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Capital Account Liberalization and Corporate Taxes

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Abstract

This paper studies whether exchange controls, particularly on the capital account, affect the choice of corporate tax rates, using a panel of 21 OECD countries over the period 1983–99. It builds on existing literature by (1) using a unique dataset with several different measures of the corporate tax rate calculated from the actual parameters of the tax systems, and (2i) allowing exchange controls to affect the intensity of strategic interaction between countries in setting taxes, as well as the levels of tax they choose. We find some evidence that (1) the level of a country's tax, other things equal, is lowered by a unilateral liberalization of exchange controls; and (2) that strategic interaction in taxsetting between countries is increased by liberalization. These effects are stronger if the country is a high-tax one and if the tax is the statutory or effective average one. There is also evidence that countries' own tax rates are reduced by liberalization of exchange controls in *other* countries.

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I. Introduction

An increasingly established conventional wisdom in academic and policy circles is that freer mobility of capital leads to a "race to the bottom" in corporate taxes. In its simplest form, the idea is that it has become harder for countries to tax internationally mobile corporations and therefore countries have cut their corporate taxes. An alternative version of this conventional wisdom is couched in terms of *strategic interactions*: in the presence of capital mobility, an initial cut in the corporate tax by one country will force others to react similarly, for fear of otherwise losing part of their mobile corporate tax bases.

There is a small but growing literature, mostly in political science, which empirically investigates whether relaxation of exchange controls, especially on the capital account, lowers either corporate tax revenues or rates (Basinger and Hallerberg (1998 and 2001), Garrett (1996), Garrett (1998a, b), Quinn (1997), Rodrik (1997), and Swank and Steinmo (2002)). The findings here are very mixed[2]: capital controls may have no significant effect on corporate tax rates or revenues, or may lower them—consistent with the conventional wisdom—or, indeed, raise them (Quinn (1997), Rodrik (1997)).

In our view, this literature, although it has helped to increase our understanding, is limited in several respects. First, a key part of the conventional wisdom is that increased capital mobility will intensify strategic interaction among governments—that is, make it more likely that they will react to each other's tax rates, or that they will react more strongly. But none of the studies cited above tests for this interaction. By contrast, an increasing body of empirical work within economics suggests that for a variety of taxes, strategic interaction between tax authorities exists (see e.g., Brueckner (2001)); and, indeed, in an earlier paper, we ourselves found strong evidence of strategic interaction in corporate tax rates between member countries of the Organization for Economic Coorperation and Development (OECD) (Devereux, Lockwood, and Redoano (2002)).

The first contribution of this paper, therefore, is to propose a simple way of testing this "intensification of strategic interaction" hypothesis.[3] Our approach is straightforward. We estimate an equation that allows the degree of exchange restrictions (as measured by a number of dummy variables, discussed in more detail below) in a country to determine *both* the level of tax set in that country[4] *and* the extent to which that country's tax is affected by the taxes set in other countries. The size of these two effects can be estimated separately. The second effect measures the extent to which strategic interaction is changed following a relaxation of exchange controls.

[2] The results of this literature are discussed in more detail in Section III. C. below.

[3] In this way, we provide a bridge between the literature, predominantly in political science, on the effects of capital controls on corporate taxation, and the literature in economics, on strategic interaction in tax setting.

[4] Conditional on taxes set in all other countries and country-specific controls.

In our view, a second weakness of the existing literature is that it treats exchange controls *asymmetrically*: it is hypothesized that a country's own level of exchange controls may affect corporate tax rates, but the exchange controls of other countries are assumed to have no effect. Again, from the perspective of the tax competition literature in economics, this is not sensible. Capital may be free to move from the United States, but if it has nowhere else to go, U.S. policymakers will not be constrained in taxing U.S. corporations. So, a second contribution of this paper is to allow for the effects of all countries' exchange controls on a given country's tax—a more symmetric specification.

A final objective of this paper is to address what we believe are limitations in the *measurement* of corporate tax rates in the existing literature in this topic. The studies referred to above can be divided according to whether they focus on corporate tax *revenues* or tax *rates*. For example, the dependent variable which is to be explained in terms of capital controls and other explanatory variables is corporate tax as a percentage of GDP in Garrett (1998) and Inclan, Quinn, and Shapiro (2001), and corporate tax as a percentage of total tax or GDP in Quinn (1997). By contrast, in Basinger and Hallerberg (1998 and 2001), Rodrik (1997), and Swank and Steinmo (2002), the dependent variable is the statutory tax rate or the effective tax rate as calculated from national accounts data.[5]

However, we believe that none of these measures of the level of corporate tax is likely to be directly "targeted" by government as a policy objective. A considerable body of theoretical work in economics[6] indicates that in the presence of mobile capital, governments will target *effective marginal tax rate (EMTR)*—the excess of the marginal cost of capital[7] with the tax over that cost without the tax, appropriately normalized—as this determines investment flows into a country and, thus, the corporate tax revenue base. More recently, it has been pointed out that is that if investment choices are discrete, firms will react to differences in countries' *effective average tax rates (EATRS),* the latter simply being the ratio of corporate tax paid to pretax profit (Devereux and Griffith (2003)). In this case, similar arguments indicate that countries will target the effective average tax rate when setting taxes (Devereux, Lockwood, and Redoano (2002)).

Either way, the ratio of corporate tax revenue to GDP or to total tax revenue, or even the effective rate of tax on capital constructed from national accounts data, are only very imprecise measures of either effective average or effective marginal corporate tax rates. Both over time and across countries, the former measures will change not only with the underlying

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[5] Following the methodology of Mendoza, Razin, and Tesar (1994).

[6] See for example, the survey by Wilson (1999).

[7] The *marginal cost of capital* is the pretax rate of return required on the marginally profitable investment project and can be defined either with or without a corporate tax system.

corporate tax parameters (the statutory rate and allowances) but also changes in GDP owing to business cycle fluctuations and changes in the size of the corporate sector.[8]

In this paper, we make use of a dataset on effective marginal and average corporate tax rates for 21 high-income OECD countries over the period 1982 to 1999. These rates are constructed by considering how the corporate tax system as a whole in any country (statutory rate and allowances) affects the net present value of a hypothetical investment project whose parameters are constant across time and over countries. Also, to check the robustness of our results, we use four different measures of the strength of exchange controls, as well as a variety of control variables.

Our main findings are as follows. First, we find that foreign exchange controls, as well as domestic exchange controls, do matter, in that they significantly affect domestic corporate tax rates. The effect is always negative, but stronger for the statutory rate and the EATR than for the EMTR. When interaction effects with domestic exchange controls are allowed for, however, the overall effect of capital account liberalization is ambiguous: that is, whether taxes fall depends on the choice of tax and exchange control variables.

Second, there is evidence of strategic interaction in taxes and also evidence that this is stronger when exchange controls are less tight, consistent with the predictions of the theoretical tax competition literature. In particular, when strategic interaction is allowed for, we can decompose the effect of a unilateral domestic capital account liberalization on the domestic tax rate into a *level* and *interaction* effect . The former measures the reaction of the domestic country, ignoring the current levels of foreign corporate taxes.[9] The second measures the change in the domestic tax rate owing only to the fact that the setting of this rate has become more sensitive to foreign taxes. We find that level effects are negative and the interaction effects are positive.

Thus, our results are consistent with the conventional wisdom, in the following sense. Consider a capital account liberalization in (say) the United States. The first-round effect will be that the United States cuts corporate taxes (the negative level effect). The second-round effect is that other countries cut their taxes in response (the positive interaction effect); the United States would respond to this cut made by other countries and so on.

The remainder of the paper is arranged as follows. Section II lay out a theoretical framework. Section III describes the data, discusses econometric issues, and presents the results. Section IV concludes.

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[8] See Devereux, Griffith, and Klemm (2002) for a detailed discussion of the deficiencies of these measures.

[9] More precisely, assuming that they are all zero.

II. Theoretical Framework

A. The Political Science Literature

The approach in the political science literature cited above is to estimate a regression of the form

$$T_{it} = \alpha D_{it} + \theta' X_{it} \qquad (1)$$

where T_{it} is a corporate tax rate, or corporate tax revenue over some denominator in country i at time t, D_{it} is a capital or general exchange control dummy, and X_{it} is a vector of other "control" variables that may affect T_{it}. We assume in what follows that D_{it} is normalized between zero and one, and that higher values of D_{it} indicate fewer restrictions on the current account, or overall. So, then, if a country moves from an initial situation with effectively no capital mobility to complete capital mobility, the corporate tax changes[10] by α.

The outcome of this exercise generally depends on which control variables are included in the regression, and this is an area of considerable discussion in the political science literature. Most studies try some combination of (i) political variables, such as the left-right orientation of the government: (ii) variables measuring the pressure on government to raise revenue, such as budget deficits or public debt, unemployment government expenditure, or demographic proxies for the demand for public goods such as the ratio of dependent population: (iii) variables describing country characteristics such as size or income per capita.

