Bilateral Effective Tax Rates and Foreign Direct Investment

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Abstract

This paper computes effective (marginal and average) tax rates that account for bilateral aspects of taxation and, therefore, vary across country-pairs and years. These tax rates serve to estimate the impact of corporate taxation on outbound stocks of bilateral foreign direct investment (FDI) among OECD countries between 1991 and 2002. The findings indicate that outbound FDI is positively related to the parent and host country tax burden and negatively associated with bilateral effective tax rates. Relying only on unilateral (country and time variant) rather than on both unilateral and bilateral (country-pair and time variant) effective tax rates leads to biased estimates of the impact of corporate taxation on FDI.

JEL classification: H25, H73, F21, F23, C33
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1 Introduction

It is now widely accepted in public economics that empirical work on the role of corporate taxation for the production and investment decisions of multinational firms should rely on a broader set of tax components rather than only on statutory corporate tax rates.[1] In this vein, an important strand of the literature recommends forward-looking effective (marginal and average) tax rates (henceforth, EMTR and EATR) as suitable measures of the corporate tax burden (see Devereux and Griffith, 2002, 2003).

Based on this literature, this paper uses EMTR and EATR to estimate the impact of corporate taxes on outbound foreign direct investment (FDI) within the OECD. In contrast to previous research, we argue that it is decisive to account for both the *unilateral* (parent- and host country-specific) and the *bilateral* (country-pair-specific) components of effective tax rates. This is motivated by the observation that bilateral tax treaties among the OECD countries are the rule rather than the exception. Also, bilateral effective tax rates account for additional financing opportunities of a multinational enterprise which are not available to a national firm.[2] Then, the question arises whether the omission the (time-variant) country-pair-specific variation in effective tax rates leads to biased estimates of the impact of corporate taxation on FDI.

We follow the conceptual framework of Devereux and Griffith (1999, 2003) in computing bilateral forward-looking EMTR and EATR for the OECD economies at the annual level between 1991 and 2002. This entails screening all national and supranational tax codes, most importantly the tax law of the European Union and bilateral tax treaties in place. Overall, the sample includes about 8000 bilateral effective tax rates.[3] The large number of economies and years covered enables us to apply panel econometric methods to control for country-pair specific heterogeneity in FDI relations. Specifically, we compare the impact of unilateral versus bilateral EMTR and EATR in our empirical analysis. One major finding is that an omission of the country-pair variation in effective tax rates leads to an underestimation of the role of taxation for FDI.

The remainder of the paper is organized as follows. The next section pro-

[1] For instance, Devereux, Griffith, and Klemm (2002, p. 452) note: "*Typically, corporate income taxes ... act as a disincentive to invest. The two aspects of these [rate-cutting and base-broadening] reforms have offsetting effects on this disincentive: the lower tax rate increases the incentive to invest, while the lower allowance increases it.*"

[2] For instance, foreign affiliates may finance an investment project at the foreign market and/or via equity from the parent company.

[3] Up to now, the most comprehensive comparable studies are Yoo (2003), computing bilateral effective tax rates for the OECD countries and three selected years (1991, 1996 and 2001), and the Commission of the European Communities (2001), calculating bilateral effective tax rates for the EU15 and from Canada and the US into the EU15 in the year 1999.

vides a brief overview of the related empirical literature. Section 3 describes the data and dissects the variation in bilateral effective tax rates into its major components. Section 4 introduces the empirical specification and lays out the estimation framework. Section 5 presents the results, and the last section summarizes the key findings.

2 A brief overview on previous empirical research

Most of the previous empirical work on corporate taxation and FDI employs statutory corporate tax rates or backward-looking average effective tax rates as contained in firm-level balance-sheet data, mainly for reasons of data availability (see Hines, 1997, 1999, for comprehensive surveys of this literature).[4] While the former ignore a possible influence of the tax base on FDI (e.g., via depreciation allowances or first-year investment incentives), the latter do not account for the forward-looking nature of a firm's investment decisions and, perhaps more importantly, the endogeneity of backward-looking tax rates from an empirical perspective (see Devereux and Griffith, 2002, p. 91).

Only a small number of studies employs forward-looking tax burden measures. These studies tend to support a significant impact of corporate tax rates on FDI. Early examples are Slemrod (1990), Papke (1991), Shah and Slemrod (1991), Cummins and Hubbard (1995) and Devereux and Freeman (1995). More recently, Devereux and Griffith (1998) analyze U.S. FDI outflows to three host economies using host country EATR. Gorter and Parikh (2003) rely on host country EMTR to assess the role of corporate taxation for FDI flows from 8 EU parent countries into 14 EU host countries. Bénassy-Quéré, Fontagné, and Lahrèche-Révil (2005) consider EMTR and EATR as published in Devereux, Griffith, and Klemm (2002) to investigate bilateral FDI flows between 11 OECD countries between 1984 and 2000.

The majority of these studies incorporates country-specific (i.e., host and/or parent) effective tax rates rather than their country-pair-specific counterparts. Only Devereux and Freeman (1995) form an exception using bilateral cost of capital data as defined in Devereux and Pearson (1995). From the remaining papers, one group uses host country effective tax rates only (Papke, 1991; Gorter and Parikh, 2003; Devereux and Griffith, 1998). A second group includes the parent and host country rates (Shah and Slemrod, 1991; Cummins and Hubbard, 1995). A few papers belonging to the latter group additionally account

[4] For example, Mutti and Grubert (2004: p. 343) note that "*[A]lthough marginal effective tax rates [...] are a preferable measure to indicate a firm's incentive to expand output in a given location, such rates are not available for [...] many [..] countries ...*"

for the method of international double taxation relief via separate regressions for credit and exemption countries (Slemrod, 1990; Bénassy-Quéré, Fontagné, and Lahrèche-Révil, 2005).[5] Although the latter approach introduces bilateral aspects in the relationship of interest, there remain some significant differences to Devereux and Freeman (1995). Most importantly, the bilateral tax burden is not only determined by the method of double taxation relief but also by other bilaterally negotiated (rather than unilaterally applied) rules of international taxation, such as the agreed level of withholding taxes on repatriated profits, and by the additional financing opportunities of multinationals as compared to national firms. In contrast to Devereux and Freeman (1995), we suggest including the parent and host country effective tax rates along with the bilateral effective tax rates. This allows for a distinction between the direct impact of bilateral tax rates and the indirect one of unilateral tax rates (affecting mainly national firms) on the investment decisions of multinational firms.

3 Conceptual framework

3.1 The concept of effective tax rates

The framework to compute (unilateral) EMTR has been developed by King and Fullerton (1984), and was subsequently applied by the OECD (1991) and the Commission of the European Community (1992, 2001), among others. The main idea behind these rates is to calculate the *tax wedge* between the rate of return of hypothetical investment projects and a given rate of return on savings. The tax wedge is determined by statutory tax rates (on retained and repatriated profits) and the definition of the tax base (e.g., depreciation allowances, first-year extra allowances or deductability of interest on debt). It is further influenced by the alternative ways to finance the project (i.e., retained earnings, new equity, and debt).

Consider a *marginal* investment whose after-tax rate of return is just equal to the after-tax rate of return on an alternative asset. The corresponding before-tax rate of return is known as the *cost of capital* (see Auerbach, 1979). The tax wedge is defined as the difference between the cost of capital and the after-tax rate of return. The EMTR is equal to the ratio of the tax wedge and the cost of capital. In contrast to the EMTR, the EATR informs about the tax burden on *average* (infra-marginal) investment projects, which yield a higher rate of return than the marginal investment discussed above (see Devereux and Griffith

[5] Bénassy-Quéré, Fontagné, and Lahrèche-Révil (2005) use the difference between the host and the parent country effective tax rates and introduce dummy variables for exemption and credit countries.

