FDI determination and corporate tax competition in a volatile world

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Abstract

This paper investigates the impact of economic and political volatility on corporate tax rates on a large dataset of countries over the 1983-2003 period. Estimation of a dynamic tax rate equation supports the hypothesis that economic volatility negatively affects statutory corporate tax rates, while political volatility has no significant effect. In order to identify the channels through which volatility works, we estimate a structural model allowing for simultaneous determination of corporate tax rates and FDI inflows, and find that economic volatility affects the corporate tax setting process through its impact on FDI inflows.

Keywords: corporate tax rates; profit shifting; tax competition.
JEL classification: C23; F23; H87.

1 Introduction

The liberalization of foreign exchange laws that occurred during the mid and late 1980s virtually implied free mobility of capital and generated a sharp rise in FDIs and multinational activity, thereby creating the conditions for international tax competition for corporate income.[1] Based on data on over one-hundred countries in the 1983-2003 period, figure 1 shows that FDI inflows rose steadily over the 1980s and 1990s, and were accompanied by a fall in the top statutory tax rate on corporate income from around 40% in 1983 to below 28% in 2003. Throughout the same period, the average degree of capital market openness - measured by the Chinn and Ito [13] index - grew consistently.[2]

The rising pressure on national governments from international tax competition has been the focus of a growing empirical research addressing the issue of the desirability and feasibility of corporate income taxation in a context of globalization and (almost) perfect capital mobility. In particular, Rodrik [44] and Devereux et al. [22] show that the relaxation of capital controls stimulates tax competition and thus reduces both statutory and effective tax rates. Slemrod [46] provides evidence of international competitive pressure by showing that the degree of capital market openness is negatively associated with statutory corporate tax rates, although not with average corporate tax rates. Based on panel data on samples of OECD countries, Garretsen and Peeters [25] find that increased international capital mobility - proxied by the volume of FDI flows - generates a downward pressure on effective average tax rates, and Bretschger and Hettich [8], Haufler et al. [28] and Winner [48] find that various measures of capital mobility exert a negative impact on (mobile) capital tax burden and a positive one on (immobile) labour tax burden.

This paper aims at adding to the existing literature both by evaluating the

[1] Lee and Gordon [33], Devereux et al. [21] and Slemrod [46] report that in the 1980s the average top corporate tax rate was about 40%, while it had fallen to slightly more than 30% in the late 1990s. Moreover, Haufler et al. [28] show that while the statutory tax rate on corporate profits exceeded by 50% the average labour tax wedge in 1980, the two were roughly the same twenty years later.

[2] A detailed description of the data upon which figure 1 and the subsequent empirical work are based is contained in the appendix.

effect of the increasing degree of openness on corporate tax rates on a large worldwide dataset, and by investigating for the first time to what extent the volatility of a country's economic and political environment affects corporate taxation policy.[3] We proxy a country's economic volatility by (five-years) standard deviations of a number of economic indicators (real interest rate, GDP growth rate and exchange rate), and its political volatility by indices of government stability and property rights protection.

Figures 2 and 3 show the evolution of an index of economic volatility - the standard deviation of the real interest rate - along with average corporate tax rates and FDI flows over the period 1983-2003. As far as OECD countries are concerned (figure 2), the average corporate tax rate falls pretty consistently over time. However, it seems to slow down its secular pace of decline - or even increase - when economic volatility drops, and to fall more pronouncedly when volatility rises. An analogous pattern emerges, though less distinctly, when average corporate tax rate and volatility are plotted for the far more numerous and heterogeneous group of non-OECD countries (figure 3). Similarly, figures 2 and 3 suggest that volatility influences the growth of FDIs, with periods of moderate volatility being accompanied by a faster growth in multinational firms' foreign activity.

In order to gain insight into the interplay of volatility, foreign direct investments and corporate taxation that seems to emerge from the above descriptive evidence, we rely on the theoretical framework developed by Panteghini and Schjelderup [40], according to which higher volatility should induce governments to reduce their tax rates on corporate profits. The reason is that, due to multinational companies' investment irreversibility, volatility reduces the overall number of foreign firms involved in foreign direct investment. Consequently, the optimal policy response to the reduction in a country's tax base consists in lowering the corporate tax rate in order to counteract the negative impact of

[3] The interaction between a country's economic and political volatility and the determination of corporate tax policy has been almost entirely neglected. One exception is Rodrik [44], who shows that higher exposure to external risk tends to be associated with higher government spending.

increased volatility.

The model predictions are first tested on a reduced-form dynamic equation of corporate tax rate determination. Generalized method of moments (GMM) estimation results confirm the hypothesis that higher economic volatility is associated with lower corporate tax rates, while political volatility and capital market openness do not appear to have any significant impact on the corporate tax setting process. In order to identify the distinct roles played by volatility, openness and competition for a mobile tax base, we first estimate a corporate tax reaction function that explicitly allows a country's tax rate to be influenced by the fiscal policies of competing countries, and then turn to a structural model where corporate tax rates and FDI inflows are determined simultaneously. While estimation of the tax reaction function fails to provide conclusive evidence of tax competition due to the well-known difficulty of separately identifying a common trend in corporate taxation from actual strategic interaction, the structural model results highlight the link between corporate taxation policy and tax base mobility: it turns out that economic volatility exerts a downward pressure on corporate tax rates through its discouraging effect on FDI inflows. Moreover, capital market openness is estimated to have a negative independent effect on corporate tax rates and a positive one on FDIs, with the two effects tending to cancel out in a reduced form tax equation.

The rest of the paper is organized as follows. Section **2** highlights the key features of the theoretical framework on which the empirical analysis is based. Section **3** tackles the estimation of a reduced-form dynamic equation of corporate tax rate determination, while section **4** turns to the empirical modelling of the tax reaction function and of the simultaneous determination of the corporate tax rate and the flow of FDIs into a country. Finally, section **5** summarises our findings.

