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Has U.S. Investment Abroad Become More Sensitive to Tax Rates?

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This paper attempts to address two related questions. The first question is how sensitive U.S. firms' investment location decisions are to tax rate differences across countries. Finding the answer to this question clearly is important for determining the revenue and efficiency consequences of many tax policies. The second question is whether the location of investment abroad by U.S. firms has become more sensitive to tax rate differences across countries. A finding that investment location decisions have become more sensitive to tax rates would be consistent with the view that technological advances and the loosening of trade restrictions and capital controls have in recent years increased the ease with which capital can cross national borders. If different locations became closer substitutes for the location of production, it would not be surprising if investment location decisions became increasingly responsive to tax considerations.

We use data from the U.S. Department of the Treasury corporate tax return files for 1984 and 1992 to address these questions. The use of these data yields two benefits not available to recent cross-sectional studies of the effect of host-country tax rates on the distribution of U.S. direct investment abroad (e.g., Grubert and Mutti 1991, 1997; and Hines and Rice 1994). The first benefit is that, with the time element in our data, we can examine whether investment location choices abroad have in fact become

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more sensitive to tax rates over the period spanned by our two sample years. The second benefit is that we can control for unmeasured country fixed effects.

Our data come from the information forms filed with the tax returns of U.S. parent corporations on each controlled foreign corporation (CFC) abroad.[1] This information form, to be described more fully later, includes details from the balance sheets and income statements of CFCs. We aggregate these data up to country level and combine it with information from a variety of other sources to control for nontax features of different locations. The data include information for almost sixty countries. We limit our analysis to the manufacturing CFCs of U.S. manufacturing parents.

Following the earlier studies by Grubert and Mutti (1991, 1997) and Hines and Rice (1994), we regress a measure of U.S. multinational firms' real capital in each country on tax rate variables and measures of nontax characteristics of each country. The focus is on the effect of differences in host-country tax rates on investment choices across foreign locations, not on the choice between investing at home or abroad. Our work has two main findings. First, we find large estimated tax elasticities for investment abroad. Controlling for country fixed effects produces tax elasticities that are slightly larger and more precisely estimated than those from our single-year cross sections. Second, our results suggest that the location of real capital in manufacturing affiliates has become more sensitive to tax rates in the period from 1984 to 1992. Our basic estimates indicate that the elasticity of real capital to changes in after-tax returns increased from about 1.5 in 1984 to 2.8 in 1992 (for countries with the most open trade regimes). Both the elasticities and the difference between them are statistically significant at standard levels.

We perform a variety of tests to check the robustness of our elasticity estimates. With few exceptions, the magnitude and significance of our 1992 and 1984 elasticities changes little when we screen our sample in various ways or change the measure of host-country taxes. The difference between the 1984 and 1992 elasticities is large in absolute terms and is statistically significant; and its absolute and statistical significance is robust to our sensitivity checks.

The remainder of the paper is organized as follows. Section 1.1 contains a brief review of studies using cross-sectional data to estimate tax effects on location decisions of U.S. multinational corporations. We highlight the elasticity estimates in previous studies and note that they provide suggestive but inconclusive evidence that investment location has become more sensitive to tax rates in recent years. Section 1.2 describes the data and

1. A CFC is a foreign corporation that is at least 50 percent owned by a group of U.S. shareholders, each of whom has at least a 10 percent interest in the company. In fact, most of the CFCs in our sample are 100 percent owned by the U.S. parent corporation.

how our tax and capital measures are constructed from the U.S. Department of the Treasury tax files. Empirical results are contained in section 1.3, and the final section presents our conclusions.

1.1 A Brief Review of the Recent Literature

While early studies of the responsiveness of U.S. direct investment to after-tax rates of return used aggregate time series data,[2] the most recent work in this area exploits cross-sectional data. In this section, we review the three studies that relate most directly to our approach: Grubert and Mutti (1991), Hines and Rice (1994), and Grubert and Mutti (1997). All three papers contain estimates of the effect of local taxes on the allocation of real capital. While the tax variable in these papers is similar (each uses a measure of average effective tax rates), it appears in different forms in the estimating equations, making the comparison of estimated tax effects difficult.

