How Does FDI React to Corporate Taxation?*

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Abstract: Based on a panel of bilateral FDI flows 11 OECD countries over 1984-2000, we show that, although agglomeration-related factors are strong determinants of FDI, tax differentials also play a significant role in understanding foreign location decisions. We further investigate non-linearities in the impact of tax differentials, and explore the impact of tax schemes. Our results are consistent with the imperfect competition literature which underscores the possibility of tax differentials across countries in equilibrium.

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1 Introduction

The traditional theory of tax competition[1] points out that, in open economies with fully mobile capital, capital taxation should tend to zero, because it is dominated by taxation of immobile factors, which cannot, by definition, escape taxes through relocation (Diamond and Mirrlees, 1971, Gordon, 1986, Razin and Sadka, 1991, and Wilson, 1999, for a survey). The liberalization of capital flows has made this theory more and more relevant to corporate profit taxation, as foreign direct investment (FDI) allows firms to choose their location on taxation grounds. According to Gordon and Hines (2002), "Tax policies are obviously capable of affecting the volume and location of FDI, since, […] higher tax rates reduce after-tax returns, thereby reducing incentives to commit investment funds".[2]

This feeling that FDI should react to corporate profit taxation is widely shared, both in academic and operational circles, even though empirical as well as theoretical reasons could justify this impact to be empirically unnoticeable and even misleading. First, the use of transfer pricing and intra-firm debt contracting allows firms to shift profits where taxation is the lowest, therefore disconnecting the location of profit and production. Second, location decisions depend on the combination of taxation and public goods provision available in host countries (Tiebout, 1956), which can soften the link between the tax level and the amount of FDI located in a country. Along the same line, the impact of tax differentials on FDI location decisions may not compare to that of structural determinants like the proximity to final markets, the characteristics of competition on the labor and goods markets, and so on (Markusen, 1995). Third, a higher tax rate can result in a higher pre-tax return in a general equilibrium framework (because of lower capital stock), with no measurable impact on post-tax returns (Scholes and Wolfson, 1990). Finally, tax differentials can be an equilibrium outcome in an imperfect competition setting combining economies of scale with trade costs and/or agglomeration forces (Haufler and Wooton, 1999, Andersson and Forslid, 1999, Baldwin and Krugman, 2004, Ludema and Wooton, 2000). In this case, tax differentials just compensate for location rents.

Despite these various reasons why FDI might be insensitive to tax differentials, empirical evidence shows that multinational firms (MNF thereafter) do react to tax incentives, be they embedded in tax rules (which avoid double taxation problems through credit or exemption schemes) or tax rates. Extensive reviews of the literature include Hines (1999) and Gordon and Hines (2002). According to the meta-analysis by de Mooij and Ederveen (2003), the semi-elasticity of FDI to tax rates varies from –22.7 to +13.2, with a mean of –3.3 or –4.0, depending on whether non significant estimates are included in the sample. As for the elasticity of FDI to tax rates, it ranges from –0.6 to –2.8, depending on the estimation method (Desai and Hines, 2001).

Some studies refine investigations by looking at the tax sensitivity of different kinds of FDI: reinvested earnings versus direct transfers (Hartman, 1984, Slemrod, 1990) or mergers and acquisitions versus new plants and plant extensions (Swenson, 2001a). Desai and Hines (2001) show US FDI to be sensitive not only to taxes on profits, but also to indirect (non-income) taxes.

A series of papers also underline the impact of double-taxation rules, in line with the theoretical studies initiated by Hamada (1966) and Musgrave (1969). Specifically, exemption schemes are expected to enhance FDI outflows to low-tax countries, because repatriated profits are then exempted from taxation. Conversely, FDI flowing from countries operating credit schemes should be less sensitive to tax incentives because repatriated profits are then subject to home-country taxation, the MNF being refunded for the tax bill paid abroad. Empirical results in this field are not conclusive. This is probably due in part to the fact that most studies concern FDI flowing in or out of the US, which does not allow disentangling the impact of tax schemes from the impact of other omitted variables. The study by Gropp and Kostial (2000), based on a panel of OECD countries between 1988 and 1997, is an exception, but the use of aggregate FDI data does not allow them to study the impact of tax differentials combined with double-taxation arrangements.

This paper addresses the specific issue of the impact of corporate tax differentials on FDI when tax schemes for avoiding double taxation are accounted for.

Indeed, because investors arbitrate not only among foreign locations but also between each foreign location and domestic investment, tax differentials rather than tax levels should be their variable of decision. As mentioned above, tax differentials must be corrected according to double taxation rules in operation, as FDI should be more sensitive to tax incentives when repatriated profits are exempted from taxation. However because parent firms are not refunded for taxes paid abroad in excess of their home country bill, higher taxes abroad should discourage FDI flowing from credit countries too. Therefore we differentiate the impact of negative and positive tax differentials. Finally, because relocation is costly, and because tax differentials are uncertain due to the complexity and instability of tax codes, tax differentials might have a non-linear impact on FDI, the latter being all the more sensitive to tax differentials when their magnitude is high. We also investigate such a non-linearity.

The analysis is run on a panel of 11 OECD countries over 1984-2000, using bilateral FDI data. Thus, it departs from studies that focus either on aggregate FDI or on bilateral inflows or outflows for a single country. Section 2 details the estimation strategy. Section 3 presents the baseline, linear results. Asymmetries and non-linear effects of tax differentials are analyzed in Section 4, while Section 5 concludes.

2 Modeling FDI in a gravity setting

The impact of tax policies on FDI is investigated on a sample of eleven OECD countries[3] during 1984-2000. The estimates are performed on annual bilateral FDI inflows from country *i* (the investor) to country *h* (the host), measured at constant price and excluding reinvested earnings (source: Eurostat).[4]

2.1 The gravity model

The gravity model, which explains the bilateral trade of two countries by their respective sizes and the distance between them, is now being applied to FDI (see Eaton and Tamura, 1994, Wei, 2000,

Bloningen and Davies, 2000, 2002, or Stein and Daude, 2001, 2003). We estimate the impact of taxation on FDI within this framework, which is refined here by the use of an original measure of the host country market.

Indeed, when considering a foreign location, MNF are not only concerned by the size of the host domestic market, but also by its density, i.e. the concentration of domestic demand around the main productive centers. The main decision variable should therefore be the market potential associated with each possible location, i.e. the distance-weighted average of national regions. This variable (transformed into log), labeled $LPOT_{ht}$, is inspired from Harris (1954).[5]

The *size of the investing country* ($LGDP_{it}$) is measured by the (log of the) GDP in purchasing parity standard. Because large countries have a greater potential than small countries for investing abroad, a positive sign is expected for this variable.