2 Theoretical framework

A common feature of the standard theoretical tax competition literature is that capital investment is fully reversible or, alternatively, that capital investment is irreversible, although it is characterized by exogenous investment timing. Moreover, most of the theoretical contributions on tax competition disregard risk.[4]

As shown in Dixit and Pindyck [23], volatility has a negative impact on investment timing. This discouraging impact does not necessarily depend on risk aversion, but rather is due to the so-called Bad News Principle (BNP),[5] according to which investment depends on the seriousness of bad news and its probability, but is independent of good news. Indeed, an increase in volatility means that good news gets better and bad news gets worse: since good news does not matter, increased volatility raises the threshold profit rate above which FDI is undertaken. Therefore, an increase in volatility delays FDI timing. This finding is in line with empirical evidence, which shows a negative relationship between uncertainty and FDI. In particular, Chen and So [11] showed that the 1997 Asian financial crisis (which caused an increase in exchange rate variability) discouraged FDI by US MNCs. Further evidence is provided by Aizenman and Marion [2], who focused on the foreign operations of US MCNs since 1989. They showed that uncertainty affects both vertical and horizontal FDI. In particular, they showed that greater supply uncertainty reduces the expected income from vertical FDI but increases the expected income from horizontal FDI. Greater demand uncertainty adversely affects the expected income under both production modes. Moreover, volatility and sovereign risk have a greater adverse impact on vertical FDI than on horizontal FDI.[6]

Applying the BNP, Panteghini and Schjelderup [40] develop a two-period model that allows for investment irreversibility and for MNCs' ability to shift profit from one country to another. Using this framework they analyze tax

[4] Exceptions are Gordon and Varian [27], Koethenbuerger and Lockwood [31] and Lee [32].
[5] See Bernanke [5].
[6] Further evidence is discussed in Markusen [35].

competition between two identical small open countries, denoted by A and B. In constructing the social welfare function for each country, they focus on the intertemporal sum between profits (or equivalently, the producer surplus) generated by FDI and tax revenue from foreign firms' FDI in the home country. The maximization of social welfare is part of a sequential game, where at stage 1 each government sets its tax rate; at stage 2, the firms in country A and B decide whether to invest abroad at time 0 or wait until time 1.[7]

Panteghini and Schjelderup [40] prove the existence of a symmetric Nash equilibrium tax rate, which equates at the margin the social cost of taxation to its social benefit. They then focus on the effects of market openness in this tax competitive setting. It is worth noting that market openness is negatively affected by the minimum size of the sunk costs needed to undertake FDI and is positively affected by the average profitability of investing firms. A fall in sunk costs may be related to globalization, as long as tighter economic integration causes a reduction in technical barriers such as national standards and other factors that lower investment costs. A rise in average profitability may also be linked to globalization and more specifically to the decrease in transportation costs as well as the formidable rise in skill-biased technology and information systems such as the Internet. It is thus reasonable to expect that such factors have a positive effect on profit income. Along this line of reasoning Panteghini and Schjelderup [40] prove that:

Proposition 1 *A decrease in size of the sunk cost needed to undertake FDI and/or an increase in profitability raises the equilibrium tax rate.*

The reasoning behind proposition 1 is straightforward: a decrease in size of the sunk cost and/or an increase in profitability encourages FDI activities. This allows the two competing countries to set a higher tax without deterring FDI. Moreover, an improvement in business profitability raises the number of MNCs and thus widens the overall tax base. Hence, higher tax rates combined

[7] In a previous version of this article (Ghinamo et al. [26]), we extend the Panteghini-Schjelderup model by assuming a continuous-time framework. We show that the quality of the results does not change.

with wider tax bases in both countries yield larger tax revenue.[8] The ability to shift profits by means of the e-banking services (and more generally the Internet) reduces transaction and financial costs and therefore raises after-tax profitability. This phenomenon has the same effect as the reduction of market barrier. As shown by Panteghini and Schjelderup [40], whenever the reduction in transaction and (tax and financial) consultancy costs overcomes the negative effect of more stringent anti-avoidance rules, it is natural to expect an increase in tax competition. This leads to a tax rate cut.[9]

Empirical evidence shows that FDI and multinational firms are a significant part of economic output and investment in many countries. For this reason, the transmission of country-specific shocks by means of MNCs' activities is a phenomenon that deserves particular attention. Panteghini and Schjelderup [40] show that:

Proposition 2 *Increased volatility lowers the equilibrium tax rates.*

The reasoning behind proposition 2 is as follows. According to the BNP, an increase in volatility discourages FDI. This induces firms with an intermediate profitability to delay their investment decision. Thus the number of firms that immediately undertake FDI is less. Subsequently, however, only a fraction of the firms who delayed will receive good news and then invest. The remaining part of firms will decide not to invest. This means that an increase in volatility reduces the overall number of firms involved in FDI. The governments' policy response is therefore to lower the tax rate in order to partially offset the negative impact of increased volatility.

These findings may help to explain the dynamics of capital income taxation. The fall in tax rates fits with the interpretation that the globalization process has led to increased volatility (proposition 2). However, the hypothesis that

[8] These results are in line with Devereux et al. [22], who find a positive relationship between the extent of tax competition and the openness of countries.

[9] This result has an interesting policy implication as it helps to explain the widespread introduction of anti-avoidance rules: as long as governments can offset avoidance by raising its cost, they can set a higher tax rate. A similar point is made by Panteghini [39], who analyzes the relationship between MNCs' financial policies and governments' tax strategies.

profits have become more volatile leads to a fall in tax revenue and thus fails to explain the empirical findings of stable tax revenue over time (as does the entire tax competition literature). Such stability may be due to the second possible explanation offered in proposition 1. Since foreign markets open up, more firms undertake FDI. This may offset the increase in volatility and make the net effect on tax revenue close to zero.

In order to provide a comprehensive analysis of the effects of volatility on the corporate tax setting process, the empirical analysis will also account for political risk. To our knowledge, there are a few articles that deal with both political reputation and tax competition, and the relevant literature leads to controversial results. As shown by Panteghini [39], a government's reputation may be a crucial determinant of fiscal policies. In particular, an increase in the risk of expropriation by the government leads to a decrease in the equilibrium tax rate. The reasoning behind this result is as follows: an increase in the risk of expropriation stimulates borrowing and allows MNCs to shift a greater amount of income.[10] In order to offset the increase in income shifting opportunities,[11] governments therefore tend to set lower tax rates. This means that an increase in credibility, i.e., a lower probability of expropriation, allows governments to set higher tax rates.[12] A different result is found by Chisik and Davies [15], who apply a two-country model with irreversible FDI. They show that, without a bilateral tax treaty, governments cannot credibly commit to tax rates. When, subsequently, a treaty is signed, the two governments can coordinate and commit to a tax rate cut.[13] In this case, therefore, an increase in credibility is expected to cause a tax-rate cut.

When turning to the empirical implementation of the theoretical model outlined above, a number of further issues need to be tackled. In particular, and

[10] On MNCs' financial strategies, see, e.g. Desai [18], [19], and Panteghini [38], [39].

[11] For a discussion on anti-avoidance rules, see e.g. Garbarino and Panteghini [24].

[12] This point has some similarities with Cherian and Perotti [12], who show that a gradual increase in reputation allows governments to attract a greater amount of FDIs.