Both Grubert and Mutti (1991) and Hines and Rice (1994) use the 1982 benchmark data on U.S. direct investment abroad from the Bureau of Economic Analysis (BEA). One important difference between these two papers is the sample studied. Grubert and Mutti analyze the allocation of capital by manufacturing affiliates of U.S. parents across thirty-three host countries; the focus of Hines and Rice is on the activity of U.S. multinationals in tax havens. Their sample includes all majority owned nonbank affiliates of U.S. parents, which results in a larger set of countries (seventy-three), more than half of which (forty-one) are tax havens with little real capital.[3]

Grubert and Mutti (1991) regress the log of the net stock of property, plant, and equipment (PPE) on two different forms of the average effective tax rate: the log of 1 minus the tax rate, and the inverse of the tax rate. The first specification gives a (constant) tax elasticity that measures the sensitivity of the demand for real capital to changes in after-tax returns (for a given pretax return) or, alternatively, to changes in the cost of capital (for given after-tax returns). The second specification allows for larger tax effects at lower tax rates. Using the first specification, Grubert and Mutti estimate tax elasticities that range from 1.5 (for all manufacturing affiliates) to 2 (for majority owned manufacturing affiliates) but that were statistically not highly significant. The inverse formulation, however, produced a highly significant tax coefficient of -0.11. At lower tax rates, this

2. This work includes Hartman (1981), Boskin and Gale (1987), and Newlon (1987). The literature on the effects of taxation on foreign direct investment abroad has been carefully reviewed in Hines (1997). This review does not include the recent work in Grubert and Mutti (1997), however.

3. Hines and Rice report that 4.2 percent of all property, plant, and equipment is located in the tax havens in 1982.

tax effect is particularly strong. Grubert and Mutti report that reducing local tax rates from 20 to 10 percent will increase U.S. affiliates' net plant and equipment in a country by 65 percent.

Hines and Rice (1994) regress the log of PPE on host-country average tax rates. The coefficient on their tax term is −3.3 and is significantly different from 0.[4] This coefficient suggests that at their mean tax rate of 31 percent, a 1 percent increase in after-tax returns leads to a 2.3 percent increase in the real capital stock of U.S. affiliates. Hines and Rice's inclusion of the tax haven countries, as well as their examining the allocation of capital in all nonbank affiliates, may be responsible for their higher estimated elasticity.

The most recent analysis of the effects of taxes on investment location decision of U.S. multinational firms is Grubert and Mutti (1997). They estimate tax elasticities using country- and firm-level cross-sectional data on the manufacturing affiliates of U.S. manufacturing parents in sixty locations from the 1992 U.S. Department of the Treasury tax file. As in their previous study, they enter the tax variable in log $(1 - t)$ form.

When compared to the results of their previous paper, the estimates from Grubert and Mutti (1997) suggest that the location of capital may have become more sensitive to differences in after-tax returns between 1982 and 1992. Using the aggregated country-level data, they estimate a tax elasticity that is greater than 3 (for open economies) and is statistically highly significant. Using the firm-level data, they calculate a combined elasticity measure that takes into account the probability of choosing to locate capital in a country and the amount of capital invested into account. They report a combined elasticity of capital to after-tax returns for open economies of about 3.

To summarize, the results of previous work with cross-sectional data indicate that taxes have a significant impact on the investment location decisions of U.S. multinational firms. In addition, a rough comparison of the elasticity estimates suggests that these decisions may have become more sensitive to host-country tax rates in recent years; however, the validity of this comparison is questionable, since the estimates were derived from different data sources.