In our empirical investigation, we estimate (1) both with and without controls, mainly to compare our results with the existing literature. However, we believe that (1) is seriously mispecified, for two reasons.

B. Symmetry

First, we would argue that the specification (1) is asymmetric. Specifically, think about the case of just two countries. A precondition for tax competition is *not only that the home country is open to capital flows, but also that the foreign country is.* If the foreign country were closed, then the home country government could raise corporate taxes without fearing an outflow of FDI or portfolio investment. Generally, speaking, the effect of a given relaxation in capital controls on the corporate tax on the home country is likely to be larger, the more open are other countries. This suggests that a sensible relaxation of the asymmetric specification (1) must include some interaction effects between the D_{it}. We therefore propose a symmetric version of (1) with interaction effects:

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[10] In practice, some studies that use panel data (e.g., Swank and Steinmo (2002)) allow for a lagged dependent variable in (1) with coefficient φ, so that the long-run change induced by complete capital mobility is $\alpha/(1-\varphi)$.

$$T_i = \alpha D_{it} + \beta \overline{D}_{-i,t} + \gamma D_{it} \overline{D}_{-i,t} + \theta' X_{it} \qquad (2)$$

where $\overline{D}_{-i} = \frac{\sum_{j \neq i} D_j}{n-1}$ is the average of capital control dummies in all countries other than i. This allows the average of the other countries' capital controls to affect tax setting in any given country. We also allow for interaction effects. So, the overall effect of a small decrease in the "home" and "foreign" country's capital account restrictions on the home country's tax rate are , respectively,

$$\frac{\partial T_i}{\partial D_i} = \alpha + \gamma \overline{D}_{-i}, \qquad \text{and} \quad \frac{\partial T_i}{\partial D_j} = \frac{\beta + \gamma D_i}{n-1}. \qquad (3)$$

In what follows, we call these the *marginal own-effect* and *marginal cross-effect* respectively. We would expect these overall effects to be negative, and given our regression results, we evaluate these at the sample mean.

C. Strategic Interaction

A second limitation of (1) is that it does not allow for strategic interaction. In particular, when capital is mobile, so that international FDI and portfolio investment are possible, whether this investment locates in country i will depend on country *i*'s corporate tax rates *relative* to other countries j≠i. So, from the point of view of country i, there is *strategic interdependence* in corporate taxes: the best tax for country i will depend on the taxes T_{jt} set in countries j≠i. Formally, country i's optimal tax is given by the *reaction function*

$$T_{it} = R_i(T_{-i,t}, X_{it})$$

where $T_{-i,t}$ is the vector of taxes set in countries other than i at time t. Generally, due to lack of degrees of freedom, it is not possible to estimate this as it stands.[11] Rather, it is generally assumed that T_{it} depends on a weighted average of the $T_{-i,t}$ (Brueckner(2001)). Also, R_i is usually assumed linear. So, this gives a specification

$$T_{it} = \beta \sum_{j \neq i} w_{ij} T_{jt} + \theta' X_{it} \qquad (4)$$

[11] If there are N countries then a system of N linear reaction functions will have N(N-1) coefficients on the taxes in other countries, plus coefficients on the controls, lagged dependent variable, country dummies, etc. So, unless T is large relative to N, estimation of a system of otherwise unrestricted linear reaction functions is infeasible.

where w_{ij} is a measure of the importance of country j's tax to the government of country i, and $\sum_{j \neq i} w_{ij} = 1$.

One simple integration of a general reaction function (4) with equation (1), which explicitly allows for the level of restrictions on the capital or current account, is the following specification:

$$T_i = \alpha D_{it} + \beta D_{it} \overline{T}_{-i,t} + \theta' X_{it} \tag{5}$$

where $\overline{T}_{-i} = \frac{\sum_{j \neq i} T_j}{n-1}$ is the unweighted average of all other countries' tax rates i.e., $w_{ij} = 1/(n-1)$.[12] Although simple, (5) captures an insight from theoretical models of tax competition that the strength of strategic interaction (i.e., the magnitude of β) will depend on the level of capital controls[13] (Persson and Tabellini (1991)).

Analogously to specification (2), there is a marginal own-effect of a small relaxation of capital controls on the home tax rate, which now depends on the average foreign tax rate:

$$\frac{\partial T_i}{\partial D_i} = \alpha + \beta \overline{T}_{-i} \tag{6}$$

Again, this effect is evaluated at the sample mean. We also estimate a more sophisticated version of specification (5), suggested by our own earlier work (Devereux, Lockwood, and Redoano(2002)). In that paper, we show that there is strong evidence that corporate tax reaction functions are asymmetric: a country will react much more to a given cut in another's tax rate if the first country's tax is initially above the average. A specification capturing this idea can be written:

$$T_i = \alpha D_{it} + \gamma A_{it} D_{it} + \beta D_{it} \overline{T}_{-it} + \delta A_{it} D_{it} \overline{T}_{-it} + \theta' X_{it} \tag{7}$$

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[12] In our previous work using the corporate tax data used here, we found our econometric results insensitive to the precise weighting scheme used, and for this reason, we do not experiment with more complex weights here.

[13] In fact, it *imposes* the condition that a country which is closed to capital flows will not react at all to other countries' taxes. This is reasonable insofar as domestic capital cannot leave to find lower taxes elsewhere, and is consistent with the existing theory (e.g., Zodrow and Mieskowski (1986), Persson and Tabellini(1991)). However, it does rule out "common intellectual trends" in tax policy. The reason for making this assumption is that a more general regression, with $\overline{T}_{-i}$ included in (5), yields poor results – coefficients generally insignificant and unstable across specifications. This is because $\overline{T}_{-i}$ and $D_i \overline{T}_{-i}$ are highly correlated.

where A_{it} is a dummy variable that takes the value 1 if $T_{it} > \overline{T}_{-i,t}$, and zero otherwise. So, specification (7) allows the home capital control dummy, *and* that dummy interacted with the average tax rate of other countries, to have different effects on the home country tax rate depending on whether the home country tax rate is above or below the average.

Again, there is a marginal own-effect of a small relaxation of capital controls on the home tax rate, which depends on whether a country's current tax is above or below the average tax:

$$\frac{\partial T_i}{\partial D_i} = \begin{cases} \alpha + \beta \overline{T}_{-i}, & T_i \geq T_{-i} \\ \alpha + \gamma + (\beta + \delta)\overline{T}_{-i}, & T_i < T_{-i} \end{cases} \quad (8)$$

which we evaluate at the sample mean.

D. Symmetry and Strategic Interaction

So far, our specifications (2) and (5) (or (7)) allow separately for symmetric treatment of exchange control dummies, and strategic interaction. An obvious final state would be to estimate an encompassing specification that allows for *both* of these features. However, a completely general equation that encompasses both (2) and (5) has six terms in D_{it} and $\overline{T}_{it}$, and one encompassing (2) and (7), even more. We did try estimating such a specification,[14] but the results were not very successful: the basic problem is that there are only two underlying variables, which is not sufficient to identify six different effects of these variables and their interactions.

An alternative, which we report in this paper, is to estimate an encompassing specification by imposing, rather than estimating, some of the coefficients. We did this in the simplest way possible, by estimating (5) but with D_{it} replaced by $MD_{it} = 0.5D_{it} + 0.5\overline{D}_{-i,t}$, where $\overline{D}_{-i,t} = \sum_{j \neq i} D_{jt} / (n-1)$ is the average of other countries' exchange control dummies. Again, a marginal effect of a relaxation in the home capital control can be calculated as in (6): but

[14] The equation we estimated was

$$T_i = \alpha D_i + \beta \overline{D}_{-i} + \gamma D_i \overline{D}_{-i} + \delta D_i \overline{T}_{-i} + \phi \overline{DT}_{-i} + \eta D_i \overline{DT}_{-i} + \theta' X_{it}$$

where $\overline{DT}_{-i} = \dfrac{\sum_{j \neq i} D_j T_j}{n-1}$ which for any country, is the weighted average of other countries' tax rates, where the weights are their capital control dummies.