[13] As Chisik and Davies [15] show, governments have an incentive to commit to gradual tax rate cuts. Due to FDI irreversibility, indeed, an initial large cut would encourage players to deviate from the cooperative equilibrium.

similarly to most of the existing models, the framework discussed in this section is based on a two-country symmetric model. However, when we bring the model to the data we must account for the fact that a large number of heterogeneous countries are simultaneously competing for foreign investments. Although formal modelling of this issue is beyond the scope of the theoretical framework applied here, it is of course a crucial aspect of the empirical investigation. In particular, we can say that, as far as the extension to $n > 2$ countries is concerned, MNCs are expected to shift profit in more than two countries. By taking advantage of multilateral tax-motivated activities, coeteris paribus, they have more opportunities to reduce their tax burden. Like an increase in market openness, therefore, an increase in the number of competing countries leads to higher competition. Still, using our model we can derive some implications of country asymmetry. In particular, if the degree of market openness differs across countries, we expect that, coeteris paribus, the lower an economy's openness, the lower is the incentive for inbound FDI. This means that the government must set a lower statutory tax rate to attract multinational activities. A similar reasoning holds for volatility. As pointed out, an increase in volatility is expected to discourage FDI. In this case, therefore, the government will have to cut the tax rate in order to offset the effects of higher uncertainty. To provide a better understanding of the effects of uncertainty we will use different measures of volatility.

Finally, in the empirical part we will account for country-specific effects, such as size. While in the theoretical part a firm's strategy is assumed not to depend on country size, the new economic geography literature shows that larger countries may lead to agglomeration rents, meaning that, coeteris paribus, the larger a country is the higher the tax rate that can be set.[14]

[14] For a discussion on this literature and its tax policy implications see, e.g., Baldwin and Krugman [4] and Garretsen and Peeters [25].

3 Empirical implementation

3.1 A reduced form corporate tax rate equation

In order to explore the impact of capital market openness and various measures of volatility on the corporate tax rate setting process, we estimate a dynamic reduced form equation such as (1) below:

$$\tau_{it} = \rho\tau_{it-1} + x'_{it}\beta + f_i + \varepsilon_{it} \tag{1}$$

where the top statutory corporate income tax rate of country i in period t (τ_{it}) is the dependent variable. Equation (1) includes among the regressors a number of structural determinants of corporate tax setting policy, various measures of economic and political volatility, and a one-period lag of the corporate tax rate (τ_{it-1}) in order to account for the high degree of persistence in the corporate tax rate that is typically observed in the data. The model also includes country fixed effects to control for country characteristics that are constant over time (such as geographic location) and a linear time trend.

Following the recent empirical literature in this area (Slemrod [46], Winner [48], Haufler et al. [28], Garretsen and Peeters [25]), the set of "internal" control variables x_{it} includes country size, an index of capital mobility, government spending, the rate of urbanization, productivity, the rate of employment, the demographic structure of the population and the personal income tax rate.

First, we measure country size by its GDP, and, as argued above, expect a positive effect of GDP on the corporate tax rate.[15] Since GDP might also be a proxy for the size of the corporate income tax base, we allow for potential endogeneity of the GDP variable with respect to corporate taxation policy when estimating equation (1).

Secondly, an often invoked reason for the apparent decline of tax rates on profits is that firms can choose the location of their plants in order to reduce their tax liabilities. Governments that impose restrictions on capital flows should face an inelastic tax base and should consequently be able to set higher tax rates

[15] See Bucovetsky [10], Wilson [47] and Haufler and Wooton [29].

than open countries. Various measures of the degree of capital openness of a country have been used in the previous literature.[16] We adopt here a similar strategy as Garretsen and Peeters [25], and employ the Chinn and Ito [13] index of capital market openness that is based on the legal restrictions imposed on the international mobility of capital and firms.[17]

Finally, equation (1) includes the (top) personal income tax rate. According to the so-called "backstop hypothesis" (Slemrod [46]), one of the key reasons for taxing corporate income is to prevent citizens from avoiding personal taxation by incorporating their income. As a result, the statutory corporate tax rate should be higher in countries where the top personal income tax rate is high.

3.2 Measures of volatility

In addition, equation (1) includes a number of economic and political volatility indicators among the regressors.

3.2.1 Economic volatility

In order to have a measure of the volatility of a country's economic environment, we follow a similar strategy as Ramey and Ramey [42] and Aghion et al. [1]. In particular, in order to fully exploit the information contained in our data set, we measure a country's economic volatility at any given point in time as the standard deviation of the relevant economic variable through the five previous years. We compute a country's degree of volatility relative to three variables: the GDP growth rate, the real interest rate and the nominal exchange rate.[18]

Firstly, GDP is a measure of the aggregate income of a country and of the

[16] See Slemrod [46] and Winner [48].

[17] In particular, Garretsen and Peeters [25] use the so-called Golub index as a measure for the (legal) restrictions placed on international capital mobility. Similarly, the Chinn and Ito [13] capital openness indicator that we use here is based on data taken from the IMF Annual Report on Exchange Arrangements and Exchange Restrictions. While similar to the widely employed Quinn [41] index of capital mobility, we use the Chinn and Ito index because it is more up-to-date (it covers the period 1970-2004, while the Quinn index is available only up to 1999 for some countries and 1997 for others) and for a larger subset of countries (181 against the 90 of the Quinn Index). See also Chinn and Ito [14].

[18] For example, in order to calculate the volatility of the interest rate of a given country in year 2000, we calculate the standard deviation of a country's interest rates from 1996 to 2000. As a result, this measure amounts to a "moving average" index of volatility.

size of the market. The literature on FDI (see, e.g., Markusen [35]) reports evidence that the horizontal-type multinational - i.e., multinationals that sell their products to the host country's customers - is the most widespread form of multinational enterprise among OECD countries. It is therefore reasonable to expect that, *coeteris paribus*, MNCs prefer to settle in stable and expanding markets, especially when the investment choice is to some extent irreversible.[19]

Secondly, interest rate volatility might be important in the light of the role of the tax system in shaping the financial structure of firms. This is due to the fact that interest expenses are usually deductible from corporate taxable income, and offer MNCs a tax shield by making use of both the internal (through the so called "debt shifting" between affiliates) and external credit market.[20] As a result, real interest rate variability could have a number of effects on MNCs' strategies. First, it could require multinational firms that invest in uncertain countries to continuously adjust the optimal debt/asset ratio in response to the changing credit market conditions. Second, MNCs that invest in uncertain environments could be forced to change their internal/external debt strategy in response to external credit market conditions of the foreign affiliates. Third, MNCs that use the internal credit market channel can shift profits and tax burden from one country to another by using the debt shifting option. However, an arm's length interest rate is typically used by fiscal authorities in order to calculate the fiscal burden on firms. Uncertainty in interest rates applicable to "between affiliates" debt shifting transactions could then affect the feasibility and profitability of such profit shifting strategies.

