PRELIMINARY

Taxes and the size of the foreign-owned capital stock

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Abstract

This paper analyses the impact of effective average and marginal tax rates on the size of the capital stock owned by foreign affiliates of US multinational companies. We use data on 20 OECD countries, 1983-1998. A simple two-stage model of location choice, and investment conditional on location, identifies the role of each form of effective tax rate. The results indicate a large and significant role for the effective average tax rate, but not for the effective marginal tax rate. This is consistent with the discrete location choice playing a more important role in determining the size of the foreign-owned capital stock.

1 Introduction

Capital is becoming increasingly mobile between countries. Multinational companies face a choice of where to locate production facilities, as well as R&D and other aspects of their organisation. In response to this mobility, there is increasing pressure on governments to maintain and attract capital into their jurisdictions. Governments may attempt to do this is in many different ways - for example, creating a flexible labour market or investing in good infrastructure. This paper focuses on the extent to which differences in the taxation of mobile capital - and more specifically the role of corporate income tax - determines where productive activity is located.

Specifically, we investigate the role of corporate income tax on the distribution of capital owned by US multinational companies. The main innovation of the paper is that we consider in more detail than the previous literature the appropriate specification of a model of multinational behaviour, and the role of taxation. In common with the theoretical literature on multinational firms, and a small subset of the empirical literature on the role of tax, we distinguish two elements of the decision-making process.

We consider a multinational which aims to serve a foreign market which may transcend the boundaries of a particular country – the most obvious example is a US-based multinational seeking to serve the EU market. Given some fixed cost of setting up a plant, the multinational will not create a plant in every country, but will set up a single plant (or at least a limited number of plants) to serve the entire market. The first decision is therefore where to locate this plant. As pointed out by Devereux and Griffith (1998), who also provide evidence to this effect, this discrete choice depends in principle on the effective average corporate tax rate. Conditional on having chosen a location, however, the multinational must then choose the size of its capital stock. That is the standard problem addressed in the investment literature, and it is well known that in this case, the size of the capital stock depends in principle on the effective marginal tax rate. Of course, this distinction between the discrete and continuous choices is general, and applies to other factors as well as tax. However, in the case of most other determinants of investment, there is no clear distinction between average and marginal rates; this would be largely true of wage rates, for example. Clearly distinguishing between the role of average and marginal tax rates therefore offers an indirect way of identifying the more general issue of the relative importance of the two types of decision for the aggregate capital stock owned by US multinationals.

We examine this issue using data on the aggregate capital stock owned by affiliates of US multinational companies in each of 20 OECD countries over the period 1983 to 1998. We concentrate on this measure since it is most closely related to the decisions we attempt to analyse. A small number of other papers have also used these data to examine the impact of taxes on foreign investment by US multinational companies. We briefly review these and other papers in Section 2 below. However, none of these papers adequately measures the two relevant forms of tax rate.

Section 3 sets up a simple, stylised, model which is helpful in describing the two-stage decision process, and in identifying the two roles of taxation. It also briefly discusses how the theoretical model can be implemented empirically. Section 4 describes the data, and Section 5 discusses estimation issues and presents the results. Section 6 concludes.

2 A brief review of previous empirical approaches

The most common approach to investigating the determinants of capital movements has been to study flows for foreign direct investment (FDI). A series of papers in the 1980s considered inward FDI into the United States and estimated the impact of various measures of corporate taxation. Slemrod (1990) surveys and extends this literature. It has also been extended to consider cross sectional variation in FDI flows as well as time series variation, including the use of a panel of bilateral flows between several countries.

However, data on FDI is not well suited to examining the investment and location decisions of multinational companies. This is primarily because FDI measures financial flows, rather than real flows. For example, if a US multinational company undertakes "real" investment in, say Sweden, it may finance that investment in several ways. One of these would be to set up a Swedish subsidiary which is financed by a loan or an injection of new equity from the parent. In this case there would be a flow of funds from the USA to Sweden which would be included in the total FDI flow from the USA to Sweden. However, it is also possible that the Swedish affiliate raises funds locally, from a Swedish bank. In this case, there is no flow of funds from the USA to Sweden, and the FDI flow is unaffected. However, the capital stock in Sweden owned and controlled by US multinationals would have increased.

For these and related reasons, we therefore investigate measures of the capital stock owned by affiliates of multinational companies. Ideally, we would use firm-level data to identify separately the two stages of the decision-making process. Firm-level data has been used to examine each of the two parts of the process. Devereux and Griffith (1998) used Compustat data to examine the impact of the effective average tax rate on the discrete location choice. And a large number of papers have used firm-level data to examine the continuous choice of the level of investment, ignoring the prior decision as to where to locate the plant. One paper closest to the spirit of this paper is Cummins and Hubbard (1995) – which uses Compustat data on the investment of foreign affiliates of individual US firms. They treat these affiliates as independent firms, and consider a standard investment model, ignoring the location choice. A similar approach is taken by Grubert and Mutti (2000) and Altshuler et al (2001), using confidential US tax return data, which incorporates detailed information about the activities of individual foreign affiliates of US firms.

Another group of papers - Grubert and Mutti (1991), Wheeler and Mody (1992) and Hines and Rice (1994) - uses the same data as in this paper to examine the geographical distribution of capital owned by US firms at a more aggregate level. This data, from the US Department of Commerce, contains information on the aggregate activities of affiliates of US firms within specific foreign countries. These previous studies have implicitly incorporated all the stages of the decision-making process into one reduced form, and attempted to evaluate the impact of tax on the final capital stock or level of investment in each jurisdiction. They have typically constructed a simple measure of the average tax rate using data on taxes paid in each jurisdiction. It is therefore not possible to identify from these studies whether, say, the capital stock of US affiliates in Sweden is affected more by the discrete choice of locating in Sweden, or by the choice of how much to invest, conditional on having chosen Sweden.

Grubert and Mutti (1991) and Hines and Rice (1994) both find large and significant negative effects of the average tax rate on the aggregate capital stock of affiliates. For example, Grubert and Mutti report that a reduction in the host country tax rate from 20% to 10% would result in an increase in the capital stock of 65%. Some of the estimates from Hines and Rice are even larger. By contrast, though, Wheeler and Mody find that tax does not play a significant role in investment decisions.

3 A simple model of location choice and investment

Consider the decisions of a single monopoly, seeking to supply goods to the markets in two countries, i and j.[1] Residents in each country are immobile. Hence the two markets are segmented; there is no cross border shopping. The size of the economy in country i is normalised to unity; country j is of size n., which may be larger or smaller than 1. We assume that the monopolist must produce in one or both countries: transport costs from its home country are prohibitively high. The choice of whether to produce in country i, or country j, or both, depends on the demand in each country, the fixed costs of setting up each plant, g, and the transport costs of moving the final product between the two countries, of s per unit of output. The basic setting we have in mind is a multinational company operating in a regional setting, for example, a US company operating in Europe.

[1] This model draws on the basic structure of Horstman and Markusen (1992).

We assume a simple production function: one unit of output requires one unit of capital. Each of these two countries is small relative to the world economy: hence each takes the post-tax required rate of return on capital, denoted *r*, as given. Hence costs are the same in both countries. This is a simplifying assumption to enable us to demonstrate the impact of tax more clearly; it is relaxed in the empirical analysis below.