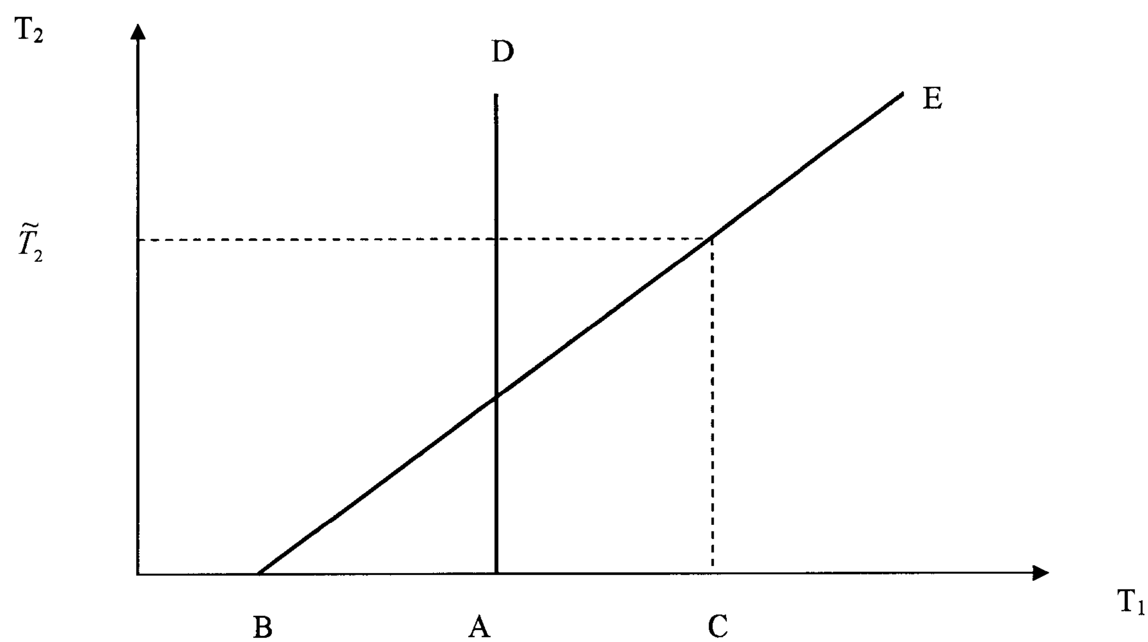
now, this has the alternative interpretation of the effect on the home country tax rate of a simultaneous marginal relaxation in all countries' exchange controls.

E. Level and Interaction Effects of Capital Account Liberalization

Note that the strategic interaction specifications allow us to distinguish *level* and *interaction* effects of capital account liberalization. An increase in D_i will affect the level of T_i directly: this is the level effect. However, an increase in D_i will also affect the responsiveness of T_i to T_j : this is the interaction effect. Consequently, we can decompose the marginal effects (6) and (8) into level and interaction effects. For example, the level effect in (6) is α, and the interaction effect is $\beta\overline{T}_{-i}$. In the asymmetric case, the level effect is $\alpha + \gamma A_i$ and the interaction effect is $\beta\overline{T}_{-i} + \delta A_i\overline{T}_{-i}$. Below, we calculate these effects separately.

The meaning of this decomposition can be made clearer by Figure 1. The lines AD and BE show the "reaction function" of country 1 (i.e., the tax that country 1 sets, given any tax of country 2) before and after capital account liberalization. As remarked above, with complete capital controls, the reaction function is assumed vertical. So, liberalization has two effects. First, it shifts the intercept from A to B : this corresponds to the level effect. Second, it rotates the reaction function, as the tax set by country 1 becomes sensitive to the tax set by country 2: this is the interaction effect. At a given level of country 2's tax, the overall effect is a change in 1's tax from A to C: so, the interaction effect is BC.

Figure 1. The Effects of Liberalization



As argued in the introduction, the informal discussion of the process of tax competition often implicitly focuses on the interaction effect, which measures the intensity with which countries react to each other in tax setting – the "race to the bottom" story. By contrast, existing empirical work has focused on estimating the size of level effects. One contribution of our paper is that we measure both. Our empirical findings are discussed in more detail below, but the main point is that the level effect is almost always negative, and the interaction effect is positive. The overall effect may be positive or negative.

F. Relationship to the Theoretical Literature in Economics

Our regression equations are not derived from any micro-founded model, and so it is of interest to ask to what extent it encompasses the predictions of the various theoretical models of competition in corporate and capital taxes that have been developed in the literature. The first point to make is that with few exceptions (e.g., Devereux, Lockwood, and Redoano (2002)), the theoretical models are not rich enough to distinguish the two kinds of taxes—that is, marginal and average effective tax rates.

A second point is that the main focus of the theoretical literature in economics has been to establish the effect of capital account liberalization on the level of Nash equilibrium taxes. Depending on the specification of the model, moving from a situation of no capital mobility to complete capital mobility will generally—although not necessarily—lower the Nash equilibrium tax rate in any country. For example, in the Zodrow-Mieskowski (1986) model, where revenues from a capital tax are used to finance a public good, the[15] equilibrium tax rate when capital is immobile is higher than with perfect capital mobility. However, in some extensions and variations of that model, it is possible that the taxes in some, or all, countries will be *higher* with mobile capital.[16] Our approach is sufficiently flexible to allow for the Nash equilibrium tax to fall or rise following full capital account liberalization, depending on the parameter values. As the above diagram makes clear, this will depend on the relative size of level and interaction effects.

By contrast, the slope of reaction functions (i.e., intensity of interaction) has not received all that much attention in the tax competition literature. This is partly because reaction functions are difficult to solve for in closed form. Existing results (e.g., Brueckner(2001a)) suggest that

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[15] In the original Zodrow-Mieskowski(1986) model, all countries are alike, so there is a single Nash equilibrium tax rate.

[16] For example, if countries are asymmetric, one country will be a capital importer in Nash tax equilibrium, and this country has an incentive to set a low tax rate on capital in order to depress the global demand for capital and thus the interest rate. If countries are sufficiently asymmetric, this effect can cause the capital importer to set a lower tax rate than in the case without capital mobility (Debater and Myers (1994), Wilson (1987)). Moreover, under some conditions, *all* countries can set higher taxes when capital is mobile. This can arise when (i) tax revenue is used to fund an infrastructure public good that attracts inward investment (Noiset (1995)), Wooders, Zissimos and Dhillon (2001)), or (ii) when the distribution of capital and land ownership within countries is heterogeneous (Lockwood and Makris (2002)).

in the case of capital taxes, reaction functions are upward-sloping. This possibility is captured by (5) or (7) if β or β , γ are positive respectively.

Finally, note that our specifications (5) and (7) are consistent with an obvious—but important—feature of most models in the literature which is that that when there is no capital mobility, countries do not react to each others' taxes.[17]

III. Empirical Results

A. Data

We use data from 21 high income OECD countries[18] over the period 1982 to 1997. We first discuss our dummy variables D_{it}. There are three main ways of measuring capital account liberalization: by legal restrictions on capital or current account flows, by actual flows, and by asset prices (Eichengreen (2001)). Eichengreen argues that "*actual inflows and outflows will be affected by a range of policies and circumstances...and not merely by restrictions on capital flows. Hence, this measure is unlikely to be an informative indicator of the capital account regime*". Moreover, the existing studies of the effect of capital controls on corporate taxes all use some coding of the legal restrictions, and we also take this route.

The main source for researchers on legal restrictions is the information in the International Monetary Fund's Exchange Arrangements and Exchange Restrictions annual. One widely used coding, originally due to Grilli and Milesi-Ferretti (1995) is a binary one, with a value of 1 indicating significant restrictions on the capital account. This coding also has three binary variables indicating the presence of restrictions on the current account: multiple exchange rates, restrictions on current account transactions, and surrender of export proceeds.

Quinn (1997) offers a more sophisticated coding that measure the intensity of capital controls. For 56 countries over the period 1950 to 1997, and an additional eight countries starting in 1954, Quinn distinguishes seven categories of statutory measures. Four are current account restrictions, two are capital account restrictions, and one denotes membership of international organizations, such as the OECD, which may constrain the ability of a country to restrict exchange and capital flows. The capital account restrictions are coded on a

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[17] Countries may react to each other's even in the absence of capital mobility if there is yardstick competition , that is, voters are using the taxes set by their own jurisdiction relative to others to evaluate the performance of the incumbent policymaker (Brueckner (2001)). However, we believe that as "corporations do not vote", yardstick competition is highly unlikely to be an explanation for any observed strategic interaction.

[18] We consider the following countries: United Kingdom, Germany, Australia, Canada, France, Ireland, Italy, Japan, Spain, United States, Austria, Belgium, Denmark, Finland, Greece, the Netherlands, New Zealand, Norway, Sweden, Switzerland, Portugal.

0–4 scale, the current account restrictions on a 0–8 scale, and membership on a 0–2 scale with half-point increments. In every case, a higher number denotes a weaker restriction.

The question then arises as to whether to use the coding of restrictions on the capital account, or all restrictions on current *and* capital account together. Here, practice varies,[19] although some have the view that there is fungibility between accounts, that is, "*where capital controls do exist, they can be avoided through current account transactions, and, as such, consideration of restrictions on the current account and other restrictions is necessary to measure the effectiveness of controls*" (Mody and Murshid (2002)). We use both kinds of measures, using the indices based on Grilli and Milesi-Ferretti (1995), and Quinn(1997). This gives us four measures of exchange controls, CGMF, EXGMF, CQ, EXQ as described in Table 7 in the Appendix. Note that all these variables are transformed so that a higher value denotes less control, and all are normalized between zero and one: this helps in the interpretation of the regression coefficients. Note that as shown in Figure 2, all these variables are trending upwards over the sample period.