1999, 2003). The underlying reasoning is that the decisions to go multinational (i.e., locating production abroad versus exporting) and where to locate a foreign subsidiary are discrete in the sense that firms choose the alternative with the highest after-tax profits. Hence, the net present value of an investment project with a given economic rent before taxes is compared with the net present value of the associated costs. This difference, related to the net present value of the income stream in the absence of taxation, defines the EATR. The EATR is equal to the EMTR for a marginal investment project, and identical to the statutory tax rate for investment projects with infinite economic rents. Hence, the EATR can be expressed as a weighted average between the EMTR and the statutory tax rate (see Devereux and Griffith, 2003; Devereux, Griffith and Klemm, 2002). Since FDI figures comprise both marginal (i.e., changing the existing capital stock abroad) and average investment (i.e., installing new plants abroad), we use both EMTR and EATR alternatively in our empirical analysis.

The assumption behind the bilateral effective tax rate is that a parent company undertakes investment through a fully owned foreign subsidiary. The corresponding profits are immediately and fully repatriated to the parent company, inducing potential double taxation of profits. Hence, bilateral effective tax rates incorporate information about alleviation of double taxation as contained in unilateral and bilateral tax law, e.g., methods of double taxation relief such as credit, exemption, and deduction, or withholding tax rates on repatriated foreign-earned profits. Further, bilateral effective tax rates account for the fact that a foreign subsidiary has additional alternatives to finance an investment project as compared to a national firm (see below for further details). We follow the conceptual framework laid out in Devereux and Griffith (1999, 2003) to compute bilateral, time-variant tax rates (see the Appendix for details on the tax legislation of the countries and years covered in our analysis).

3.2 Theoretical background for the impact of effective tax rates on FDI

In the subsequent empirical analysis, we argue that – with coexisting national (potentially exporting) and multinational enterprises – bilateral multinational activity as reflected in FDI depends on both home and host country unilateral effective tax rates but also on bilateral ones. Let us illustrate this argument by means of the expressions for EMTR derived from three conditions for firm-type-specific profits in some market j: the one pertaining to firms based in market i which serve consumers in j via exports (indexed by superscript e_i); the one of multinational firms headquartered in i which serve consumers in market j

locally (indexed by superscript m_i); and the one referring to domestic producers of j who serve consumers there locally (indexed by superscript d_j).

Before stating the expressions for the EMTR for these firm types, it is useful to introduce some notation. Let us denote the market (i.e., minimum) return to capital by $r^\star$ and the economic rate of depreciation by δ. Both $r^\star$ and δ are assumed to be identical across countries. Furthermore, f_i^d refers to debt financing of an investment by the firm (headquarters) in market i, f_j^i are intra-company loans of the parent company in i to its subsidiary in j, and f_j^n indicates financing of an investment of the subsidiary in market j by issuing new equity. Finally, let us introduce three corporate tax parameters: t_i is the statutory corporate tax rate in country i; a_i denotes the net present value of tax depreciation of an investment in country i; and σ_{ji} is the additional tax burden for a multinational firm which repatriates profits from a subsidiary in country j to parent country i. Notice that σ_{ji} is a function of the withholding tax rate on repatriated the profits and, depending on the relevant method of double-taxation relief, the statutory corporate tax rates in the host and the parent country.[6] Following Devereux and Griffith (1999), the EMTR for the mentioned three firm types serving consumers in market j are calculated from the corresponding costs of capital ($\widetilde{p}_j^{e_i}$, $\widetilde{p}_j^{m_i}$, $\widetilde{p}_j^{d_j}$) in the following way:[7]

$$\text{EMTR}_j^{e_i} = \frac{\widetilde{p}_j^{e_i} - r^\star}{\widetilde{p}_j^{e_i}}; \quad \widetilde{p}_j^{e_i} = \frac{(r^\star + \delta)(1 - a_i)}{(1 - t_i)} - \frac{f_i^d(1 + r^\star)}{(1 - t_i)} - \delta \tag{1}$$

$$\text{EMTR}_j^{m_i} = \frac{\widetilde{p}_j^{m_i} - r^\star}{\widetilde{p}_j^{m_i}}; \quad \widetilde{p}_j^{m_i} = \frac{(r^\star + \delta)(1 - a_j)}{(1 - t_j)} - \frac{(f_i^d + f_j^i + f_j^n)(1 + r^\star)}{(1 + \sigma_{ji})(1 - t_j)} - \delta \tag{2}$$

$$\text{EMTR}_j^{d_j} = \frac{\widetilde{p}_j^{d_j} - r^\star}{\widetilde{p}_j^{d_j}}; \quad \widetilde{p}_j^{d_j} = \frac{(r^\star + \delta)(1 - a_j)}{(1 - t_j)} - \frac{f_j^d(1 + r^\star)}{(1 - t_j)} - \delta. \tag{3}$$

[6] More precisely, σ_{ji} is defined as (see Devereux and Griffith, 1999, p. 41)

$$\sigma_{ji} = \begin{cases} \tau_{ji} & : \text{ Exemption} \\ \max[(t_j - t_i)/(1 - t_i), \tau_{ji}] & : \text{ Credit (with deferral)} \\ t_i(1 - \tau_{ji}) + \tau_{ji} & : \text{ Deduction (with deferral)} \end{cases}$$

where τ_{ji} is the withholding tax rate on repatriated profits.

[7] To compute the domestic EMTR, one takes the net present value of investment financed by retained earnings as the baseline. The income stream from other financing opportunities (i.e., debt and new equity) is expressed as the difference to this baseline and enters in (1), (2) and (3) negatively (see Devereux and Griffith, 1999: pp. 18). In the absence of shareholder taxation (as in our case) the income stream from retained earnings financing is identical to that from new equity. Hence, we only refer to debt financing here.

Typically, $\widetilde{p}_j^{e_i} \neq \widetilde{p}_j^{m_i}$ will hold since different statutory tax rates and depreciation allowances apply to profits on exports as compared to ones on local sales of a foreign subsidiary so that $(1-a_i)/(1-t_i) \neq (1-a_j)/(1-t_j)$. Moreover, the financing opportunities of an investment are different for firms in i with exports to j from those of multinationals headquartered in i with a subsidiary in j: while for the exporting firm only to debt financing, f_i^d, matters a multinational may use debt-financing of a foreign investment through f_i^d (i.e., a parent's incremental debt to finance the subsidiary), through f_j^i (i.e., intra-company loans), and/or through f_j^n (i.e., the subsidiary's issuing of new shares). Finally, a multinational's foreign profits are treated differently from the ones of a firm which exports from i to j due to σ_{ji} which captures double-taxation of repatriated profits.

Even more importantly, $\widetilde{p}_j^{m_i} \neq \widetilde{p}_j^{d_j}$ will typically hold for similar reasons. In particular, double-taxation (σ_{ji}) and the respective opportunities to finance the investment in j are sources of the difference between $\text{EMTR}_j^{m_i}$ and $\text{EMTR}_j^{d_j}$. Hence, even under the exemption system there is typically a difference between $\text{EMTR}_j^{m_i}$ and $\text{EMTR}_j^{d_j}$. Only if double-taxation is absent and under identical financing opportunities, we would obtain $\text{EMTR}_j^{m_i} = \text{EMTR}_j^{d_j}$ from (2) and (3). In our sample, there is not the case for any country-pair.

By construction, there is some overlap between $\text{EMTR}_j^{m_i}$ and $\text{EMTR}_j^{d_j}$, while there is almost none between $\text{EMTR}_j^{m_i}$ and $\text{EMTR}_j^{e_i}$. An increase in t_j will raise both $\text{EMTR}_j^{m_i}$ and $\text{EMTR}_j^{d_j}$ *ceteris paribus*. However, $\text{EMTR}_j^{m_i}$ can obviously be affected by σ_{ji} without altering $\text{EMTR}_j^{d_j}$. From (2) and (3) we obtain

$$\text{EMTR}_j^{m_i} - \text{EMTR}_j^{d_j} \quad = \quad \frac{\widetilde{p}_j^{m_i} - \widetilde{p}_j^{d_j}}{\widetilde{p}_j^{m_i}\widetilde{p}_j^{d_j}} r^\star \tag{4}$$

Hence, using $\text{EMTR}_j^{d_j}$ and $\text{EMTR}_j^{e_i}$ along with $\text{EMTR}_j^{m_i}$ in an empirical model to explain multinational activity from i to j is equivalent to using $\text{EMTR}_j^{m_i} - \text{EMTR}_j^{d_j}$ instead of $\text{EMTR}_j^{m_i}$.[8]

Ultimately, we need to answer why it is important to consider $\text{EMTR}_j^{e_i}$, $\text{EMTR}_j^{m_i}$, and $\text{EMTR}_j^{d_j}$ simultaneously, when analyzing the impact of effective marginal tax rates on FDI. The answer is that – with coexisting firm types e_i, m_i, and d_j in market j – profits of m_i multinational firms in j depend on those of the other firms active in that market. The lower $\text{EMTR}_j^{e_i}$ is, the cheaper it is *ceteris paribus* to serve consumers via exports rather than producing locally

[8] Provided the negligible conceptual overlap between $\text{EMTR}_j^{m_i}$ and $\text{EMTR}_j^{e_i}$, we may ignore the associated difference term with those two EMTR.

through foreign subsidiaries or domestic firms in market j. The lower $\text{EMTR}_j^{d_j}$ is, the cheaper it is *ceteris paribus* to serve consumers via local sales of domestic firms in j rather than via exports from abroad or via foreign-owned subsidiaries. Competition among different firm types for consumers in j renders any activity dependent on the three EMTR together. Similar arguments hold for the corresponding effective average tax rates (EATRs; see Devereux and Griffith, 1999, for the relation of EMTRs and EATRs).