1.2 The Data

Our principal source of data is the body of U.S. Department of the Treasury corporate tax files compiled by the Statistics of Income (SOI)

4. Hines and Rice (1994) also report results of regressions that include both the tax rate and the square of the tax rate as explanatory variables. However, the squared tax rate is not significantly different from zero.

division of the Internal Revenue Service. This data set is derived from a variety of tax and information forms filed by U.S. parent corporations. Many of the data necessary for our analysis come from the Form 5471, which reports on the activities of each CFC of a U.S. parent. This form, which U.S. parents must file for each of their CFCs, reports subsidiary-level information on assets, taxes paid, earnings and profits, and other information from balance sheets and income statements.

Information from the Form 5471 is compiled only in even years and was available to us from 1980 through 1992. However, the level of detail recorded from this form on the SOI files differs from year to year. For example, both the 1984 and 1992 files provide information on the composition of assets from the balance sheet portion of the Form 5471, whereas the files from other sample years do not. The interval from 1984 to 1992 is particularly appropriate for our study, since it covers a period of large declines in effective tax rates in some locations abroad.[5] We use the information in the remaining even years between 1980 and 1992 to calculate country average effective tax rates. These effective tax rates are used in various forms as independent variables in our regressions.

We restrict our sample to the manufacturing CFCs of all large U.S. manufacturing corporations.[6] We aggregate the subsidiary-level information from the Form 5471 across parents by country.[7] One advantage of using country-level data is that such data eliminate some of the complicated statistical problems associated with subsidiary-level data—for example, the problems that arise from using data that are truncated at zero when errors may be correlated across observations within a country because of omitted variables. A drawback is that we lose information on the characteristics of the parent corporations that may affect their location decisions.

Aggregating across subsidiaries in each country leaves us with data for

5. This period also straddles that of the U.S. Tax Reform Act of 1986, which made significant changes in U.S. taxation of both domestic and international business. Our analysis considers the choice of investment across foreign locations, not between domestic and foreign locations. However, we allow the intercept in our estimates to vary by year, which to some extent may capture the effect of changes in U.S. taxes over the time period. Some evidence of the responsiveness of foreign investment to changes in U.S. tax rates is provided in Harris (1993). He finds that firms that were most negatively impacted by the 1986 tax reform responded by increasing their investment abroad.

6. Although beyond the scope of this project, it is possible that the behavior of firms in the manufacturing industry differs from those in other industries. As discussed in section 1.1, the difference between the estimates of the elasticity of property, plant, and equipment to average host-country tax rates found in Grubert and Mutti (1991) and Hines and Rice (1994) may be due to the inclusion of nonbank affiliates in the latter study. Given the focus of this paper on the location of real capital, it seemed appropriate to limit the sample to data from manufacturing affiliates.

7. The 1984 sample includes all U.S. corporations with at least one CFC and total assets greater than $250 million. All U.S. corporations with at least $500 million in assets were included in the 1992 sample.

fifty-eight locations for 1984 and 1992.[8] Our two cross sections are "unlinked" in that there is no requirement that the same parents (or the same CFCs) appear in both years of data. We also experimented with a sample drawn from a panel that contains *only* those CFCs associated with parents that appear in both years.[9] We report results using this linked data set in our sensitivity analysis.[10]

We augment the Form 5471 data with country-specific information from some other sources to help control for countries' nontax characteristics that may affect location decisions. We obtained population, GDP, and inflation data from the *International Monetary Fund International Financial Statistics* (International Monetary Fund 1984, 1992) supplemented in a few cases by information from statistics from the United Nations. As in Grubert and Mutti (1997), we use the trade regime classification developed in the *World Development Report* (World Bank 1987) to control for the degree of openness of each country's economy. This measure is based on observations from 1973 to 1985 of (1) the country's effective rate of protection, (2) its use of direct controls such as quotas, (3) its use of exports, and (4) the extent of any overvaluation of its exchange rate. The variable runs from 0 (most open) to 3 (most restrictive). Unfortunately, there is only one observation of this measure—it has not been updated for the years after 1985.