Finally, in line with Chen and So [11], we use the exchange rate volatility as a measure of the variability of the relative price of domestic and foreign goods. As shown in a survey provided by Russ [45], empirical evidence on the exchange rate-FDI relationship is mixed and depends on the sample period, the country

[19] This finding is in line with Panteghini and Schjelderup [40].

[20] In particular, external credit market conditions proved to be important determinants of the financial structure of multinationals'affiliates in developed credit markets countries (see Desai et al. [20]) and of partly foreign-owned firms (see Mintz and Weichenrieder [36]). Moreover, as shown in Desai et al. [20], multinational affiliates substitute external and internal debt according to the evolution of credit market conditions.

set and the econometric techniques applied.[21]

3.2.2 Political volatility

Vector v_{it} in equation (1) also includes two measures of "political volatility." First, we proxy government instability by a variable reporting the number of changes of a country's government over the previous five years (see the Appendix for details). Since changes in government composition are often associated with relevant policy changes, this variable should capture the degree of predictability of the policy of a country's government. Second, we control for private property protection using an indicator (ranging from 0 to 10) that measures the degree of private property protection and consequently the probability of expropriation.[22] Descriptive statistics and data sources of all variables used in the analysis are reported in the Appendix.

3.3 Results

Equation (1) is estimated on the unbalanced panel data set described in the Appendix using the system GMM estimator developed by Blundell and Bond [7]. The advantage of using a GMM approach is that we can also control for potential endogeneity of other right-hand-side variables (in particular, government spending, GDP and personal income tax rate) using the exogenous right hand side variables and their lags as instruments.

The two-step GMM estimation results of equation (1) are shown in tables 1 and 2, along with robust and finite sample corrected standard errors. The Arellano and Bond [3] tests for the presence of auto-correlation in the residuals as well as the Hansen test results reported at the bottom of tables 1 and 2 cannot reject the validity of the instruments.

[21] Lubik and Russ [34] provide a rational for this ambiguous relationship. They prove that entry by less productive firms may cause a higher volatility in nominal and, in some cases, real exchange rates.

[22] Using an index of "social conflict" measuring the degree of social tension in a country (including various symptoms of social unrest, such as strikes, anti-government demonstrations, political assassinations and riots) and the probability of an abrupt change in government's policy and composition gave very similar results.

Table 1, column (a), reports the estimation results of a standard specification including no measure of volatility; columns (b), (c) and (d) show the estimates when the five-year standard deviation of the real interest rate, of the nominal exchange rate and of the GDP growth rate are included in the equation as measures of economic volatility. Table 2 reports similar results when the political volatility variables are included as well: the index of property rights protection and the number of changes in government over the previous five years.

As far as the control variables are concerned, larger countries in terms of GDP size - as well as those with higher percentages of young and old population - tend to set higher corporate tax rates, while the other control variables are estimated imprecisely. Similarly to the results obtained by Slemrod [46], neither the level of the personal income tax rate nor the index of capital market openness have a statistically significant effect once country fixed effects are included.

As far as our volatility indicators are concerned, the standard deviation of the real interest rate has a significant negative effect on the corporate tax rate, though its magnitude is pretty small: at mean values, a 10% increase in the volatility of the interest rate lowers the corporate tax rate by less than 0.1 percentage points, with an elasticity of around -0.01.[23] On the other hand, while nominal exchange rate volatility also has a negative and significant impact on tax rates, GDP growth rate volatility, political volatility variables and capital market openness are not estimated to have any significant effect on the corporate tax rate.

Given that the set of countries considered here is highly heterogeneous and that they might respond in a different way to the volatility of their economic and political environment, table 3 reports the estimation results of the tax equation while allowing for a different effect of the volatility variables between OECD and non-OECD countries. The volatility variables are interacted with a dummy variable that equals 1 for OECD countries. In general, the results are not dramatically affected when allowing for heterogeneous responses to volatility,

[23] Similar results, though slightly less precise, are obtained when employing the nominal interest rate volatility.

with the interaction terms typically turning out to have an insignificant effect. However, it seems that OECD countries' corporate tax rates are less intensely influenced by interest rate volatility than the other countries, suggesting that, due to reputation effects or to the presence of an agglomeration rent (Baldwin and Krugman [4]), the attractiveness of core, central economies to foreign investors depends to a lesser extent on the volatility of its economic environment than that of peripheral, developing countries.

4 Testing the corporate tax competition hypothesis

4.1 A direct test

In the light of the results in tables (1) to (3), it is tempting to move one step forward and try and ascertain directly the extent of corporate tax competition by estimating a corporate tax reaction function relating a country's corporate tax policy to the policies of the other countries. A popular way of specifying the reaction function is as in equation (2):[24]

$$\tau_{it} = \phi \sum_{j=1}^{n} w_{ijt}\tau_{jt} + \rho\tau_{it-1} + x'_{it}\beta + f_i + \varepsilon_{it} \tag{2}$$

In the first-order auto-regressive specification (2), the tax rate of each country is allowed to be affected by a linear function of the tax rates set by the other countries, where ϕ (with $-1 < |\phi| < 1$ to ensure stationarity) represents the auto-correlation coefficient to be estimated, and w_{ijt} (with $w_{ijt} = 0$ for $i = j$) are scalar weights representing the assumed degree of interdependence between countries i and j in year t.

Table 4 reports, mainly for illustrative purposes, the results of GMM estimation of (2) based on a variety of weighting criteria.[25] In particular, the table shows the range of estimates of the auto-regressive coefficient ϕ depending on the specification, along with their respective p-values. In all cases, the

[24] Recent works in this direction are Devereux et al. [22], Davies and Vogt [16], Garretsen and Peeters [25], Haufler et al.[28], Overesch and Rincke [37] and Redoano [43].

[25] In order to have a consistent set of observations across time, the dataset we employ here is a balanced panel of 34 countries (reported in the appendix) for 15 years (1988-2002).

exogenous determinants of corporate tax rates (vector x'_{jt}) weighted by matrix $W_t = \{w_{ijt}\}$ and their lags are used as instruments for the endogenous average tax $\sum_{j=1}^{n} w_{ijt}\tau_{jt}$ (Kelejian and Prucha [30]).

The results reported in the left column of table 4 are based on weight matrices that are row-normalised - meaning that the weights sum to 1 for each country, so that $\sum_{j=1}^{n} w_{ijt}\tau_{jt}$ can be interpreted as a weighted average - while those on the right are not. The first seven rows are based on weight matrices that ignore the geographical pattern altogether. The first line uses uniform normalised weights, so that each country is weighted $\frac{1}{n-1}$. The next lines use weights that are based either on population (lines 2, 3 and 4) or on GDP size (lines 5, 6 and 7), with the weight that country i attributes to country j depending on the population size (or GDP) of country j. In lines 2, 3, 5 and 6, the matrix of weights is row-normalised, implying by construction that the weight country i assigns to country j is inversely related to the size (population or GDP) of country i.[26] On the other hand, the weights w_{ijt} in lines 4 and 7 equal the time-averaged population $\overline{pop}_j$ ($\overline{GDP}_j$) of country j relative to the time-averaged population (GDP) in country i.

