit Loss Before Tax★	12,133	253,919.3	911,499.5	-1.57e+07	1.15e+07
Intangible Asset Holdings	23,428	.6371	.4808	0	1
GDP per Capita♦	23,428	27,651.4	5,800.5	2,798.1	65,113.1
Population	23,428	3.83e+07	2.95e+07	422,050	8.25e+07
Unemployment Rate	21,102	.0680	.0247	.0210	.1980

Notes:

★ In thousands of US dollars, current prices.

♦ In euros, current prices.

Table 3: Baseline Estimation

Variable	*(1)*	*(2)*	*(3)*	*(4)*
Lag Fixed Assets	0.6615***	0.7032***	0.6837***	0.6751***
	(0.0582)	(0.0663)	(0.0665)	(0.0648)
Corporate Tax Rate, Subs	−1.4210***	−1.6733***	−1.6597***	
	(0.3240)	(0.3548)	(0.3576)	
Corporate Tax Rate, Par	−0.6040***	−0.7056***	−0.6363***	−0.5596**
	(0.2453)	(0.2740)	(0.2791)	(0.2854)
GDP p.c., Subs		0.3157	0.4589	
		(0.3424)	(0.3450)	
GDP p.c., Par		−0.1239	−0.1477	−0.2991
		(0.4155)	(0.4161)	(0.4217)
Population, Subs		0.5980	0.8546	
		(0.9889)	(1.0004)	
Population, Par		1.1283	0.9616	1.4911
		(1.2570)	(1.2546)	(1.2550)
Unemployment Rate, Subs		0.0543	0.0693	
		(0.0676)	(0.0667)	
Unemployment Rate, Par		−0.0169	−0.0359	−0.0411
		(0.0687)	(0.0688)	(0.0675)
Industry - Year Dummies			√	√
Country - Year Dummies				√
Number of Observations	23,428	20,604	20,203	20,701
Number of Affiliates	5,048	4,743	4,644	4,773
Kleibergen-Paap Statistic★	0.000	0.000	0.000	0.000
Sargan-Hansen Statistic★	0.549	0.506	0.407	0.409
Arellano-Bond, AR(1)▲	0.000	0.000	0.000	0.000
Arellano-Bond, AR(2)▲	0.461	0.273	0.318	0.282

Dependent variable: log of subsidiary fixed assets. Robust standard errors in parentheses. *** / ** / * indicates statistical significance at the 1% / 5% / 10% level. ★/▲ indicates that the p-value/z-value is reported. Specifications (1) and (2) includes a full set of year effects. 'Corporate Tax Rate' stands for the statutory corporate tax rate, 'GDP p.c.' for the log of GDP per capita, 'Population' for the log of population size and 'Unemployment Rate' for the log of the unemployment rate. 'Subs' indicates the subsidiary, 'Par' the parent firm. At the bottom of the table the Kleibergen-Paap test for weak instruments, the Sargan-Hansen test of overidentifying restrictions and the Arellano-Bond test for first and second-order autocorrellation is reported.

Table 4: Manufacturing Firms and EMTR				
Variable	*(1)*	*(2)*	*(3)*	*(4)*
Lag Fixed Assets	0.6329***	0.6441***	0.6152***	0.6362***
	(0.0981)	(0.0926)	(0.0983)	(0.0924)
Corporate Tax Rate, Subs	−0.9705***		−1.0307**	
	(0.3910)		(0.4447)	
Corporate Tax Rate, Par	−1.4484***	−1.3401***	−1.7085***	−1.6503***
	(0.4423)	(0.4466)	(0.5656)	(0.5703)
GDP p.c., Subs	0.4203		0.5928	
	(0.4961)		(0.4956)	
GDP p.c., Par	0.1219	0.1758	0.1105	0.1378
	(0.6159)	(0.6425)	(0.6139)	(0.6410)
Population, Subs	−1.7942		−2.3259	
	(1.6317)		(1.5930)	
Population, Par	2.7470	2.9684	1.7027	1.9761
	(1.9031)	(1.9296)	(1.8537)	(1.8884)
Unemployment Rate, Subs	0.0784		0.1259	
	(0.0855)		(0.0869)	
Unemployment Rate, Par	−0.1439	−0.0994	−0.0963	−0.0577
	(0.1039)	(0.1025)	(0.1026)	(0.1020)
Country - Year Dummies		√		√
EMTR			√	√
Number of Observations	6,258	6,382	6,258	6,382
Number of Affiliates	1,315	1,348	1,315	1,348
Kleibergen-Paap Statistic★	0.000	0.000	0.000	0.000
Sargan-Hansen Statistic★	0.996	0.926	0.982	0.943
Arellano-Bond, AR(1)▲	0.000	0.000	0.000	0.000
Arellano-Bond, AR(2)▲	0.506	0.409	0.512	0.415

Dependent variable: log of subsidiary fixed assets. Robust standard errors in parentheses. *** / ** / * indicates statistical significance at the 1% / 5% / 10% level. ★/▲ indicates that the p-value/z-value is reported. All specifications include a full set of industry-year effects. 'Corporate Tax Rate' stands for the statutory corporate tax rate (Specifications (1) and (2)) and for the effective marginal tax rate (Specifications (3) and (4)) respectively, 'GDP p.c.' for the log of GDP per capita, 'Population' for the log of population size and 'Unemployment Rate' for the log of the unemployment rate. 'Subs' indicates the subsidiary, 'Par' the parent firm. At the bottom of the table the Kleibergen-Paap test for weak instruments, the Sargan-Hansen test of overidentifying restrictions and the Arellano-Bond test for first and second-order autocorrellation is reported.