We now turn to our tax rate measures T_{it}. As argued in the introduction, all studies (with the exception of our earlier paper) use *either* the statutory tax rate *or* some measure of the effective tax rate based on national accounts data. For reasons explained in our earlier paper, we believe that neither of these measures is consistent with the literature in economics on the effects of corporate taxes on investment decisions, which emphasizes that it is either the marginal or average effective tax rate on new investment projects that determines FDI flows (Devereux and Griffith (2003)), depending on whether the investment is incremental, or a discrete project that generates some economic rent. So, in our empirical work, we use constructed marginal or average effective tax rates on new investment projects for the counties and years in our sample.

These effective tax rates (denoted EMTR, EATR) will differ with (i) the type of investment (building, or plant and machinery, as the two typically have different depreciation allowances), and (ii) the method of financing (debt or equity). We calculate the EMTR and EATR for each of the four possible combinations, and then construct the weighted average of the relevant tax rate across these four [20] More detail on the construction of these data is available in Devereux, Lockwood, and Redoano (2002). The average values (across countries) of the tax variables are trending downwards, as shown in Figure 3. This figure shows quite clearly that the downward trend on corporate taxes is not confined to the statutory rate.

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[19] For example, Swank and Steinmo (2002) using only the coding for the capital account, that is, the 0-4 measure, whereas Quinn (1997) himself uses both, and Mody and Murshid(2002) use only the 0–4 measure based on Grilli and Milesi-Ferretti's coding of both current and capital accounts.

[20] The weights are: 0.234 for investment in buildings financed by equity/retained earnings, 0.416 for investment in plant and machinery financed by equity/retained earnings, 0.126 for investment in buildings financed by debt, 0.224 for investment in plant and machinery financed by debt. These weights are our calculations, based on OECD (1991), and are representative proportions for the countries in our sample.

Figure 2: Exchange Control Dummies, Country Averages over Time

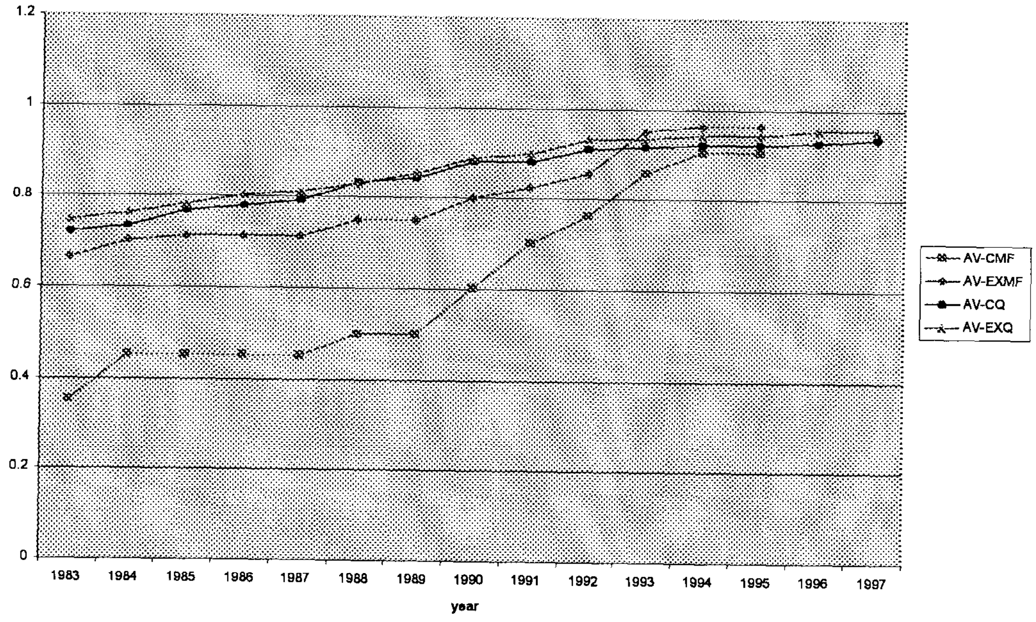
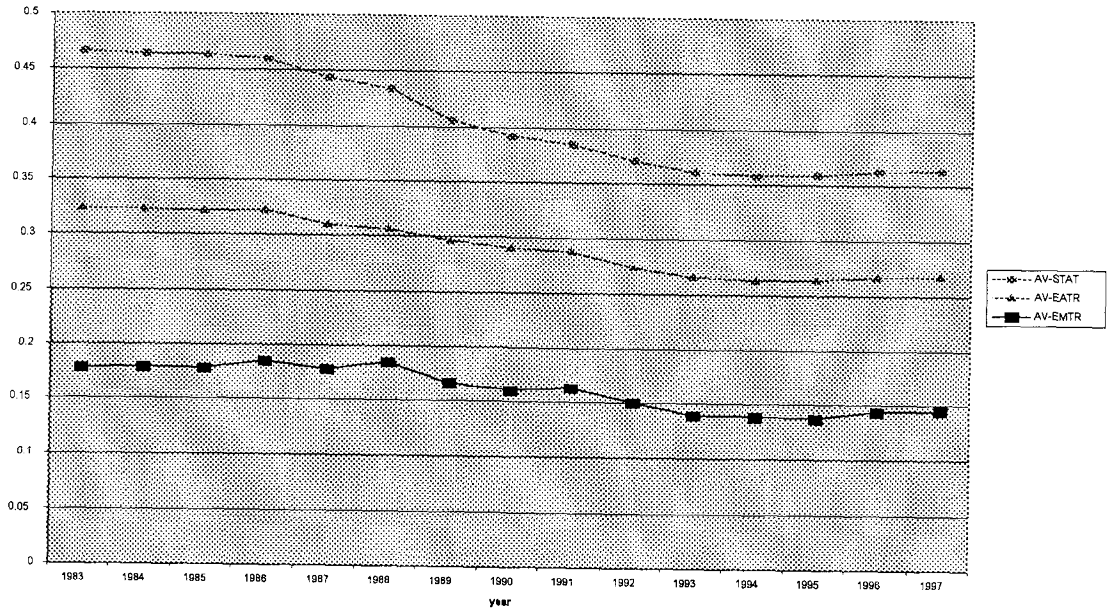


Figure 3: Corporate Tax Rates, Country Averages over Time



The other control variables we use are those country-specific variables that satisfy the following criteria: (i) that might plausibly explain corporate taxes in any country; (ii) that appear with consistent and plausible signs in the "basic" regressions reported below. These are listed in full in Table 7 of the Appendix, and are discussed in more detail below.

B. Econometric Methodology

We will estimate the following equations. First, for purposes of comparison to the existing literature, we estimate (1) both without and with controls. Then, we estimate (2), followed by (5), and then finally the encompassing specification (9). In this way, we look for symmetry and strategic interaction separately, and then together. However, as they stand, these equations are insufficiently flexible to be a good representation of the data. First, tax rates are highly persistent, so in each case, we include a lagged value of T_{it}. Second, countries will be heterogeneous, which we capture by allowing for common fixed effects.

In specifications (5) and (9), all tax rates are jointly determined, and so the regressors $\overline{T}_{-i}$, $\overline{DT}_{-i}$ are clearly endogenous. We deal with this using an instrumental variables approach. As a first stage, we first regress T_{it} on its lag and on $\mathbf{X}_{it}$. We estimate this as a panel, and derive predicted values of T_{it}. We then generate the regressors $\overline{T}_{-i}$, $\overline{DT}_{-i}$ using the predicted values of T_{it} from the first regressions: these are used to estimate (5) and (9).

Obviously, one can make the argument that the D_{it} are endogenous as well. However, following the existing literature on the effects of exchange controls on corporate taxes, we take the D_{it} to be exogenous. One possible defense of this is that the evidence suggests that the determinants of exchange controls tend to be institutional and cultural (democracy, central bank independence, the exchange rate regime, etc—see Eichengreen(2002) for more details) and therefore unlikely to be influenced by corporate tax rates.

Our IV approach is robust to spatial correlation in the error term, u_{it}. Nevertheless, we test for such spatial correlation using the Burridge (1980) test. We also test for first order auto-correlation in the error term, using a standard test for panel data (Baltagi, 1996). The test for autocorrelation is straightforward, since we test for correlation between ε_{it} and ε_{it-1}. In investigating correlation across countries, however, there are 21 observations in each period: it is not clear what ordering they should have for the purpose of the test. Following Burridge, we combine the residuals from the other countries using the weighting matrix; in this case with equal weights for each country (for more details, see also Anselin and others (1996)). Each of the test statistics is distributed as χ^2 distribution with one degree of freedom.

C. Results

Base Regressions—Specification (1)

We first estimated a very restricted version of (1) with γ=**0** (no controls), . The purpose of this exercise was to see which measure of exchange controls would play any role in explaining the various tax measures in a very parsimonious specification. As we have three different tax measures, and four different exchange control dummies, this means twelve regressions. The results are reported in Table 1 below.

Statistically, these regressions perform well: all have high R^2s, and the diagnostic tests for spatial and serial correlation are all passed. Moreover, the dummy for relaxation of exchange controls has the expected negative sign for all four exchange control measures, and all three tax measures. The coefficients are significant at 5 percent or better in six out of the twelve cases. The exchange control measure that performs best in the sense of being consistently significant is Quinn's capital control dummy, CQ. This is perhaps not surprising, as it focuses explicitly on capital controls, and measures their intensity as well as their presence.