The bottom seven rows rely instead either on criteria based on inverse distance between capital cities (line 8) or on an inverse distance metric weighted by the relative sizes of countries in terms of population (lines 9, 10 and 11) and GDP (lines 12, 13 and 14). Again, the left column weights are row-normalized, implying that the total effect of the other countries' tax policies is assumed to be the same for all countries in the sample, and that it is "relative" distance to the other countries that matters,[27] while those in the right column are not.

Overall, little or no evidence of auto-correlation among countries' corporate tax rates emerges from the estimation of the dynamic reaction function (2) that includes a temporal lag of the dependent variable as well as fixed country

[26] For instance, a row-standardised GDP-based weighting scheme implies that the US attribute more weight to, say, Netherland's tax policy than Germany does.

[27] For instance, a row-standardised inverse distance weights matrix implies in our sample that, in spite of being twice as far, India weighs Sweden more than Portugal does.

effects and a common time trend.[28] In particular, no truly spatial pattern emerges. This could be due either to a genuinely global competition process where distance plays a minor role, or to the incompleteness and mismeasurement of the spatial structure. Similarly, while the homogeneous weighting scheme (line 1) and the population-weighted ones in lines 2 and 3 vaguely point to some positive auto-correlation in tax rates, ϕ is never estimated to be different from zero at conventional levels of significance.

4.2 An indirect test

In order to identify the distinct roles played by countries' internal determinants of corporate taxation policy and by the international tax competition pressure, we therefore turn to the estimation of a structural model that allows for simultaneous determination of the corporate tax rate and the FDI flow into a country. In fact, the corporate tax equation (1) can be thought of as a reduced form of a two-equation structural model (Brett and Pinkse [9]). The structural form specification comprises an equation modelling the FDI flow into a country (b_{it}) as a function of a set of variables reflecting its attractiveness for foreign investors, including its corporate tax rate (Bloningen et al. [6], de Mooij and Ederveen [17]). Secondly, the model includes the tax rate setting equation, where the corporate tax rate (τ_{it}) is regressed on a set of variables that includes the endogenously determined size of FDI:

$$\tau_{it} = \rho_1 \tau_{it-1} + \lambda b_{it} + z'_{it}\gamma + f_i + \nu_{it} \tag{3}$$

$$b_{it} = \kappa \tau_{it} + q'_{it}\theta + g_i + \eta_{it}. \tag{4}$$

In order to identify the processes of tax base and tax rate determination, we need variables that affect the corporate tax rate and can be excluded from the FDI equation, as well as variables that can be thought to affect the corporate tax rate through FDIs only. As for the former, the demographic structure of a country (percentage of old and young people, and rate of participation to

[28] Similar results are obtained by Davies and Voget [16] and Overesch and Rincke [37].

the workforce) and the personal income tax rate can reasonably be expected to affect the corporate tax policy, while having a negligible impact on the inflow of FDIs. Second, we hypothesize productivity, rate of urbanization and our measures of volatility to affect FDIs and not to have a direct impact on the corporate tax rate, while the other control variables are allowed to enter both equations.[29]

The empirical model represented by equations (3) and (4) is estimated by three stage least squares (3SLS). The results obtained when using the standard deviation of the real interest rate as a measure of economic volatility are reported in table 4.[30] In order to allow for the fact that FDI inflow might itself affect the volatility of the real interest rate, we treat the latter variable as endogenous and use its own lags as instruments. On the other hand, the two political volatility variables are taken as exogenous.

The results show that the statutory corporate tax rate has a negative, though not statistically significant, effect on the size of FDIs flowing into a host country. The economic volatility variable is estimated to have a negative, highly significant and large impact on FDI: at mean values, the implied elasticity of FDI with respect to the interest rate volatility equals around -1, suggesting that the volatility of a country's economic environment is a key determinant of foreign investors' decisions. Coherently with the reduced form estimates, the political volatility indicators are not estimated to have a significant role in the FDI determination process. As far as the other variables are concerned, productivity and urbanization do not appear to influence the FDI inflow.

Estimation of the tax rate determination equation that explicitly includes FDI on the right hand side shows that the latter variable has the expected positive impact on the corporate tax rate. Unlike the reduced form results, though, the personal income tax rate is estimated to be positively correlated

[29] When included directly in the tax rate equation, the indices of economic and political volatility turn out to be jointly insignificant, and are therefore dropped.

[30] Since analogous results emerge when using the nominal exchange rate volatility, they are not reported and are available on request. Similarly to the reduced form estimates, the volatility of the GDP growth rate is not estimated to have any significant impact on FDIs.

with the corporate tax rate, thus lending support to the backstop hypothesis, and the Chinn-Ito measure of capital market openness now has the expected negative impact on the corporate tax rate, consistent with the view that opening up an economy reinforces the competitive downward pressure on tax rates. It is remarkable, though, that the openness variable is estimated to have a positive effect on the inflow of FDI: this suggests that the insignificance of the capital openness variable when estimating the reduced form tax setting equation might be due to the fact that the two opposite effects of the capital openness measure on FDI and tax rates respectively tend to cancel each other out.

Overall, the estimation of the structural model provides intriguing and consistent evidence in support of the hypothesis of international tax competition for a mobile tax base, and highlights the crucial roles played by volatility as well as by capital market openness in the process of determination of FDI flows and corporate taxes. In particular, our results point to the central role of economic volatility in inhibiting FDI inflows and, by reducing the available tax base, exerting a negative effect on the level of the corporate tax rate.

5 Concluding remarks

Based on a theoretical framework that allows for irreversibility in the investment decision of MNCs and for the possibility of profit shifting via transfer pricing, this paper has investigated the impact of capital market openness and of various measures of political and economic volatility on corporate taxation policy. In particular, this paper models for the first time the impact of the above variables both on the FDI flows into a country and on its corporate tax rate setting process.

The empirical analysis on a large panel data set of countries over the 1983-2003 period gives a number of novel results. First, when a conventional reduced-form dynamic equation of corporate tax rate determination is estimated by the generalized method of moments (GMM), the top statutory corporate tax rate turns out to be negatively and significantly affected by economic volatility.

Similarly to the evidence emerging from previous studies, the index of capital market openness, while having the expected sign, does not have any significant impact on corporate taxation policy once country fixed effects are allowed for.

