# Corporate tax effects on the quality and quantity of FDI[1]

by

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**Abstract**

This paper measures the relative importance of quality and quantity effects of corporate taxation on foreign direct investment. Taxes reduce the equilibrium stock of foreign capital in a given country (quantity effect) and decrease the extent to which investment contributes to the corporate tax base (quality effect). We build a model with heterogeneous investment projects in order to analyse the interdependent effects of taxes on investment quantity and quality. The model predictions are tested using data from a large sample of European multinationals. We find that the quality effect accounts for almost half of the total effect of taxes on the size of the tax base. An important implication is that governments should not only care about the size of inbound FDI flows also about its specific characteristics.

**JEL Codes:** H25, F23

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# 1 Introduction

Governments seek to attract foreign direct investment (FDI) because it is generally assumed that countries benefit from capital inflows. An important (though not the only) measure of these benefits is to which extent inbound FDI contributes to the domestic corporate tax base. This implies that the *quality* of foreign direct investment matters, not just the *quantity*. The standard view on international capital implies that high-tax countries have lower equilibrium stocks of FDI, but the marginal unit of investment contributes more to tax revenue than in low-tax countries because of the higher marginal return and larger tax rates. Thus, at the margin, high-tax countries receive investment of higher quality than low-tax countries.

In this paper, we show that this regularity postulated by the standard model may vanish or even be reversed under plausible assumptions on multinational firm behaviour. We adopt and modify a model developed by Grossman & Rossi-Hansberg (2008) which considers multinational firms with investment projects that need heterogeneous inputs. Taxation affects the way in which multinational firms organise their worldwide production of input goods. As a consequence, high tax countries attract FDI with lower quality than low tax jurisdictions, i.e. investment in high tax countries contributes less to the tax base in these countries than FDI located in low tax countries. Profit shifting via manipulation of transfer prices may reinforce the quality effect, but the effect also occurs in the absence of profit shifting.

We test the predictions of the model using micro-level firm data from European countries. We find that the quality effects accounts for almost half of the overall effect. To the best of our knowledge, our paper is the first to empirically investigate the implications of corporate taxes for welfare effects of inbound foreign direct investment, not just quantity effects.

The intuition for our main argument can be explained as follows. Consider a multinational firm with a headquarter in one country and an affiliate in another country. Production of the final output requires a set of intermediate input goods and services, or tasks like e.g. product development, customer services, marketing, accounting, controlling, call centres and so on. Firms may locate the production of these tasks either in the headquarter country or in the country of the affiliate. Tasks may differ in the costs associated with the different locations, and they may therefore also differ with respect to the taxable income they generate. International tax differences create incentives to locate tasks that generate high taxable profits in low tax countries and vice versa. Thus, from the perspective of countries hosting direct investment of multina-

tional firms, taxes affect not just the quantity but also the quality of inbound foreign direct investment, where quality means the contribution of the investment to the domestic corporate tax base. For instance, tax cuts in a particular country induce firms to reorganize their production so that more projects and more profitable tasks are located in that country. The main purpose of this paper is to disentangle the quantity effects of tax changes on the corporate tax base from quality effects. From a policy perspective, this distinction is of key importance. For example, it may well be that countries with high taxes attract primarily loss making investment. The quantity of investment may not differ much from that of other countries, but the welfare effects of this investment would be different because the investment diminishes the tax base and possibly also domestic welfare.

As noted above, quality effects emerge if investment affects activity elsewhere in the multinational group or firms may shift profits or both.[1] Thus, our paper integrates two strands of literature which so far have not been considered as interrelated. The first strand deals with evidence for tax induced profit shifting. These studies start from the observation that profitability is higher in low-tax affiliates than in high-tax affiliates, see e.g. Grubert & Mutti (1991), Hines & Rice (1994), Huizinga & Laeven (2008), Dischinger (2008), Dischinger & Riedel (2008) and Weichenrieder (forthcoming). The second strand provides evidence for the hypothesis that investing abroad influences the profitability, productivity, employment etc. of the investor firm. These studies show that investment abroad has a significant impact on all types of activity or performance indicators of the parent company, see Desai, Foley & Hines (2005, 2009), Egger & Pfaffermayr (2003), Castellani & Barba Navaretti (2004), Jaeckle (2006) and Simpson (2009). Our model allows integrating these two strands. The model considers a representative multinational firm which produces a consumption good at the foreign affiliate. Production requires a number of input goods which can either be produced at the headquarter or at the affiliate. If input goods are produced at the headquarter, intra-firm trade arises which may be used to shift profits from the affiliate to the headquarter or the other way around. Thus, due to intra-firm trade, production at the affiliate is likely to affect activity and income at the headquarter - even if transfer prices cannot be manipulated. We assume that input goods are heterogeneous. In

[1] In research on international taxation, cross-border effects have been neglected so far, an exemption being Becker & Riedel (2008, 2009). In contrast, the literature on multinational firms recognizes their importance and points out that synergies between different firms of a multinational group and complementarities of their assets are an important factor for the formation and the existence of these firms. See e.g. the introduction to the theory of multinational firms in Markusen (2002), ch. 1.

equilibrium, some input goods are produced at the headquarter and some at the affiliate. If tax reforms change the location decisions for input good production, affiliate investment not only changes in quantity, but also in quality in terms of tax revenue (and other characteristics).