According to these regressions, in the short run, the effects of a complete relaxation of exchange controls (D_{it} changing from 0 to 1) is can be significant in the short run, and very large in the long run. For example, using CQ, and recalling that the dependent variable is a tax rate between zero and one, complete abolition of exchange controls lowers the statutory tax rate by 8 percentage points in the short run, and 44 percentage points in the long run, although the estimated effect on the EATR and EMTR is about half this. Of course, these effects may well be overestimates, as we have excluded controls and time dummies. In particular, as shown in Figures 2 and 3 above, both corporate taxes and exchange controls have been trending downwards during our sample period, so these coefficients may just be evidence of a common time trend.

Table 2 describes the results when controls are added, that is, we estimate (1) without the restriction θ=0. This corresponds most directly to the specifications in the political science literature, and for this reason, we spend some time discussing the performance of the controls. Again, there are twelve regressions. Our choice of controls was made on the basis of our previous work on this topic, plus the choice of control variables by other researchers,[21] plus data constraints. Overall, the control variables are those that might plausibly affect the setting of corporate taxes. A full list of the controls, giving descriptive statistics, is in the Appendix.

[21] For example, Garrett (1997) and Swank and Steinmo (2002) use the TRADE variable, as defined here, and Swank and Steinmo (2002) also use unemployment and government debt.

Table 1. Equation (1) Without Controls

	Statutory Tax Rate				EATR				EMTR			
D	HCMF	HEXMF	HCQ	HEXQ	HCMF	HEXMF	HCQ	HEXQ	HCMF	HEXMF	HCQ	HEXQ
$T_{i,t-1}$	0.881*** (0.037)	0.885*** (0.038)	0.820*** (0.045)	0.845*** (0.041)	0.872*** (0.044)	0.874*** (0.045)	0.821*** (0.047)	0.837*** (0.046)	0.820*** (0.056)	0.817*** (0.057)	0.806*** (0.056)	0.807*** (0.056)
D_{it}	-0.006 (0.009)	-0.010 (0.009)	-0.080*** (0.024)	-0.058*** (0.020)	-0.005 (0.003)	-0.008 (0.007)	-0.048*** (0.015)	-0.040*** (0.014)	-0.002 (0.004)	-0.010 (0.011)	-0.037** (0.017)	-0.041** (0.018)
Countries Dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.92	0.92	0.93	0.93	0.91	0.91	0.92	0.92	0.90	0.90	0.90	0.90
LM serial	0.381	0.469	0.399	0.169	1.262	1.330	1.165	0.801	1.719	1.1745	1.116	1.127
LM spatial	0.0471	0.0044	0.0008	0.0017	0.0002	0.0003	0.00000	0.000007	0.000001	0.0001	0.0004	0.0004
Observations	260	260	300	300	260	260	300	300	260	260	300	300

Table 2. Equation (1) With Controls

	Statutory Tax Rate				EATR				EMTR			
D	CMF	EXMF	CQ	EXQ	CMF	EXMF	CQ	EXQ	CMF	EXMF	CQ	EXQ
$T_{i,t-1}$	0.792*** (0.056)	0.792*** (0.057)	0.775*** (0.056)	0.786*** (0.055)	0.794*** (0.056)	0.796*** (0.055)	0.779*** (0.054)	0.785*** (0.053)	0.783*** (0.045)	0.788*** (0.044)	0.781*** (0.043)	0.781*** (0.043)
D_{it}	0.004 (0.006)	0.026* (0.016)	-0.060*** (0.022)	-0.026 (0.019)	0.004 (0.004)	0.017 (0.011)	-0.034** (0.015)	-0.023* (0.014)	0.009 (0.004)	0.015 (0.013)	-0.011 (0.020)	-0.012 (0.020)
POPOLD	-0.056 (0.293)	-0.260 (0.324)	0.463** (0.236)	0.309 (0.259)	-0.083 (0.204)	-0.196 (0.227)	0.272 (0.172)	0.239 (0.190)	-0.314 (0.332)	-0.322 (0.362)	-0.096 (0.309)	-0.074 (0.304)
TOPINC	0.150*** (0.049)	0.160*** (0.052)	0.107*** (0.038)-	0.127*** (0.042)	0.090*** (0.033)	0.095*** (0.034)	0.064** (0.025)	0.072*** (0.025)	0.090** (0.040)	0.0890* (0.040)	0.068* (0.036)	0.069* (0.038)
SIZE	-0.323 (0.225)	-0.243 (0.223)	0.496** (0.221)	-0.465** (0.221)	-0.041 (0.139)	0.003 (0.142)	-0.167 (0.134)	-0.162 (0.136)	-0.475 (0.298)	-0.457 (0.308)	-0.517** (0.250)	-0.520** (0.251)
UNEMPL	-0.414** (0.192)	-0.433** (0.191)	-0.230 (0.144)	-0.284* (0.154)	-0.345** (0.148)	-0.345** (0.142)	-0.207* (0.110)	-0.233** (0.115)	-0.270* (0.145)	-0.226* (0.134)	-0.129 (0.119)	-0.135 (0.116)
DEBT	0.010 (0.022)	0.013 (0.022)	-0.004 (0.016)	0.0003 (0.016)	0.015 (0.016)	0.016 (0.016)	0.005 (0.011)	0.007 (0.011)	0.035* (0.021)	0.033 (0.021)	0.025 (0.019)	-0.025 (0.018)
Countries Dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.94	0.94	0.94	0.94	0.93	0.93	0.94	0.94	0.91	0.91	0.91	0.90
LM serial	0.331	0.311	0.253	0.695	0.382	0.291	0.208	0.068	2.013	1.785	0.567	0.583
LM spatial	0.0001	0.0000	0.0000	0.0001	0.00002	0.000007	0.000004	0.00002	0.0008	0.0007	0.0007	0.0007
Observations	250	250	290	290	250	250	290	290	250	250	290	290

Again, the regressions perform well statistically, that is, the overall fit is good and there is no evidence of temporal or spatial autocorrelation. However, the success of the controls at explaining corporate taxes is mixed. The most successful is the top rate of income tax, TOPINC. It has frequently been argued that corporation tax is a necessary "backstop" for income tax: that is, in the absence of corporation tax, individuals could potentially escape tax on their earnings by incorporating themselves. So, we should expect a positive coefficient on this variable, and that is the case, with the variable being positive and significant at the 5 percent level for the statutory tax rate and the EATR, and positive and significant at the 10 percent level for the EMTR. Moreover, in the long run, the effect is large: for example, in the case of capital control measure CMF, a 1 percentage point increase in the top rate of income tax will increase the statutory rate of corporation tax by 0.77 percentage points.

The unemployment rate, UNEMPL, is also reasonably successful. This has a uniformly negative coefficient in all regressions, and is significant at the 10 percent level or greater in nine of the twelve regressions. One possible explanation for the negative coefficient is that countries with high unemployment rates may wish to attract inward FDI and so may lower their corporation tax rates (e.g., Ireland).

The country size control, SIZE, which measures by GDP relative to the U.S. is also reasonably successful. In fact, the coefficient on SIZE is negative in eleven of the twelve regressions. It is also significant in four regressions, and has an ordinary t-statistic of greater than one (thus increasing the overall fit of the regression, as measured by the $\overline{R}^2$) in ten of the twelve regressions. Unfortunately, although the stability of the sign of the coefficient across specifications is impressive, the negative sign is not consistent with existing theory for example, Haufler and Wooton (1999). Note though, that persistent differences in country size are allowed for by the including of country-specific fixed effects. The SIZE variable is therefore reflects changes over time in relative size. This is likely to be determined by relative growth rates.

The remaining controls, POPOLD and DEBT, are less successful. Both are rarely significant and moreover the sign of POPOLD varies across specifications. It is worth noting however, that the sign of the coefficient on debt is positive in ten of the twelve cases, as would be predicted by simple economics: higher debt pressures governments to raise taxes, and so one would expect it to have a positive coefficient.

We now turn to the main focus of interest, the exchange control dummies. Here, it is clear that the results are dominated by which quantitative measure of exchange restrictions is used. A relaxation of exchange controls, as measured by Quinn (1997), lowers all three measures of tax, although the effect is only significant in three out of the six cases. However, a relaxation of exchange controls, as measured by Grilli and Milesi-Ferretti (1995), raises all three measures of tax, although the effect is only significant in one out of the six cases. This discrepancy between the indices is quite striking. It could occur of the effect of relaxation of capital controls on taxes was non-monotonic.[22] Alternatively, if one believes (2) (or (5) or (7)) to be the correct specification, it could simply be a consequence of omitted variable bias.

Finally, although these regressions are not our main focus of interest, but rather the building blocks on the way to estimation of the full regressions of the form (7), we believe that these results add value to the existing political science literature. Papers in that literature tend to use only one or two measures of the corporate tax rate or revenue, and only one measure of liberalization. In contrast, we take a comparative approach, allowing for three measures of the corporate tax rate, and four different measures of exchange control restrictions. Our results highlight that the qualitative findings are especially sensitive to the choice of exchange control restrictions. Perhaps this explains the wide variety of results in the existing literature.