3.3 Calculation of effective tax rates

Since different types of assets are subject to different tax depreciation allowances and the returns on investment are taxed differently when paid out as dividends, interest, or capital gains, we first need assumptions about the types of assets and about the various ways to finance the investment. Here, we assume that investment projects consist of three different assets: buildings, machinery, and inventory. Following Yoo (2003), we allow for three sources of financing – retained earnings, new equity, and debt – when computing the unilateral effective tax rates, and for seven alternatives for financing a foreign subsidiary which matters for calculating the bilateral effective tax rates.[9] In sum, we obtain 9 combinations between investment projects and financing opportunities for domestic firms and, hence, unilateral effective tax rates. In contrast, there are 21 such combinations for foreign subsidiaries, entering bilateral effective tax rates. To calculate average EMTR and EATR we use the following weights (see OECD, 1991; Yoo, 2003): both parent companies as well as foreign subsidiaries are assumed to be financed at 55 percent by retained earnings, at 35 percent by debt, and at 10 percent by new equity; 28 percent of the average investment is in buildings, 50 percent in machinery, and 22 percent in inventories.

The required minimum pre-tax rate of return, $r^\star$, is 5 percent. With EATR we assume an economic rent of 20 percent (as in Devereux and Griffith, 1999, 2003). In line with the OECD (1991), economic depreciation, δ, is set at 3.61 percent for buildings, at 12.25 percent for machinery, and at zero for inventory. The inflation rate is 2.5 percent and the real exchange rate is held constant throughout. $r^\star$, δ, the inflation rate, and the exchange rate are identical for all countries.

We use information from national tax codes about the following tax variables: statutory corporate tax rates including local profit taxes, rates of

[9] Of the nine possible combinations of retained earnings, new equity, and debt used by the parent and the subsidiary, we exclude the cases where the investment is financed via retained earnings by the subsidiary and via debt or new equity by the parent company. Further, debt financing of the subsidiary may only take the form of intra-company loans from the parent.

tax depreciation (the number of years for which depreciation allowances can be claimed), the allowance schemes (straight line and declining balance as well as combinations thereof), and the valuation of inventories (LIFO, FIFO, and weighted average). In the presence of alternative depreciation allowance schemes, we use the most generous one.[10] From the allowance schemes and the rates of depreciation, we derive a net present value of depreciation allowances (Yoo, 2003, p: 41, provides the corresponding formulas; see also King and Fullerton, 1984). Withholding tax rates on repatriated profits of foreign-owned subsidiaries (assuming qualified ownership of the foreign entity) are taken from national tax codes and bilateral tax treaties. Information about the applied method of double taxation relief (exemption, credit, or deduction) is available from bilateral tax treaties and the EC Parent-Subsidiary Directive (stipulating zero withholding tax rates), and is used whenever international tax law has primacy over domestic tax law. Notice that we do not account for the shareholder and, therefore, abstract from personal income taxation at this level (i.e., dividend and capital gains taxation) for the sake of transparency. For the same reason, we also abstract from property taxation, here. Further information on the sources of unilateral and bilateral tax law is provided in the Appendix.

3.4 Dissecting bilateral effective tax rates

Let us start with a descriptive analysis of the bilateral effective tax rates as compared to their unilateral counterparts. To describe the distribution of effective tax rates, we use box plots. Bold lines within the boxes represent the median, whereas the boundaries of the boxes indicate the two quartiles at the center of the distribution (i.e., the interquartile range). The whiskers in the plots have a length of 1.5 times the interquartile range. Entries outside the whiskers refer to observations in the upper or lower tails of the distribution.

Figures 1 and 2 display the box plots for the unilateral, time-variant, forward-looking effective tax rates.[11] We observe a downward trend in effective tax rates. The medians of the EATR are in the range of 25 to 32 percent, whereas the ones of the EMTR are lower, as expected. In case of the EMTR,

[10] In some cases, tax law allows a change from the declining balance to the straight line system. Typically, the tax law defines a specific point in time for this switch. Otherwise, we assume that the switch takes place as soon as the value of the straight line depreciation exceeds the one of the declining balance (see also Devereux and Griffith, 1999).

[11] To save space, we display unilateral EATR and EMTR for host countries only. In a balanced panel, the moments of the unilateral host-specific rates would be identical to the parent-specific ones. Since our panel data-set is unbalanced, the moments for the parent countries deviate from their host country counterparts. However, this difference is rather small.

we obtain even negative entries in the first three years of the sample period.[12]

> Figures 1 and 2 <

Bilateral effective tax rates are displayed in Figures 3 and 4. Similar to the unilateral ones, they tend to decrease over the sample period. The medians of the bilateral effective tax rates are higher and their spread is wider than for the unilateral ones, especially for the EMTR. Apart from domestic tax law, the bilateral effective tax rates depend on various details of taxation as laid out in bilateral tax treaties (such as double taxation relief and withholding taxes) and on the financing opportunities of multinational firms. Further, the time variation seems to be small but sufficient for fixed country-pair effects estimation (to see this, consider the fluctuations in the upper and lower bounds of the whiskers).[13]

> Figures 3 and 4 <

To illustrate the importance of bilateral tax rates, Figures 5 and 6 focus on the difference between the bilateral effective tax rates and the unilateral ones. Roughly, this difference can be interpreted as the additional tax burden for profits of foreign affiliates as compared to the ones of national firms as in equation (4). It represents the change in the effective tax rate, if a country-j-owned domestic firm becomes an affiliate of a country-i-based multinational. It is obvious from the figures that foreign affiliates pay higher taxes (in terms of EATR and EMTR) than their domestic counterparts, reflecting an additional tax burden for multinational firms (e.g., due to withholding taxes on repatriated profits). The median of the additional tax burden of a multinational firm is around 7 percent for EATR and around 9 percent for EMTR, and it declines during the observation period.

[12]The negative outliers are Austria (1991, 1992, 1993), Belgium (1991) and Ireland (1991). With Austria, a 20 percent extra first-year allowance is responsible for the negative values in 1991, 1992 and 1993. With Belgium, the negative EMTR is due to a 1 percent plus inflation extra first-year allowance in combination with generous declining balance deprecation allowances and a high statutory corporate tax rate. The negative entry in Ireland is due to a 50 percent immediate depreciation allowance (abolished in 1992).

[13]The cross-country dimension of the sample changes over the years (notably in 1996) with new countries entering the OECD. In the subsequent empirical analysis, we exploit only variation within country-pairs. Hence, an increase in the number of country-pairs as such is irrelevant for the parameter estimates.