Before turning to our empirical results, we briefly discuss how we use the Form 5471 information to calculate effective tax rates and to measure real capital. These variables are reported in appendix tables 1A.1 and 1A.2.

1.2.1 Measuring Assets

Our measure of real capital in each year is composed of end-of-year depreciable assets (plant and equipment) and inventories from the balance sheet information reported on the Form 5471. Because parents are required to report subsidiary assets according to U.S. accounting principles, these figures are not distorted by host-country incentives such as accelerated depreciation. However, the asset measures reflect historical book values and therefore may be affected by local inflation and exchange rates.[11]

Another potential problem with our real capital measure is that the

8. Locations for which there were fewer than five CFCs were eliminated from the analysis. This left us with sixty locations. Our analysis was further limited to fifty-eight countries because we were unable to locate complete information for Taiwan and the Cayman Islands.

9. The link is based largely on employer identification numbers (EINs), but a special effort using corporate names was made to identify large companies whose EINs may have changed. Companies may disappear because of mergers and may appear because they moved over the threshold for inclusion during our time interval.

10. Our unlinked panel has, however, some advantages over the linked panel. For example, if a parent disappears due to a merger, the unlinked country totals will contain both the parent's 1984 and 1992 assets and income.

11. In some cases the parent may maintain historical values in terms of dollars originally invested (particularly in locations with hyperinflation), but this is not mandated.

assets reported by a CFC may not be located in the country in which the CFC is incorporated. This problem is especially serious in tax haven countries, which are often hosts to holding companies and financial CFCs. Including only manufacturing affiliates in our country data helps mitigate this problem. In addition, we investigate how our results are affected when we remove countries that are likely to be tax havens from the analysis.

1.2.2 Measuring Effective Tax Rates

We calculated the average effective tax rate for manufacturing CFCs incorporated in each country by dividing total income taxes paid by total earnings and profits.[12] Both variables appear on the Form 5471. Parent corporations must report their CFCs' earnings and profits using the definition provided by the U.S. Internal Revenue Code. This measure of earnings and profits is meant to reflect net economic income, not host-country (or domestic U.S.) taxable income, which would be affected by investment incentives such as accelerated depreciation.[13]

One potential problem with our country average effective tax rate calculations, particularly in small countries with few CFCs, is that they appear to contain noise. We were particularly concerned about the 1984 effective tax rates. Appendix table 1A.3 reports the results of regressing previous-year average effective tax rates on 1986 and 1990 average effective tax rates. We found that the 1982 effective tax rates are better predictors of 1986 effective tax rates than are the 1984 rates. To diminish the role of the 1984 effective tax rates in our analysis, we averaged them with effective tax rates from the previous two even years. For consistency, we average the 1992 effective tax rates with those from 1990 and 1988. We also experiment with using lagged effective tax rates.

Another potential problem with our effective tax rate measures is that they may be correlated with inflation, because depreciation allowances are based on the historic costs of assets. In addition to including inflation as an explanatory variable, we also checked the relation between differences in inflation and differences in effective tax rates. We found that the change in inflation between 1984 and 1992 explains less than 4 percent of the variation in our effective tax rate variables.

A further issue is that average effective tax rates are, to some extent, endogenous to investment decisions. The effective tax rate in a country

12. Only CFCs with positive income were included in the calculation; otherwise, the tax measure would be biased upward. As indicated, only income taxes are included in the average effective tax rate measure. However, foreign affiliates operating in host countries are sometimes also subject to property and assets taxes. These taxes may also influence the investment patterns of U.S. multinationals. Our data do not permit us to identify these taxes.