Accounting for heterogeneity in input goods offers a complementary explanation for tax driven differences in profitability. In the literature, these difference are mainly interpreted as reflecting tax-induced profit shifting. The model demonstrates, though, that even in the absence of profit shifting, this pattern can be compatible with profit-maximizing firm behaviour. Moreover, it shows that profit shifting and project selection are actually closely linked. Profit shifting via transfer pricing requires intra-firm trade, which itself requires that production at some location uses inputs from some other locations. Then, investment triggers activity at other locations by inducing an increase in input production. Unfortunately, our data do not allow testing profit shifiting against project selection. We leave this question to future research. We might however state that project selection may help explaining the puzzle that international profit shifting is large when indirectly measured through cross-country profitability differences, as in Huizinga & Laeven (2008), but small when the use of profit shifting instruments is considered.[2] Moreover, tax practitioners often report that the use of transfer pricing is substantially limited by legal provisions of the high-tax countries.

Our findings on quality aspects of foreign direct investment have some important implications. Firstly, the welfare cost of tax distortions may be higher than suggested by studies focusing on the quantity aspect alone. Secondly, as mentioned above, observed tax induced profitability differences may not only be due to the shifting of book profits across countries. Thirdly and more generally, policies which aim at attracting foreign direct investment may have to pay more attention to the qualitative dimension of this investment.

The rest of the paper is set up as follows. In section 2, we present the model. Section 3 discusses some extensions. In section 4, we provide suggestive evidence for the main hypotheses. Section 5 concludes.

[2]E.g., Huizinga, Laeven & Nicodeme (2008) and Buettner & Wamser (forthcoming) show that taxes only have a small impact on the use of intra-firm loans. With regard to transfer pricing, the evidence is rather mixed. Whereas Swenson (2001) only finds a small impact of taxes on trade prices, Clausing (2003) reports a considerable influence.

# 2 The model

The below presented model is strongly inspired by Grossman & Rossi-Hansberg (2008). Building on their work, we had to modify the model in order to focus on specific tax-related questions. In the following, the model is outlined before we define the notions of quantity and quality within the model framework.

## 2.1 Setup, equilibrium and comparative statics

Assume a world with two countries, $h$ and $a$. A representative multinational firm is headquartered in country $h$ and has an affiliate in country $a$. The affiliate produces an output $Q$ which is sold on the world market at a constant price of unity. The production of $Q$ requires a composite input good $X$. The production function is $Q = Q(X)$, and strictly concave. Each unit of $X$ requires of a continuum of intermediate goods and services $\mathbf{y}$.

The production of each individual intermediate good $y_i$ requires $\alpha_i$ units of labor input and $1 - \alpha_i$ units of capital input $k_i$. For each input good $y_i$, the firm chooses whether to produce it at the headquarter or at the affiliate. If it is produced at the headquarter, a transport cost $\theta_i$ has to be borne. For tax purposes, a transfer price $p_i$ applies. The transfer price is determined by comparison with market prices or on the basis of cost accounting. Corporate taxes are given by $t^h$ and $t^a$. The wage per unit of labour is denoted by $w$. The nontax cost of capital $k_i$ is denoted by $r$. Labor expenses are deductible, capital expenses are not.

In the following, we will allow intermediate goods to differ in a certain dimension $z$ which is a dummy variable for some good-specific aspect. $z$ is assumed to be uniformly distributed over $[z^-, z^+]$. If intermediate good production takes place in both locations, this is due to the heterogeneity in intermediate goods. Then, there is some critical value $z^c \in [z^-, z^+]$ at which the firm is indifferent between producing the related intermediate good at the headquarter or at the affiliate. Thus, a number $\int_{z^-}^{z^c} dz$ of goods is produced at the affiliate and the remainder, $\int_{z^c}^{z^+} dz$ is produced at the headquarter. Below, we will discuss three examples of what $z$ could stand for: transport costs $\theta$, transfer prices $p$ and labour intensities $\alpha$.

The after-tax profits are given by

$$\Pi = (1 - t^a)\left(Q\left(X\right) - w^a L^a - \Theta - P\right) + \left(1 - t^h\right)\left(P - w^h L^h\right) - rK \qquad (1)$$

where $L^a = X\int_{z^-}^{z^c} \alpha_i dz$ is the labor input at the affiliate, $\Theta = X\int_{z^c}^{z^+} \left(\theta_i\right) dz$

is the transport cost of importing intermediate goods from the headquarter, $P = X\int_{z^c}^{z^+}(p_i)\,dz$ is the related transfer price and $L^h = X\int_{z^c}^{z^+}\alpha_i dz$ is the labor input at the headquarter. Finally $K = X\int_{z^-}^{z^+}(1-\alpha_i)\,dz$ is the firm's capital input.

The firm chooses the overall activity $X$ and the location of the intermediate good production $z^c$. For a given level of $X$ optimal location implies $\partial\Pi/\partial z^c = 0$ or

$$(1-t^a)\,\theta^c = \left(t^a - t^h\right)p^c + \alpha^c\left[w^a\left(1-t^a\right) - w^h\left(1-t^h\right)\right] \tag{2}$$

In the location-related profit maximum, the disadvantage of producing at the headquarter (the transport cost) equals its advantage (the gain from profit shifting and lower after-tax labor costs). In the following, we consider three sources of heterogeneity: transport costs, transfer prices and labour-capital-ratios.