Second, estimation of a corporate tax reaction function that explicitly allows a country's tax rate to be influenced by the fiscal policies of competing countries fails to provide conclusive evidence of tax competition due to the well-known difficulty of separately identifying a common trend in corporate taxation from actual strategic interaction.

On the other hand, estimation of a structural model that allows for simultaneous determination of the corporate tax rate and the flow of FDIs into a country is supportive of the hypothesis of tax competition. It turns out that a country's degree of capital market openness is an important determinant of FDI inflows. In particular, the index of capital market openness is estimated to have a negative independent effect on the level of the statutory corporate tax rate and a positive one on the size of FDI inflows, with the two effects tending to cancel each other out in a reduced-form tax setting equation. Furthermore, economic volatility is estimated to have a crucial impact on corporate taxation policy: a country's economic volatility tends to inhibit FDI inflows and, by reducing the available tax base, it exerts a negative effect on the level of the corporate tax rate.

Finally, the backward-looking indices of political volatility that we have employed (based on government instability and protection of property rights) are not estimated to have any significant impact either on corporate taxation policy in the reduced-form equation or on FDI inflows in the two-equation model, calling for further research into alternative, forward-looking and more imaginative signals of the volatility of a country's institutional and political environment.

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Table 1 Tax rate determination: economic volatility

	(a)	(b)	(c)	(d)
τ_{it-1}	0.929***	0.925***	0.894***	0.929***
	(0.0280)	(0.0262)	(0.0349)	(0.0244)
personal income tax	-0.00299	-0.00837	0.000492	-0.00542
	(0.0125)	(0.0109)	(0.0110)	(0.00881)
public spending	0.0242	0.0187	0.0128	0.0175
	(0.0269)	(0.0291)	(0.0221)	(0.0263)
size	0.165*	0.169**	0.235**	0.181**
	(0.0872)	(0.0770)	(0.108)	(0.0837)
old	0.0918*	0.0936*	0.178***	0.105**
	(0.0537)	(0.0509)	(0.0664)	(0.0446)
young	0.0506*	0.0593**	0.0981***	0.0490**
	(0.0274)	(0.0274)	(0.0363)	(0.0235)
urbanization	-0.00636	0.00387	-0.00466	-0.00686
	(0.00605)	(0.00774)	(0.00814)	(0.00598)
employment	-1.883	-1.677	-2.124	-1.858
	(2.290)	(2.499)	(2.062)	(2.099)
productivity	-0.00511	-0.0131	0.00120	-0.00576
	(0.0112)	(0.0123)	(0.0117)	(0.0106)
openness	-0.00523	0.0114	-0.0628	-0.00502
	(0.0789)	(0.0995)	(0.0823)	(0.0718)
year	-0.0264**	-0.0350**	-0.0384**	-0.0299*
	(0.0133)	(0.0137)	(0.0157)	(0.0176)
interest rate s.d.		-0.0690***		
		(0.0247)		
exchange rate s.d.			-0.0778***	
			(0.0298)	
GDP growth rate s.d.				0.0258
				(0.0225)
Observations (countries)	1565 (109)	1330 (98)	1428 (99)	1524 (106)
Hansen test (p value)	73.31 (0.37)	52.07 (0.22)	52.11 (0.35)	77.69 (0.25)
AR(1) test: zstat.	-4.801***	-4.291***	-4.733***	-4.851***
AR(2) test: zstat.	0.0757	0.100	-0.0357	-0.0131

Notes: 1) dependent variable: top statutory corporate income tax rate; 2) standard errors in parentheses; 3) *, **, ***: significant at 10%, 5%, 1%; 4) the Arellano-Bond test for an AR(1)/AR(2) error process as $z(0,1)$; 5) the Hansen test of overidentifying restrictions is distributed as $\varkappa^2$.

Table 2 Tax rate determination: economic and political volatility

	(a)	(b)	(c)	(d)
τ_{it-1}	0.918***	0.920***	0.885***	0.925***
	(0.0385)	(0.0246)	(0.0369)	(0.0273)
personal income tax	0.00270	-0.00797	0.000970	-0.00452
	(0.0144)	(0.0105)	(0.0109)	(0.0101)
public spending	0.0198	0.0279	0.0127	0.0160
	(0.0316)	(0.0401)	(0.0313)	(0.0308)
size	0.197**	0.186**	0.277**	0.191**
	(0.0992)	(0.0795)	(0.118)	(0.0871)
old	0.117**	0.0900*	0.202***	0.103**
	(0.0573)	(0.0512)	(0.0674)	(0.0494)
young	0.0570*	0.0514*	0.110***	0.0489**
	(0.0306)	(0.0280)	(0.0371)	(0.0235)
urbanization	-0.00407	0.00590	-0.00259	-0.00612
	(0.00793)	(0.00846)	(0.00847)	(0.00599)
employment	-2.381	-1.622	-1.870	-1.177
	(2.470)	(2.557)	(2.322)	(2.715)
productivity	0.00101	-0.00854	0.00493	-0.00155
	(0.0162)	(0.0172)	(0.0163)	(0.0129)
openness	0.00801	0.0299	-0.0504	0.0158
	(0.0827)	(0.0927)	(0.0842)	(0.0742)
year	-0.0263*	-0.0408***	-0.0485**	-0.0349*
	(0.0158)	(0.0145)	(0.0189)	(0.0196)
interest rate s.d.		-0.0766***		
		(0.0289)		
exchange rate s.d.			-0.0906***	
			(0.0311)	
GDP growth rate s.d.				0.0267
				(0.0267)
property rights	-0.105	-0.109	-0.0681	-0.0779
	(0.120)	(0.152)	(0.115)	(0.109)
political volatility	0.0195	0.141	0.0663	0.0356
	(0.118)	(0.114)	(0.105)	(0.120)
Observations (countries)	1459 (98)	1290 (93)	1367 (92)	1492 (100)
Hansen test (p value)	49.56 (0.33)	42.21 (0.59)	50.19 (0.43)	76.56 (0.28)
AR(1) test: zstat.	-4.705	-4.278	-4.631	-4.750
AR(2) test: zstat.	-0.0456	0.0753	-0.0825	-0.0109