> Figures 5 and 6 <

The quantitative importance of different dimensions of variation in bilateral effective tax rates can be investigated by means of an analysis of variance. In this regard, the following questions seem to be interesting. First, how important is the country-pair-specific variation as compared to the parent and the host country-specific ones. Second, for fixed effects (within) estimation it is relevant how important the country-pair variation in tax rates is as compared to the time-specific variation in the data. Third, how important are the combined idiosyncratic (country-pair-time-specific) and country-pair-specific variations as a measure of the difference in variation between the bilateral tax rates and the unilateral ones. Table 1 summarizes the corresponding findings for both the bilateral effective average tax rate and the effective marginal tax rate, covering exactly the same number of observations that will be used to estimate the effect of corporate taxation on FDI, below. The three subscripts with bilateral effective tax rates (FDI parent country i; FDI host country j; time period, t) are associated with a three-dimensional space of variation.

To simplify the notation in the empirical analysis and to avoid superscripts, we refer to effective tax rates of an exporter in parent country i and year t as $EATR_{it}$ and $EMTR_{it}$ rather than as $EATR_{jt}^{e_i}$ and $EMTR_{jt}^{e_i}$. Accordingly, we refer to the bilateral tax rates of an i-based MNE with a plant in j in year t as $EATR_{ijt}$ and $EMTR_{ijt}$ rather than as $EATR_{jt}^{m_i}$ and $EMTR_{jt}^{m_i}$. Finally, we use $EATR_{jt}$ and $EMTR_{jt}$ instead of $EATR_{jt}^{d_j}$ and $EMTR_{jt}^{d_j}$, respectively.

> Table 1 <

In Table 1, the total variance in effective tax rates is split into two major components: the one explained by a set of dummy variables (i.e., the 'model') and the rest (the 'residual'). Here, we are only interested in dissecting the two bilateral effective tax rates. Accordingly, there are no covariates included so that the model and residual variances sum up to the total variance of the tax rates. The model variance is made up of three 'main' effects (parent country, host country, and time) and a comprehensive set of three pairwise interaction effects (parent country×host country, parent country×time, and host country×time). It is important to emphasize that the main effects are nested in the interaction effects. Hence, the space of the three main effects is included in the one spanned by the interaction effects. This implies that there are restrictions on the parameters. The main effects sum up to zero, but also the

sum over all interaction effects is restricted to zero.[14] In less formal accounts: after dropping the main effects, the inclusion of the interactive effects without restrictions would still lead to the same model and residual variances.

The first two columns of Table 1 reflect the variance in absolute and in relative terms. The latter is the variance due to each effect in percent of the total variance. The overall set of dummy variables (including the constant, which is not reported) accounts for 98.13 (97.56) percent of the variation in the $EATR_{ijt}$ ($EMTR_{ijt}$). The third column of results summarizes the degrees of freedom corresponding to each effect, i.e., the number of dummy variables reflecting parent countries, host countries, years, or interactions thereof in the sample. The last column reports the mean squared errors.

The second column of the table indicates which dimension of the panel actually accounts for the lion's share in the variation of tax rates. Obviously, this is the host country dimension for both $EATR_{ijt}$ and $EMTR_{ijt}$. Hence, a major component of bilateral tax rates is due to time-invariant, host-country-specific differences in tax law. However, almost 12 percent of the variance is country-pair-specific and time-invariant. Altogether, the time-invariant variance components (constant, parent country, host country, and country-pair) account for about 90 percent of the total variation in effective tax rates (of this, more than 70 percentage points are contributed by the time-invariant deviations from the overall mean). Hence, a panel econometric analysis with fixed country-pair effects may exploit about 10 percent (=2.37+0.91+4.47+1.87) of the variation in EATR. In the case of EMTR, about 16 percent of the variation is left. If fixed time effects are included as well, another 2 percentage points of the variation are wiped out. However, in a large data-set as ours the tax rate effects on FDI should still be easily identifiable.

4 Empirical analysis

Specification and econometric issues: In the subsequent analysis, we focus on the impact of effective corporate tax burden on outbound FDI. In a basic version of the model we employ a gravity specification of bilateral outbound FDI, where we include forward-looking effective tax rates (EMTR and EATR). The gravity model typically includes parent and host country GDP as well as GDP per capita (see Blonigen and Davies, 2004; Mutti and Grubert, 2004; Bénassy-Quéré, Fontagné, and Lahrèche-Révil, 2005, for the use of grav-

[14] This guarantees that the mean of the model is equal to the overall mean.

ity models in the analysis of corporate tax issues on FDI).[15] Following recent research (see Bénassy-Quéré, Fontagné, and Lahrèche-Révil, 2005; Blonigen, Davies, Waddell, and Naughton, 2007), we account for the host country market potential – i.e., inverse distance-weighted real GDP of all third markets – to account for export-platform motives of FDI.[16] We use real GDP and real GDP per capita in U.S. dollars with 2000 as the base year from the World Bank's World Development Indicators 2005.

All of our empirical models rely on fixed country-pair and fixed time effects estimation. Hence, any potentially important time-invariant determinants such as bilateral distance, common language, adjacency, but also time-invariant political and institutional factors are comprehensively captured by the fixed effects. The estimated specifications based on unilateral forward looking effective tax rates are

$$\begin{aligned} FDI_{ijt} &= \alpha_1 \tau_{i,t-1} + \alpha_2 \tau_{j,t-1} + \beta_1 GDP_{it} + \beta_2 GDP_{jt} \\ &+ \beta_3 GDPPC_{it} + \beta_4 GDPPC_{jt} + \beta_5 MP_{jt} + \mu_{ij} + \lambda_t + \nu_{ijt}, \quad (5) \end{aligned}$$

where $\tau \in \{EATR, EMTR\}$. FDI_{ijt} denotes the logarithm of bilateral outbound stocks of FDI of parent country i in host country j and year t.[17] $EATR_{i,t-1}$ and $EATR_{j,t-1}$ ($EMTR_{i,t-1}$ and $EMTR_{j,t-1}$) are effective tax rates of the parent and the host country, respectively. We treat these variables as predetermined and use their lagged values to avoid a possible endogeneity bias. GDP_{it} and $GDPPC_{it}$ denote parent country log real GDP and log real GDP per capita. A similar indexation applies for the corresponding host country variables. MP_{jt} is the inverse-distance weighted average size of all third markets for host country j and year t. μ_{ij} are fixed country-pair effects, capturing all unobserved time-invariant influences on outward FDI. λ_t denote fixed time effects, reflecting time-specific shocks common to all country-pairs in the sample. ν_{ijt} is a remainder error term. The latter may be autocorrelated and/or heteroskedastic.

[15] Other representative studies employing gravity equations of FDI are Hufbauer, Lakdawalla, and Malani (1994), Eaton and Tamura (1994), Wei (1998), Levy Yeyati, Stein and Daude (2003), and Braga Nonnenberg and Cardoso de Mendonca (2004). If FDI is mostly market-seeking, we would expect host country market size to exert a positive impact. If it is mostly low-cost seeking, we would expect a country's outbound FDI to decrease in a host country's per-capita income (as a measure of factor costs).

[16] The literature on multinational firms speaks of export-platform FDI as one that is conducted primarily to serve third markets apart from the host market itself (see Baltagi, Egger, and Pfaffermayr, 2007, 2008; Ekholm, Forslid, and Markusen, 2007). We would expect host countries with large and close-by third markets to attract a lot of export-platform FDI.

[17] Recently, Mutti and Grubert (2004) indicate that a specification of FDI in logs is preferable over one in levels.