We assume a linear demand in each country for the output of the multinational.[2]

$$p_i = \boldsymbol{a}_i - \boldsymbol{b}c_i , \qquad p_j = \boldsymbol{a}_j - \frac{\boldsymbol{b}c_j}{n} \tag{1}$$

where p_i , p_j are the prices of the final good in the two countries and c_i , c_j are the amount of the good consumed in each country. We allow preferences to differ between the two countries by not requiring $\boldsymbol{a}_i = \boldsymbol{a}_j$. Clearly the size of the market also affects demand.

Each country imposes a standard source-based corporation tax, with tax rates $\boldsymbol{t}_i$ and $\boldsymbol{t}_j$, and with allowance rates, a_i and a_j. These allowance rates are assumed to apply both to the cost of capital and to the fixed costs. They summarise, for example, depreciation allowances and any relief for the costs of finance. However, it is convenient to translate these parameters of the tax regimes into effective marginal and average tax rates; these are defined below.

We proceed by comparing the profit that the firm will make from each of three options: (A) produce in country *i* (B) produce in country *j* (C) produce in both countries. In analysing each case we assume that the multinational does not have an existing plant in either country. If instead it already operates a plant in one or both countries, the analysis would be the same except that the fixed cost of setting up a new plant would be zero. Sine these costs are fixed, the investment decision conditional on location would not be affected; however, the choice between the three options may be affected. We discuss this further below.

[2] This can be easily derived from maximising a quadratic utility function.

Case A: Produce in country *i*

If the monopoly produces in country i, then it maximises profits defined as

$$\pi^A = (1-\tau_i)\left\{p_i c_i + (p_j - s)c_j\right\} - (1 - a_i \tau_i)\left[rK - g\right]. \tag{2A}$$

The production function is simple: $c_i + c_j = K$, where K is capital, available at cost r per unit. Exports to country j incur transport costs of s per unit. Substituting for the production function and prices from (1), and maximising profit with respect to output in each country yields:

$$c_i = \frac{\alpha_i - (1+m_i)r}{2\beta} \;\; ; \quad c_j = \frac{n(\alpha_j - s - (1+m_i)r)}{2\beta} \tag{3A}$$

Here m_i is the effective marginal tax rate:

$$m_i = \frac{\tau_i(1-a_i)}{1-\tau_i} \;\; . \tag{4}$$

This is the usual way in which the investment literature treats the effect of tax on the size of capital investment, and hence the size of the firm. In this simple model (with no depreciation), $(1+m_i)r$ is the standard user cost of capital. Given the simple production function used here, we can also write the capital stock in the two countries in this case to be:

$$K_i^A = \frac{\alpha_i - (1+m_i)r + n(\alpha_j - s - (1+m_i)r)}{2\beta}; K_j^A = 0 \tag{5A}$$

Substituting these values back into the expression for profit and rearranging gives the maximised value of the post-tax profit for case A as

$$\boldsymbol{p}^{A} = (1-\boldsymbol{t}_i)\left[\frac{\left\{\left[\boldsymbol{a}_i-(1+m_i)r\right]^2 + n\left[\boldsymbol{a}_j - s-(1+m_i)r\right]^2\right\}}{4\boldsymbol{b}} - (1+m_i)g\right]. \qquad (6)$$

To investigate the impact of taxes on the choice between the three options open to the multinational, it is useful to define an effective average tax rate: the proportion of the profit arising from the investment which is taken in tax. This could be defined with reference to (i) the profit which would have been earned had there been no tax at all; or (ii) the pre-tax profit which would be earned, conditional on the effects of tax on the level of investment. The first of these would simply be the expression in (6) with the two tax rates, $\boldsymbol{t}_i$ and m_i, set to zero. The second is a little more complicated:

$$\boldsymbol{p}^{A}_{pre}(m_i) = \frac{1}{4\boldsymbol{b}}\left\{\begin{array}{l}\left[\boldsymbol{a}_i-(1+m_i)r\right]^2 + n\left[\boldsymbol{a}_j - s-(1+m_i)r\right]^2 \\ +2m_i r\left[\boldsymbol{a}_i-(1+m_i)r\right] + n\left[\boldsymbol{a}_j - s-(1+m_i)r\right]\end{array}\right\} - g\ . \qquad (7)$$

where we explicitly write this as depending on the effective marginal tax rate, m_i. Here we define the effective average tax rate, EATR as $\boldsymbol{l}^A$, where

$$\boldsymbol{l}^A = \frac{\boldsymbol{p}^{A}_{pre}(m_i) - \boldsymbol{p}^{A}}{\boldsymbol{p}^{A}_{pre}(m_i)}\ . \qquad (8)$$

Case B: Produce in country *i*

This case is symmetric with case A. Profit is

$$\boldsymbol{p}^B = (1-\boldsymbol{t}_j)\{(p_i - s)c_i + p_j c_j\} - (1 - a_j \boldsymbol{t}_j)[(c_i + c_j)r - g]. \tag{2B}$$

Maximising profit with respect to output in each country yields:

$$c_i = \frac{\boldsymbol{a}_i - s - (1+m_j)r}{2\boldsymbol{b}} \;; \qquad c_j = \frac{n(\boldsymbol{a}_j - (1+m_j)r)}{2\boldsymbol{b}} \tag{3B}$$

The capital stocks in this case are:

$$K_i^A = 0; K_j^A = \frac{\boldsymbol{a}_i - s - (1+m_j)r + n(\boldsymbol{a}_j - (1+m_j)r)}{2\boldsymbol{b}} \tag{5B}$$

These imply that the maximised value of post-tax profit for case B is

$$\boldsymbol{p}^A = (1-\boldsymbol{t}_j)\left[\frac{\left\{[\boldsymbol{a}_i - s - (1+m_j)r]^2 + n[\boldsymbol{a}_j - (1+m_j)r]^2\right\}}{4\boldsymbol{b}} - (1+m_j)g\right]. \tag{6B}$$

As before, we define the effective average tax rate as

$$\boldsymbol{l}^B = \frac{\boldsymbol{p}^B_{pre}(m_j) - \boldsymbol{p}^B}{\boldsymbol{p}^B_{pre}(m_j)} \tag{8B}$$

where

$$\boldsymbol{p}^B_{pre}(m_j) = \frac{1}{4\boldsymbol{b}}\left\{\begin{array}{l}[\boldsymbol{a}_i - s - (1+m_j)r]^2 + n[\boldsymbol{a}_j - (1+m_j)r]^2 \\ + 2m_j r[\boldsymbol{a}_i - s - (1+m_j)r] + n[\boldsymbol{a}_j - (1+m_j)r]\end{array}\right\} - g\,. \tag{7B}$$

Case C: Produce in both countries

The third possibility is that the multinational chooses to produce in both countries, and supplies the market in each country without the need to transport the final goods between countries. This implies setting up two plants, with two fixed costs. Profit is again a straightforward extension of Case A:

$$\pi^C = (1-\tau_i)p_i c_i - (1-a_i\tau_i)[c_i r - g] + (1-\tau_j)p_j c_j - (1-a_j\tau_j)[c_j r - g]. \tag{2C}$$

Maximising profit with respect to output in each country yields the output and the capital stock in each country:

$$c_i = K_i^C = \frac{\alpha_i - (1+m_i)r}{2\beta}\ ; \quad c_j = K_j^C = \frac{n(\alpha_j - (1+m_j)r)}{2\beta} \tag{3C}$$

These imply that the maximised value of post-tax profit for case C is

$$\begin{aligned}\pi^C &= (1-\tau_i)\left[\frac{[\alpha_i - (1+m_j)r]^2}{4\beta} - (1+m_i)g\right] \\ &\quad + (1-\tau_j)\left[\frac{[\alpha_j - (1+m_j)r]^2}{4\beta} - (1+m_j)g\right].\end{aligned} \tag{6C}$$

In this case, the effective average tax rate in both countries may affect profit. Define $\pi_{i,pre}^C(m_i)$ and $\pi_{j,pre}^C(m_j)$ to be the pre-tax profits which would be earned under Case C in countries i and j, respectively. Then the effective average tax rates are defined from:

$$\pi^C = (1-\lambda_i^C)\pi_{i,pre}^C(m_i) + (1-\lambda_j^C)\pi_{j,pre}^C(m_j). \tag{8C}$$

Note that these measures are not necessarily the same as those in the previous two cases, since the effective average tax rate depends on the level of profit earned.