13. As noted in Grubert and Mutti (1997), earnings and profits on the Form 5471 seem very close to book income (which is also reported).

may be low in a given year because of a recent increase in investment activity in that country that qualifies for investment incentives, such as accelerated depreciation, that accrue early in an investment's life.[14] One approach to avoiding this potential endogeneity problem is to replace average effective tax rates with statutory rates. Although statutory rates have the virtue of being exogenous to investment decisions, they do not reflect all the variation in the tax advantages of investment in different locations because they do not measure tax base differences across countries. Statutory rates also do not capture ad hoc deals between host countries and individual foreign investors. For this reason, statutory rates are better indicators of the advantages of placing financial capital in a location and the gains to income shifting. Nevertheless, we use statutory rates as well as instrumental variable techniques to test the sensitivity of our results to alternative measures of taxes. We collected country statutory tax rates from the Price Waterhouse (1984, 1992) guides.

Given that we are implicitly modeling investment decisions, it might seem appropriate to use host-country marginal effective tax rates rather than average effective tax rates. Marginal effective tax rates were not available for many of the countries included in our sample. Even if Hall-Jorgenson-King-Fullerton marginal effective tax rates as they are usually modelled were calculated for all the countries and both years in our sample, it is not clear that they would be superior at capturing the effects of taxes on investment location decisions. As discussed previously by others, there are serious drawbacks to the use of marginal effective tax rates. For example, taking into account all of the feature of tax systems that are important for investment decisions in the calculation of marginal effective rates is generally not feasible. There may be features of tax codes that are difficult to model (such as the alternative minimum tax in the United States), tax incentives that apply to only some regions of countries, and ad hoc deals between companies and host countries. Finally, the formulas used to compute Hall-Jorgenson-King-Fullerton tax rates are sensitive to the required rate of return assumed.

The tax variable used in the location equations, the local average effective tax rate, tends to overstate the cross-country variation in tax burdens, and thus to understate the true investment elasticity. For one thing, multinational corporations can allocate more debt to high (statutory) tax locations, diluting the impact of the local tax on net equity income. In addition, the tax variable does not include the residual U.S. tax on repatriations

14. Grubert and Mutti (1997) found that recently incorporated CFCs had significantly lower effective tax rates than the country average in the 1992 file. To correct for age effects, they adjust the country average effective tax rates by the age distribution of CFCs in each country. Their tax elasticity estimates were unaffected by this adjustment. Grubert (chap. 5 in this volume) indicates that age effects were the same in 1984 as in 1992.

Table 1.1 **Global Decline in Average Effective Tax Rates, 1980–92 (average effective tax rates for manufacturing in fifty-eight countries)**

Year	Mean	Standard Deviation
1980	.321	.115
1982	.340	.131
1984	.339	.134
1986	.303	.133
1988	.306	.155
1990	.245	.119
1992	.234	.113

Note: The table presents the means and standard deviations of average effective tax rates for U.S. manufacturing subsidiaries in fifty-eight countries. Average effective tax rates in each country are calculated by dividing the total income taxes paid by U.S. controlled foreign corporations in the manufacturing sector by their total earnings and profits.

from each location.[15] If anything, residual U.S. taxes would tend to even out differences in tax rates across the countries; if a company's foreign tax credits do not fully offset its U.S. tax liability on repatriated income, additional repatriations from a low-tax country trigger an additional U.S. tax, while repatriations from countries with a tax rate above the U.S. rate yield a bonus because some of the foreign tax credits can shield other income (see Grubert and Mutti 1997 for a discussion of this issue).