In gravity models of trade, *distance* (which is a proxy for transportation, transaction or, more generally, information costs) is a crucial determinant of trade flows. Its impact on FDI is debated however, because transportation costs interact with economies of scale. Increasing returns reduce the efficient number of plants, while impediments to trade have the opposite effect (Brainard, 1997). Hence, when plant fixed costs are limited compared to trade costs, the MNF will locate production units close to the markets, and FDI will be a substitute for trade: in this case, larger distance between the investor and the host raises FDI at the expense of trade. However geographic distance also stands for transaction and information costs and cultural distance. It is then as detrimental to FDI as it is to trade. Furthermore, whenever FDI inflows involve additional imports (inputs or investment goods), FDI and trade are complements, and distance can be detrimental to FDI just because it is so to trade (see Fontagné, 1999). In brief, the sign of the coefficient on (log of) the *investor-to-host distance* variable ($LDIST_{hi}$) in theoretically indeterminate.

Finally, consistent with a number of studies using gravity equations, a *common language* dummy ($CLNG_{hi}$) is introduced in the analysis. This dummy is designed to catch cultural factors that significantly contribute to international trade and financial linkages between countries, for instance through network externalities.

2.2 Tax rates

The measurement of taxation is a non-trivial issue. Statutory rates are the most obvious and readily available measure, but they can be misleading since low statutory rates can be offset by a broader definition of taxable income.[6] Apparent tax rates (the ratio of observed receipts to observed taxable income) provide a more accurate measure of the effective tax burden, as they also account for any possible exemption. This advantage is balanced by the *ex post* nature of this measure: if MNF locate in tax-friendly countries, the host-country taxation can appear heavier *ex post* than it is *ex ante* (Hines and Rice, 1994). In addition, apparent corporate tax rates seem to be cyclical (Nicodème, 2001), meaning that changes in apparent tax rates could be endogenous to FDI inflows. To circumvent these difficulties, a series of papers inspired by King and Fullerton (1984) provide effective, marginal or average tax rates computed on the basis of tax codes[7]. Compared to statutory or *ex post* rates, these *ex ante* measures correctly reflect tax incentives, and are better candidates to gauge the impact of taxation of FDI decisions by firms.

Whenever empirical analysis is run on a single recipient or exporting country, the impact of corporate tax policies can only be caught through the tax-level of the partner country. Using a bilateral, multinational panel allows one to catch tax incentives more properly, through the computation of the tax differential between the host and the investor country. According to Devereux et al. (2002), discrete location decisions by firms should be influenced by the statutory and/or the average effective tax rate, whereas the decision to increase existing capital in one country should be influenced by the

marginal effective tax rate. Macro-economic FDI flow data, however, do not allow disentangling the two FDI motives; therefore estimates are run with each tax measure.

TS_{hit} denotes the statutory corporate tax rates differential between the country (h) and in the investing country (i), computed as a simple difference. TA_{hit}, TM_{hit} and TE_{hit} respectively refer to the (similarly computed) corporate tax differentials on average effective tax rates, marginal effective tax rates and apparent effective tax rates. The first three variables are provided by Devereux and Griffith (2003). The last measure is drawn from Mendoza et al. (1994). It is computed as the ratio between corporate tax revenues and the operating surplus, using OECD data.

2.3 Additional variables

We test for the impact of production costs on FDI by successively adding to our baseline equation bilateral relative unit labor costs ($LULC_{hit}$, in logs) and bilateral real exchange rates in level ($LRER_{hit}$, also in logs). Finally, the literature on tax competition underlines the possible compensation of high taxation by the provision of public goods. We explore this issue by measuring the impact of two additional variables: the (log of the) amount of total public expenses in the host country ($LPEXP_{ht}$) and the share of public investment in total public expenses ($ISHARE_{ht}$). The former variable catches the size of the public sector. The latter accounts for the composition of public expenses. We expect a higher share of public investment to be an attracting factor for FDI, as this proxy is likely to be closer to the building of public goods.

All variables and data sources are detailed in the Appendix.

3 Baseline results

Panel estimations are carried out with fixed effects on investors and host countries, and fixed coefficients. The total number of fixed effects (20) is much lower than the number of investor-host couples (110), which in principle allows the distance variable to catch some of the variance despite it being constant over time.

3.1 The linear impact of taxation on FDI

In a first step, FDI flows from country *i* to country *h* are explained by gravity variables and tax differentials only. The baseline estimation is the following :

$$LFDI_{hit} = a_1 TAX_{hit} + a_2 LPOT_{ht} + a_3 LGDP_{it} + a_4 LDIST_{hi} + a_5 CLNG_{hi} + v_h + w_i + e_{hit} \quad (1)$$

where TAX_{hit} is the general expression for tax differentials between the host and the investor, this variable being computed using all four definitions of the tax burden (TS_{hit}, TA_{hit}, TM_{hit} and TE_{hit}).

The results are reported in Table 1. Size variables bear the expected significant sign: a larger market potential increases inward FDI (demand effect), and larger countries tend to export more FDI (supply effect). The coefficient on investor-to-host distance is negative, but nonsignificant at standard levels of confidence (the p-value is around 7%). This suggests that FDI data embody both firms reacting to the "proximity-concentration trade-off" (which implies FDI to be a substitute for trade), and firms involved in complementary-to-trade FDI.

The coefficient on tax differentials is negative and highly significant, highlighting the adverse effect of higher taxation in the host country on FDI inflows. The semi-elasticity of the statutory tax differential is –4.22, meaning that a 1 point rise in the host corporate statutory rate relative to the investor reduces FDI inflows by 4.22%. The semi-elasticity is very similar for the average effective tax differential. It is smaller (-2.89) for the marginal effective tax differential, but much higher for the apparent tax differential (-9.39), a difference that stems from the lower value (in absolute level) of this tax measure.

< Insert Table 1 >

In sum, this first set of results shows that, even when imperfect-competition-related determinants are introduced in the estimation, tax differentials play a significant role in the location decisions of MNF.[8] However, tax differentials can also compensate for differences in market potentials: according to Column (1) estimates, a host country suffering from a 10% disadvantage in terms of market potential

(compared to other host countries) can offset this handicap by a 5 percentage-point lower statutory tax rate.

3.2 Checking robustness

The first set of estimates deserves two kinds of robustness check. The first one relates to effective taxation, for which reverse causality can be suspected: changes in apparent tax rates could be endogenous to FDI inflows. In order to overcome this possible endogeneity, apparent tax differentials are instrumented with their lagged value or with the statutory tax differential. The results are displayed in Table 2a. In both cases, the coefficient on tax differentials remains highly significant, while other coefficients remain stable.

< Insert Table 2a >

The second set of robustness checks concentrates on the average effective tax differential which Young (1999) and Devereux and Griffith (2003) point out to be the most relevant measure for the location decision of a multinational.[9] Three issues are addressed, and results are displayed in Table 2b. Firstly, the impact of adding control variables is investigated. Cost variables are first introduced, through relative unit labor costs (Column (1)) and bilateral real exchange rates (Column (2)). The impact of the tax and gravity variables remains unchanged. As to the cost variables, they have a significant, but counter-intuitive, impact, since higher costs attract more FDI. One interpretation is the Balassa-Samuelson effect, which links the real exchange rate to GDP per capita, on both the cross-section and the time-series dimensions. Another potential source of collinearity is the cyclical pattern of relative costs stemming from the Phillips curve. A final explanation can be that unit labor costs are positively related to the quality of labor.[10] While a bit surprising, these results match the conclusions of the few existing studies that include cost differentials in FDI estimates for industrial countries.[11] For instance, Devereux and Griffith (1998) show unit labor costs to be non-significant determinants of the location choices of US multinationals in the European Union. They explain this result by the

insufficiently disaggregated measure of productivity which does not reflect the heterogeneity of firms within each industry.