To start, consider heterogeneity in transport costs. It seems plausible to assume that the related cost of offshoring differ across intermediate goods, be it due to transaction or coordination cost or because of mere transport costs in the strict sense. Let $\theta$ be uniformly distributed over $\theta \in [\theta^-, \theta^+]$ and $p$ and $\alpha$ be constant across all intermediate goods. Assume that (2) holds for some $\theta^- < \theta^c < \theta^+$. Then, intermediate goods with low transport costs will be produced at the headquarter. It follows that

$$\frac{d\theta^c}{dt^a} = \frac{p + \theta^c - \alpha w^a}{1-t^a} \equiv -\frac{dz^c}{dt^a} \tag{3}$$

It follows from (2) that $p + \theta^c - \alpha w^a = \left(p^c - \alpha w^h\right)\left(1-t^h\right)/\left(1-t^a\right)$. Thus, if the tax base of the marginal intermediate good is positive, an increase in $t^a$ increases production at the headquarter level. This implies $\frac{dz^c}{dt^a} < 0$. Equivalently, it can be shown that $\frac{dz^c}{dt^h} > 0$.

Now, consider heterogeneity in transfer prices. The literature on transfer pricing shows that it is often a complex issue to determine adequate transfer prices. Accordingly, the transfer prices may differ for a given cost of production. Heterogeneity in transfer prices may equivalently interpreted as a heterogeneity in the ability to manipulate transfer prices for tax purposes. Assume that transfer prices are given by $p \in [p^-, p^+]$ and $\theta$ and $\alpha$ are constant across intermediate goods. An allocation of production to both locations only occurs if (2) holds which requires that the tax differential is large enough. If $t^a > t^h$, all intermediate goods with high transfer prices are produced at the headquarter, and vice versa. It follows that

$$\frac{dp^c}{dt^a} = -\frac{p^c + \theta - \alpha w^a}{t^a - t^h} \equiv \frac{dz^c}{dt^a} \tag{4}$$

which implies $\frac{dz^c}{dt^a} < 0$. Again, if the tax base of the marginal intermediate good is

positive, an increase in $t^a$ increases production at the headquarter level. Equivalently, it can be shown that $\frac{dz^c}{dt^h} > 0$.

Finally, assume that intermediate goods differ in the labor intensity $\alpha$ with $\alpha \in [\alpha^-, \alpha^+]$ and $\theta$ and $p$ constant across intermediate goods. Assume that (2) holds for some $\alpha^- < \alpha^c < \alpha^+$ which requires that the difference in after-tax wage cost is large enough. If $w^a(1-t^a) > w^h\left(1-t^h\right)$, labor intensive goods will be produced at the headquarter. It follows

$$\frac{d\alpha^c}{dt^a} = -\frac{p+\theta-\alpha^c w^a}{w^a(1-t^a)-w^h(1-t^h)} \equiv \frac{dz^c}{dt^a} \tag{5}$$

which implies $\frac{dz^c}{dt^a} < 0$. An implication is that, if $w^a(1-t^a) > w^h\left(1-t^h\right)$, an increase in $t^a$ decreases the average labor-capital intensity at the affiliate level, and vice versa. Equivalently, it can be shown that $\frac{dz^c}{dt^h} > 0$.

Now, consider the choice of the activity level $X$. Profits are maximized if marginal revenue equals marginal cost:

$$Q' = X^{-1}\left[\frac{r}{1-t^a}K + w^a L^a + \frac{1-t^h}{1-t^a}w^h L^h + \frac{t^h-t^a}{1-t^a}P + \Theta\right] \tag{6}$$

from which follows:

$$\frac{dX}{dt^a} = \frac{XQ' - w^a L^a - P - \Theta}{XQ''} = \frac{r}{1-t^a}\frac{K}{XQ''} - \frac{1-t^h}{1-t^a}\frac{P-w^h L^h}{XQ''} \tag{7}$$

$$\frac{dX}{dt^b} = \frac{P-w^h L^h}{XQ''} \tag{8}$$

The above equations show that if the transfer prices equal wage cost at the headquarter, tax rate changes at the headquarter have no impact on production. If the headquarter receives positive net income from production, the effect of affiliate taxes is mitigated.

## 2.2 Quantity and quality effects

Now, we can calculate the effects of taxes on quality and quantity of foreign direct investment. Firstly, consider quantity. The affiliate's capital stock is given by

$$K^a = X\int_{z^-}^{z^c}(1-\alpha_i)\,dz \tag{9}$$

The tax effect on the quantity of investment is given by

$$\frac{dK^a}{dt^a} = \frac{\partial X}{\partial t^a}\int_{z^-}^{z^c}(1-\alpha_i)\,dz + X(1-\alpha^c)\frac{\partial z^c}{\partial t^a} \tag{10}$$

With $\frac{\partial z^c}{\partial t^a} < 0$, there are two types of negative effects of taxes on the affiliate capital stock. Firstly, production is reduced, and secondly, production is shifted towards the headquarter.