The discrete choice: A, B or C

The analysis until now has described the second part of a two-stage approach. That is, conditional on choosing one of the three options, we have identified the optimal investment in each country and the maximised value of post-tax profit. We now analyse the first stage: the multinational chooses between the three options in order to maximise post-tax profit. Following such a strategy, the firm's profit will be

$$\begin{aligned} \boldsymbol{p} &= \max\left\{\boldsymbol{p}^{A}, \boldsymbol{p}^{B}, \boldsymbol{p}^{C}\right\} \\ &= \max\left\{\begin{matrix}(1-\boldsymbol{l}^{A})\boldsymbol{p}^{A}_{pre}(m_i), (1-\boldsymbol{l}^{B})\boldsymbol{p}^{B}_{pre}(m_j), \\ (1-\boldsymbol{l}^{C}_{i})\boldsymbol{p}^{C}_{i,pre}(m_i) + (1-\boldsymbol{l}^{C}_{j})\boldsymbol{p}^{C}_{j,pre}(m_j)\end{matrix}\right\}. \end{aligned} \tag{9}$$

where we explicitly write this in terms of the effective average tax rate in order to highlight the role of this measure of tax in the discrete choice.

Existing plants

If the multinational has existing plants in either country, then it is reasonable to suppose that it can expand capacity at the existing plant, rather than setting up a new plant. This is most simply modeled by assuming that such expansion does not incur the fixed cost, g. Note that this does not affect the optimal capital stocks conditional on the choice of where to invest. However, it is clearly the case that the absence of a fixed cost may affect the discrete choice of where to invest.

The most obvious case is Case C. If the multinational has existing plants in both countries, then it can eliminate both fixed costs and transport costs by following strategy C; and in this case, Strategy C is likely to dominate both A and B. Comparing (6A), (6B) and (6C) with $g=0$ implies that strategy C yields higher profit unless the effective average tax rate is so much higher in one country – say i - that the multinational would prefer to locate only in j and export to i. Thus the fact that the multinational has existing plants does not affect the basic role of tax: it remains the case that differences in the effective average tax rate are one determinant of the location choice.

Aggregation

In this paper we aim to examine the determinants of the foreign-owned capital stock in each country. We do not have data on individual firm decisions, but only on the aggregate capital stock in each country owned by US multinational companies. We therefore need to consider the aggregation of the discrete and marginal choices.

In aggregating, we must allow firms to differ from each other; otherwise they would all make the same choice. We can in principle allow firms to differ according to (a) national preferences for the final good – summarised by a_i and a_j; (b) transport costs, s; and (c) fixed costs, g. However, allowing variation in either preferences or transport costs would clearly imply that consumption of the final product, and hence the capital stock, also varies across firms. We therefore introduce a further superscript h to denote the capital stock and output of firm h.

We summarise the position by ordering firms according to whether the conditions they face mean that they would choose A, B or C. Specifically, suppose that there are N firms. The first N_A firms choose A, the next N_B firms choose B and the remainder choose C. This allows us to summarise the total capital stock which will result in each country:

$$K_i = \sum_{h=1}^{N_A} K_i^{Ah} + \sum_{h=N_A+N_B}^{N} K_i^{Ch} . \qquad (10)$$

$$K_j = \sum_{h=N_A+1}^{N_B+N_B} K_j^{Bh} + \sum_{h=N_A+N_B}^{N} K_j^{Ch} .$$

where the capital stocks of the individual firms in each case are defined in (5A), (5B) and (3C). Clearly, the main role of tax is (a) the individual capital stocks, conditional on choice of location, are determined by the effective marginal tax rates; while (b) the location choices – the number of firms choosing each option – depend primarily on the effective average tax rates.

Empirical specification

We aim to investigate how taxes affect the size of the capital stock owned by US multinationals in other OECD countries. The basic idea of the empirical specification is embedded in (10). The number of firms following each strategy depends on the effective average tax rate, while the capital stock conditional on location choice depends on the effective marginal tax rate. However, there are a number of steps to be considered in formulating an empirical relationship. We consider four issues here.

i Control variables

Each stage of the decision may depend on a number of factors. As in a standard investment model, the continuous choice of the level of investment depends on its expected rate of return; this is clearly consistent with the analysis above. In a standard empirical model, this expected rate of return can be proxied by various characteristics, such as the current or past rate of profit, or Tobin's (average) Q. We have data on aggregate sales and net income of the affiliates in each country; following the investment literature, we include the aggregate net income, lagged by one period. This is denoted $p_{i,t-1}$, as for the single firm above.

The first stage location decision clearly also depends on the expected rate of profit, but here the focus is on how countries differ from each other. In principle, relevant variables would include measures of country size, openness, the size of existing production activity in that country/industry, which might be expected to generate positive externalities in production, demographics and differences in costs across countries. We denote these variables $\boldsymbol{X_{vt}}$; the precise variables used are set out below.

ii More than two countries

In practice we have data on 20 countries which host affiliates of US companies. Prior to allowing for the effects of tax, it is unlikely that all these countries are equally likely to host the investment. This implies that the relevant tax rate is that in country *i* relative to that in the main alternative location. Of course, the alternative location is unknown. We therefore follow the empirical tax competition literature in allowing the decision to invest in *i* depend on a weighted average of tax rates in other countries. The weights used here is GDP.

iii Functional form

The model above uses a specific functional form to generate a simple relationship between the capital stock and the effective marginal tax rate, conditional on location choice. However, the appropriate form for incorporating the discrete location choice as well as the continuous investment choice is less clear, since it depends on the distribution of the characteristics of the firms. In the empirical analysis below, we assume a linear relationship between the level of investment and each form of tax rate.

iv Dynamics

One of the issues discussed above is the possibility of avoiding the fixed costs of plant setup if an existing plant already exists; clearly that makes it more likely that the multinational will choose the location of the existing plant. A related issue here is whether we should attempt to explain the level of the capital stock in any period, or additions to the capital stock. On the grounds that the capital stock may have been installed in previous years, it seems reasonable to attempt to explain the level of investment in any period. To allow for existing plants, we include the beginning of period capital stock as an explanatory variable.[3]

4 Data

Our data on the investment positions of US multinationals is from the Bureau of Economic Analysis of the US Department of Commerce. This provides data on the aggregate operations of foreign affiliates of US parent companies. Most of the variables are available aggregated to the level of individual countries (they are also available by industry). We have extracted data from this source on the aggregate value of the capital stock owned by the affiliates of US parents in 20 OECD countries over the period 1983 to 1998. In addition, we have also extracted data on sales and net income.