Table 5: Intangibles Holdings vs. No Intangibles Holdings at Parent

Variable	*(1)*	*(2)*	*(3)*	*(4)*
Lag Fixed Assets	0.7611***	0.6070***	0.7533***	0.5813***
	(0.1042)	(0.0997)	(0.1021)	(0.0948)
Corporate Tax Rate, Subs	−0.8497***	−3.1446***		
	(0.4061)	(0.7017)		
Corporate Tax Rate, Par	−0.8425***	−0.2284	−0.7580**	−0.3363
	(0.3533)	(0.4553)	(0.3618)	(0.4728)
GDP p.c., Subs	0.6122	0.2333		
	0.4347	(0.5955)		
GDP p.c., Par	−0.0714	0.2327	−0.4953	0.3274
	(0.5897)	(0.6987)	(0.5939)	(0.7167)
Population, Subs	−0.4599	3.1009		
	(1.1988)	(2.1561)		
Population, Par	2.6178*	−2.1499	3.2962**	−1.2032
	(1.5155)	(2.6626)	(1.5425)	(2.7336)
Unemployment Rate, Subs	0.0950	0.0209		
	(0.0854)	(0.1119)		
Unemployment Rate, Par	0.0715	−0.1333	0.0379	−0.1327
	(0.0884)	(0.1291)	(0.0876)	(0.1272)
Country - Year Dummies			√	√
Subgroup	Intangibles	No Intangibles	Intangibles	No Intangibles
Number of Observations	12,943	7,260	13,280	7,421
Number of Affiliates	3,479	2,307	3,573	2,355
Kleibergen-Paap Statistic★	0.000	0.000	0.000	0.000
Sargan-Hansen Statistic★	0.528	0.585	0.472	0.591
Arellano-Bond, AR(1)▲	0.000	0.000	0.000	0.000
Arellano-Bond, AR(2)▲	0.501	0.787	0.520	0.784

Dependent variable: log of subsidiary fixed assets. Robust standard errors in parentheses. *** / ** / * indicates statistical significance at the 1% / 5% / 10% level. ★/▲ indicates that the p-value/z-value is reported. All specifications include a full set of industry-year effects. 'Corporate Tax Rate' stands for the statutory corporate tax rate, 'GDP p.c.' for the log of GDP per capita, 'Population' for the log of population size and 'Unemployment Rate' for the log of the unemployment rate. 'Subs' indicates the subsidiary, 'Par' the parent firm. At the bottom of the table the Kleibergen-Paap test for weak instruments, the Sargan-Hansen test of overidentifying restrictions and the Arellano-Bond test for first and second-order autocorrellation is reported.

Table 6: Low Profits vs. High Profits at Parent Firm				
Variable	*(1)*	*(2)*	*(3)*	*(4)*
Lag Fixed Assets	0.9409***	0.4295***	0.9423***	0.4181***
	(0.1637)	(0.1249)	(0.1560)	(0.1295)
Corporate Tax Rate, Subs	−1.6174***	−1.5076**		
	(0.5765)	(0.5747)		
Corporate Tax Rate, Par	−1.0603***	−0.5916	−1.0105*	−0.4107
	(0.5244)	(0.4598)	(0.5299)	(0.4693)
GDP p.c., Subs	0.3274	0.7584		
	0.6623	(0.5921)		
GDP p.c., Par	−2.0764**	0.0276	−2.4560	0.0826
	(0.9779)	(0.8276)	(1.0271)	(0.8210)
Population, Subs	−5.2836	1.1489		
	(2.4767)	(1.6660)		
Population, Par	4.7528	−1.0243	3.5919	−0.9886
	(3.0781)	(2.6759)	(3.2705)	(2.6244)
Unemployment Rate, Subs	−0.0263	0.2872**		
	(0.1540)	(0.1220)		
Unemployment Rate, Par	0.1494	−0.0046	−0.0367	−0.0388
	(0.1900)	(0.1838)	(0.2025)	(0.1776)
Country - Year Dummies			√	√
Subgroup	Low Profit	High Profit	Low Profit	High Profit
Number of Observations	5,379	5,295	5,493	7,421
Number of Affiliates	1,794	1,593	1,835	2,355
Kleibergen-Paap Statistic★	0.000	0.000	0.000	0.000
Sargan-Hansen Statistic★	0.542	0.405	0.434	0.317
Arellano-Bond, AR(1)▲	0.000	0.006	0.000	0.008
Arellano-Bond, AR(2)▲	0.982	0.630	0.757	0.610

Dependent variable: log of subsidiary fixed assets. Robust standard errors in parentheses. *** / ** / * indicates statistical significance at the 1% / 5% / 10% level. ★/▲ indicates that the p-value/z-value is reported. All specifications include a full set of industry-year effects. 'Corporate Tax Rate' stands for the statutory corporate tax rate, 'GDP p.c.' for the log of GDP per capita, 'Population' for the log of population size and 'Unemployment Rate' for the log of the unemployment rate. 'Subs' indicates the subsidiary, 'Par' the parent firm. At the bottom of the table the Kleibergen-Paap test for weak instruments, the Sargan-Hansen test of overidentifying restrictions and the Arellano-Bond test for first and second-order autocorrellation is reported.