In terms of quality, we have to distinguish between average quality and marginal quality. Average quality is simply given by $B^a/K^a$ where $B^a$ denotes the affiliate's tax base given by

$$B^a = Q(X) - w^a L^a - P^a Y^h \tag{11}$$

Marginal quality is defined as $b^a \equiv \frac{dB^a/dX}{dK^a/dX}$ given by

$$b^a = \frac{Q' - w^a \int_{z^-}^{z^c} \alpha_i dz - \int_{z^c}^{z^+} (p_i + \theta_i)\, dz}{\int_{z^-}^{z^c} (1 - \alpha_i)\, dz} \tag{12}$$

Thus, average quality can be expressed as

$$\frac{B^a}{K^a} = \frac{Q(X) - XQ'}{K^a} + b^a \tag{13}$$

An increase in the affiliate tax rate has the following effect on average quality:

$$\frac{\partial \frac{B^a}{K^a}}{\partial t^a} = -\frac{XQ''}{K^a} - \frac{Q(X) - XQ'}{(K^a)^2} \frac{dK^a}{dt^a} + \frac{\partial b^a}{\partial t^a} \tag{14}$$

The first two terms are positive. The tax effect on marginal quality is

$$\frac{\partial b^a}{\partial t^a} = b^a \left[ 1 - \frac{(1 - \alpha^c) \frac{dz^c}{dt^a}}{\int_{z^-}^{z^c} (1 - \alpha_i)\, dz} \right] + \frac{(p^c + \theta^c - \alpha^c w^a)}{\int_{z^-}^{z^c} (1 - \alpha_i)\, dz} \frac{dz^c}{dt^a} \tag{15}$$

The first term in square brackets is positive. This captures an increase in $Q'$ and a decrease in the denominator. The second term is negative, though. An increase in $t^a$ leads the firm to shift production of those intermediate goods to the headquarter which have the largest tax base at the affiliate. Ceteris paribus, this leads to a reduction in investment quality.

The overall effect is ambiguous. We will evaluate the above model empirically in order to disentangle quality from quantity effects of taxation.

# 3 Data

We use the commercial database AMADEUS which is compiled by Bureau van Dijk. The version of the database available to us contains detailed information on firm structure and accounting of national and multinational corporations in European countries.

We focus on 29 countries (Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Great Britain, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Russia, Serbia, Slovakia, Spain, Sweden, Ukraine) and on the time period of 1995 – 2005 as these countries and years are sufficiently represented by the database. Our data comprises subsidiaries of multinational firms that observe capital investments in more than one country world wide. Precisely, subsidiaries are included into the analysis if their parent firm is located in a foreign country. A country distribution of the subsidiaries in our sample is presented in table 1. The country pattern of the subsidiaries in our sample thereby broadly corresponds to the FDI distribution in Europe.

Moreover, we restrict our analysis to firms with a positive pre–tax profit. This is partly justified by the strong skewness of the profit distribution which suggests to take the logarithm of the variable to mitigate the effect of outliers in regressions. On the other hand, the restriction on firms with positive profits is also suggestive from a theoretical point of view as corporate taxation is relevant only if the considered firm earns a positive profit.

The observational unit in our analysis is the multinational subsidiary per year. In total, our sample comprises $49,236$ observations from $11,813$ subsidiaries for the years 1995 to 2005. Hence, we observe each affiliate for 4.2 years on average. Moreover, we enrich our data set by merging time-varying country characteristics: the statutory corporate tax rate, GDP, GDP per capita, a country's corruption index and the national unemployment rate.[3]

– Table 1 here –

Table 2 displays basic sample statistics. The affiliates in our sample observe an average pre-tax profit of 6.6 million US dollars and an total asset investments of 86.2 million US dollars on average. The average asset profitability is measured with 15% whereas the sample exhibits a considerable spread in the profitability distribution. Moreover, the average firm employs around 228 workers whereas the median of the distribution is substantially smaller. Moreover, the mean of the statutory tax rate distribution is measured with 31.5% and observes a considerable spread across affiliates between 10% and 59%. Apart from that, the sample distribution for the control variables exhibits

[3]The statutory tax rate data for the EU–25 is taken from the European Commission (2006), while the rates for affiliates outside the EU are based on data of the tax consultancy firm KPMG (2006). Country data for GDP per capita and population are obtained from the OECD.

the expected pattern with an average GDP of 939 billion US dollar, and average GDP per capita rate of 25,844 US dollars and an average unemployment rate of 8.58%.

– Table 2 here –

# 4 Estimation Approach

To disentangle the above described quality and quantity effects of corporate taxation, we estimate two regression models. First, we determine the impact of corporate taxes on a firm's capital investment employing a simple empirical model of the following form

$$\log k_{i,t} = \beta_0 + \beta_1 t_{i,t} + \beta_2 X_{i,t} + \rho_t + \phi_i + \epsilon_{i,t} \tag{16}$$

whereas $k_{i,t}$ represents the fixed asset investment of subsidiary $i$ at time $t$. Since the fixed asset variable exhibits a rather skewed distribution, we employ the logarithm of fixed assets as a dependent variable. The variable of central interest is the statutory corporate tax rate $t_{i,t}$. The coefficient estimate for $\beta_2$ captures the quantity effect of corporate taxation and determines how changes in the corporate tax rate affect the size of the subsidiary's corporate capital stock. $X_{i,t}$ comprises time–varying country control characteristics like GDP per capita and the unemployment rate. Furthermore, year dummies $\rho_t$ are included to capture shocks over time common to all affiliates. $\epsilon_{i,t}$ describes the error term. As our micro data has a panel dimension, we are able to add fixed effects for the multinational group to control for non-observable, time-constant firm specific characteristics $\phi_j$. While the use of a fixed-effects model is suggestive in our setting, it is also preferred to a random-effects model suggested by a Hausman-Test.

The estimation approach described above so far does not take into account that adjusting capital demand at the firm level might be associated with considerable positive adjustment costs. Thus, we expect a subsidiary's capital stock in previous periods to be a predictor for the capital stock today and include the first lag of a subsidiary's capital stock $k_{i,t-1}$ as additional explanatory variable in our estimation equation.