The corresponding empirical models employing bilateral effective tax rates are

$$\begin{aligned} FDI_{ijt} &= \alpha_1 \tau_{i,t-1} + \alpha_2 \tau_{j,t-1} + \alpha_3 \tau_{ij,t-1} + \beta_1 GDP_{it} \\ &+ \beta_2 GDP_{jt} + \beta_3 GDPPC_{it} + \beta_4 GDPPC_{jt} \\ &+ \beta_5 MP_{jt} + \mu_{ij} + \lambda_t + \nu_{ijt} \end{aligned} \tag{6}$$

where $EATR_{ij,t-1}$ ($EMTR_{ij,t-1}$) is included to take into account that parent country i's multinationals are directly affected by the bilateral tax rate rather than by the unilateral host and parent country tax rates only. In accordance with Devereux and Freeman (1995), we expect a negative coefficient of the bilateral tax rate for multinationals of country i operating subsidiaries in j. A higher bilateral tax rate discourages country i's FDI in j and creates an incentive to serve this market via exports, for example. However, in contrast to Devereux and Freeman (1995) but in line with our reasoning in the previous section, the unilateral parent and host country tax rates $EATR_{i,t-1}$ and $EATR_{j,t-1}$ ($EMTR_{i,t-1}$ and $EMTR_{j,t-1}$) are additionally included in the model. The parent's unilateral tax rate accounts for the corporate tax environment of national firms (exporters) at the domestic market. Intuitively, a higher effective tax rate in country i increases the tax burden of national firms. Then, it is more attractive for these firms to shift (parts of) their production abroad and go multinational. Hence, we predict a positive relationship between the domestic effective tax rates and outbound FDI. Similarly, the host's unilateral effective tax rate captures the tax environment for national firms there. We would expect this variable to enter positively, exerting an indirect impact on multinational firms headquartered in i and investing in j. The higher the effective tax rate of national firms in j – holding constant the bilateral tax rate of foreign affiliates in j – the more FDI we would expect firms from i to conduct in this country.[18]

The FDI data contain numerous missing values (accordingly, our sample reduces from about 8000 possible bilateral effective tax rate data points to 2361 observations in Table 2). These could be randomly missing but there could also be systematic variation, resulting in a sample selection bias (see Razin, Rubinstein, and Sadka, 2005, for an application of a cross-sectional sample selection model in international taxation). We apply a test on sample selection with a

[18] While there is some correlation between the bilateral and the unilateral host country tax rate, the two rates are sufficiently independent to identify their impact separately. In our sample, the correlation coefficient between $EMTR_{ij}$ and $EMTR_j$ ($EATR_{ij}$ and $EATR_j$) is estimated at 0.77 (0.80) in the average year (see Table A2). This is sufficient for identification, given the large number of observations.

fixed effects panel data estimator (Wooldridge, 1995). This entails estimating a (binary choice; in our case, a probit) sample selection model for each year separately. The dependent variable in this model is an indicator taking the value 0 whenever bilateral FDI is missing in a given year and 1 else. We employ a gravity model using parent and host country GDP, GDP per capita, market potential, and bilateral distance in the selection equation.[19] Based on the vector of estimated model predictions in the selection equation, we can compute the Mills' ratio for all years to control for the selection bias in the FDI model. Identification is based on two sources: the year-specific estimation and the non-linear functional form of the selection probability model. The coefficient of the Mills' ratios in Tables 2 and 3 is significant in all models, indicating that there is systematic selection into the sample. Ignoring this endogenous selection could lead to biased parameter estimates. Consequently, we follow Wooldridge (1995) in applying the selection correction with panel data. This is based on a Mundlak-type approach which includes the group means of all explanatory variables as additional regressors instead of the country-pair dummy variables. In this way, one obtains the same within parameters as with the least-squares dummy variable estimator. For the sake of brevity, we do not report the parameters of the group means of the explanatory variables. A test on their joint significance indicates whether a simple pooled OLS model is rejected against the Wooldridge-type fixed effects estimator (the test statistic is given at the bottom of Table 2 and is significant throughout). The estimation of the standard errors of the parameters has to take into account that the Mills' ratio itself is estimated in the first stage.

Estimation results: The regression results for specifications (5) and (6) are summarized in Table 2. (5) is represented by "Model 1" and "Model 3", and (6) is labeled "Model 2" and "Model 4".

> Table 2 <

Generally, the estimated models in Table 2 seem well specified. Especially, the control variables take the expected signs: Market potential enters positively, suggesting the importance of platform FDI. With regard to the home and host

[19] Hence, we assume that FDI data are more likely missing if parent and host countries are small, exhibit a low GDP per capita, and are distant from each other. This is strongly confirmed by the estimation results of the selection models (detailed model output is available from the authors upon request but suppressed here for the sake of brevity).

country GDPs we should be careful when interpreting the corresponding parameter estimates. For instance, taking the derivative of log FDI with respect to host country GDP reveals that the overall marginal effect depends on GDP and GDP per capita, and is positive overall.

In all models, we account for the parent and host country unilateral tax rates ($EATR_{i,t-1}$, $EATR_{j,t-1}$, and $EMTR_{i,t-1}$, $EMTR_{j,t-1}$, respectively). When excluding bilateral effective tax rates from the specification, a higher parent country unilateral tax rate stimulates outbound FDI, whereas a higher host country unilateral tax rate impedes it, although insignificantly so (see Models 1 and 3 in Table 2). This result is in line with recent research focusing on the impact of unilateral effective tax rates on bilateral FDI.[20] However, this model maintains that all domestic and multinational firms in the host country pay the same tax rate and ignores bilateral variation in the tax burden. This is at odds with the intuition that higher effective tax rates for national firms in the host country should increase outbound FDI into this economy.

The estimated impact of the host country unilateral tax rate changes substantially, if we include the bilateral tax rate in addition to the unilateral ones (see Models 2 and 4 in Table 2). As said before, the impact of the host country unilateral tax rate then captures the taxation environment there, given the bilateral tax rate for multinationals of parent i. In accordance with our expectation discussed above, the sign of the parameter estimate is now positive. Hence, there are two dimensions of host country taxation. We should distinguish an increase in the tax rate affecting national firms, exhibiting an indirect positive effect on bilateral FDI, from an increase of a parent country's bilateral tax rate with the same host, exerting a direct negative effect on bilateral FDI. Omitting the bilateral tax rate from the specification results in a bias of the absolute impact of corporate taxation on bilateral FDI. In particular, the relevance of the bilateral dimension of taxation is not acknowledged appropriately in this case.

In Table 3, we estimate specifications which are based on the Markusen's (2002) knowledge-capital model of the multinational enterprise rather than a gravity model. The knowledge-capital model emphasizes the role of skilled labor endowments for multinational activity. Carr, Markusen, and Maskus (2001) and Markusen and Maskus (2002) propose an empirical model which includes total bilateral market size, $\log(GDP_{it}+GDP_{jt})$, the squared difference in parent and

[20]For instance, Bénassy-Quéré, Fontagné, and Lahrèche-Révil (2005) investigate the impact of the tax rate differential between host and parent countries on FDI inflows. They find a significantly negative impact of this tax difference. This is consistent with the finding of a negative (positive) impact of the host (parent) country tax rate.

host market size, $(\log(GDP_{it}/GDP_{jt}))^2$, and four interaction terms which involve parent and host country skill endowment variables.[21] For the introduction of these interaction terms, it is useful to define the dummy variables $D(SK_{it} > SKjt)$ and $D(SK_{it} < SKjt)$ which are set to one if the condition in parentheses holds zero else (SK_{it} and SK_{jt} indicate the parent and host country's skilled labor endowments). Furthermore, let us refer to the logarithm of bilateral distance between countries i and j by $\log(Dist_{ij})$. The four interaction terms are: $(SK_{it}-SK_{jt})\log(GDP_{it}/GDP_{jt})^2 D(SK_{it} > SK_{jt})$, $(SK_{it}-SK_{jt})\log(GDP_{it}+GDP_{jt})D(SK_{it} > SK_{jt})$, $-(SK_{it}-SK_{jt})\log(GDP_{it}+GDP_{jt})D(SK_{it} < SK_{jt})$, $(SK_{it} - SK_{jt})^2 \log(Dist_{ij})$. A negative sign of the parameters for the first three interaction terms would indicate a dominance of market-seeking (horizontal) multinational activity. A positive sign of the parameter for the second term and a negative one for the last one would indicate a dominance of low-production-cost-seeking (vertical) multinational activity (see Markusen, 2002). With this specification and unilateral effective tax rates only, the estimated empirical model reads

$$\begin{aligned} FDI_{ijt} &= \alpha_1 \tau_{i,t-1} + \alpha_2 \tau_{j,t-1} \\ &+ \beta_1 \log(GDP_{it} + GDP_{jt}) + \beta_2 (\log(GDP_{it}/GDP_{jt}))^2 \\ &+ \beta_3 (SK_{it} - SK_{jt}) \log(GDP_{it}/GDP_{jt})^2 D(SK_{it} > SK_{jt}) \\ &+ \beta_4 (SK_{it} - SK_{jt}) \log(GDP_{it} + GDP_{jt}) D(SK_{it} > SK_{jt}) \\ &+ \beta_5 (-(SK_{it} - SK_{jt}) \log(GDP_{it} + GDP_{jt}) D(SK_{it} < SK_{jt})) \\ &+ \beta_6 (SK_{it} - SK_{jt})^2 \log(Dist_{ij}) + \mu_{ij} + \lambda_t + \nu_{ijt}, \end{aligned} \tag{7}$$

where $\tau \in \{EATR, EMTR\}$. As in the gravity model, we estimate a second specification where the bilateral effective tax rate, $\tau_{ij,t-1}$, enters additionally in (7). The unilateral specifications are indicated by "Model 5" and "Model 7", and the bilateral ones are labeled "Model 6" and "Model 8". The estimation results for the knowledge-capital model are presented in Table 3.