Figure 1 gives an indication of the size of the capital stock owned by affiliates of US multinationals in each country; the Figure presents the mean capital stock over the period analysed, 1983 to 1998, for each country, in 1995 prices ($billion). There is clearly a very unequal distribution across countries. On average, over this period, the value of the capital stock in the UK and Canada was far larger than elsewhere, with over $50 billion. Only three other countries - Germany, Australia and France – had an average in excess of $10 billion.

Figure 2 shows the total net investment into these countries over time (as measured by the difference in the capital stock between successive years); and also the mean value of the capital stock across all the countries. The mean capital stock roughly tripled in real terms over this period. However, the total investment line shows that this rise was a volatile process, with high investment in the late 1980s and again in the mid 1990s, but also with periods – notably in 1991/2 - where there was a net reduction in the aggregate real capital stock.

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[3] In practice, there is no separate variable for investment; hence investment can only be approximated as the change in the capital stock between periods. The model estimated is therefore a reparameterisation of the case in which the dependent variable is the capital stock in period t, and a lagged dependent variable is included.

We use data on the corporation tax regimes of 20 OECD countries over the period 1983 to 1998. There are two broad approaches to the measurement of effective tax rates on capital income. One is based on the ratio of tax payments to a measure of the profit of the company, or at aggregate level, to the operating surplus of the economy. This approach is not ideal for analyzing the impact of taxes on investment flows, for several reasons. First, at best it is a measure only of an effective average tax rate, and so does not measure either the statutory rate or the EMTR. Second, it does not necessarily reflect the impact of taxes on the incentive to invest in a particular location, because tax revenues depend on the history of past investment and profit and losses of a firm. Third, this measure – especially at the aggregate level - can vary considerably according to underlying economic conditions, even when tax regimes do not change; the variation is therefore due to factors outside the immediate control of the government. Fourth, at a more disaggregated level, then the amount of tax paid is endogenous: higher investment generates a higher allowance and hence lower tax.

The tax rate measures used in this paper are therefore based instead on an analysis of the legislation underlying different tax regimes. We use the measures of the effective average tax rate and effective marginal tax rate proposed by Devereux and Griffith (2003), which broadly correspond to those set out in Section 2. Following the standard approach, they consider the taxation of a hypothetical unit perturbation to the capital stock. In this paper, we consider investments in buildings and in plant and machinery, financed by equity and debt. we take a weighted average of the effective tax rates for each of these four different types of investment.[4]

We construct the EATR, the cost of capital and also the effective marginal tax wedge – equal to the difference between the cost of capital and the real rate of interest – using data on the statutory tax rate, ô, and the allowance rules, for all the observations for which we have the BEA data ie. 20 OECD countries between 1983 and 1998. These data have also

[4] Following Chennells and Griffith (1997), the weights are assumed to be: plant and machinery 64%, industrial buildings 36%; and equity 65%, debt 35%.

been used in other studies: see, for example, Devereux, Griffith and Klemm, (2002) and Devereux, Lockwood and Redoano (2004). More details of their construction are given in these papers. Briefly, the statutory rate is typically the headline rate of corporation tax. However, in many countries there are additional local corporation taxes (typically using a very similar tax base), which vary within each country. Where appropriate, we have included "typical" local taxes. The cost of the increased capital stock is offset by tax allowances, defined by the legislation. The additional revenue is taxed under the statutory tax rate. In the empirical analysis below, we use the cost of capital instead of the effective marginal tax rate. This is because there are cases where the denominator of the effective marginal tax rate – the real rate of interest - is close to zero, which generates very high values of the effective marginal tax rate.

Figures 3-5 below show key features of our tax rate variables. As shown in Figure 3, which presents the statutory rate for each country in both 1983 and 1998, almost all countries have reduced their statutory rates, many significantly. It is interesting to note that Germany, essentially the last country in 1998 with a high tax rate, has subsequently cut its tax rate substantially. Ireland is the only country which stands out from the others - here we have used the special 10% rate for manufacturing used in Ireland throughout the period analysed.

Figure 4 presents our estimates of effective average tax rates, in the same format. This measure has also tended to fall in most countries, in some cases substantially. However, the rate-reducing, base-broadening reforms which occurred in many countries have not had such a dramatic effect on effective tax rates as on the statutory rate, due to the offsetting effect of the broader base. This is even more apparent in the case of the effective marginal tax wedge, shown in Figure 5, where in many countries there has actually been an increase over the period considered. For example, the 1984 tax reform in the UK substantially reduced capital allowances on both types of asset analysed here; in computing the tax wedge this outweighs the very substantial reduction in the statutory rate which occurred at the same time. A thorough description of the development of these taxes is provided in Devereux, Griffith and Klemm (2002).

Finally, it is worth noting that we do not incorporate international aspects of tax, such as taxes levied by the USA on repatriation of profit. The main reason is that there is plenty of evidence that multinational companies are skilled at tax planning. This implies that the straightforward calculation of effective tax rates taking into account additional taxes at an international level may be seriously misleading. We believe that a more reasonable approach is to assume that multinational firms typically avoid any further tax at an international level. Hence we include only the taxes levied in the source country.

Table 1 summarises the data used in this paper. As well as the data on US affiliates and the measures of taxation, we use a number of country-specific control variables which reflect other influences on the location choices. We include a measure of country size (GDP relative to the USA); two measures of openness (the trade to GDP ratio, and a dummy variable indicating whether there are significant capital controls[5] – this is based on data from Quinn 1997, and takes the value of 1 in the absence of controls, and 0 in the presence of controls); the size of the government sector, proxied by the ration of public consumption to GDP; and a number of demographic variables.

5 Econometric specification and results

We estimate the following model:

$$I_{it} = b_1 K_{i,t-1} + \hat{a}_2 p_{it} + \mathbf{X_{it}} \hat{\mathbf{a}}_{\mathbf{3}} + \mathbf{T_{it}} \tilde{\mathbf{a}} + h_i + h_t + e_{it} \qquad (11)$$

where $\mathbf{T_{it}}$ represents the various tax rate measures used, h_i is a country-specific fixed effect and h_j is a fixed year effect. It is likely that, given some serial correlation in the error term, that lagged income and the lagged capital stock are endogenous: we therefore instrument these variables using their own lags, and the lag of sales, from period *t-2*. We present a test of the over-identifying restrictions implied by the instruments. We cluster standard errors by country to account for any remaining serial correlation (we also present a test of serial correlation); standard errors are also robust to heteroscedasticity. We estimate the model in levels, including dummy variables to account for the fixed effects.

The results are presented in Table 2. We begin in columns 1 to 3 by including the three measures of tax separately: the effective average tax rate (column 1), the statutory rate (column 2) and the cost of capital (column 3). We include the real interest rate in the first two columns: this is replaced by the cost of capital in column 3. In each case we also include the weighted average of the relevant tax rate in other countries, where the weight used is GDP. The hypothesis is that a high tax rate in other countries increases the likelihood of locating in country *i*. In all cases, we include lagged capital stock, lagged net income, and the control variables. All the specifications in Table 1 comfortably pass the test of over-identifying restrictions. They also marginally pass the test of serial correlation; but the standard errors are in any case clustered to account for serial correlation.