1.2.3 Variation in Effective Tax Rates across Countries and Time

Our empirical strategy relies on the existence of variation in effective tax rates across countries and across our time period. Fortunately, this was a period of intense tax reform activity around the world. Along with the United States, many countries reduced their corporate tax rates (including Canada, the United Kingdom, France, Belgium, and the Netherlands). These reforms resulted in substantial declines in average effective tax rates for U.S. CFCs between 1984 and 1992.[16]

Table 1.1 provides information on the mean and standard deviation of average effective tax rates (for manufacturing) for the fifty-eight locations in our data set. The table shows that average effective tax rates in our sample steadily declined between 1980 and 1992. In addition, the standard deviation of average effective tax rates was greater than 11 percent in each year. We also calculated the variation in country average effective tax rates

15. See Altshuler and Newlon (1993) or Grubert (1998) for a detailed description of repatriation taxes.

16. Grubert, Randolph, and Rousslang (1996) found that there was a substantial decrease in the average foreign tax rate faced by U.S. multinationals on repatriated income between 1984 and 1992. They conclude that the decrease in average foreign tax rates (from 36 percent in 1984 to 25 percent in 1992) was due primarily to reductions in country average effective tax rates and not to changes in income repatriation patterns.

across years. We found that average effective tax rates in manufacturing fell by more than 10 percentage points between 1984 and 1992. The standard deviation of the change was 17 percentage points, indicating substantial variation in the change in tax rates.[17]

1.3 Estimation Results

For our estimates we use a reduced-form model that follows the model used in Grubert and Mutti (1997) and is similar to the models used in Grubert and Mutti (1991) and Hines and Rice (1994).The model assumes that the derived demand for capital by multinational firms in a country is a function of after-tax rates of return and exogenous country characteristics that affect supply and demand (such as GDP and GDP per capita).[18] This reduced-form relation between tax rates and investment in real capital would result from a standard partial equilibrium economic model in which parent firms allocate capital abroad to maximize after-tax returns.

$$\log K_{it} = \text{const}_t + a'\mathbf{Z}_{it} + \beta \log(1 - t_{it}) + \gamma \text{TRADE}_i * \log(1 - t_{it}) + \varepsilon_{it}, \quad (1)$$

where i indicates countries, subscript t indicates the year of analysis (t = 1984 or 1992), K is real capital, $\mathbf{Z}$ is a vector of nontax country characteristics, t is the tax variable, and TRADE is the trade policy variable. Notice that our tax variable is interacted with the trade variable (which also appears by itself in the vector $\mathbf{Z}$) to control for the possibility that the benefit of low tax rates may be smaller in more restrictive trade regimes. Thus, the estimated coefficient β describes the elasticity of total real capital with respect to after-tax returns (for a given pretax return), for the most open regimes (in which the trade variable is zero). We use log GDP and log population as scale variables to reflect the economic size of each country. Since we use the log form, we are implicitly controlling for differences in GDP per capita across countries.

17. As will be explained shortly, we use differences in effective tax rates averaged over three years, lagged effective tax rates, and statutory tax rates in our regression analysis. The decline in effective tax rates averaged over the years 1980, 1982, and 1984, and in effective tax rates averaged over the years 1988, 1990, and 1992, was 11 percentage points with a standard deviation of 12. Average effective tax rates fell by 9.5 percentage points (with a standard deviation of 15) between 1982 and 1990. Finally, statutory tax rates fell almost 14 percentage points between 1984 and 1992 with a standard deviation of 14.

18. We recognize that there may be general equilibrium responses in factor returns that affect the role of taxes in multinational behavior. As Gordon (1986) shows in a small country model with homogeneous capital and perfect mobility of portfolio capital, any increase in the local tax rate on capital is offset by lower local wage costs; but, as discussed in Grubert and Mutti (1997), many features of a more realistic model would diminish or even reverse this general equilibrium response. In any case, if the Gordon (1986) model is valid, we should observe no effect of local taxes on the location of multinational corporations. Indeed, bringing potential U.S. tax credits into the picture would predict that U.S. companies should locate in high-tax countries.

1.3.1 Single-Year Cross-Sectional Analysis

Table 1.2 presents our main results.[19] The first column reports regression results for the 1992 cross section. We include regional dummies to control for unmeasured geographic characteristics.[20] Our results indicate that the open regime tax elasticity is 2.7 and is highly significant. The trade regime variable is also highly significant and negative, indicating the adverse effect of trade restrictions on the desirability of a location for investment. As expected, the presence of trade restrictions lessens the responsiveness to lower tax rates: The trade-tax interaction term is negative and significant at the 5 percent level. Although we included inflation as an independent variable in other estimates, we do not report these results in the table because inflation rates had no effect on the tax variables and were never a significant explanatory variable.