In a second step, public expense variables are introduced, either through the amount of total public expenses (Column (3)) or through the share of public investment in total public expenses (Column (4)). The results suggest that higher public expenses do not affect the amount of bilateral FDI (the estimated coefficient is not significant). However, while there seems to be no scale effect of public expenses, the composition effect appears highly significant: a higher share of investment in the host country increases inward FDI flows. This result tends to confirm that a higher provision of public goods increases the attractiveness of a country for FDI, and suggests that higher taxes can be partially compensated by an increase in the building up of public infrastructures, consistent with Tiebout's intuition. Notice that including the composition of public expenditure leads to a weakening of both agglomeration and tax estimates: the semi-elasticity of FDI to tax differentials is cut by around 25% (from -4 to –3 approximately), which highlights that a higher tax rate can be compensated for by higher attractiveness in terms of public goods provision. The same is true as far as market potential is concerned, since the estimated coefficient falls from around 2.5 to 1.6.

Finally, Columns (5) and (6) deal with the impact of taxation in third countries, in a way inspired by Young (1999). When considering international investment, MNF not only compare a given location to their home country; they also take into account other potential hosts. For this reason, the whole vector of tax differentials of the home against any potential host should matter. We therefore built a new variable summarizing taxation in alternative locations, which is defined using the weighted average of taxes in all alternative possible locations, the weighting factor being the inverse of the distance between the host and its potential competitors. Indeed, weighting by distance makes alternative locations comparable as to the relative tax incentive, as low-tax but remote countries exert a lower competitive pressure than low-tax but close countries. We then compute the difference between this

competitor's tax rate average and the tax rate of the potential host, TAX_{zht}. The estimates are run in a first step using the average effective tax differential (TA_{zht} Column (5)). Tax differentials between the host and the investor fail to significantly explain FDI, which seems to react only to tax differentials between the competitors and the investor. We believe this result stems from the correlation between host-country and third-country taxation in the case of *ex ante* taxes, which biases the estimates.[12] Such a correlation is not observed for effective tax rates, and re-estimating the equation using TE_{zht} (Column (5)) indeed yields very significant results: while higher taxes in the host country relative to the investor discourages FDI, higher taxes in third countries tend to significantly increase FDI into the host.

< Insert Table 2b >

4 The non-linear impact of tax differentials

The first set of estimates confirms the sensitivity of FDI to tax differentials, whatever the definition of tax rates and the alternative specifications of the empirical model. However, the initially very simple specification of tax incentives requires further qualification, in order to account for the effective operation of tax systems. This section investigates how firms react to corporate tax differentials along three lines.

Firstly, as soon as FDI in undergone, MNF are potentially affected by a double taxation problem, as they may be taxed both in the country of the affiliate and when profit is repatriated. To avoid this double taxation, OECD countries have implemented double-taxation arrangements. Under the crediting system, taxes must be paid according to the tax system in operation in the country of the parent firm, which is granted a credit for the taxes paid in the country of the affiliate. Hence, the net-of-tax income raised from the foreign subsidiary is $p_h[1-t_h-\max(t_i-t_h,0)]=p_h[1-\max(t_i,t_h)]$, where t_i and t_h respectively denote the tax rates of the investor and the host, and p_h is the profit of the affiliate. As a consequence, as long as $t_h \leq t_i$, the parent should be indifferent to the tax level abroad. Under the exemption system, repatriated profits are exempted from taxation, and the MNF

only bears the tax burden of the country of its foreign affiliate. In this case, it should react to any tax differential between the country of origin and the host. Section 4.1 investigates the impact of countries operating under differing tax rules.[13]

However, because excess foreign tax credit is not reimbursed, only higher taxes abroad should discourage FDI stemming from crediting countries: Section 4.2 investigates the impact of negative and positive tax differentials, looking for potential differences in FDI behavior according to the sign of these differentials.

Finally, relocation is costly, taxes sometimes appear uncertain, and the existence of tax deferrals and various measures allow for partial avoidance of taxation. Hence, tax differentials might have a non-linear impact on FDI, the latter being all the more sensitive to tax differentials when their magnitude is high. This issue is addressed in section 4.3.

4.1 Tax schemes

We control for tax schemes in operation in the investor's country by two multiplicative dummies: $EXEMP_i$ takes the value of 1 when the country of the investor applies an exemption rule, zero otherwise; $CRED_i$ takes the value of 1 when the country of the investor applies a crediting system, and zero otherwise. The estimated equation is changed as follows (for the sake of reading simplicity, all gravity variables are embedded in Z_{hit} in the subsequent equations)[14]:

$$LFDI_{hit} = a_1 CRED_i \times TAX_{hit} + a_2 EXEMP_i \times TAX_{hit} + Z_{hit} + v_h + w_i + e_{hit} \qquad (2)$$

As shown in Table 3 (column (1)), the semi-elasticities to tax differentials are significant for both credit and exemption countries. Both coefficients are negative, but – contrary to intuition – FDI flowing from countries operating under a credit scheme seems to be more sensitive to tax differentials than FDI flowing from exemption-scheme countries (although the difference is not statistically significant). A similar result was found by Hines and Rice (1994), working on the FDI behavior of US multinationals in tax havens. They showed that firms submitted to tax credits can be willing to invest

in low-tax countries even though there is no immediate incentive for that. As a consequence, while theory would suggest that crediting arrangements would protect capital-exporting countries from tax competition, empirical results show that tax incentives do impact on FDI decision in these countries.

One explanation for this result could be that countries applying credit schemes (with the exception of Japan) generally display relatively low taxation rates. Since multinationals are not refunded for excess taxation paid abroad, they do react to the level of taxes in the host country. This intuition is investigated in the next Section.

< Insert Table 3 >

4.2 Negative versus positive tax differentials

Because investors operating under crediting arrangements are not refunded for excess taxes paid abroad, the response of FDI to tax variations should be asymmetric: it should be more affected by a tax increase in the host country when taxation is already higher there. Head and al. (1999) indeed find such an asymmetry, concluding that Japanese investments in the US are diverted by high tax rates, but not much attracted by low tax rates.

As a first step, we separate the impact of positive and negative tax differentials on FDI in order to catch such asymmetric incentives. POS_{hit} is a dummy which takes the value of 1 when taxation is higher in the host (h) than in the investing (i) country (positive tax differential), and NEG_{hit} is a dummy that takes the value of 1 when taxation is lower in the host than in the investing country (negative tax differential). The estimated equation is the following:

$$LFDI_{hit} = \alpha_1 POS_{hit} \times TAX_{hit} + \alpha_2 NEG_{hit} \times TAX_{hit} + Z_{hit} + u_h + w_i + e_{hit} \qquad (3)$$

The results are reported in the second Column (2) of Table 3. The coefficient on positive tax differentials is larger (in absolute value) than that on negative differentials, meaning that a higher tax

rate in the host country is more harmful to inward FDI than a lower tax rate is attractive for foreign capital. This conclusion provides a first qualification as regards the strength of tax incentives in determining FDI flows: FDI is less sensitive to tax incentives than to tax disincentives. This has a consequence for tax policies, as increasing FDI inflows through tax cuts could prove more efficient in high-tax countries than in low-tax ones.