The income of the affiliates in country *i* in period *t-1* generally has a positive and significant effect on investment in country *i*. This is consistent with standard investment models, where this term is proxying for the expected profit of current investment. Several of the control variables are also significant across the whole table. Abolishing capital controls has a strongly significant and positive impact on investment by US affiliates: for example, in column 1, removing such controls would yield higher investment of over $800 million (in 1995 prices). Conditional on this effect, though, the trade to GDP ratio has a negative impact on investment. This may reflect substitution on the part of the US multinationals between exporting from the US and producing locally. Finally, the size of the public sector, measured by the public consumption to GDP ratio, has a negative impact on investment.

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[5] The precise variable we use is described in more detail in Devereux, Lockwood and Redoano (2004).

Column 1 demonstrates that the effective average tax rate has a negative and significant impact on investment, as predicted by the location choice part of the model in Section 2. However, the weighted average of effective average tax rates in other countries is not significant. The size of the effect of the host country tax rate is very substantial. A one percentage point reduction in the effective average tax rate implies an increase in investment of $70 million (1995 prices) – compared to the mean of $779 million, this is a 9% rise. This corresponds to an elasticity, evaluated at the mean, of around 2.6.

Column 2 substitutes the statutory rate in place of the effective average tax rate. Note that these two rates are fairly highly correlated – not surprisingly, then, the statutory rate has similar (although slightly smaller) effects to the effective average tax rate.

This contrasts significantly with column 3, where the cost of capital is used in place of the other tax rates. The cost of capital is not significant. Given the two-stage model described in Section 2, this strongly suggests that it is the first stage which has the more decisive impact on the level of the capital stock. This would be consistent with the case in which the scale of the plant is relatively fixed, and does not depend on the effective marginal tax rate; indeed, this result is broadly consistent with most of the large empirical literature on the impact of taxes on the level of investment. However, in contrast to this literature, the effective average tax rate appears to play an important role in the location decision; and it is the location decision which appears to determine the ultimate size of the capital stock in each location.

The remaining three columns explore this result further. Column 4 includes all three measures of taxation; column 5 includes the effective average tax rate and the statutory rate; and the last column is closest to the model set out in Section 2, by including both the effective average tax rate and the cost of capital. The broad conclusions are not affected. For example, in column 6, it remains the case that the coefficient on the effective average tax rate is large and significant, whilst that on the cost of capital is not significant.

One possible alternative explanation for these results is that multinational companies primarily take into account only the statutory rate. In a world where profit shifting is relatively easy, then it may be the statutory rate which is critical in determining the overall level of tax on the multinational's activities. However, this is not borne out by the results in column 5. There, the effective average tax rate continues to play a marginally significant role, even in the presence of the statutory rate, although the size of the coefficient is smaller than in column 1. But the statutory rate is not significant.

6 Conclusions

This paper has re-examined the role of taxes in determining the size of the foreign-owned – specifically owned by US multinationals - capital stock in OECD countries. Its main contribution is to examine carefully the decision-making process of multinational companies, and to address the particular form of effective tax rate relevant for each part of the decision. It sets out a simple model of a two-stage process. In stage 1, the company makes a discrete location choice, which is affected by the effective average tax rate. In stage 2, conditional on the location choice, the company chooses the scale of its investment, a decision affected by the effective marginal tax rate.

The empirical results indicate a large and significant impact of the effective average tax rate, but no statistically significant impact of the effective marginal tax rate. Indirectly, this suggests that the more important part of the decision-making process is the first stage. The decision as to where to locate seems to be a fine one, easily affected by differences in taxation. However, conditional on location, there is no evidence of any impact of taxation on the scale of investment.

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Table 1: Data Description

variable	description	mean	standard deviation
Data on Affiliates of US multinationals, from Bureau of Economic Analysis			
K_{it}	capital stock (property, plant and equipment) of affiliates of US multinational companies in period t, country i (billion $ 95)	10.77	16.85
$invest_{it}$	net investment in period t, country i = $K_{it} - K_{i,t-1}$, (billion $ 95)	0.779	2.03
p_{it}	net income of affiliates of US multinational companies in period t, country i (billion $ 95)	2.56	3.31
Y_{it}	net sales of affiliates of US multinational companies in period t, country i (billion $ 95)	47.9	60.5
Tax rate data			
$EATR_{it}$	effective average tax rate in period t, country i; as described in the text	28.9	7.70
$EATR_{-i,t}$	mean $EATR_{it}$ for all other countries in period t, weighted by GDP	32.75	1.22
t_{it}	statutory corporation tax rate in period t, country i	40.2	11.4
$\bar{t}_{-i,t}$	mean t_{it} for all other countries in period t, weighted by GDP	44.2	3.41
$cost\ of\ capital_{it}$	pre-tax required rate of return = real rate of interest, plus marginal tax wedge, period t, country i	11.50	3.54
$cost\ of\ capital_{-i,t}$	mean cost of capital for all other countries in period t, weighted by GDP	9.12	3.42
Controls			
r_{it}	real interest rate in period t, country i	6.55	2.73
DCQ_{it}	Dummy variable measuring extent of capital controls in period t country i; data from Quinn (1997)	0.61	0.49
$size_{it}$	GDP_{it} as a proportion of USA GDP_t	0.079	0.097
$tradegdp_{it}$	(imports + exports)/GDP in period t, country i	0.59	0.26
$popyou_{it}$	proportion of population under 14 in period t, country i	0.19	0.027
$popold_{it}$	proportion of population over 65 in period t, country i	0.14	0.020
$popurb_{it}$	proportion of population living in urban areas in period t, country i	0.75	0.127
$pconsgdp_{it}$	public consumption as a proportion of GDP in period t, country i	0.187	0.042