Table 7: Profit Shifting and Investment			
Variable	*(1)*	*(2)*	*(3)*
Fixed Assets, Lag 1	0.6614***	0.7041***	0.6848***
	(0.0582)	(0.0664)	(0.0666)
Corporate Tax Rate, Subs	−1.4178***	−1.7049***	−1.6869***
	(0.3246)	(0.3505)	(0.3538)
Corporate Tax Rate, Par	−0.9161***	−1.2186***	−1.1219***
	(0.3264)	(0.3645)	(0.3684)
Absolute Tax Difference	0.4235	0.6397**	0.6027**
	(0.2880)	(0.3088)	(0.3094)
GDP per Capita, Subs		0.2258	0.3723
		(0.3461)	(0.3490)
GDP per Capita, Par		−0.1061	−0.1316
		(0.4155)	(0.4160)
Population, Subs		0.8066	1.0467
		(0.9926)	(1.0035)
Population, Par		1.1700	1.0028
		(1.2615)	(1.2587))
Unemployment Rate, Subs		0.0566	0.0710
		(0.0676)	(0.0668)
Unemployment Rate, Par		−0.0211	−0.0400
		(0.0687)	(0.0688)
Industry - Year Dummies			√
Number of Observations	23,428	20,604	20,203
Number of Affiliates	5,048	4,743	4,644
Kleibergen-Paap Statistic★	0.000	0.000	0.000
Sargan-Hansen Statistic★	0.543	0.501	0.404
Arellano-Bond, AR(1)▲	0.000	0.006	0.000
Arellano-Bond, AR(2)▲	0.455	0.630	0.310

Dependent variable: log of subsidiary fixed assets. Robust standard errors in parentheses. *** / ** / * indicates statistical significance at the 1% / 5% / 10% level. ★/▲ indicates that the p-value/z-value is reported. Specifications (1) and (2) include a full set of year effects. 'Corporate Tax Rate' stands for the statutory corporate tax rate, 'Absolute Tax Difference' for the absolute difference between the subsidiary's and the parent firm's statutory corporate tax rate. 'GDP p.c.' indicates the log of GDP per capita, 'Population' the log of population size and 'Unemployment Rate' the log of the unemployment rate. 'Subs' indicates the subsidiary, 'Par' the parent firm. At the bottom of the table the Kleibergen-Paap test for weak instruments, the Sargan-Hansen test of overidentifying restrictions and the Arellano-Bond test for first and second-order autocorrellation is reported.

Table 8: Profit Estimation			
Variable	*(1)*	*(2)*	*(3)*
Fixed Asset Investment	0.4513^{***}	0.3781^{***}	0.3533^{***}
	(0.1333)	(0.1386)	(0.1361)
Tax Difference	-0.8406^{***}	-0.7347^{***}	-0.7057^{**}
	(0.2857)	(0.3021)	(0.3108)
GDP per Capita, Subs		2.5256^{***}	2.4824^{***}
		(0.5590)	(0.5663)
GDP per Capita, Par		0.9363	0.8500
		(0.6926)	(0.7015)
Population, Subs		-2.8574^{*}	-3.2446^{*}
		(1.6973)	(1.7218)
Population, Par		-0.0557	0.2004
		(2.5025)	(2.5054)
Unemployment Rate, Subs		0.0564	0.0338
		(0.1145)	(0.1166)
Unemployment Rate, Par		0.0680	0.0528
		(0.1066)	(0.1077)
Industry - Year Dummies			$\surd$
Number of Observations	17,199	15,262	14,971
Number of Affiliates	4,262	3,985	3,905
Kleibergen-Paap Statistic$^{\bigstar}$	0.000	0.000	0.000
Sargan-Hansen Statistic$^{\bigstar}$	0.135	0.243	0.305

Dependent variable: logarithm of subsidiary pre-tax profit. Robust standard errors in parentheses. *** / ** / * indicates statistical significance at the 1% / 5% / 10% level. $^{\bigstar}$ indicates that the p-value is reported. Specifications (1) and (2) include a full set of year effects. 'Fixed Asset Investment' stands for the logarithm of fixed assets at the subsidiary, 'Tax Difference' for the difference between the statutory corporate tax rate at the subsidiary and at the parent location. 'GDP p.c.' indicates the log of GDP per capita, 'Population' the log of population size and 'Unemployment Rate' the log of the unemployment rate. 'Subs' indicates the subsidiary, 'Par' the parent firm. At the bottom of the table the Sargan-Hansen test of overidentifying restrictions and the Kleibergen-Paap test for weak instruments is reported.

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