Table 3 Tax rate determination: OECD vs. non-OECD countries

	(a)	(b)	(c)	(d)
τ_{it-1}	0.914***	0.914***	0.878***	0.922***
	(0.0379)	(0.0232)	(0.0351)	(0.0299)
public spending	0.0194	0.0293	0.0139	0.0180
	(0.0303)	(0.0416)	(0.0308)	(0.0267)
size	0.220**	0.226***	0.302**	0.193**
	(0.102)	(0.0854)	(0.121)	(0.0901)
old	0.138**	0.122**	0.215***	0.111**
	(0.0613)	(0.0530)	(0.0712)	(0.0470)
young	0.0636**	0.0603**	0.115***	0.0482**
	(0.0299)	(0.0280)	(0.0364)	(0.0236)
urbanization	-0.00518	0.00303	-0.00432	-0.00691
	(0.00795)	(0.00800)	(0.00839)	(0.00764)
employment	-2.662	-2.039	-2.457	-1.641
	(2.418)	(2.499)	(2.204)	(2.761)
productivity	0.00128	-0.00693	0.00194	-0.00326
	(0.0156)	(0.0155)	(0.0164)	(0.0142)
political volatility	-0.0795	0.0691	0.000247	-0.0886
	(0.138)	(0.131)	(0.121)	(0.160)
(political volatility)*(OECD dummy)	0.336*	0.257	0.261	0.324
	(0.199)	(0.206)	(0.219)	(0.230)
property rights	-0.0833	-0.0886	-0.0670	-0.105
	(0.121)	(0.154)	(0.118)	(0.107)
(property rights)*(OECD dummy)	-0.0580	-0.0789	0.00328	-0.0649
	(0.0505)	(0.0614)	(0.0576)	(0.0713)
interest rate s.d.		-0.0701**		
		(0.0278)		
(interest rate s.d.)*(OECD dummy)		0.0794**		
		(0.0338)		
exchange rate s.d.			-0.0912***	
			(0.0295)	
(exchange rate s.d.)*(OECD dummy)			-1.103	
			(1.243)	
GDP growth rate s.d.				0.0194
				(0.0270)
(GDP growth rate s.d.)*(OECD dummy)				0.200*
				(0.109)

Table 3 Tax rate determination: OECD vs. non-OECD countries (continued)

	(a)	(b)	(c)	(d)
personal income tax	0.0061	-0.0027	0.0044	-0.0040
	(0.0141)	(0.0090)	(0.0110)	(0.0106)
openness	0.0288	0.0650	-0.0515	0.0298
	(0.0803)	(0.0942)	(0.0864)	(0.0899)
year	-0.0273*	-0.0425***	-0.0459**	-0.0297
	(0.0157)	(0.0143)	(0.0179)	(0.0256)
Observations (countries)	1459 (98)	1290 (93)	1367 (92)	1492 (100)
Hansen test (p value)	48.17 (0.39)	41.92 (0.60)	47.38 (0.54)	74.25 (0.34)
AR(1) test: zstat.	-4.720***	-4.285***	-4.638***	-4.763***
AR(2) test: zstat.	-0.0353	0.0839	-0.0757	0.0268

Table 4 Corporate tax reaction function: auto-correlation coefficient

	w_{ijt}	$\widehat{\phi}_{[p-value]}$	w_{ijt}	$\widehat{\phi}_{[p-value]}$
1	$\frac{1}{n-1}$	$\left(0.17_{[0.44]}, 0.22_{[0.33]}\right)$	—	—
2	$\frac{pop_{jt}}{\sum_{k\neq i} pop_{kt}}$	$\left(0.14_{[0.20]}, 0.17_{[0.15]}\right)$	—	—
3	$\frac{\overline{pop}_j}{\sum_{k\neq i} \overline{pop}_k}$	$\left(0.14_{[0.19]}, 0.16_{[0.15]}\right)$	—	—
4	—	—	$\frac{\overline{pop}_j}{\overline{\overline{pop}}_i}$	$\left(\text{-}0.03_{[0.40]}, \text{-}0.02_{[0.58]}\right)$
5	$\frac{GDP_{jt}}{\sum_{k\neq i} GDP_{kt}}$	$\left(\text{-}0.16_{[0.50]}, \text{-}0.13_{[0.60]}\right)$	—	—
6	$\frac{\overline{GDP}_j}{\sum_{k\neq i} \overline{GDP}_k}$	$\left(\text{-}0.11_{[0.63]}, \text{-}0.08_{[0.71]}\right)$	—	—
7	—	—	$\frac{\overline{GDP}_j}{\overline{\overline{GDP}}_i}$	$\left(\text{-}0.05_{[0.40]}, \text{-}0.02_{[0.71]}\right)$
8	$\frac{d_{ij}^{-1}}{\sum_{k\neq i} d_{ik}^{-1}}$	$\left(0.10_{[0.54]}, 0.13_{[0.40]}\right)$	$\frac{1}{d_{ij}}$	$\left(\text{-}0.07_{[0.30]}, \text{-}0.04_{[0.57]}\right)$
9	$\frac{d_{ij}^{-1} pop_{jt}}{\sum_{k\neq i} d_{ik}^{-1} pop_{kt}}$	$\left(0.11_{[0.27]}, 0.12_{[0.24]}\right)$	$\frac{pop_{jt}}{d_{ij}}$	$\left(\text{-}0.08_{[0.42]}, \text{-}0.06_{[0.46]}\right)$
10	$\frac{d_{ij}^{-1} \overline{pop}_j}{\sum_{k\neq i} d_{ik}^{-1} \overline{pop}_k}$	$\left(0.11_{[0.26]}, 0.12_{[0.23]}\right)$	$\frac{\overline{pop}_j}{d_{ij}}$	$\left(\text{-}0.10_{[0.20]}, \text{-}0.09_{[0.23]}\right)$
11	—	—	$\frac{1}{d_{ij}} \frac{\overline{pop}_j}{\overline{\overline{pop}}_i}$	$\left(\text{-}0.04_{[0.40]}, \text{-}0.03_{[0.42]}\right)$
12	$\frac{d_{ij}^{-1} GDP_{jt}}{\sum_{k\neq i} d_{ik}^{-1} GDP_{kt}}$	$\left(\text{-}0.09_{[0.41]}, \text{-}0.08_{[0.46]}\right)$	$\frac{GDP_{jt}}{d_{ij}}$	$\left(0.02_{[0.59]}, 0.03_{[0.44]}\right)$
13	$\frac{d_{ij}^{-1} \overline{GDP}_j}{\sum_{k\neq i} d_{ik}^{-1} \overline{GDP}_k}$	$\left(\text{-}0.07_{[0.51]}, \text{-}0.06_{[0.55]}\right)$	$\frac{\overline{GDP}_j}{d_{ij}}$	$\left(\text{-}0.08_{[0.18]}, \text{-}0.07_{[0.20]}\right)$
14	—	—	$\frac{1}{d_{ij}} \frac{\overline{GDP}_j}{\overline{\overline{GDP}}_i}$	$\left(\text{-}0.03_{[0.54]}, \text{-}0.02_{[0.77]}\right)$