Table 2: Results

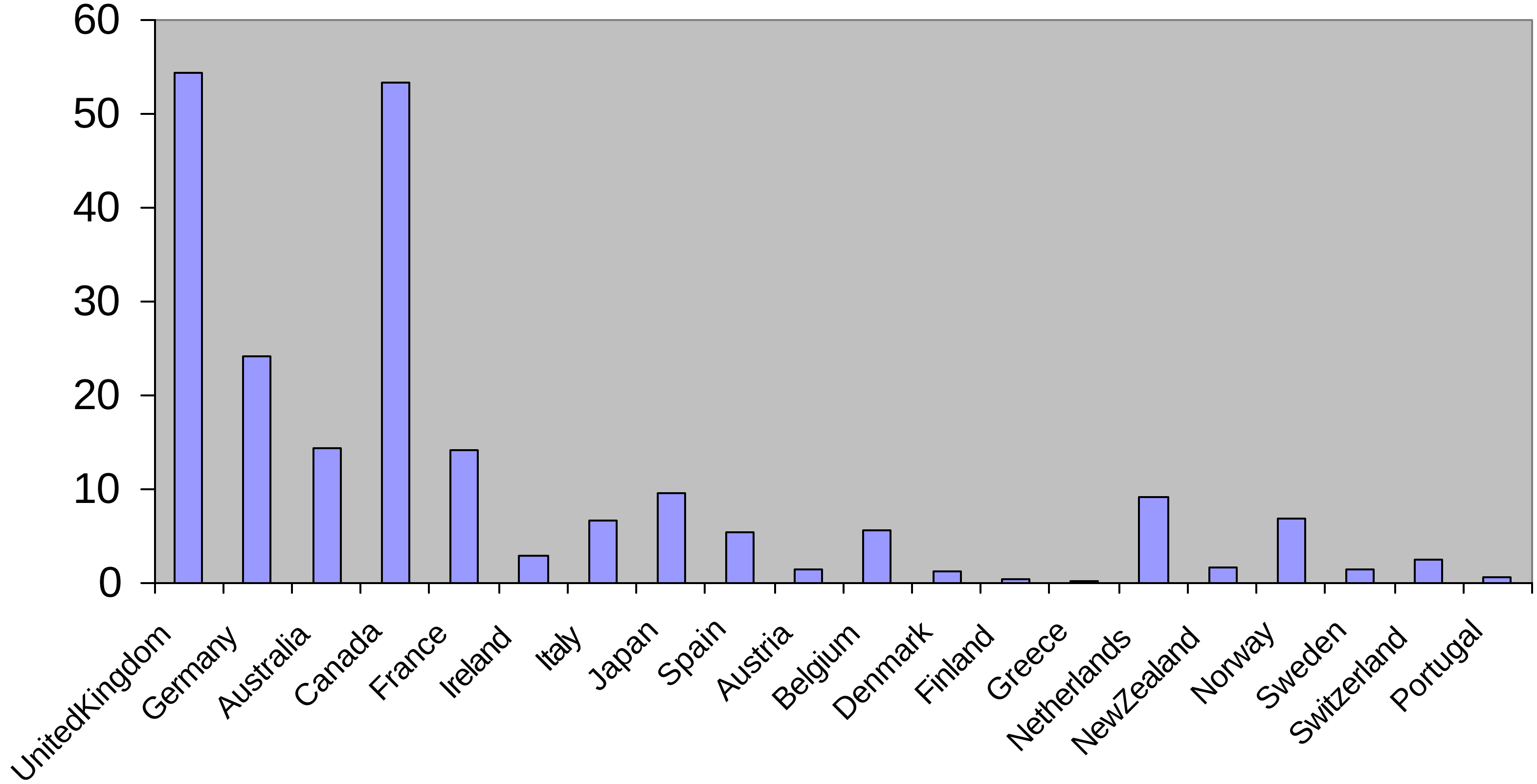
Dependent variable: $Invest_{it}$

$EATR_{it}$	-0.071			-0.043	-0.040	-0.068
	(2.85)*			(1.76)	(1.85)	(2.59)*
$EATR_{-i,t}$	-0.090					
	(0.20)					
t_{it}		-0.050		-0.028	-0.029	
		(2.42)*		(1.38)	(1.55)	
$\bar{t}_{-i,t}$		0.078				
		(0.13)				
$cost\ of\ capital_{it}$			0.022	-0.005		-0.021
			(0.54)	(0.11)		(0.51)
$cost\ of\ capital_{-i,t}$			0.530			
			(1.02)			
$K_{i,t-1}$	-0.052	-0.054	-0.068	-0.052	-0.052	-0.053
	(0.72)	(0.73)	(0.87)	(0.74)	(0.74)	(0.75)
$p_{i,t-1}$	0.556	0.567	0.538	0.564	0.564	0.556
	(2.19)*	(2.18)*	(2.08)	(2.19)*	(2.20)*	(2.19)*
r_{it}	-1.855	3.852				
	(0.32)	(0.80)				
DCQ_{it}	0.842	0.732	0.837	0.764	0.763	0.837
	(2.16)*	(1.97)	(1.95)	(2.13)*	(2.12)*	(2.24)*
$size_{it}$	13.657	10.000	14.921	11.728	11.737	14.133
	(0.79)	(0.63)	(0.98)	(0.75)	(0.76)	(0.87)
$tradegdp_{it}$	-4.006	-3.687	-3.125	-4.145	-4.084	-4.079
	(2.35)*	(2.15)*	(1.62)	(2.52)*	(2.29)*	(2.54)*
$popyou_{it}$	-17.771	-20.130	-8.320	-21.173	-21.060	-18.107
	(0.76)	(0.88)	(0.32)	(0.93)	(0.93)	(0.78)
$popold_{it}$	-13.093	-14.754	-18.124	-13.207	-13.383	-11.925
	(0.35)	(0.43)	(0.51)	(0.39)	(0.40)	(0.35)
$popurb_{it}$	-0.665	0.394	1.554	-0.294	-0.241	-0.856
	(0.10)	(0.07)	(0.23)	(0.05)	(0.04)	(0.14)
$pconsgdp_{it}$	-27.589	-27.547	-25.437	-28.202	-28.214	-27.562
	(1.99)	(2.05)	(1.81)	(2.04)	(2.05)	(2.00)
over-id test	0.030	0.000	0.143	0.020	0.017	0.031
ser. corr	0.063	0.066	0.033	0.067	0.067	0.062
Observations	280	280	280	280	280	280
R-squared	0.50	0.50	0.49	0.50	0.50	0.50

Notes.

1. All columns include country fixed effects and year effects. There is a balanced panel of 20 countries and 14 years, 1985 to 1998. (Earlier years are used for lagged variables).
2. Robust t statistics in parentheses, * significant at 5%. Standard errors clustered by country.
3. $K_{i,t-1}$ and $p_{i,t-1}$ are treated as endogenous. Instruments are: $p_{i,t-2}$, $K_{i,t-2}$ and $Y_{i,t-2}$. The test of over-identifying restrictions is distributed as $c^2(1)$ (with a critical value of 3.84 at the 95% confidence level); see Wooldridge (2002).
4. The test for serial correlation shows the p-value of the significance of the lagged residuals included in a regression of the dependent variables on the explanatory variables: see Wooldridge (2002).

Figure 1. Mean Capital Stock owned by Affiliates of US Multinationals, 1983-1998 ($billion, 1995)