The well–known *dynamic panel bias* implies that including the first lag of the dependent variable as additional control in a fixed–effects framework leads to biased coefficient estimates because the lagged dependent variable is endogenous to the fixed effects in the error term. Thus, we follow the Andersen and Hsiao (1982) approach which was further developed by Arellano and Bond (1991) and estimate a first–difference generalized method of moments (GMM) model and instrument for the first difference in the

lagged dependent variable by deeper lags of the *level* of the dependent variable.[4] The estimation equation then takes on the following form

$$\Delta \log(k_{it}) = \gamma_1 \Delta \log(k_{i,t-1}) + \gamma_2 \Delta t_{i,t} + \gamma_2 \Delta X_{i,t} + \Delta \rho_t + \Delta \mu_{i,t}. \tag{17}$$

whereas $\Delta$ depicts the difference operator and the variable definitions correspond to the ones in previous sections. 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 GMM estimator relies on the absence of second–order serial correlation. The Arellano and Bond (1991) test for second–order serial correlation will be reported at the bottom of the result tables. We check for the exogeneity of the instrument set by employing a Sargan/Hansen overidentification test.

To determine the quality effect of corporate taxation on the subsidiary's investment level, we moreover estimate a second regression model which employs the affiliate's pre-tax profits as dependent variable and is described by the following equation

$$\log \pi_{i,t} = \alpha_0 + \alpha_1 t_{i,t} + \alpha_2 X_{i,t} + \rho_t + \phi_i + \eta_{i,t},$$

with $\pi_{i,t}$ capturing the profitability of subsidiary $i$ at time $t$ which is defined as the logarithm of the pre-tax profit over corporate assets. Moreover, $X_{i,t}$, $\rho_t$, $\phi_i$ capture time-varying country controls, time fixed effects and subsidiary fixed effects. $X_{i,t}$ also accounts for the subsidiary's labor intensity and for the affiliate's size as measured by the total assets. As suggested by previous work, the former variable is expected to exert a positive effect on corporate profitability while with decreasing returns to scale the latter is expected to depict a negative sign. $\eta_{i,t}$ is the error term. According to the hypothesis derived in our theoretical model, we expect that the level of total assets contributes less to the affiliate pre-tax profits the higher the corporate tax rate of the hosting country. Hence, we presume that $\alpha_1 < 0$.

However, clearly the input factors in the profit equation may be prone to reverse causality since a firm's profitability may determine the firm's investment and employment level. We therefore employ the levels estimator proposed by Andersen and Hsaio (1982) which suggests to control for time constant affiliate effects by taking the first differences of the estimation equation and to instrument for the difference in the endogenous variable by employing lagged *levels* of this variable.[5] Thus, we use a two-stage

[4]Note that the difference in the lagged dependent variable correlates with the differenced error term. However, deeper lags (starting from the second lag) of the dependent variable (in levels) are available as valid instruments as they are orthogonal to the error term.

[5]With panel data on more than two time periods, it is not equivalent to apply a fixed effect and

instrumental variables approach (2SLS) to estimate the following model

$$\Delta \log \pi_{i,t} = \delta_1 \Delta t_{i,t} + \delta_2 \Delta X_{i,t} + \Delta \rho_t + \Delta \varphi_{i,t},$$

whereas again $\Delta$ indicates the first difference operator. Our result tables will report the test–statistic for the relevance of the instruments at the first stage of the regression model as determined by the Kleinbergen/Paap statistic and a Sargan/Hansen test of overidentifying restrictions which tests for the validity of the instruments employed, i.e. for their exogeneity with respect to the error term $\Delta \epsilon_{it}$.

# 5 Results

Tables 3 and 4 present our results. In table 3, the impact of corporate taxes on capital investment is measured. Specifications (1) and (3) use subsidiary-fixed effects. In column 1, a baseline estimation is presented without any additional control variables. Columns 2 and 3 show the results of estimations with a set of industry-year fixed effects and a number of country-specific control variables like gross domestic product, GDP per capita, the unemployment rate and the corruption index. In all three specifications, the estimations show a strongly and significantly negative semi-elasticity of investment with respect to changes in the corporate tax rate. According to specification (3), a ten percentage point increase in the corporate tax rate decreases the capital stock by slightly more than twenty per cent.

Nevertheless, as described above the presented capital estimations may be misspecified as a firm's capital stock is known to be sticky and cannot be adjusted without a positive adjustment cost. Thus, in specifications (4) to (6) we reestimate the baseline regressions in columns (1) to (3) accounting for a dynamic investment context in an Arellano-Bond framework. All three specifications indicate that capital investment is sticky as the coefficient estimate for the lagged dependent variable is positive and quantitatively large. Most importantly, all three specifications moreover confirm the negative effect of corporate taxes on subsidiary investment whereas the coefficient estimate the coefficient estimate for the corporate tax effect in columns (1) to (3) remains

first–differencing approach respectively. 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. Our results, however, turn out to be largely robust against using fixed–effects and first–differencing estimators.

quantitatively large. Column (6) suggests that a 1 percentage point increase in the corporate tax rate at the subsidiary's host location reduces capital investment by 1.24% in the short-run. Note, however, that the dynamic specification implies a much larger corporate tax rate on the long-run investment level which is estimated to be around 3.26%.[6]

– Table 3 here –

The validity of the Arellano-Bond approach relies on two central assumptions: the exogeneity of the instruments with respect to the error term and the absence of second order autocorrelation. We test for the exogeneity of our set of instruments using a Sargan/Hansen overidentification test. As indicated in Table 3, the test is passed in all three specifications. As the Sargan/Hansen statistic may be weak with a large set of instruments, we collapsed the instruments in the estimation which accounts for a full set of industry-year effects. Moreover, the Arellano-Bond test for second order autocorrelation is equally passed and consequently, we consider our estimation approach to be valid.