Regressions with Symmetric Treatment of Capital Control Dummies—Specification (2)

These results are reported in Table 3. Again, the fit is good and the regressions pass tests for temporal and spatial autocorrelation. The comments above on the control variables also apply to this specification. Here, we focus on the performance of the additional dummy variables. Note that in this specification, the coefficient on Dit is now negative for all possible measures of the corporate tax and capital controls. This is more consistent with economic intuition. The coefficient on D_{-it} is also uniformly negative, as predicted, and significant at 5 percent or better for Quinn's measures of capital and exchange controls. So, it appears at first sight that a more general symmetric treatment of capital control dummies leads to a more plausible regression equation. However, the interaction effects are positive, and this will offset the linear effects of D_{it}, D_{-it}.

Ultimately, what is of interest are the marginal own and cross-effects (3) above: that is, the effect of a small relaxation of the home or foreign capital control on home taxes, taking into account both linear and interaction effects. These are reported in the last two rows of Table 3. The interpretation of these figures is as follows. The own-marginal effects are the percentage point reductions in the home country tax rate caused by a change from full to no exchange controls in the home country (D_i from 0 to 1), with other variables calculated at their sample means. The marginal cross-effects are the percentage point reductions in the home country tax rate caused by a change from full to no exchange controls in all other countries (D_{-i} from 0 to 1), with other variables calculated at their sample means. Note that these effects are calculated conditional on $T_{i,t-1}$ and so are *short-run* effects. Long-run effects are obtained by

[22] Suppose for example, that taxes were initially rising with capital control relaxation, and then falling. The CMF measure effectively weights all degrees of relaxation above a certain threshold equally, whereas the CQ measure gives higher weight to larger relaxations, over four categories. So, the CQ measure effectively weights more heavily country-year observations with both lower taxes and lower exchange controls.

Table 3. Equation (2)

	Statutory Tax Rate				EATR				EMTR			
	CMF	EXMF	CQ	EXQ	CMF	EXMF	CQ	EXQ	CMF	EXMF	CQ	EXQ
$T_{i,t-1}$	0.772***	0.765***	0.731***	0.734***	0.779***	0.782***	0.765***	0.796***	0.782***	0.789***	0.768***	0.773***
	(0.063)	(0.063)	(0.065)	(0.066)	(0.059)	(0.056)	(0.057)	(0.057)	(0.045)	(0.045)	(0.044)	(0.044)
D_{it}	-0.025	-0.084	-0.343***	-0.376***	-0.013	-0.075	-0.203***	-0.236***	-0.0002	-0.033	-0.332	-0.362*
	(0.016)	(0.090)	(0.100)	(0.132)	(0.010)	(0.065)	(0.072)	(0.093)	(0.001)	(0.075)	(0.164)	(0.196)
$\overline{D}_{-it}$	-0.069*	-0.218	-0.457***	-0.560***	-0.048*	-0.168*	-0.246***	-0.307***	-0.032	-0.099	-0.337**	-0.387*
	(0.038)	-(0.144)	(0.124)	(0.168)	(0.026)	(0.104)	(0.090)	(0.118)	(0.028)	(0.106)	(0.169)	(0.211)
$D_{it} * \overline{D}_{-it}$	0.052*	0.155	0.370***	0.452***	0.032*	0.128	0.218***	0.268**	0.018	0.068	0.395**	423*
	(0.028)	(0.126)	(0.123)	(0.162)	(0.019)	(0.093)	(0.089)	(0.115)	(0.024)	(0.099)	(0.195)	(0.234)
POPOLD	0.381	0.186	1.084***	0.837***	0.248	0.119	0.558***	0.484***	-0.076	-0.111	0.035	0.004
	(0.326)	(0.289)	(0.292)	(0.285)	(0.222)	(0.204)	(0.197)	(0.203)	(0.349)	(0.346)	(0.312)	(0.296)
TOPINC	0.129***	0.143***	0.090***	0.108***	0.074***	0.079***	0.053**	0.057**	0.077*	0.077*	0.072*	0.065*
	(0.044)	(0.046)	(0.036)	(0.039)	(0.028)	(0.028)	(0.024)	(0.025)	(0.045)	(0.044)	(0.038)	(0.039)
SIZE	-0.372*	-0.219	-0.360*	-0.308	-0.042	0.033	-0.072	-0.055	-0.460	-0.424	-0.454*	-0.453*
	(0.225)	(0.222)	(0.219)	(0.215)	(0.138)	(0.142)	(0.139)	(0.139)	(0.320)	(0.324)	(0.243)	(0.245)
UNEMPL	-0.378**	-0.430**	-0.305**	-0.367**	-0.320**	-0.338**	-0.230**	-0.258**	-0.245*	-0.209*	0.025	-0.159
	(0.185)	(0.187)	(0.154)	(0.159)	(0.140)	(0.139)	(0.114)	(0.116)	(0.142)	(0.132)	(0.119)	(0.115)
DEBT	0.017	0.031	0.009	0.020	0.022	0.030	0.012	0.017	0.041*	0.042*	0.025	0.030
	(0.026)	(0.028)	(0.018)	(0.019)	(0.018)	(0.021)	(0.012)	(0.013)	(0.025)	(0.026)	(0.020)	(0.020)
Countries Dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.94	0.94	0.95	0.94	0.93	0.93	0.94	0.94	0.91	0.91	0.91	0.91
LM serial	0.403	0.230	0.445	0.0431	0.756	0.376	0.340	0.124	2.233	1.887	0.802	0.657
LM spatial	0.00007	0.00001	0.001	0.0009	0.000008	0.0000	0.00003	0.00007	0.0009	0.0007	0.0001	0.0003
Observations	250	250	290	290	250	250	290	290	250	250	290	290
Marginal Own Effect	0.55	3.95	-3.11	1.54	0.60	2.73	-1.93	-0.29	1.06	2.18	0.13	0048??
Marginal Cross Effect	-0.20	-0.49	-0.76	-0.88	-0.15	-0.35	-0.32	-0.39	-0.11	-0.23	-0.02	-0.10

Note: marginal effects give percentage point reduction in home country tax rate given change from full to no exchange controls (D_i from 0 to 1), with other variables calculated at their sample means.

dividing though the calculated marginal effect by one minus the coefficient on the lagged dependent variable, and are thus around five times as large.

So, for example, if the dependent variable is the statutory tax rate, and the exchange control measure is CQ, we see from column 3 of Table 4 that the own-effect is -3.11 (i.e., full liberalization in the home country is predicted to lower the statutory rate by about three percentage points in the short run), and that the cross-effect is -0.76 (i.e., full liberalization in all other countries is predicted to lower the statutory rate by about three-quarters of a percentage point in the short run). In the long run, these reductions would be around fifteen and four percentage points respectively. These effects seem of a plausible size.

Looking at the marginal effects across all the different specifications, intuition suggests that these should both be negative: however, both are negative *only in the case where the dependent variable is the statutory rate or EATR, and the measure of capital controls is CQ*. However, this is to some extent what we might expect. First, our earlier work (Devereux, Lockwood, and Redoano(2002)) suggests that if countries compete at all over corporate taxes, they do so with respect to the statutory rate or EATR. Second, the most precise measure of capital controls is probably Quinn's for reasons discussed above.

Regressions with Strategic Interaction—Specification (5)

These results are reported in Table 4. Again, the fit is good and the regressions pass tests for temporal and spatial autocorrelation. Here, we focus on the performance of D_{it} and the interaction term $D_{it}\overline{T}_{-it}$. The coefficient on the home dummy D_{it} is uniformly negative, as we would expect, although only significant when the dependent variable is the statutory rate. The sign of the coefficient on the interaction term $D_{it}\overline{T}_{-it}$ variable is uniformly positive, as the theory would predict. However, it is only significant in four cases. Overall, the specification that works best is where the dependent variable is the statutory tax rate.

The last row in the table reports the marginal own-effects. Again, the interpretation of this figure is the predicted percentage point reduction in the domestic tax rate resulting from a full domestic capital account liberalization. These effects are negative in only five of the twelve cases. However, these five cases are five of the six specifications for which Quinn's measure of exchange controls is used, which we believe to be the more accurate of the two.

Finally, note that when the decomposition of the marginal effect (also given in the last row of the table) is examined, if the marginal effect is positive, this is always because a negative level effect is dominated by a positive interaction effect. This is reassuring because this sign pattern is the one predicted by economic theory. As emphasized above, there is no strong prediction from theory that the overall marginal effect should be negative.