> Table 3 <

In the data at hand, there is no clear-cut implicit evidence for the dominance of horizontal multinational activity as compared to vertical activity. Moreover,

[21] As before, GDP is measured in real terms. Skilled labor endowments are approximated by the fraction of technicians as available from the International Labor Organization (ILO) and also used in the studies of Carr, Markusen, and Maskus (2001) and Markusen and Maskus (2002).

while the knowledge-capital model specification is superior to the gravity model when considering effective marginal tax rates the reverse is true for effective average tax rates (compare the corresponding model R^2 in Tables 2 and 3). However, the conclusions derived from including bilateral effective tax rates along with unilateral ones in are similar for both types of models: the parameter of the host country unilateral effective tax rate turns significantly positive only after including the bilateral effective tax rate.

We may summarize our findings in the following way. There is a positive impact of unilateral effective tax rates *given bilateral tax rates* and a direct negative impact of bilateral effective tax rates *given unilateral ones*. The latter effect is consistent with Devereux and Freeman (1995), who find that bilateral costs of capital are negatively related to flows of outbound FDI.

Robustness: We assess the sensitivity of the results in various ways. However, provided the similar conclusions from the specifications in Tables 2 and 3, we focus on three modifications of the gravity model in Table 2 for the sake of brevity. In order to facilitate the comparison of the estimation results, we use the same Probit specification for sample selection throughout. We only report the parameters of the tax variables of interest. The model numbers indicate which baseline specification in Table 2 the parameters should be compared to.

> Table 4 <

Letters 'a' to 'c' with the model labels refer to the corresponding robustness experiment. 'a' indicates models that exclude the (low-tax) transition countries from the estimation (Czech Republic, Hungary, and Poland). This is motivated by the conjecture that our previous results could be driven by the low tax rates in Central and Eastern Europe. However, it turns out that the pattern of changes from a unilateral specification to a bilateral one is qualitatively similar to the results in Table 2.

'b' labels a specification that excludes all non-European economies from the sample (both as parent and as host countries). This leads to a dramatic decline in the number of observations from originally 2361 to 1489. The reason is that especially the U.S. and also Japan are among the most important parent and host countries in the world but they are now excluded from the sample. Therefore, not all of the tax parameters of interest can be estimated at the same level of significance as before. However, the qualitative change in the parameter

point estimates due to the inclusion of the bilateral effect tax rate is similar to the original outcome.

Finally, in all models with label 'c' we apply a dynamic model instead of the static ones in Table 2. This specification can be justified by the presumption that firms might be unable to adjust their location decisions immediately after a shock (see Devereux and Freeman, 1995, for a discussion). To avoid an endogeneity bias inherently present in dynamic panels with fixed effects (see, e.g., Baltagi, 2005, p. 136), we use a GMM-estimator as proposed by Arellano and Bond (1991). The estimates of the lagged dependent variable are rather low and only weakly significant (see the notes in Table 4). The results concerning the signs of the tax variables of interest are unchanged. However, the Wooldridge-type sample selection correction is not applicable here. Therefore, the results should be interpreted with care and are not directly comparable to the original ones in Table 2.

Overall, we conclude that our finding of the importance of the bilateral dimension in tax rates for bilateral FDI is robust. Empirical work should infer the role of corporate taxation for FDI based on unilateral and bilateral tax rates together for the sake of consistent inference.

5 Conclusions

This paper suggests using bilateral effective tax rates in addition to unilateral ones when assessing the impact of corporate taxation on foreign direct investment. We follow Devereux and Griffith (1999, 2003) in computing effective (average and marginal) tax rates at the bilateral level. Screening national tax codes and all tax treaties in place among the OECD economies, we construct a panel of unilateral and bilateral effective tax rates among the OECD economies for a time span reaching from 1991 to 2002.

Our findings suggest that unilateral tax rates significantly affect the production and location decisions of multinational firms. This result is in line with most of the previous empirical studies. However, our specific focus on the country-pair-specific tax burden motivates some additional conclusions. The parameter of bilateral tax rates captures the direct impact on bilateral FDI, given the tax rates for national firms. The parameters of the unilateral parent and host country tax rates reflect the indirect impact through their role for national firms a given parent and host country, respectively. Relying on unilateral effective tax rates only may result in misleading conclusions about the impact of a change in bilateral tax instruments (e.g., through bilateral tax treaties) on bilateral FDI. In particular, an increase in host country unilateral tax rates

that affect national firms is erroneously associated with a decline in FDI there with our data at hand. When controlling for unilateral and bilateral effective tax rates simultaneously, we find a robust negative coefficient of the bilateral tax burden and a robust positive one of both the unilateral parent and the unilateral host country tax burden. The latter is consistent with general equilibrium models where bilateral tax rates affect FDI directly but unilateral ones affect it indirectly (and positively) through their negative impact on national, competing enterprises.

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Appendix: Data and descriptive statistics

1. **Data on foreign direct investment:** We use bilateral outbound FDI stock data as published by UNCTAD (FDI Country profiles), covering the period 1991-2002.

   Parent country coverage: The sample includes 22 OECD parent economies: Australia, Austria, Canada, Czech Republic, Denmark, Finland, France, Germany, Hungary, Iceland, Italy, Japan, Luxembourg, Netherlands, Norway, New Zealand, Poland, Portugal, Sweden, Switzerland, United Kingdom, United States.

   Host country coverage: We have 26 host countries in the sample: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, Norway, New Zealand, Poland, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States.

2. **GDP and GDP per capita:** Data on real GDP and GDP per capita at constant U.S. dollars (base year is 2000) are collected from the World Bank's World Development Indicators 2005. **Skill labor endowments** are available for the ILO database.

3. **Tax rates, depreciation allowances, tax treaties:** Information on tax codes (i.e., statutory corporate tax rates including local business taxes, withholding taxes on repatriated profits, depreciation allowances, first-year extra allowances) and bilateral tax treaties (i.e., methods of double taxation relief, withholding taxes) are primarily taken from the following online databases of the International Bureau of Fiscal Documentation (IBFD):

   - *Central/Eastern Europe - Taxation & Investment*
   - *Corporate Taxation in Europe*
   - *Tax News Service*
   - *Tax Treaties Database*

   Further, we exploit information of tax legislation from the following publications:

   - Baker&McKenzie, 1999. *Survey of the effective tax burden in the European Union*, Amsterdam.
   - Commission of the European Communities, 1992. *Report of the committee of independent experts on company taxation*, Brussels and Luxembourg.
   - Commission of the European Communities, 2001. *Towards an internal market without tax obstacles. A strategy for providing companies with a consolidated corporate tax base for their EU-wide activities*, COM (2001) 582 final, Brussels.
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4. **Descriptive statistics:** Table A1, Table A2

Table 1: Analysis of Variance of Effective Tax Rates

Source	Bilateral effective average tax rate: $EATR_{ijt}$				Bilateral effective marginal tax rate: $EMTR_{ijt}$			
	Absolute	in %	Degrees of freedom	Mean squared error	Absolute	in %	Degrees of freedom	Mean squared error
Model	17.737	98.13	756	0.023	14.038	97.56	756	0.019
Parent country effect	1.172	6.48	21	0.056	1.391	9.66	21	0.066
Host country effect	9.388	51.94	25	0.376	6.657	46.27	25	0.266
Time effect	0.428	2.37	11	0.039	0.313	2.18	11	0.028
Bilateral interaction	2.156	11.93	342	0.006	1.721	11.96	342	0.005
Parent country effect * Time effect	0.165	0.91	160	0.001	0.228	1.59	160	0.001
Host country effect * Time effect	0.808	4.47	197	0.004	1.368	9.51	197	0.007
Overall mean (constant)	3.621	20.03	1	3.621	6.059	42.11	1	6.059
Residual	0.337	1.87	2040	0.000	0.351	2.44	2040	0.000
Total	18.075	100.00	2796	0.006	14.389	100.00	2796	0.005