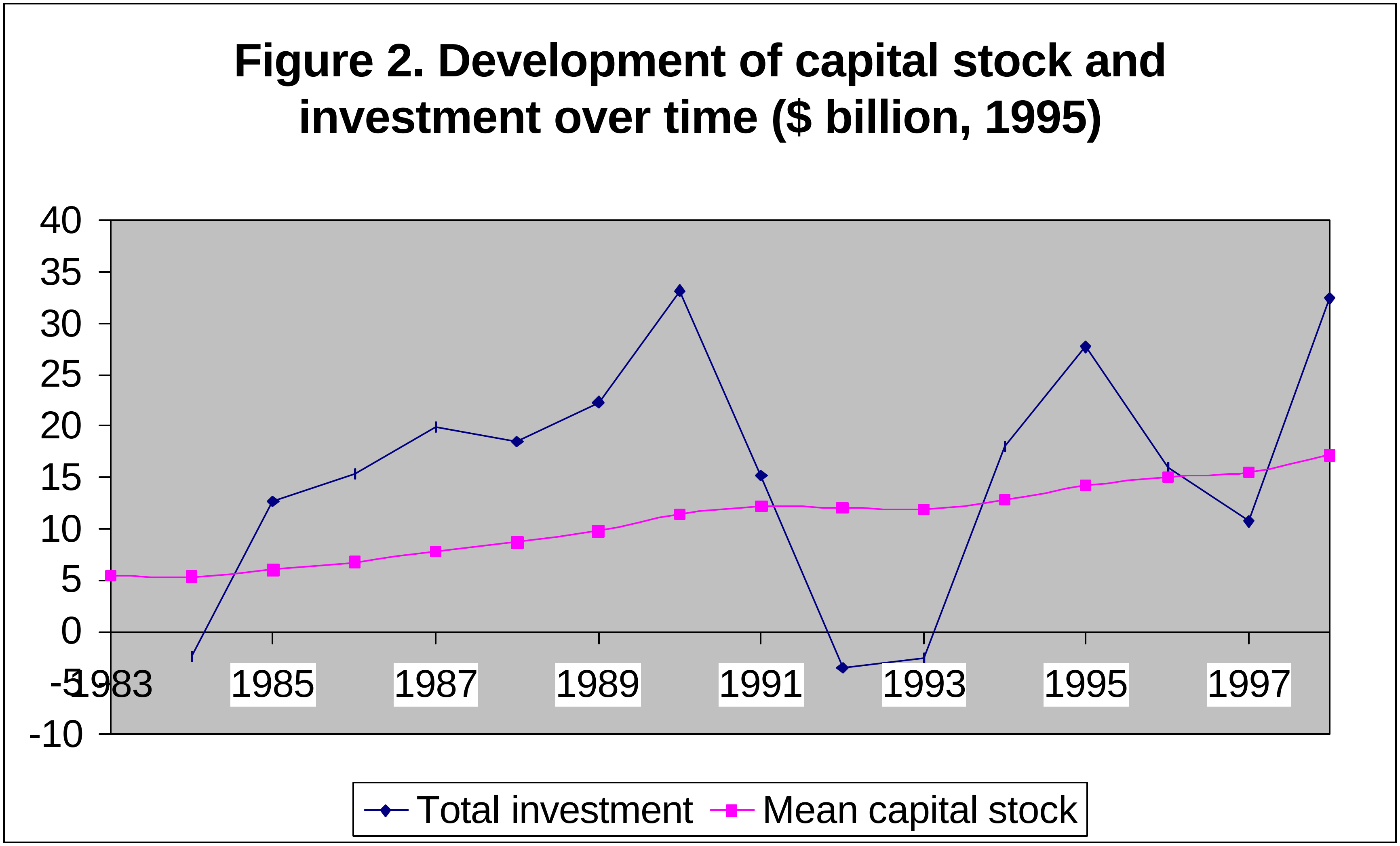


Figure 2. Development of capital stock and investment over time ($ billion, 1995)
40
35
30
25
20
15
10
5
0
-5
-10
1983
1985
1987
1989
1991
1993
1995
1997
Total investment
Mean capital stock

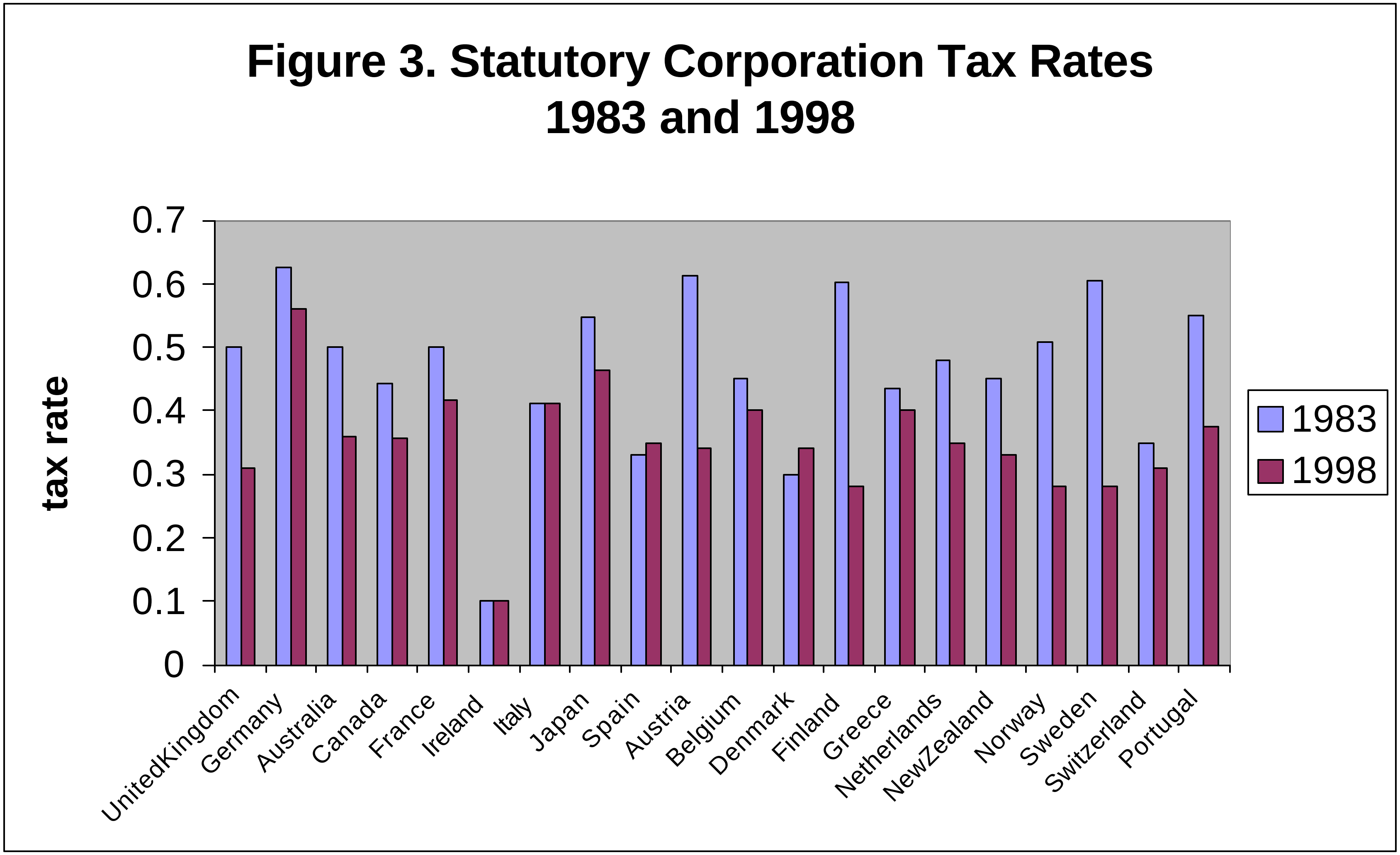
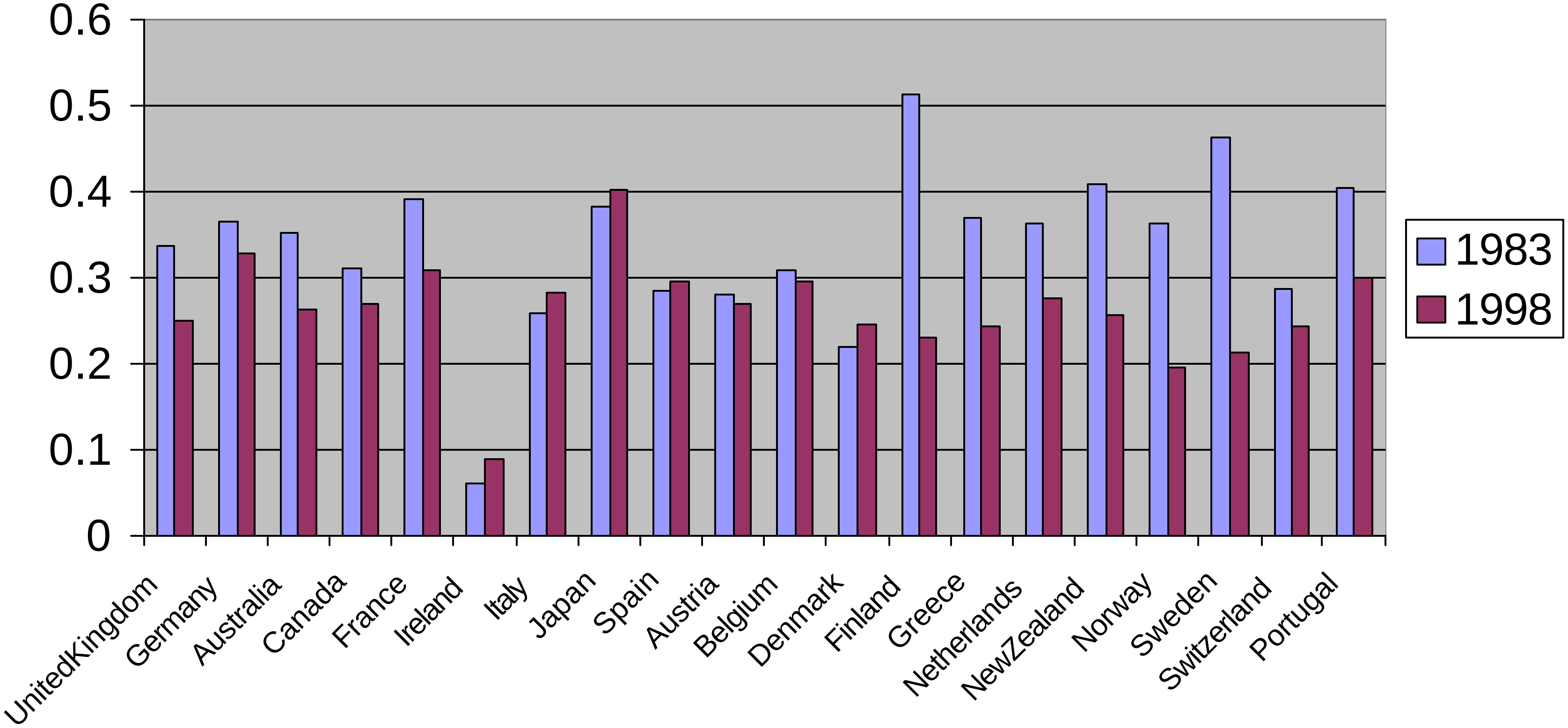