Table 4. Equation (5)

	Statutory Tax Rate				EATR				EMTR			
D	CMF	EXMF	CQ	EXQ	CMF	EXMF	CQ	EXQ	CMF	EXMF	CQ	EXQ
$T_{i,t-1}$	0.787*** (0.060)	0.739*** (0.068)	0.750*** (0.063)	0.749*** (0.063)	0.789*** (0.058)	0.782*** (0.057)	0.773*** (0.055)	0.776*** (0.054)	0.789*** (0.045)	0.799*** (0.045)	0.787*** (0.045)	0.787*** (0.045)
D_{it}	-0.006 (0.023)	-0.070** (0.031)	-0.113*** (0.039)	-0.091** (0.039)	-0.012 (0.019)	-0.030 (0.022)	-0.060 (0.027)	-0.054 (0.027)	-0.018 (0.029)	-0.017 (0.030)	-0.026 (0.025)	-0.026 (0.027)
$D_{it}.\overline{T}_{-i,t}$	0.296 (0.060)	0.256** (0.099)	0.146* (0.076)	0.193** (0.082)	0.060 (0.068)	0.178** (0.090)	0.095 (0.073)	0.120 (0.073)	0.172 (0.184)	0.225 (0.200)	0.104 (0.176)	0.104 (0.171)
POPOLD	-0.015 (0.293)	0.264 (0.273)	0.698** (0.273)	0.599** (0.290)	-0.036 (0.208)	0.002 (0.213)	0.358* (0.186)	0.344* (0.206)	-0.217 (0.328)	-0.151 (0.363)	-0.024 (0.297)	-0.010 (0.298)
TOPINC	0.150*** (0.049)	0.156*** (0.049)	0.099*** (0.036)	0.119*** (0.039)	0.090*** (0.033)	0.091*** (0.033)	0.060** (0.024)	0.067*** (0.025)	0.086** (0.041)	0.080* (0.042)	0.063 (0.038)	0.064 (0.040)
SIZE	-0.297 (0.232)	-0.087 (0.250)	-0.470** (0.223)	-0.415* (0.22)	-0.010 (0.141)	0.078 (0.157)	-0.152 (0.134)	-0.139 (0.136)	-0.408 (0.314)	-0.369 (0.325)	-0.492** (0.259)	-0.493* (0.260)
UNEMPL	-0.423** (0.200)	-0.459** (0.189)	-0.268* (0.149)	-0.329** (0.158)	-0.352** (0.150)	-0.338** (0.140)	-0.212* (0.111)	-0.236** (0.115)	-0.261* (0.143)	-0.187 (0.133)	-0.117 (0.117)	-0.121 (0.115)
DEBT	0.012 (0.023)	0.023 (0.023)	0.003 (0.017)	0.009 (0.017)	0.017 (0.016)	0.021 (0.016)	0.008 (0.012)	0.011 (0.012)	0.040 (0.023)	0.038* (0.022)	0.027 (0.019)	0.027 (0.019)
Countries Dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.94	0.94	0.95	0.94	0.93	0.93	0.94	0.94	0.91	0.91	0.91	0.91
LM serial	0.253	0.0007	0.020	0.0255	0.289	0.119	0.083	0.004	2.253	1.887	0.512	0.528
LM spatial	0.0001	0.00008	0.00001	0.00002	0.00001	0.000004	0.0000	0.000006	0.001	0.001	0.001	0.001
Observations	250	250	290	290	250	250	290	290	250	250	290	290
Marginal own-effects (Level effect, Interaction Effect)	0.53 (-0.69, 1.22)	3.41 (-7.07, 10.48)	-5.39 (-11.36, 5.97)	-1.21 (-9.10, 7.89)	0.52 (-1.24, 1.76)	2.16 (-3.08, 5.24)	3.24 (-6.03, 9.27)	-1.92 (-5.46, 3.54)	1.03 (-1.84, 2.87)	1.99 (-1.75, 2.74)	-0.92 (-2.65, 1.73)	-0.87 (-2.60, 1.73)

Regressions with Asymmetric Strategic Interaction—Specification (7)

These results are reported in Table 5. Again, the fit is good and the regressions pass tests for temporal and spatial autocorrelation. Again, we focus on the performance of the terms in D_{it}. First, both D_{it} and $A_{it}D_{it}$ enter negatively throughout, with the best-performing specification being the statutory rate. This indicates that high-tax countries will cut their tax rates more than low-tax ones, for a capital account liberalization of a given size.

Second, the coefficient on $D_{it}\overline{T}_{-it}$ is positive throughout, again as theory predicts and moreover, the coefficient on $A_{it}D_{it}\overline{T}_{-it}$ is positive in nine of the twelve cases. When the dependent variable is the statutory rate, the coefficient on $A_{it}D_{it}\overline{T}_{-it}$ is highly significant in three of the four cases. The interpretation of a positive coefficient on $A_{it}D_{it}\overline{T}_{-it}$ is that that high-tax countries will cut their tax rates more than low-tax ones in response to a cut of given size by other countries, and for a given level of capital or exchange controls.

Finally, the marginal effects are presented in the last two rows in the table, separately for countries below and above the mean tax rate. Two comments can be made. First, the sign pattern of the marginal effects is similar to the basic regression (5), in the sense that a negative marginal effect is associated with use of Quinn's exchange control variable.[23] Together with the results from the previous equation, our conclusion is that there is good evidence that a unilateral capital account liberalization will decrease the corporate tax rate in a country.

Second, note that as before, an marginal effect is generated by the sum of a usually negative level effect and a usually positive interaction effect—in the case of the twelve regressions using Quinn's measure, this is *always* the case. Also, both the level and interaction effects tends to be bigger (sometimes, much bigger) for countries above the mean than for those below.

Regressions with Both Strategic Interaction and Foreign Capital Controls

These results are reported in Table 6. Again, the fit is good and the regressions pass tests for temporal and spatial autocorrelation. The coefficient on the dummy MD_{it} is uniformly negative, as we would expect, although more significant when the dependent variable is the statutory rate. The sign of the coefficient on the interaction term $MD_{it}\overline{T}_{-it}$ variable is uniformly positive, as the theory would predict. However, it is only significant in three cases. Overall, the specification that works best is where the dependent variable is the statutory tax rate.

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[23] Of the twelve marginal effects calculated from regressions where Quinn's variable is used, eight are negative.

Table 5. Equation (7)

	Statutory Tax Rate				EATR				EMTR			
D	CMF	EXMF	CQ	EXQ	CMF	EXMF	CQ	EXQ	CMF	EXMF	CQ	EXQ
$T_{i,t-1}$	0.790*** (0.062)	0.730*** (0.074)	0.737*** (0.067)	0.731*** (0.069)	0.794*** (0.060)	0.798*** (0.063)	0.797*** (0.056)	0.798*** (0.057)	0.785*** (0.047)	0.792*** (0.052)	0.792*** (0.053)	0.791*** (0.054)
D_{it}	0.017 (0.028)	-0.014 (0.030)	-0.070** (0.035)	-0.049 (0.033)	-0.010 (0.019)	-0.029 (0.022)	-0.056** (0.027)	-0.049* (0.028)	-0.012 (0.030)	-0.014 (0.031)	-0.022 (0.027)	-0.020 (0.031)
$D_{it}.\overline{T}_{-i,t}$	-0.052 (0.041)	-0.136*** (0.047)	-0.122** (0.051)	-0.130** (0.051)	-0.003 (0.005)	-0.007 (0.006)	-0.001 (0.005)	-0.001 (0.005)	-0.011 (0.008)	-0.017** (0.008)	-0.010 (0.006)	-0.010 (0.006)
$A_{i,t}D_{it}$	-0.028 (0.073)	0.111 (0.084)	0.029 (0.060)	0.068 (0.063)	0.056 (0.067)	0.189** (0.093)	0.096 (0.074)	0.122 (0.075)	0.159 (0.186)	0.270 (0.198)	0.126 (0.176)	0.133 (0.171)
$A_{it}.D_{it}.\overline{T}_{-i,t}$	0.122 (0.101)	0.332*** (0.116)	0.304** (0.124)	0.328*** (0.126)	0.001 (0.018)	0.006 (0.18)	-0.014 (0.015)	-0.011 (0.015)	0.017 (0.060)	0.035 (0.066)	-0.001 (0.068)	0.001 (0.066)
POPOLD	0.034 (0.295)	0.472*** (0.048)	0.897*** (0.299)	0.871*** (0.324)	-0.042 (0.211)	0.012 (0.215)	0.370* (0.194)	0.344 (0.213)	-0.214 (0.340)	-0.075 (0.367)	0.063 (0.305)	0.049 (0.299)
TOPINC	0.153*** (0.050)	0.158*** (0.048)	0.100*** (0.037)	0.119*** (0.0.39)	0.091*** (0.033)	0.093*** (0.034)	0.061** (0.026)	0.069* (0.027)	0.091** (0.041)	0.096** (0.044)	0.076* (0.042)	0.078* (0.045)
SIZE	-0.177 (0.258)	0.189 (0.289)	-0.329 (0.237)	-0.257 (0.241)	-0.008 (0.143)	0.095 (0.162)	-0.146 (0.133)	-0.134 (0.136)	-0.412 (0.315)	-0.351 (0.318)	-0.507* (0.262)	-0.504* (0.261)
UNEMPL	-0.431 (0.201)	-0.459** (0.190)	-0.257* (0.149)	-0.305* (0.156)	-0.362** (0.153)	-0.370** (0.150)	-0.0225* (0.120)	-0.251** (0.125)	-0.308** (0.147)	-0.296* (0.153)	-0.188 (0.134)	-0.194 (0.136)
DEBT	0.013 (0.024)	0.020 (0.024)	0.002 (0.019)	0.006 (0.018)	0.019 (0.017)	0.026 (0.019)	0.012 (0.014)	0.014 (0.014)	0.044* (0.023)	-0.296* (0.153)	0.035* (0.019)	0.035* (0.019)
Countries Dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.94	0.94	0.95	0.94	0.93	0.93	0.94	0.94	0.91	0.91	0.91	0.91
LM serial	0.294	0.010	0.023	0.013	0.300	0.084	0.0141	0.010	2.021	1.283	0.187	0.190
LM spatial	0.0001	0.0001	0.0001	0.00002	0.00003	0.000002	0.000001	0.00004	0.001	0.001	0.001	0.001
Observations	250	250	290	290	250	250	290	290	250	250	290	290
Marginal own-effect, below-average (Level effect, Interaction Effect)	0.588 (1.733, -1.145)	3.095 (-1.473, 4.569)	-5.865 (-7.081, 1.215)	-2.134 (-4.921, 2.786)	0.652 (-1.006, 1.658)	2.603 (-2.974, 5.578)	-2.768 (-5.604, 2.835)	-1.355 (-4.953, 3.598)	1.433 (-1.211, 2.645)	3.028 (-1.457, 4.485)	-0.183 (-2.287, 2.104)	0.195 (-2.012, 2.207)
Marginal own-effect, above-average (Level effect, Interaction Effect)	0.402, (-3.475, 3.877)	2.985 (-15.161, 18.146)	5.652 (-19.317, 13.664)	-1.823 (-18.017, 16.194)	0.367 (-1.340, 1.707)	2.018 (-3.739, 5.757)	-3.336 (-5.742, 2.406)	1.866 (-5.133, 3.267)	0.601 (-2.332, 2.933)	1.836 (-3.239, 5.075)	0.376 (-3.333, 3.709)	-0.787 (-3.024, 2.237)