In table 4, we present the results for our quality estimations which determine the impact of corporate taxes on the profitability of corporate investment. Specifications (1) to (4) follow a standard fixed affects approach. While column (1) contains the baseline estimation, again, columns 2 to 3 add time-varying control variables and a full set of industry-year dummies. Column 4 additionally controls for the affiliate's labor intensity and for the size of the overall corporate investment as captured by the stock of total asset investment. The corporate tax rate is found to exert a strong and significantly negative impact on corporate profitability in all specifications. Quantitatively, column 4 suggests that an increase in the corporate tax rate by 1 percentage point reduces the pre-tax profit per corporate assets by 1.13%.

Moreover, in column (5) we reestimate the baseline regressions but additionally account for potential reverse causality between firm profits and the labor intensity and size of corporate investment by using an instrumental variables approach following Anderson and Hsiao (1982). For this estimation approach to be valid, the chosen instrument set of lagged levels of the input factors, must be a relevant predictor for the first-differenced inputs and it must be exogeneous with respect to the error term. Both

[6]The long-run effect is estimated by multiplying the coefficient estimate for the corporate tax rate with $1/(1-\gamma_1)$ with $\gamma_1$ being the coefficient estimate for the lagged dependent variable in the dynamic panel model.

assumptions are confirmed by the test statistics (p-value) for the Sargan/Hansen test and the Kleinbergen-Paapen test presented in the table. Interestingly, when we instrument for the input factors, the corporate tax effect on an affiliate's capital profitability increases as indicated by the coefficient estimate for the interaction term between the corporate tax rate and fixed asset investment. Interestingly, accounting for reverse causality enlarges the estimated corporate tax effect on affiliate profitability, suggesting that a increase in the corporate tax rate by 1 percentage point reduces subsidiary's asset profitability by more than 2%.

– Table 4 here –

From these estimates, we can easily derive the relative importance of the quantitative and qualitative effect of corporate taxes on capital investment. To see this, consider the corporate tax effects on the tax base of an affiliate in its host country which can be defined as $B = \pi \cdot k$, with $\pi$ and $k$ depicting the pre-tax profit per earned per total assets and the level of total asset investment respectively, as described above. The semi-elasticity of the corporate tax base $B$ with respect to the corporate tax rate is captured by

$$\frac{\partial B}{\partial t}\frac{1}{B} = \frac{\partial \pi}{\partial t} \cdot \frac{k}{B} + \frac{\partial k}{\partial t} \cdot \frac{\pi}{B} = \delta_1 + \left(\frac{\gamma_2}{1-\gamma_1}\right) = -2.08 - 3.26 = -5.34 \quad (18)$$

Consequently, while an increase in the corporate tax rate by 1 percentage point is predicted to lower affiliate pre-tax profit by 5.3%. The quantity and the quality effect are found to contribute in about equal shares to the overall effect, with the quality effect accounting for 40% and the quantity effect accounting for 60%.

# 6 Discussion and concluding remarks

In this paper we theoretically and empirically analyse the effect of inbound FDI flows on the domestic tax base. We differentiate between quantity effects of taxation, i.e. the extent to which taxes reduce the inbound FDI stock, and quality effects, i.e. in how far taxes reduce the extent to which capital translate into an increase in tax base. We find that quality effects account for almost half of the total effect.

These results have important implications. If taxes distort the quality more than the quantity of FDI, measures of investment distortions based on investment quantity are likely to substantially underestimate the efficiency cost of taxation. In addition, policy-makers should be more concerned about the specific characteristics of inbound

investment than about there mere size level. At this point, it is useful to discuss some caveats of the analysis. Of course, tax revenue is not the only benefit that FDI may provide. It seems straightforward to extend our model to take into account job markets, technological spillovers etc. These extensions may substantially affect the size and the nature of tax effects on the quality of FDI.

Moreover, our results may alter the interpretation of certain "success stories". For example, from 1990 to 2000, Germany increased its stock of foreign held capital by about 520% (source: OECD) and performed much better in attracting foreign FDI than the UK (115%), France (205%), the US (180%) or Japan (410%). The standard way of reading these figures is that Germany attracted FDI *despite* its relatively high tax rates (before the tax reform in 2001, the corporate tax rates in Germany were between 52% and 58% and thus among the highest throughout the developed world). In the light of our results, one would expect these large inflows of capital to be of minor quality.

Finally, it is important to know whether profitability differences are due to profit shifting or project selection. If we interpret all tax induced profitability differences as a result of profit shifting, it is natural to conclude that anti tax avoidance measures like e.g. transfer pricing documentation requirements or thin capitalization rules may increase corporate tax revenues. But if the composition effect partly explains these differences, the revenue raising potential of measures directed against the shifting of book profits is overestimated. Given that these policies may imply substantial costs and distortions of firm behavior, a misinterpretation of the data may lead to unnecessary welfare losses.