Table 2: Estimation results - impact of corporate income taxation on FDI
Gravity specification

	EATR		EMTR	
Explanatory variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Parent country effective tax rate ($EMTR_{i,t-1,}$ $EATR_{i,t-1}$):	4.128 ***	5.101 ***	4.074 ***	4.230 ***
	(0.891)	(0.927)	(0.899)	(0.863)
Host country effectivetax rate ($EMTR_{j,t-1,}$ $EATR_{j,t-1}$):	-0.215	4.152 ***	-0.079	2.737 ***
	(0.883)	(1.176)	(0.616)	(0.878)
Bilateral effective tax rate ($EMTR_{ij,t-1}$, $EATR_{ij,t-1}$):	-	-5.133 ***	-	-3.641 ***
	-	(0.855)	-	(0.840)
$Log(GDP_{it})$	-1.852	-1.922	-1.692	0.430
	(2.774)	(2.716)	(2.571)	(2.560)
$Log(GDP_{jt})$	-19.570 ***	-17.211 ***	-19.311 ***	-15.723 ***
	(3.037)	(2.908)	(3.287)	(3.075)
$Log(GDP_{it}$ per $capita_{it})$	3.455	3.433	3.399	0.669
	(3.068)	(3.008)	(2.842)	(2.880)
$Log(GDP_{jt}$ per $capita_{jt})$	20.175 ***	17.489 ***	20.228 ***	16.427 ***
	(3.279)	(3.123)	(3.553)	(3.322)
Market potential (MP_{jt})	8.833 **	7.417 *	12.739 ***	7.877
	(4.396)	(4.439)	(4.662)	(4.929)
Observations	2361	2361	2361	2361
R^2	0.970	0.972	0.969	0.971
Fixed time effects, χ^2-test (9)	56.33	56.33	52.93	45.20
p-value	0.000	0.000	0.000	0.000
Sample selection (Mills' ratio), t-test	-0.587	-0.563	-0.529	-0.490
p-value	0.003	0.005	0.008	0.014
Test on between transformed variables, χ^2-test	2363.82	2363.82	2374.99	2849.46
p-value	0.000	0.000	0.000	0.000

Notes: Standard errors in parentheses according to Wooldridge (1995), Procedure 4.2. The test for samlpe selection is calculated according to Wooldridge (1995), Procedure 3.2, using serial correlation and heteroskedasticity robust standard errors according to Newey and West (1987). *** significant at 1%; ** significant at 5%; * significant at 10%. $EATR_i$, $EATR_j$, $EMTR_i$ and $EMTR_j$ are unilateral effective tax rates as defined in Devereux, Griffith and Klemm (2002). The bilateral effective tax rates $EATR_{ij}$ and $EMTR_{ij}$ are defined in Devereux and Griffith (1998, 2003).

Table 3: Estimation results - impact of corporate income taxation on FDI
Knowledge capital specification

	EATR		EMTR	
	Model 5	**Model 6**	**Model 7**	**Model 8**
Parent country effective tax rate ($EMTR_{i,t-1,}$ $EATR_{i,t-1}$):	6.660 ***	7.940 ***	5.628 ***	5.386 ***
	(1.171)	(1.113)	(0.926)	(0.890)
Host country effectivetax rate ($EMTR_{j,t-1,}$ $EATR_{j,t-1}$):	-0.060	6.267 ***	-0.883	1.730 **
	(1.051)	(1.286)	(0.683)	(0.856)
Bilateral effective tax rate ($EMTR_{ij,t-1}$, $EATR_{ij,t-1}$):	-	-7.776 ***	-	-3.612 ***
	-	(0.975)	-	(0.925)
$Log(GDP_{it}+GDP_{jt})$	-2.249 **	-1.629	-1.842	-1.283
	(1.111)	(1.136)	(1.189)	(1.155)
$Log(GDP_{it}/GDP_{it})^2$	-0.160	-0.135	-0.219 **	-0.136
	(0.109)	(0.099)	(0.101)	(0.093)
$(SK_{it}-SK_{it})log(GDP_{it}/GDP_{it})^2D(SK_{it}>SK_{it})*1000$	0.793	0.712	-0.587	-0.871
	(1.789)	(1.723)	(1.752)	(1.706)
$(SK_{it}-SK_{jt})log(GDP_{it}+GDP_{jt})D(SK_{it}>SK_{jt})*1000$	0.548 ***	0.261	1.003 ***	0.827 ***
	(0.229)	(0.215)	(0.232)	(0.214)
$-(SK_{it}-SK_{jt})log(GDP_{it}+GDP_{jt})D(SK_{it}<SK_{jt})*1000$	0.436 *	0.257	0.792 ***	0.739 ***
	(0.243)	(0.228)	(0.241)	(0.226)
$(SK_{it}-SK_{it})^2log(Dist_{ij})*1000$	-0.021 **	-0.008	-0.039 ***	-0.034 ***
	(0.011)	(0.010)	(0.010)	(0.010)
Observations	2361	2361	2361	2361
R^2	0.968	0.971	0.969	0.972
Fixed time effects, χ^2-test (9)	70.81	72.24	45.08	43.22
p-value	0.000	0.000	0.000	0.000
Sample selection (Mills' ratio), t-test	-0.543	-0.531	-0.477	-0.439
p-value	0.000	0.001	0.001	0.003
Test on between transformed variables, χ^2-test	586.76	896.12	590.00	781.74
p-value	0.000	0.000	0.000	0.000

Notes : Standard errors in parentheses according to Wooldridge (1995), Procedure 4.2. The test for samlpe selection is calculated according to Wooldridge (1995), Procedure 3.2, using serial correlation and heteroskedasticity robust standard errors according to Newey and West (1987). *** significant at 1%; ** significant at 5%; * significant at 10%. $EATR_i$, $EATR_j$, $EMTR_i$ and $EMTR_j$ are unilateral effective tax rates as defined in Devereux, Griffith and Klemm (2002). The bilateral effective tax rates $EATR_{ij}$ and $EMTR_{ij}$ are defined in Devereux and Griffith (1998, 2003).

Table 4: Robustness

	Model 1a	Model 2a	Model 1b	Model 2b	Model 1c	Model 2c
Effective average tax rate						
$EATR_{i,t-1}$	3.128 ***	4.823 ***	2.634 ***	3.519 ***	0.825	1.319 **
	(0.784)	(0.875)	(0.959)	(1.005)	(0.634)	(0.637)
$EATR_{j,t-1}$	-0.470	5.646 ***	-1.592 *	2.842 **	-1.168	0.526
	(0.896)	(1.196)	(0.957)	(1.274)	(0.817)	(1.051)
$EATR_{ij,t-1}$	–	-7.493 ***	–	-4.912 ***	–	-1.891 **
		(0.940)		(1.005)		(0.915)

	Model 3a	Model 4a	Model 3b	Model 4b	Model 3c	Model 4c
Effective marginal tax rate						
$EMTR_{i,t-1}$	3.112 ***	4.126 ***	2.530 **	2.779 ***	2.104 ***	2.557 ***
	(0.950)	(1.020)	(1.060)	(1.045)	(0.729)	(0.754)
$EMTR_{j,t-1}$	-0.069	3.905 ***	-1.233 *	0.921	-0.909	1.138
	(0.686)	(0.961)	(0.687)	(0.919)	(0.581)	(0.862)
$EMTR_{ij,t-1}$	–	-5.384 ***	–	-2.797 ***	–	-2.577 ***
		(0.919)		(0.919)		(0.953)

Notes: Standard errors in parentheses according to Wooldridge (1995), Procedure 4.2. The test for samlpe selection is calculated according to Wooldridge (1995).
All Models indicated with "a" (2147 observations): Excluding transition economies (Czech Republic, Hungary and Poland).
All Models indicated with "b" (1489 observations): Excluding non-European economies (Australia, Canada, Japan, USA, New Zealand).
All Models indicated with "c" (1792 observations): Dynamic model as proposed by Arellano and Bond (1991). Sample selection is not accounted for in the regressions. Lagged dependent variable amounts to 0.200 (s.e. = 0.109) in Model 1e, 0.206 (s.e. = 0.108) in Model 2e, 0.172 (s.e. = 0.110) in Model 3e, 0.183 (s.e. = 0.110) in Model 4e.