Figure 3. Statutory Corporation Tax Rates
1983 and 1998
tax rate
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
UnitedKingdom
Germany
Australia
Canada
France
Ireland
Italy
Japan
Spain
Austria
Belgium
Denmark
Finland
Greece
Netherlands
NewZealand
Norway
Sweden
Switzerland
Portugal
1983
1998

Figure 4. Effective Average Tax Rates 1983 and 1998



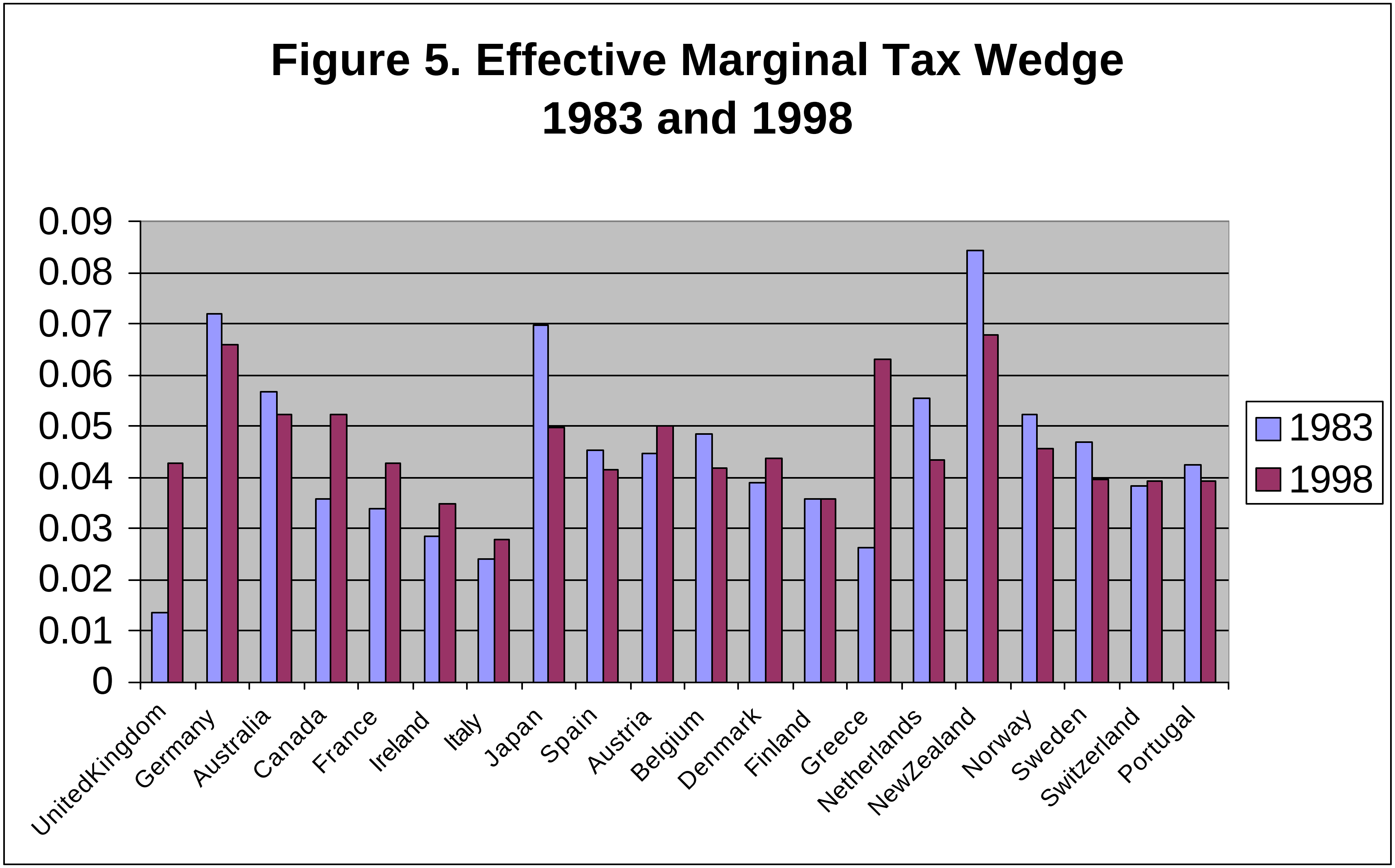


Figure 5. Effective Marginal Tax Wedge
1983 and 1998
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
UnitedKingdom
Germany
Australia
Canada
France
Ireland
Italy
Japan
Spain
Austria
Belgium
Denmark
Finland
Greece
Netherlands
NewZealand
Norway
Sweden
Switzerland
Portugal
1983
1998