As a second step, Equation (3) is complemented by controlling also for the tax scheme in operation in the investing country. The estimated equation becomes:

$$\begin{aligned} LFDI_{hit} = {} & a_1 EXEMP_i \times POS_{hit} \times TAX_{hit} + a_2 EXEMP_i \times NEG_{hit} \times TAX_{hit} \\ & + a_3 CRED_i \times POS_{hit} \times TAX_{hit} + a_4 CRED_i \times NEG_{hit} \times TAX_{hit} \\ & + Z_{htt} + u_h + w_i + e_{hit} \end{aligned} \qquad (4)$$

The results are reported in Table 3, Column (3). They show that firms originating from crediting countries do react to the level of tax differentials when these differentials are positive (i.e. when taxation is higher in the host than in the investor country), whereas they do not react to the level of the tax differential when it is negative, confirming that investors from crediting countries asymmetrically react to tax differentials. Firms from exempting countries display the same asymmetric behavior.

On the whole, these results suggest that tax competition to attract FDI might not be a major risk, as the sensitivity of inward FDI to lower taxes abroad is not significant. In contrast, higher tax rates are harmful to inward FDI, meaning that there could be a strong incentive for high-tax recipient countries to lower the tax burden if they intend to attract FDI.[15]

4.3 Are there nonlinearities in the response of FDI to tax differentials?

Given the complexity and instability of tax codes, information about taxation might be expected to be highly imperfect. In addition, relocating from one country to another is costly. Finally, because of the existence of tax deferrals and various measures that allow partial avoidance of taxation, tax differentials might have a nonlinear impact on FDI. In such a framework, large discrepancies should matter more than small ones. We test for nonlinearities by including cubic tax differentials in the

estimation[16], expecting a negative sign on both differentials and cubic differentials. We also further investigate the impact of tax schemes on the sensitiveness of FDI to tax differentials, through a separate estimation of the impact of negative and positive tax differentials, which is a second step combined with tax scheme. Three equations are therefore estimated, the results being displayed in Table 4:

$$LFDI_{hit} = a_1 TAX_{hit} + a_2 TAX_{hit}^3 + Z_{hit} + u_h + w_i + e_{hit} \quad (5)$$

$$\begin{aligned} LFDI_{hit} = {} & a_1 CRED_i \times TAX_{hit} + a_2 EXEMP_i \times TAX_{hit} \\ & + a_3 CRED_i \times TAX_{hit}^3 + a_4 EXEMP_i \times TAX_{hit}^3 \\ & + Z_{hti} + u_h + w_i + e_{hit} \end{aligned} \quad (6)$$

$$\begin{aligned} LFDI_{hit} = {} & a_1 EXEMP_i \times POS_{hit} \times TAX_{hit} + a_2 EXEMP_i \times NEG_{hit} \times TAX_{hit} \\ & + a_3 CRED_i \times POS_{hit} \times TAX_{hit} + a_4 CRED_i \times NEG_{hit} \times TAX_{hit} \\ & + a_5 EXEMP_i \times POS_{hit} \times TAX_{hit}^3 + a_6 EXEMP_i \times NEG_{hit} \times TAX_{hit}^3 \\ & + a_7 CRED_i \times POS_{hit} \times TAX_{hit}^3 + a_8 CRED_i \times NEG_{hit} \times TAX_{hit}^3 \\ & + Z_{hit} + u_h + w_i + e_{hit} \end{aligned} \quad (7)$$

The first column in Table 4 provides a first confirmation that FDI inflows do react to tax differentials in a non-linear manner: larger discrepancies have a stronger impact on FDI flows (the coefficient on the cubic tax differential is significant and negative).

Column (2) displays the reaction of FDI according to the double-taxation arrangement in operation in the capital-exporting country. According to our estimates, investors operating under exemption arrangements exhibit linear reaction to tax differentials (the coefficient on the cubic tax differential is not significant), while investors operating under crediting arrangements only react to large tax differentials.

Introducing asymmetries (Column (3)) reinforces the conclusions of Section 4.2. Firstly, only positive tax differentials matter, confirming that tax disincentives are more influential in investment decisions than tax incentives. Secondly, when investors operate under exemption arrangements, they react linearly to tax differentials. When a credit scheme is applied, investors' sensitivity to tax differentials

is nonlinear, suggesting that limited positive tax differentials are not very harmful to inward FDI in this case. This result is consistent with the fact that credit is only partial: for large positive tax differentials, there is a strong probability that the tax bill paid by the affiliate (which depends on both the tax rate and the amount of profit) exceeds that of the mother. Conversely, crediting arrangements include provisions for tax deferrals: by softening the burden of national taxation, these could cancel out small tax differentials (Gordon and Hines, 2002).

As a consequence of this asymmetry in the behavior of FDI inflows from crediting and exempting countries, the impact of a change in tax differential should be conditioned to the geographic composition of inward FDI: for a low level of tax differentials, the loss essentially stems from exemption-scheme countries. Investors submitted to a credit scheme significantly react to tax differentials at larger tax differentials. Turning back to the possible shape of tax competition, these results would suggest a more complete convergence in tax rates when inward FDI mainly stems from exemption countries, whereas limited tax differentials could well survive whenever investors mainly stem from countries applying credit schemes.

< Insert Table 4 >

4.4 Quantifying the impact of tax differentials on FDI inflows

Because structural determinants of FDI (like scale economies, market size, cultural proximity) play an overwhelming role in the location of MNF, most empirical studies conclude that the impact of taxation should only be marginal. Here, we quantify this impact relative to the main structural determinant of FDI in our estimates, namely the market potential. Two main results emerge from our empirical analysis. The first and most general one is that, whatever the double-taxation arrangement in operation, FDI only reacts to higher taxation abroad. The second one is that the response of FDI to tax differentials is nonlinear in the magnitude of this differential when the MNF confronts a crediting arrangement, while it is linear when the MNF confronts an exempting arrangement.

We investigate the change in tax differential that would be needed to keep FDI constant if agglomeration effects were to change. Namely, we look at the compensation in tax differentials that would be "sustainable" if the market potential of the host were to increase by 1 standard deviation. These simulations are performed on the basis of two reference equations: Equation (4), which combines the sign of tax differentials with the double-taxation arrangement in operation in the country of the parent; and equation (7), which takes account of nonlinearities in the reaction of FDI to tax differentials, combining this with double-taxation arrangements.

The average standard deviation of the (log of the) market potential in the host country is .14; in both equations, the estimated coefficient for this variable is 2.2. According to equation (4) (Table 3, Column (3)), a 1 standard-deviation increase in the market potential induces a 31 % increase in inward FDI flows. When the investor confronts a crediting rule, the recipient country can afford a relative increase in corporate taxation by 7 percentage points compared to the investor; the sustainable increase in taxation is 10 percentage points when the investor is allowed exemption to foreign corporate taxation. Turning back to the new economic geography literature, this result suggests that there can indeed be taxable rents associated with the presence of agglomeration externalities.