Table A1: Descriptive statistics

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
Real outward FDI stock (in Tsd. 2000 US$)	2361	0.00	0.00	0.00	0.00
Bilateral EATR	2361	0.34	0.08	0.09	0.56
Bilateral EMTR	2361	0.23	0.07	0.03	0.51
Host country domestic EATR	2361	0.28	0.07	0.08	0.44
Host country domestic EMTR	2361	0.15	0.06	-0.05	0.36
Parent country domestic EATR	2361	0.29	0.06	0.16	0.44
Parent country domestic EMTR	2361	0.16	0.05	-0.05	0.36
Host country real GDP (in Billions 2000 US$)	2361	0.00	0.00	0.00	0.00
Parent country real GDP (in Billions 2000 US$)	2361	0.00	0.00	0.00	0.00
Host country real GDP per capita	2361	22040.90	8632.52	3799.71	45205.65
Parent country real GDP per capita	2361	23516.24	8659.63	3799.71	45205.65
Host country market potential	2361	26.49	0.22	25.91	26.76

Table A2: Correlation matrix

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Real outward FDI stock	(1)	1										
Bilateral EATR	(2)	-0.040	1									
Bilateral EMTR	(3)	-0.030	0.815	1								
Host country domestic EATR	(4)	-0.065	0.766	0.705	1							
Host country domestic EMTR	(5)	-0.024	0.490	0.799	0.742	1						
Parent country domestic EATR	(6)	-0.066	0.310	0.311	0.174	0.081	1					
Parent country domestic EMTR	(7)	-0.016	0.105	0.115	0.044	0.017	0.708	1				
Host country real GDP	(8)	0.427	-0.092	-0.075	-0.066	-0.024	-0.147	-0.005	1			
Parent country real GDP	(9)	0.289	-0.136	-0.068	-0.148	-0.032	-0.042	-0.002	0.090	1		
Host country real GDP per capita	(10)	0.319	-0.272	-0.157	-0.184	-0.014	-0.290	-0.048	0.409	0.402	1	
Parent country real GDP per capita	(11)	0.263	-0.356	-0.221	-0.311	-0.092	-0.184	0.030	0.367	0.487	0.741	1
Market potenial	(12)	0.3053	-0.4342	-0.2824	-0.3429	-0.0898	-0.3201	-0.0185	0.4084	0.4651	0.8345	0.8648

Figure 1: Unilateral (host) EATR

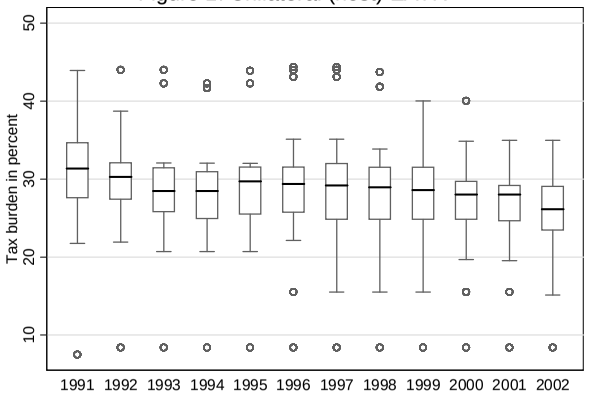


Figure 3: Bilateral EATR

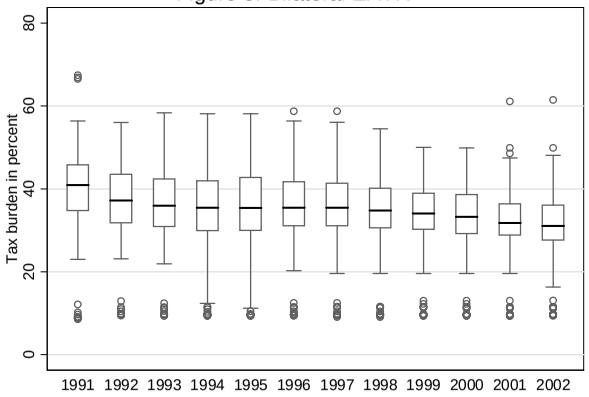


Figure 5: Bilateral minus unilateral (host) EATR

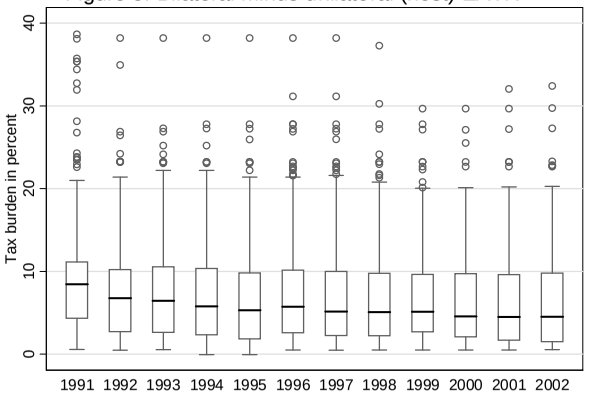


Figure 2: Unilateral (host) EMTR

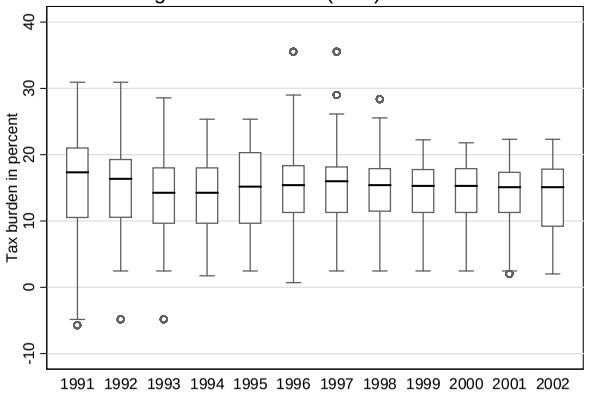


Figure 4: Bilateral EMTR

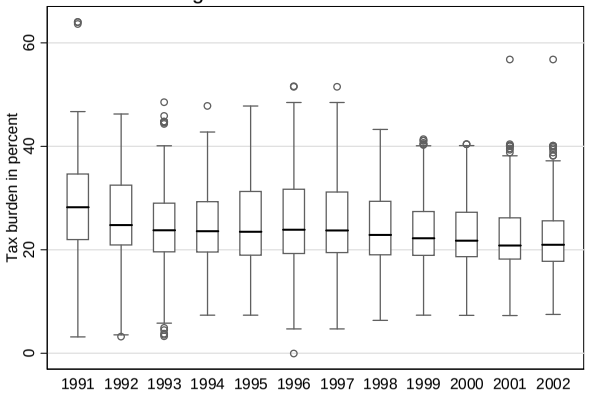
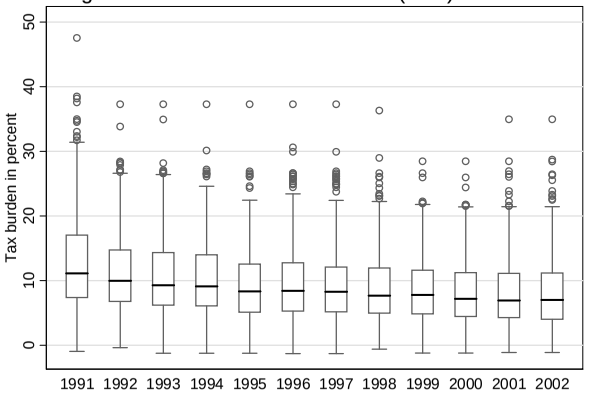


Figure 6: Bilateral minus unilateral (host) EMTR



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