# References


[23] Becker, J. & Riedel, N. (2008). Cross-Border Tax Effects on Affiliate Investment - Evidence from European Multinationals, Oxford University Centre for Business Taxation Working Paper 08/16.

[23] Becker, J. & Riedel, N. (2008). Employment Reallocation and Corporate Tax Reforms - Evidence from European Multinationals. Working Paper.

[23] Buettner, T. & Wamser, G. (forthcoming). Intercompany Loans and Profit Shifting - Evidence from Company-Level Data, International Tax and Public Finance.

[23] Castellani, D. & Barba Navaretti, G. (2004). Investments Abroad and Performance at Home: Evidence from Italian Multinationals, CEPR Discussion Paper No. 4284.

[23] Clausing, K. A. (2003). Tax-Motivated Transfer Pricing and US Intrafirm Trade Prices, Journal of Public Economics 87(9-10): 2207–2223.

[23] Desai, M. A., Foley, C. F. & Hines, J. R. (2005a). Foreign Direct Investment and the Domestic Capital Stock, American Economic Review 95(2): 33–38.

[23] Desai, M. A., Foley, C. F. & Hines, J. R. (2009). Domestic Effects of the Foreign Activities of U.S. Multinationals, American Economic Journal: Economic Policy 1(1): 181-203.

[23] Devereux, M. P., Griffith, R. & Klemm, A. (2002). Corporate Income Tax Reforms and International Tax Competition, Economic Policy 17(2): 450–493.

[23] Dischinger, M. (2008). Profit Shifting by Multinationals and the Ownership Share: Evidence from European Micro Data, Munich Economics Discussion Papers, No. 2008-17.

[23] Dischinger, M. & Riedel, N. (2008). Corporate Taxes, Profit Shifting, and the Location of Multinational Headquarters, Working Paper.

[23] Egger, P. & Pfaffermayr, M. (2003). The Counterfactual to Investing Abroad: An Endogenous Treatment Approach of Foreign Affiliate Activity, University of Innsbruck Working Papers in Economics No. 2003-2.

[23] Grossman, G. M. & Rossi-Hansberg, E. (2008). Trading Tasks: A Simple Theory of Offshoring, American Economic Review 98(5): 1978-1997.

[23] Grubert, H. & Mutti, J. H. (1991). Taxes, Tariffs and Transfer Pricing in Multinational Corporate Decision Making, Review of Economics and Statistics 73: 285–293.

[23] Hines, J. R. & Rice, E. M. (1994). Fiscal Paradise: Foreign Tax Havens and American Business, Quarterly Journal of Economics 109(1): 149–182.

[23] Huizinga, H. & Laeven, L. (2008). International Profit Shifting Within European Multinationals, Journal of Public Economics, 92(5/6): 1164-1182.

[23] Huizinga, H.; Laeven, L. & Nicodème, G. (2008). Capital Structure and International Debt Shifting, Journal of Financial Economics, 88(1): 80-118.

[23] Huizinga, H. & Nielsen, S. B. (1997). Capital Income and Profit Taxation with Foreign Ownership of Firms, Journal of International Economics 42: 149–165.

[23] Jaeckle, R. (2006). Going Multinational: What Are the Effects on Home Market Performance?, Bundesbank Discussion Paper No. 3-2006 .

[23] KPMG (2006). Corporate Tax Rate Survey.

[23] Markusen, J. R. (2002). Multinational Firms and the Theory of International Trade, Massachussets Institute of Technology, Cambridge, USA.

[23] Simpson, H. (2009). Investment abroad and adjustment at home: evidence from UK multinational firms. Oxford University Centre for Business Taxation Working Paper 09/03.

[23] Swenson, D. L. (2001). Tax Reforms and Evidence of Transfer Pricing, National Tax Journal 54(1): 7–25.

[23] Weichenrieder, A. J. (forthcoming). Profit Shifting in the EU: Evidence from Germany, International Tax and Public Finance.

# 7 Tables

| Table 1: Country Statistics | |
|---|---|
| *Country* | *Number of Firms* |
| Austria | 119 |
| Belgium | 684 |
| Bulgaria | 213 |
| Croatia | 158 |
| Czech Republic | 314 |
| Denmark | 526 |
| Estonia | 214 |
| Finland | 341 |
| France | 1,018 |
| Germany | 659 |
| Great Britain | 2,175 |
| Greece | 54 |
| Hungary | 21 |
| Ireland | 74 |
| Island | 1 |
| Italy | 732 |
| Lithuania | 62 |
| Latvia | 113 |
| Luxembourg | 9 |
| Netherlands | 659 |
| Norway | 375 |
| Poland | 763 |
| Portugal | 122 |
| Russia | 774 |
| Serbia | 70 |
| Slovakia | 56 |
| Spain | 920 |
| Sweden | 488 |
| Ukraine | 99 |
| *Sum* | 11,813 |

| Table 2: Descriptive Statistics | | | | | |
|---|---|---|---|---|---|
| *Variable* | *Obs.* | *Mean* | *Median* | *Min.* | *Max.* |
| **Affiliate Characteristics** | | | | | |
| Profit before Tax ★ | 49,236 | 6,632.38 | 68,371.01 | 1 | 8,055,052 |
| Total Assets★ | 49,236 | 86,190.93 | 783,166 | 1 | $6.31e+07$ |
| Profitability | 49,236 | .1508 | 2.2515 | 1 | 400 |
| Number of Employees | 49,236 | 227.68 | 1026.18 | 16 | 80,146 |
| **Country Characteristics** | | | | | |
| Corporate Tax Rate | 49,236 | .315 | .062 | .1 | .59 |
| GDP▲ | 49,223 | 939.20 | 815.54 | 5.03 | 3,320.91 |
| GDP per Capita◄ | 49,235 | 25,843.52 | 13,300.21 | 632.64 | 83,484.79 |
| Corruption Index | 49,055 | 6.967 | 2.049 | 1.5 | 10 |
| Unemployment Rate | 45,328 | .0858 | .0403 | .018 | .227 |

Notes:

★ Unconsolidated value, in thousand US dollars, current prices.