Turning to equation (7) (Table 4, Column (3)), the impact of an increase in market potential is similar as long as the country of the parent is applying exemption: a 1 standard-deviation increase in market potential opens room for a 7 percentage points increase in the tax differential. But when the parent can benefit from a crediting system when repatriating the benefits of its affiliate, a similar increase in market potential leaves room for a 24 percentage points increase in tax differentials. This reinforces the assumption of taxable rents arising from the simulation of equation (4), as it suggests that when the country of the parent applies a crediting system, a rise in the market potential creates a huge potential for taxable rents.

5 Conclusion

The new economic geography literature points out that, due to size effects and agglomeration economies, corporate tax competition need not lead to zero taxation, because attractive countries might exploit their location rent to maintain higher taxation rents. Using a panel of bilateral FDI flows across 11 OECD countries over the 1984-2000 period and four measures of corporate tax rates, we show that high relative corporate taxation does discourage FDI inflows, even when gravity factors and the provision of public goods are controlled for. Therefore, although market potential does matter, corporate tax differentials also play a significant role in driving FDI flows. Two qualifications apply to this result.

Firstly, there is an asymmetry in the impact of tax differentials on FDI: while lower tax rates in the recipient countries fail to significantly attract foreign investment, higher taxes tend to discourage new FDI inflows. Secondly, the impact of positive tax differentials is not homogeneous regarding the double-taxation arrangement in operation in the capital-exporting countries: while narrow tax differentials do not much discourage inward FDI coming from crediting countries, large tax differentials produce proportionally more important FDI outflows. Such an asymmetry does not exist for FDI stemming from exempting countries, which reacts linearly to tax differentials.

These results bear several policy implications. First, although tax differentials do matter for FDI flows, this should not lead to zero taxation, because market potential and public investment also matter, and because FDI reacts asymmetrically to positive and to negative tax differentials so that the incentive to cut taxes essentially falls on high tax countries. Second, because there is an asymmetry in FDI stemming from countries applying exemption or credit to repatriated profits, the incentive for tax competition should depend on the composition of investing countries. Typically, in an integrated area like the EMU, where most FDI stems from countries applying exemption schemes, tax competition might well end up in a convergence of tax rates to the lowest continental level.

Appendix: variables and data sources

FDI data is extracted from the Eurostat data-base Cronos. The first chain ownership concept (as opposed to the ultimate beneficial owner concept) is applied in order to identify the source country. We consider total FDI in all sectors, excluding reinvested earnings for all countries except the US and Japan, this difference in data definition being controlled for by the use of fixed effects for investing and host countries. Germany includes East Germany from 1991. Flows are recorded in current ECU millions at market values. They are converted into constant dollars using IMF exchange rates and prices of investment in the host country. The endogenous variable is the (natural) logarithm of FDI flows ($LFDI_{hit}$). This transformation excludes null and negative observations: 398 FDI values are missing, and 268 negative or zero values are excluded from the analysis. Preliminary estimations carried out on FDI levels showed that working on logarithms (without null and negative values) does not introduce a selection bias.

Gravity variables

The market potential is defined as the ratio of the GDP (in purchasing parity standards, source: CEPII-CHELEM database) of the host to its average internal distance:

$$LPOT_{ht} = \ln\left(GDP_{ht}/d_{hh}\right)$$

We are grateful to Thierry Mayer for providing us with internal distances.

The size of the investing country: $LGDP_{it}$ is the logarithm of the investing country's GDP (in purchasing parity standards, source : CHELEM-CEPII database).

Transportation costs: $LDIST_{hi}$ is the logarithm of the great arc-cycle distance between i and h economic centers (source: CEPII, available on http://www.cepii.fr/anglaisgraph/bdd/distances.htm).

Common language: $CLNG_{hi}$ is a dummy controlling for potential network externalities provided by the sharing of a common culture. It takes the value of one when countries use the same language.

Corporate tax differentials

Corporate tax differentials are calculated as simple differences between the corporate-tax rates in the host country (*h*) and in the investing country (*i*). This calculation is carried out on a set of four tax variables (all in percentage): (i) statutory tax rates (TS_{hi}), (ii) average effective tax rates (TA_{hi}), (iii) marginal effective tax rates (TM_{hi}) and (iv) apparent effective tax rates (TE_{hi}).

Statutory, average effective and marginal effective tax rates are taken from Michael Devereux's home page (http://www.warwick.ac.uk/fac/soc/economics/staff/faculty/devereux/). Apparent effective tax rates are calculated as the ratio between corporate tax revenues and the operating surplus, using OECD data, namely taxes on corporate income as a % of GDP (Line 12 OECD, Financial and Fiscal Affairs, Compendium), available for the whole time sample; GDP is in local currency (OECD, national accounts); operating surplus is also in local currency (OECD, national accounts).

Note that other location incentives such as subsidies or exemptions granted by local authorities should be considered too. However, reliable data is missing, especially on a multi-country basis, and there is some evidence that these policies are implemented everywhere and thus are likely to at least partially offset each other.

Other variables

$LRER_{hit}$ is the logarithm of the bilateral, real exchange rate between the host country *h* and the investor country *i* (a rise in $LRER_{hit}$ points to a real depreciation in country *h*). This variable compares the nominal exchange rate to the PPP one, which allows for both geographic and time variance in real exchange rates (source: CEPII-CHELEM database).

Unit labour costs are taken from the OECD, and converted into dollars using IMF exchange rates. Relative unit labor costs ($LULC_{hit}$) are computed as the difference in the (natural logarithm of) unit labour costs in the host against the investor.

Public expenses: denoting public consumption by PC and public investment by PI, both in volume converted in current US dollar, the size of total public expenses is defined as follows: $LPEXP_{ht} = \ln(PC_{ht} + PI_{ht})$. The composition of public expenses is defined as follows: $ISHARE_{ht} = \left(\frac{PI_{ht}}{PI_{ht} + PC_{ht}} \right)$. All variables are provided by the OECD (line CGV for public consumption data in volume, line IGV for public investment data), and are converted into US dollar using IMF (International financial Statistics) data.

Number of observations

The theoretical number of observations for bilateral FDI is 1870 (11 investors x 10 hosts x 17 years). However there are 398 missing values, and 268 negative or zero values need to be excluded since we are working on the logarithm of FDI flows.

There are also missing values among explanatory variables. In particular, Denmark is missing in the Devereux and Griffith database. This leaves us with 1163 observations when the Devereux and Griffith database is used, and to 1307 observations when apparent taxation is used.

References

Andersson, Frederik, and Rikard Forslid. (2003). "Tax Competition and Economic Geography". Journal of Public Economic Theory, 5 (2), 279-303.

Baldwin, Richard, and Paul Krugman. (2004). "Agglomeration, Integration and Tax Harmonization". European Economic Review, 48 (1), 1-23.

Bloningen, Bruce A., and Ronald B. Davies. (2000). "The Effect of Bilateral Tax Treaties on US FDI Activity". NBER Working Paper No. 7929.