Table 6. Equation (5) with Average of Home and Foreign Exchange Control Dummies

	Statutory Tax Rate				EATR				EMTR			
D	CMF	EXMF	CQ	EXQ	CMF	EXMF	CQ	EXQ	CMF	EXMF	CQ	EXQ
$T_{i,t-1}$	0.775*** (0.063)	0.741*** (0.067)	0.741*** (0.064)	0.747*** (0.063)	0.787*** (0.058)	0.785*** (0.056)	0.766*** (0.056)	0.772*** (0.056)	0.794*** (0.045)	0.806*** (0.045)	0.790*** (0.045)	0.790*** (0.045)
MD_{it}	-0.051 (0.040)	-0.087** (0.037)	-0.144*** (0.048)	-0.106** (0.043)	-0.042 (0.030)	-0.053* (0.028)	-0.070** (0.030)	-0.063** (0.030)	-0.046 (0.037)	-0.021 (0.031)	-0.017 (0.029)	-0.017 (0.029)
$MD_{it} A_{i,t}$	0.153 (0.118)	0.410*** (0.157)	0.065 (0.081)	0.174* (0.092)	0.176 (0.120)	0.339** (0.156)	0.015 (0.087)	0.060 (0.082)	0.412 (0.251)	0.414 (0.256)	0.154 (0.210)	0.154 (0.210)
POPOLD	0.139 (0.292)	0.344 (0.273)	0.823*** (0.286)	0.686** (0.298)	0.042 (0.209)	0.064 (0.209)	0.419** (0.192)	0.402* (0.210)	-0.166 (0.342)	-0.145 (0.363)	-0.067 (0.302)	-0.067 (0.302)
TOPINC	0.148*** (0.049)	0.149*** (0.046)	0.093** (0.036)	0.114*** (0.039)	0.088*** (0.033)	0.088*** (0.032)	0.056** (0.024)	0.063** (0.024)	0.086** (0.042)	0.081* (0.042)	0.070* (0.039)	0.070* (0.039)
SIZE	-0.247 (0.238)	-0.038 (0.255)	-0.475** (0.222)	-0.409* (0.225)	0.0009 (0.144)	0.096 (0.160)	-0.146 (0.134)	-0.137 (0.136)	-0.392 (0.303)	-0.342 (0.316)	-0.473* (0.255)	-0.473* (0.255)
UNEMPL	-0.413** (0.199)	-0.478** (0.192)	-0.273* (0.148)	-0.323** (0.156)	-0.341** (0.146)	-0.336** (0.139)	-0.222** (0.110)	-0.238** (0.114)	-0.245* (0.140)	-0.180 (0.130)	-0.127 (0.144)	-0.127 (0.114)
DEBT	0.015 (0.023)	0.024 (0.023)	0.004 (0.017)	0.009 (0.017)	0.018 (0.016)	0.022 (0.017)	0.009 (0.012)	0.011 (0.012)	0.041* (0.022)	0.037* (0.021)	0.029 (0.019)	0.029 (0.193)
Countries Dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.94	0.94	0.94	0.94	0.93	0.93	0.94	0.94	0.91	0.91	0.91	0.91
LM serial	0.110	0.018	0.065	0.020	0.202	0.098	0.123	0.013	2.169	1.777	0.515	0.510
LM spatial	0.0001	0.0002	0.0001	0.000006	0.00002	0.00001	0.00001	0.00000	0.001	0.001	0.001	0.001
Observations	250	250	290	290	250	250	290	290	250	250	290	290
Marginal own-effects (Level effects, cross-effects)	1.078 (-5.182, 6.260)	7.984 (-8.795, 16.779)	-11.716, (-14.405, 2.689)	-3.491 (-10.637, 7.146)	0.911 , (-4.272, 5.183)	4.613, (-5.377, 9.991)	-6.635 (-7.080, 0.445)	-4.617, (-6.383, 1.765)	2.208 (-4.636, 6.844)	4.734 (-2.131, 6.864)	0.811 (-1.754, 2.565)	1.388 (-1.355, 2.744)

The last row in the table reports the marginal own-effects. The interpretation of the effect is now that it is the percentage point fall in the domestic tax rate following full liberalization of capital controls in all countries.[24] These effects are negative only when Quinn's exchange control variable is used, and then when the tax variable is the statutory rate of EATR. This is consistent with the findings of earlier regressions.

IV. Conclusions

This paper has studied whether exchange controls, particularly on the capital account, affect the setting of taxes on corporate income. We have found evidence that (i) the level of a country's tax, other things equal, is lowered by a unilateral liberalization of exchange controls; and (ii) strategic interaction in taxsetting between countries is increased by liberalization. These effects are stronger if the country is a high-tax one and if the tax is the statutory or effective average one. There is also evidence that countries' own tax rates are reduced by liberalization of exchange controls in *other* countries, as well as in their own.

One limitation of the analysis of this paper is that we assume all countries take the tax policy of other countries as given when testing for strategic interaction. Another hypothesis, which we hope to study in future work, is that one country, such as the United States, or possibly a group of countries, are Stackleberg leaders.

[24] By construction, a unilateral liberalization by the home country is equal to half the marginal effect.

Table 7. Definitions, Sources, and Summary Statistics

Variable Name	Definition	Source	Number of Observations	Mean	Minimum	Maximum
U	Unemployment rate	???	315	0.078	0.0046	0.239
TRADE	The value of imports plus exports as a fraction of GDP	World Bank, World Development Indicators	315	0.561	0.139	1.3758
DEBT	Government debt as a fraction of GDP	IMF, Government Financial Statistics, OECD Economic Outlook	299	0.640	0.108	1.381
TOPINC	top rate of personal income tax	Price Waterhouse.	315	0.532	0.28	0.92
PUBCON	Public consumption as a fraction of GDP	OECD National Accounts	315	0.187	0.088	0.289
SIZE	GDP as a fraction of U.S. GDP	Datastream	315	0.123	0.007	1
POPOLD	Population 65 or over as a fraction of total population	World Bank, World Development Indicators	315	0.137	0.097	0.178
STAT	Statutory corporate tax rate	Devereux, Lockwood, and Redoano (2002)	315	0.405	0.1	0.627
EATR	effective average corporate tax rate	Devereux, Lockwood, and Redoano (2002)	315	0.291	0.052	0.438
EMTR	effective marginal corporate tax rate	Devereux, Lockwood, and Redoano (2002)	315	0.162	-0.211	0.647
CMF	0-1 indicator of capital account exchange restrictions	Grilli and Milesi-Ferretti (1995)	264	0.609	0	1
EXMF	0-4 indicator of overall exchange restrictions	Grilli and Milesi-Ferretti (1995)	264	0.799	0.25	1
CQ	0-4 indicator of capital account exchange restrictions	Quinn (1997)	315	0.851	0.375	1
EXQ	0-14 indicator of capital account exchange restrictions	Quinn (1997)	315	0.869	0.392	1

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