Table 5 Structural-form model: FDI and corporate tax rate

	b_{it}	τ_{it}
τ_{it}	-0.00290	
	(0.0396)	
τ_{it-1}		0.535***
		(0.204)
b_{it}		3.244**
		(1.375)
public spending	-0.121	0.190
	(0.167)	(0.772)
size	0.215	6.927
	(3.997)	(15.91)
openness	0.181**	-0.795*
	(0.0888)	(0.449)
% old		0.681
		(1.564)
% young		-0.0109
		(0.946)
employment		-11.39
		(106.5)
personal income tax		0.472**
		(0.229)
productivity	-0.0582	
	(0.120)	
urbanization	-0.0781	
	(0.110)	
interest rate s.d.	-0.235***	
	(0.0828)	
political volatility	0.0176	
	(0.0843)	
property rights	0.0596	
	(0.0882)	
Observations (countries)	751 (72)	
Sargan test (p-value)	27.13 (0.51)	

Notes

1) dependent variables: τ_{it} = top statutory corporate income tax rate; b_{it} = log(FDI inflow);

2) standard errors in parentheses;

3) the Hansen-Sargan test of overidentifying restrictions is distributed as χ^2;

4) *, **, ***: significant at 10%, 5%, 1%.

Appendix: dataset description

a) Baseline full sample of countries (114 countries); longest time period: 1983-2003 (unbalanced panel)

Argentina, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belgium, Belize, Bolivia, Botswana, Brazil, Bulgaria, Cambodia, Cameroon, Canada, Chile, China, Colombia, Congo (Republic of), Costa Rica, Cote d'Ivoire, Croatia, Cyprus, Czech Republic, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Fiji, Finland, France, Gabon, Germany, Ghana, Greece, Guatemala, Haiti, Honduras, Hong Kong, Hungary, Iceland, India, Indonesia, Iran, Ireland, Israel, Italy, Jamaica, Japan, Kazakhstan, Kenya, Republic of Korea, Kuwait, Latvia, Liberia, Lithuania, Malawi, Malaysia, Malta, Mauritius, Mexico, Morocco, Mozambique, Namibia, Netherlands, Netherlands Antilles, New Zealand, Nicaragua, Nigeria, Norway, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russia, Saudi Arabia, Senegal, Singapore, Slovak Republic, Slovenia, Solomon Islands, South Africa, Spain, Sri Lanka, Suriname, Swaziland, Sweden, Switzerland, Tanzania, Thailand, Trinidad & Tobago, Turkey, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Uzbekistan, Venezuela, Vietnam, Zambia, Zimbabwe.

b) Variable name (mean, standard deviation, minimum value, maximum value), description and source.

- Capital market openness index (0.068; 1.548; -1.753; 2.623): Chinn-Ito capital openness measure. This indicator assumes higher values when countries become more open. Chinn and Ito [13]. Dataset downloadable at: www.ssc.wisc.edu.
- Corporate tax rate (34.32; 10.78; 0; 75): central government top corporate income statutory tax rate. World Tax Database at the Michigan Ross School of Business (www.bus.umich.edu), integrated with data from World Bank (WDI) and from KPMG (Corporate tax rates survey, issues from 1998 to 2003).
- Employment (0.444; 0.066; 0.241; 0.599): ratio of total employment over total population. This variable should measure the importance of the tax base composed of wages and salaries. Own calculations based on PWT data.
- FDI inflow (6.95; 2.28; -0.78; 12.68): log of total FDI inflow in constant 2000 US dollars (million). UNCTAD, FDI indicators, available at

http://stats.unctad.org/fdi/. Converted into constant 2000 US dollar using local currency/US dollar nominal exchange rate taken from PWT, and CPI from IMF, International Financial Statistics.

- Old (6.232; 4.274; 1.00; 19.33): share of population aged 65 or more. WDI.
- Young (34.76; 10.27; 14.11; 50.40): share of population aged 14 or less. WDI.
- Personal income tax (38.28; 18.17; 0; 90): central government top personal income tax rate. World Tax Database at the Michigan Ross School of Business (www.bus.umich.edu) . Integrated with data from the World Bank (WDI) and, for OECD countries, with data from the OECD Tax Database.
- Public spending (23.663; 10.950; 2.12; 98.27): government expenditure as a share of GDP. Penn World Tables (PWT).
- Size (16.807; 2.269; 10.806; 23.112): log of Purchasing Power Parity Gross Domestic Product in thousands of currency units. Penn World Tables (PWT).
- Urbanization (51.20; 23.70; 4.22; 100): share of urban population. WDI.
- Exchange rate volatility (25.37; 73.97; 0; 798.8): standard deviation in the rate of growth of the nominal exchange rate with the USA dollar. In the estimates that use this variable, the USA are dropped from the sample. PWT.
- GDP volatility (5.419; 5.308; 0.258; 60.035): standard deviation of the GDP growth rate in the preceding five years. GDP is in Purchasing Power Parity. Penn World Tables (PWT).
- Interest rate volatility (5.84; 9.81; 0.17; 346.20): standard deviation of the real interest rate (defined as nominal lending rate minus inflation rate computed as the rate of growth of the GDP deflator) in the preceding five years. WDI.
- Political instability (0.469; 0.694; 0; 4): total number of changes, recorded in the preceding five years, in the executive composition. Own calculations based on the Polcon dataset (management.wharton.upenn.edu).
- Property rights protection (5.518; 1.885; 1.022; 9.624): degree of property rights protection. Fraser Institute (www.freetheworld.com). Until 1999, this variable is provided on a five years basis. Consequently, in years with missing data, it equals to the most recent data available.

c) Sample of countries for estimation of the corporate tax reaction function:

Australia, Belgium, Bolivia, Botswana, Canada, Chile, Denmark, Finland, France, Germany, Guatemala, India, Indonesia, Ireland, Italy, Japan, Kenya, Malaysia, Mauritius, Netherlands, New Zealand, Norway, Papua New Guinea, Paraguay, Philippines, Portugal, Singapore, South Africa, Spain, Sweden, Thailand, United Kingdom, United States, Venezuela.

Notes:

1. PWT refers to: Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006.

2. WDI: World Development Indicators (2006), World Bank.

3. The FDI inflow variable comprises capital provided (either directly or through other related enterprises) by a foreign direct investor to a FDI enterprise or capital received by a foreign direct investor from a FDI enterprise. FDI includes: equity capital, reinvested earnings and intra-company loans. Equity capital is the foreign direct investor's purchase of shares of an enterprise in a country other than that of its residence. Reinvested earnings include the direct investor's share of earnings not distributed as dividends by affiliates or earnings not remitted to the direct investor. Such retained profits by affiliates are reinvested. Intra-company loans or intra-company debt transactions refer to borrowing and lending of funds between parent and affiliated enterprises.