▲ In billion US dollars, current prices, IMF WEO Database Oct08.

◄ In US dollars, current prices, IMF WEO Database Oct08.

**Table 3: Quantity Effect - Impact of Taxes on Corporate Investment**
**Dep. Variable: Log Fixed Asset Investment, Panel 1995–2005**

| **Model** | **Fixed Effects Model** | | | **Dynamic Model** | | |
|---|---|---|---|---|---|---|
| *Explanat. Var.:* | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* |
| Lag Log Fixed Assets | | | | .767*** | .668*** | .612*** |
| | | | | (.180) | (.271) | (.245) |
| Corporate Tax Rate | -1.796*** | -1.835*** | -1.457*** | -1.126*** | -1.145*** | -1.238*** |
| | (.167) | (.166) | (.174) | (.238) | (.150) | (.163) |
| Log GDP per Capita | | | 2.323*** | | | .366 |
| | | | (.388) | | | (.551) |
| Log GDP | | | -1.246*** | | | -.014 |
| | | | (.392) | | | (.420) |
| Unemployment Rate | | | -1.077*** | | | .654 |
| | | | (.215) | | | (.405) |
| Corruption Index | | | -.113** | | | -.210 |
| | | | (.057) | | | (.101) |
| Year Dummies | √ | √ | √ | √ | √ | √ |
| Industry-Year Dummies | | √ | √ | | √ | √ |
| Sargan/Hansen Test | – | – | – | 0.697 | 0.4561 | 0.3312 |
| Kleinbergen/Paap | – | – | – | 0.000 | 0.000 | 0.000 |
| # Observations | 49,236 | 48,813 | 44,887 | 17,138 | 15,652 | 14,400 |
| # Firms | 11,813 | 11,708 | 10,598 | 4,938 | 4,629 | 3,956 |

Notes:

Heteroscedasticity robust standard errors adjusted for firm clusters in parentheses. *, **, *** indicates significance at the 10%, 5%, 1% level. The observational units are multinational subsidiaries per sample year. All regressions include a full set of firm fixed effects. The dependent variable is the logarithm of a subsidiary's fixed asset investment. In specifications (1) to (3) a fixed effect model is estimated while specifications (4) to (6) estimate a dynamic first difference GMM model as proposed by Arellano and Bond (1991). Sargan Test indicates the p-value of the Sargan overidentification test. Second Order Autoc. depicts the p-value for the test of second order autocorrelation.

**Table 4: Quality Effect - Impact of Taxes on Investment Profitability**
**Dep. Variable: Log of Pre-tax Profitability, Panel 1995–2005**

| **Model** | **Fixed Effects Model** | | | | **IV Model** |
|---|---|---|---|---|---|
| *Explanat. Var.:* | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* |
| Corporate Tax Rate | -1.281*** | -1.269*** | -1.067*** | -1.132*** | -2.084*** |
| | (.288) | (.290) | (.345) | (.280) | (.551) |
| Log GDP per Capita | | | .652 | 1.394*** | -.0702 |
| | | | (.765) | (.584) | (1.158) |
| Log GDP | | | -.704 | -1.088*** | .602 |
| | | | (.775) | (.598) | (1.139) |
| Unemployment Rate | | | .491 | .005 | 0.767 |
| | | | (.450) | (.360) | (.805) |
| Corruption Index | | | .124* | .181** | -.088 |
| | | | (.071) | (.087) | (.187) |
| Labor Productivity | | | | .158*** | .320 |
| | | | | (.015) | (.232) |
| Log Total Assets | | | | -.202*** | -.294*** |
| | | | | (.016) | (.120 |
| Year Dummies | √ | √ | √ | √ | √ |
| Industry-Year Dummies | | √ | √ | √ | √ |
| Sargan/Hansen Statistic | – | – | – | – | 0.1713 |
| Kleinbergen-Paap Statistic | – | – | – | – | 0.000 |
| # Observations | 49,236 | 48,813 | 44,887 | 52,403 | 23,036 |
| # Firms | 11,813 | 11,708 | 10,598 | 12,670 | 5,710 |

Notes:

Heteroscedasticity robust standard errors adjusted for firm clusters in parentheses. *, **, *** indicates significance at the 10%, 5%, 1% level. The observational unit is the multinational subsidiary per sample year. The dependent variable is the logarithm of a subsidiary's pre-tax profits. In specifications (1) to (4) a fixed effect model is estimated while specifications (5) estimates a first difference model which accounts for the potential reverse causality between affiliate profitability and fixed asset investment and employment intensity by using an instrumental variable approach. Sargan/Hansen Test indicates the p-value of the Sargan/Hansen overidentification test. Kleinbergen-Paap Statistic stands for the Kleinbergen-Paap Statistic which tests the revelevance of the instruments employed.