The analogous regression for 1984 is presented in the second column of table 1.2. In contrast to the 1992 results, neither the tax term nor the trade-tax interaction term is significant at conventional levels in the 1984 cross section. In addition, the coefficient on the tax term in the 1984 regression is (about) half the size of that in the 1992 regression.

Before turning to the fixed effects estimates, we pool the data and test whether the coefficients on the $\log(1 - t)$ terms are statistically different from each other in 1984 and 1992. We restrict all of the coefficients except the ones on $\log(1 - t)$ terms to be equal; an F-test does not reject this specification.

The pooled regression results appear in column (3) of table 1.2. In these regressions, the tax term ($\log(1 - t)$) appears by itself and interacted with a year variable that equals one in 1984. Therefore the 1992 open economy elasticity is the coefficient on the $\log(1 - t)$ term, the interacted term gives the difference between the 1984 and 1992 open economy elasticities, and the sum of the two terms gives the 1984 open economy elasticity. The bottom two rows of the table report the 1984 and 1992 elasticity estimates with standard errors.[21]

Interestingly, in the pooled regression, the 1992 coefficient decreases in size and significance; the opposite is true of the 1984 coefficient, which is now significant at the 10 percent level. In addition, the difference between the rates, although still large, is not statistically significant. Controlling for country fixed effects will increase the precision of these estimates if our tax terms are correlated with omitted nontax country variables. To the

19. Since the number and size of CFCs differ across countries in our data set, we report White-corrected standard errors to correct for heteroskedasticity.

20. The excluded countries are a highly heterogeneous group that includes African, Scandinavian, and Middle Eastern countries, among others.

21. The standard error comes from the analogous regression in which YEAR84 = 1 for the 1992 observations.

Table 1.2 **The Effect of Taxes on the Location of Real Capital Abroad by U.S. Manufacturing Companies (results for cross-sectional, pooled, and fixed effects regressions)**

	Dependent Variable			
	Log of Capital 1992 (1)	Log of Capital 1984 (2)	Log of Capital (3)	Difference in Log of Capital (4)
Log(1−Ave ETR for 1988–92)	2.68**			
	(.720)			
Log(1−Ave ETR for 1980–84)		1.32		1.24**
		(.874)		(.324)
Log(1−Ave ETR)			2.21**	
			(.691)	
Log(1−Ave ETR)∗YEAR84			−.795	
			(.768)	
Difference in log(1−Ave ETR)				2.77**
				(.744)
TRADE	−.719**	−.638*	−.630**	
	(.200)	(.320)	(.183)	
TRADE∗log(1−Ave ETR for 1988–92)	−1.14**			
	(.445)			
TRADE∗log(1−Ave ETR for 1980–84)		−.752		
		(.464)		
TRADE∗log(1−Ave ETR)			−.707**	
			(.306)	
TRADE∗difference in log(1−Ave ETR)				−.496
				(.440)
Log GDP, 1992	1.08**			
	(.104)			
Log GDP, 1984		1.18**		
		(.172)		
Log GDP			1.08**	
			(.091)	
Difference in log GDP				.580**
				(.163)
Log population, 1992	−.223**			
	(.111)			
Log population, 1984		−.314		
		(.193)		
Log population			−.230**	
			(.105)	
Difference in log population				−.317**
				(.139)
Regional dummies				
North America	2.04**	1.82**	1.97**	
	(.269)	(.303)	(.194)	
Latin America	1.18**	1.16**	1.14**	
	(.253)	(.344)	(.213)	

Table 1.2 (continued)