Bloningen, Bruce A., and Ronald. B. Davies. (2002). "Do Bilateral Tax Treaties Promote Foreign Direct Investment?". NBER Working paper No. 8834, March.

Brainard Lael S. (1997). "An Empirical Assessment of the Proximity-Concentration Trade off between Multinational Sales and Trade". American Economic Review, 87 (4), 520-44.

Desai, Mihir A., and James R. Hines. (2001). "Foreign Direct Investment in a World of Multiple Taxes". NBER Working paper no. 8440, August.

Devereux, Michael P., and Rachel Griffith. (1998). "Taxes and the Location of Production: Evidence from a Panel of US Multinationals". Journal of Public Economics, 68, 335-367.

Devereux, Michael P., Rachel Griffith. and Alexander Klemm. (2002). "Corporate Income Tax Reforms and International Tax Competition". Economic Policy, 35, 449-496.

Devereux, Michael P., and Rachel Griffith. (2003). "Evaluating tax policy for location decisions". International Tax and Public Finance, 10 (2), 107-126.

Diamond, P.A. and J. Mirrlees. (1971). "Optimal Taxation and Public Production, I: Production Efficiency (II: Tax Rules)". American Economic Review, 61, 8-27 (261-278).

Eaton, Jonathan, and Akiko Tamura. (1996). "Japanese and US Exports and Investment as Conduits of Growth". In Takatoshi Ito and Anne O. Kueger (eds), Financial Deregulation and Integration in East Asia, Chicago and London : University of Chicago Press, 51-72.

Fontagné, Lionel. (1999). "Foreign Direct Investment and International Trade: Complements or Substitutes?". STI Working Papers, 1999-3, OECD-DSTI.

Gordon, Roger H. (1986). "Taxation of Investment and Savings in a World Economy". American Economic Review, 76, 1086-1102.

Gordon, Roger H., and James R. Hines Jr. (2002). "International Taxation". NBER Working Paper No. 8854.

Gresik, T. (2001). "The Taxing Task of Taxing Multinationals". Journal of Economic Literature, vol. XXXIX, 800-838.

Gropp, Reint, and Kristina. Kostial. (2000). "The Disappearing Tax Base: Is Foreign Direct Investment Eroding Corporate Income Taxes?". IMF Working Paper, WP/00/173.

Hamada, Koichi.(1966). "Strategic Aspects of Taxation of Foreign Investment Income". Quarterly Journal of Economics, 80, 361-75.

Harris, Chauncy. (1954). "The Market as a Factor in the Localization of Industries in the United States". Annals of the Association of American Geographics, 64, 315-348.

Hartman, David G. (1984). "Tax Policy and Foreign Direct Investment in the United States". National Tax Journal 37, 475-488.

Haufler, Andreas, and Ian Wooton. (1999). "Country Size and Tax Competition for Foreign Direct Investment". Journal of Public Economics, 71, 121-139.

Head, Kieth, John Ries, and Deborah Swenson. (1999). "Attracting Foreign Manufacturing: Investment Promotion and Agglomeration". Regional Science and Urban Economics (29), 197-218.

Hines, James R., and Eric M. Rice. (1994). "Fiscal Paradise: Foreign Tax Heavens and American Business". Quarterly Journal of Economics 109 (1), 149-182.

Hines James R. (1999). "Lessons from Behavioral Responses to International Taxation". National Tax Journal, 52, (2), 305-323.

Hines James R., (2001). "'Tax sparing' and direct investment in developing countries". In: James R. Hines (ed.), International Taxation and Multinational Activity, University of Chicago Press, Chicago, 39-66.

King, Mervin A. and Don Fullerton. (1984). The Taxation of Income from Capital. Chicago: The University of Chicago Press.

Ludema, Rodney D., and Ian Wooton. (2000). "Economic Geography and the Fiscal Effects of Regional Integration". Journal of International Economics, 52 (2), 331-57.

Markusen, James R. (1995). "The Boundaries of Multinational Enterprises and the Theory of International Trade". Journal of Economic Perspectives, 9, 169-189.

Mendoza, Enrique G., Assaf Razin, and Linda L. Tesar, (1994). "Effective Tax Rates in Macroeconomics: Cross-Country Estimates of Tax Rates on Factor Incomes and Consumption". Journal of Monetary Economics, 34, 297-323.

de Mooij, Ruud.A., and Sjef Ederveen. (2003). "Taxation and Foreign Direct Investment: a Synthesis of Empirical Research", International Tax and Public Finance, 10, 673-693.

Musgrave, Peggy (1969). United States Taxation of Foreign Investment Income: Issues and Arguments. Cambridge, MA: Int. Tax Program, Harvard Law School.

Nicodème, Gaetan. (2001). "Computing Effective Corporate Tax Rates: Comparisons and Results", Economic Papers, 153, June.

Razin, Assaf, and Ephraim Sadka. (1991). "Efficient Investment Incentives in the Presence of Capital Flight", Journal of International Economics, 31, 171-18.

Scholes, Myron, and Mark A. Wolfson. (1990). "The Effects of Changes in Tax Law on Corporate Reorganization Activity". Journal of Business 63, S141-S164.

Slemrod, Joel. (1990). "Tax Effects of Foreign Direct Investment in the United States: Evidence from Cross-Country Comparison". In Assaf Razin and Joel Slemrod (eds.), Taxation in a Global Economy, Chicago, Chicago University Press, 79-117.

Stein, Ernesto, and Christian Daude. (2001). "Institutions, Integration and the Location of Foreign Direct Investment". Mimeo, Inter-American Development Bank.

Stein, Ernesto, and Christian Daude. (2003). "Longitude Matters : Time Zones and the Location of FDI". Mimeo, Inter-American Development Bank.

Swensson, Deborah. (2001a). "Transaction Type and the Effect of Taxes on the Distribution of Foreign Direct Investment in the United States". In James. R. Hines (ed.), International Taxation and Multinational Activity, University of Chicago Press.

Swensson, Deborah. (2001b). "Tax Reforms and Evidence of Transfer Pricing". National Tax Journal, vol. LIV No. 1.

Tiebout Charles M. (1956), "A Pure Theory of Local Expenditures". Journal of Political Economy, 64, 416-24.

Wei, Shang-Ji. (2000). "How Taxing is Corruption on International Investors ?". The Review of Economics and Statistics, LXXXII (2), 1-11.

Wilson, John D. (1999). "Theories of Tax Competition". National Tax Journal, LII, (2), 263-304.

Young, Garry. (1999). "The Influence of Foreign Factor Prices and International Taxation on Fixed Investment in the UK". Oxford Economic Papers 51, 355-373.

Table 1. Baseline estimation

	(1)	(2)	(3)	
Intercept	-29.07** [3.97]	-28.10** [3.99]	-27.84** [4.02]	-23.51** [3.70]
Tax differentials				
Statutory tax (TS_{hit})	**-4.22**** **[0.97]**	-	-	-
Average effective tax (TA_{hit})	-	**-4.23**** **[.94]**	-	-
Marginal effective tax (TM_{hit})	-	-	**-2.89**** **[.72]**	
Apparent effective tax (TE_{hit})	-	-	-	**-9.40**** **[1.18]**
Market potential ($LPOT_{ht}$)	2.31** [.61]	2.48** [.61]	2.53** [.62]	4.09** [.59]
Size of investor country ($LGDP_{it}$)	4.23** [0.71]	4.04** [.71]	3.99** [.72]	2.98 [.68]
Investor-to-host distance ($LDIST_{hi}$)	-.14 [.09]	-.15 [.09]	-.15 [.09]	-.13 [.09]
Common language ($CLNG_{hi}$)	.61** [.16]	.61** [.16]	.61** [.16]	.55** [.14]
Number of observations	1163	1163	1163	1307
Adjusted R^2	.472	.473	.540	.471
Hausman test	$\chi^2(5)$=141.43 p=[.000]	$\chi^2(5)$=144.86 p=[.000]	$\chi^2(5)$=187.71 p=[.000]	$\chi^2(5)$=157.18 p=[.001]
F test	F(9,1139)=36.99 p=[.000]	F(9,1139)=36.69 p=[.000]	F(10,1281)=36.26 p=[.000]	F(11,837)=4.794 p=[.000]
Breusch-Pagan LM test	$\chi^2(1)$= 1321.36 p=[.000]	$\chi^2(1)$= 1361.01 p=[.000]	$\chi^2(1)$= 1471.43 p=[.000]	$\chi^2(1)$= 1346.29 p=[.000]

Note: standard errors in brackets. **, * : significant at the 1%, 5% respectively.

Table 2a. Reverse causality in apparent tax differential

	Instrumented by TE(-1)	Instrumented by TS
	(1)	(2)
Intercept	-20.02** [3.94]	-28.134** [4.23]
Apparent effective tax differential (TE_{hit})	**-11.57** [1.56]**	**-14.29** [3.44]**
Market potential ($LPOT_{ht}$)	4.01** [.61]	2.65** [.65]
Size of investor country ($LGDP_{it}$)	2.46** [.72]	3.99** [.75]
Investor-to-host distance ($LDIST_{hi}$)	-.13 [.09]	-.15 [.09]
Common language $CLNG_{hi}$	.54** [.15]	.67** [.16]
Number of observations	1237	1091
Adjusted R^2	.512	.473
Hausman test	$\chi^2(5)=120.78$ p=[.000]	$\chi^2(5)=134.11$ p=[.000]
F test	F(10,1211)=34.77 p=[.000]	F(9,1067)=32.90 p=[.000]
Breusch-Pagan LM test	1230.21	120.78

Note: standard errors in brackets. **, * : significant at 1%, 5% respectively. p refer to p-values.

Table 2b. Robustness: adding control variables

	Relative unit labour costs	Real exchange rate	Total public expenses	Share of public investment	Competitors' tax rate	
	(1)	(3)	(3)	(4)	(5)	(6)
Intercept	-32.59** [4.06]	-29.75** [3.99]	-14.11** [9.82]	-34.66** [4.12]	-25.708** [3.98]	-22.366** [3.74]
Tax differentials						
Average effective (TA_{hit})	**-4.18** [0.93]**	**-4.17** [.94]**	**-4.00** [.96]**	**-3.03** [.96]**	**-.198 [1.24]**	-
Apparent effective (TE_{hit})	-	-	-	-	-	**-7.321** [1.54]**
Apparent effective in third countries (TE_{zit})	-	-	-	-	-	**4.720* [2.24]**
Average effective in third countries (TA_{zit})	-	-	-	-	**9.155** [1.87]**	-
Market potential ($LPOT_{ht}$)	2.51** [.61]	2.21** [.61]	1.95** [.72]	1.63** [.63]	2.696** [.61]	4.190** [.59]
Size of investor country ($LGDP_{it}$)	4.12** [.70]	4.36** [.71]	3.83** [.72]	4.88** [.72]	3.699** [.71]	2.776** [.69]
Investor-to-host distance ($LDIST_{hi}$)	-0.15 [.09]	-.15 [.09]	-.14 [.09]	-.13 [.09]	-.150 [.09]	-.130 [.09]
Common language ($CLNG_{hi}$)	.61** [.16]	.61** [.16]	.60 [.16]	.61** [.16]	.597** [.16]	.557** [.14]
Relative unit labour costs ($LULC_{hit}$)	**1.52** [.32]**	-	-	-	-	-
Real exchange rate ($LRER_{hit}$)	-	**-1.42** [.36]**	-	-	-	-
Size of total public expenditure (LP_EXP_{hit})	-	-	**1.09 [.75]**	-	-	-
Public investment ($dINV_{hit}$)	-	-	-	**13.4** [.244]**	-	-
Number of observations	1163	1163	1163	1163	1163	1307
Adjusted R^2	.483	.48	.474	.486	.483	.542
Hausman test	$\chi^2(6)=154.01$ p=[.000]	$\chi^2(6)=140.34$ p=[.000]	$\chi^2(6)=64.69$ p=[.000]	$\chi^2(6)=153.55$ p=[.000]	$\chi^2(6)=166.40$ p=[.000]	$\chi^2(6)=160.92$ p=[.000]

F test	F(9,1138)=24.23 p=[.000]	F(9,1138)=38.63 p=[.000]	F(9,1138)=35.87 p=[.000]	F(9,1138)=38.40 p=[.000]	F(9,1138)=27.69 p=[.000]	F(10,1280)=32.68 p=[.000]
Breusch-Pagan LM test	$\chi^2(1)$=866.78 p=[.000]	$\chi^2(1)$=1271.53 p=[.000]	$\chi^2(1)$=1376.07 p=[.000]	$\chi^2(1)$=1367.56 p=[.000]	$\chi^2(1)$=1283.31 p=[.000]	$\chi^2(1)$=1531.82 p=[.000]

Note: standard errors in brackets. **, * : significant at 1%, 5% respectively. p refer to p-values.

Table 3. Tax schemes and effective average tax asymmetries

	Credit versus exemption	Negative versus positive differential	Combination
	(1)	(2)	(3)
Intercept	-28.75** [4.03]	-27.35** [3.99]	-28.473 [4.03]
Tax differential, investor applying exemption $EXEMP_i \times TAX_{hit}$	**-2.20** [.85]**	-	-
Tax differential, investor applying credit $CRED_i \times TAX_{hit}$	**-2.76** [1.01]**	-	-
Positive tax differentials POS_{hit}	-	**-4.69** [1.23]**	-
Negative tax differentials NEG_{hit}	-	**-3.84** [1.16]**	-
Credit + positive tax differential $CRED_i \times POS_{hit} \times TAX_{hit}$	-	-	**-4.09** [1.36]**
Credit + negative tax differential $CRED_i \times NEG_{hit} \times TAX_{hit}$	-	-	**-0.63 [1.74]**
Exemption + positive tax differential $EXEMP_i \times POS_{hit} \times TAX_{hit}$	-	-	**-3.24** [1.35]**
Exemption + negative tax differential $EXEMP_i \times NEG_{hit} \times TAX_{hit}$	-	-	**-1.21 [1.14]**
Market potential $LPOT_{ht}$	2.29** [.62]	2.46** [.61]	2.23** [.62]
Size of investor country $LGDP_{it}$	4.21** [.72]	4.04** [.71]	4.21** [.72]
Investor-to-host distance $LDIST_{hi}$	-.15 [.09]	-.15 [.09]	-.16 [.09]
Common language $CLNG_{hi}$	.55** [.17]	.59** [.16]	.57** [.17]
Number of observations	1163	1163	1163
Adjusted R^2	.467	.473	.4685
Hausman test	$\chi^2(6)=158.04$ p=[.000]	$\chi^2(6)=156.71$ p=[.000]	$\chi^2(8)=123.16$ p=[.000]
F test	F(9,1138)=34.23 p=[.000]	F(9,1138)=35.10 p=[.000]	F(9,1136)=32.64 p=[.000]
Breusch-Pagan LM test	$\chi^2(1)=1168.99$ p=[.000]	$\chi^2(1)=1145.37$ p=[.000]	$\chi^2(1)=1066.28$ p=[.000]

Note: standard errors in brackets. **, * : significant at 1%, 5% respectively. p refer to p-values.

Table 4. Non-linear responsiveness of FDI to effective average tax differentials

	Non-linearity	Credit vs. Exemption	Sign of tax differentials
	(1)	(2)	(3)
Intercept	-27.50** [3.99]	-28.62** [4.04]	-28.57** [4.05]
Tax differential TAX_{hit}	**-3.58** [.98]**	-	-
Cubic tax differential TAX^3_{hit}	**-11.36* [4.96]**	-	-
Tax differential, investor in exemption scheme $EXEMP_i \times TAX_{hit}$	-	**-1.81** [.94]**	-
Tax differential, investor in credit scheme $CRED_i \times TAX_{hit}$	-	**-1.52 [1.19]**	-
Cubic tax differential, investor in exemption scheme $EXEMP_i \times TAX^3_{hit}$	-	**-4.81 [5.89]**	-
Cubic tax differential, investor in credit scheme $CRED_i \times AX^3_{hit}$	-	**-23.49* [11.31]**	-
Credit scheme + positive tax differential $CRED_i \times POS_{hit} \times TAX_{hit}$	-	-	**-2.40 [1.65]**
Credit scheme + negative tax differential $CRED_i \times NEG_{hit} \times TAX_{hit}$	-	-	**-1.21 [3.64]**
Exemption scheme + positive tax differential $EXEMP_i \times POSE_{hit} \times TAX_{hit}$	-	-	**-4.71* [2.46]**
Exemption scheme + negative tax differential $EXEMP_i \times NEG_{hit} \times TAX_{hit}$	-	-	**-.31 [1.35]**
Cubic, credit scheme + positive tax differential $CRED_i \times POS_{hit} \times TAX^3_{hit}$	-	-	**-23.76* [12.20]**
Cubic, credit scheme + negative tax differential $CRED_i \times NEG_{hit} \times TAX^3_{hit}$	-	-	**-3.65 [52.41]**
Cubic, exemption scheme + positive tax differential $EXEMP_i \times POS_{hit} \times TAX^3_{hit}$	-	-	**37.44 [58.37]**
Cubic, exemption scheme + negative tax differential $EXEMP_i \times NEG_{hit} \times TAX^3_{hit}$	-	-	**-7.76 [6.69]**
Market potential $LPOT_{ht}$	2.65** [.62]	2.37** [.62]	2.27** [.63]
Size of investor country $LGDP_{it}$	3.92** [.71]	4.155** [.72]	4.19** [.72]
Investor-to-host distance $LDIST_{hi}$	-.16 [.09]	-.14 [.09]	-.15 [.09]

Common language $CLNG_{hi}$	.63** [.16]	.53** [.17]	.54** [.18]
Number of observations	1163	1163	1163
Adjusted R^2	.475	.470	.471
Hausman test	$\chi^2(6)=157.38$ p=[.000]	$\chi^2(8)=174.15$ p=[.000]	$\chi^2(12)=173.76$ p=[.000]
F test	F(9,1138)=36.1 p=[.000]	F(9,1136)=33.5 p=[.000]	F(9,1132)=32.1 p=[.000]
Breusch-Pagan LM test	$\chi^2(1)=1326.60$ p=[.000]	$\chi^2(1)=1137.45$ p=[.000]	$\chi^2(1)=1031.29$ p=[.000]

Note: standard errors in brackets. **, * : significant at 1%, 5% respectively. p refer to p-values.

Footnotes

1

[1] See Wilson, 1999, for a survey.

[2] Gordon and Hines (2002), p. 43.

[3] EU12 less Portugal and Greece (Belgium and Luxembourg are treated together), plus the US and Japan.

[4] In the case of the US and Japan, reinvested earnings are included due to data limitations. The gap in data definitions is controlled through the use of fixed-effects in the panel estimates.

[5] Therefore, the market potential accounts for transportation costs supported when shipping the output of the affiliate within the host market.

[6] Indeed, Devereux and Griffith (2002) show that there has been partial compensation between statutory tax cuts and base broadening in most OECD countries over the 1990s.

[7] These computations also rely on a set of assumptions concerning, more specifically, the financing of investment (retained earnings, debt or equity).

[8] The robustness of estimates to the definition of the market potential has been checked, through the use of both lagged market potential (reverse causality of FDI on market potentials is a possible bias of the estimates) and enlarged market potential: if firms focus regional (as opposed to national) demand, it is possible that they select host countries according to their situation of potential beachhead for exporting to neighbouring countries. The "enlarged market potential" catches regional density by adding the (inverse of) distance-weighted market potential of possible alternative locations to the market potential of a given country.

[9] The conclusions of the robustness check are the same for the three other measures of tax differentials.

1

[10] To circumvent this potential collinearity problem, estimates were also run using lagged relative unit labour costs and real exchange rates. While the results qualitatively remain, the impact of cost differentials is much lowered, which seems to confirm our interpretation. The coefficient on tax differentials is unaffected.

[11] Young (1999) in an exception. He finds a negative impact of higher aggregated costs in the UK on total (domestic and foreign) investment in the country.

[12] Indeed, summing up taxation in the source, the host and in competing countries in only one (*ad hoc*) tax differential (namely, TA_{ht}-0.5(TA_{it}+TA_{zt}) leads to a correctly signed and significant result. This is not reported here, but is available from the authors upon request.

[13] See Gresik (2001) for a theoretical analysis of double-taxation tax arrangements, and Desai and Hines (2001) for an empirical analysis.

[14] Gropp and Kostial (2000) use additive dummies and show that, other things equal, FDI flowing out from exempting countries is larger. However, because they use aggregate FDI, this result cannot be conditioned on the tax differential.

[15] Along these lines, tax competition should not necessarily end up in zero taxation. The underlying force behind the competition for attracting FDI could rather produce a convergence in tax rates, led by cuts in high tax countries. These two features (limited race to the bottom, convergence in tax rates) are consistent with the stylised facts of the last ten years (see, for instance, Devereux et al., 2002, p. 464).

[16] Because they are always positive, squared differentials were not included.