	Dependent Variable			
	Log of Capital 1992 (1)	Log of Capital 1984 (2)	Log of Capital (3)	Difference in Log of Capital (4)
Asia	.289	.159	.200	
	(.306)	(.330)	(.219)	
EEC	.410	.644*	.531**	
	(.341)	(.383)	(.260)	
YEAR84			−.346	
			(.334)	
Constant	4.01**	3.32**	3.86**	.782**
	(.539)	(.731)	(.512)	(.188)
Adjusted R^2	.860	.755	.826	.327
N	58	58	116	58
1992 Tax Elasticity	2.68**		2.21**	2.77**
	(.720)		(.691)	(.744)
1984 Tax Elasticity		1.32	1.42*	1.53**
		(.847)	(.741)	(.722)

Note: The columns report estimated OLS coefficients. Columns (1) and (2) present estimated coefficients from regressions using cross-sectional data for 1992 and 1984, respectively. Column (3) presents estimated coefficients using pooled data from the 1984 and 1992 cross sections. Column (4) presents estimated coefficients from a regression of first differences of the 1984 and 1992 cross-sectional data. "Ave ETR for 1988–92" is equal to the country average effective tax rate averaged over 1988, 1990, and 1992. "Ave ETR for 1980–84" is equal to the country average effective tax rate averaged over 1980, 1982, and 1984. "Difference in log(1−Ave ETR)" equals "log(1−Ave ETR for 1988–92)" minus log(1−Ave ETR for 1980–84)." The dummy variable "YEAR84" equals 1 for 1984. The trade regime variable, "TRADE," runs from 0 (most open) to 3 (most restrictive). The bottom panel of the table reports the tax elasticity estimates from each regression. White-corrected standard errors are in parentheses.

*Denotes significance at the 10 percent level.

**Denotes significance at the 5 percent level.

extent that these omitted variables do not vary over time, we can control for their fixed effects by estimating the model in first difference form.

1.3.2 Controlling for Permanent Nontax Features of Different Locations

As in the pooled regression, we allow the tax coefficients to differ over time. This gives the following model in difference form:

$$(2)\quad \log K_{i,92} - \log K_{i,84} = \text{const} + \alpha'(\mathbf{Z}_{i,92} - \mathbf{Z}_{i,84}) + \beta_{92}\log(1 - t_{i,92}) - \beta_{84}\log(1 - t_{i,84}) + \gamma\text{TRADE}_i[\log(1 - t_{i,92}) - \log(1 - t_{i,84})] + \iota_t.$$

By rearranging this equation as follows we can test directly whether tax elasticities have changed over time while controlling for country fixed effects:

$$\begin{aligned}(3)\quad \log K_{i,92} - \log K_{i,84} = {} & \text{const} + \alpha'(\mathbf{Z}_{i,92} - \mathbf{Z}_{i,84}) \\ & + \beta_{92}[\log(1 - t_{i,92}) - \log(1 - t_{i,84})] \\ & + \beta_{\text{diff}} \log(1 - t_{i,84}) + \gamma \text{TRADE}_i[\log(1 - t_{i,92}) \\ & - \log(1 - t_{i,84})] + \iota_i,\end{aligned}$$

where $\beta_{\text{diff}} = \beta_{92} - \beta_{84}$.

The fourth column of table 1.2 presents estimates of equation (3); summary statistics on the regression variables are presented in appendix table 1A.4. Three main findings emerge. First, the 1992 elasticity increases substantially in magnitude (from 2.21 to 2.77).[22] Second, the 1984 coefficient also becomes larger (from 1.42 to 1.53) and is more precisely estimated.[23] And finally, the difference in elasticities is greater than 1 and is significant at the 5 percent level, indicating that the location of real manufacturing capital by manufacturing firms may indeed have become more sensitive to tax rates.[24] These results indicate that the estimates in column (3) may have been affected by correlation between the tax rate variable and omitted country characteristics.

Notice that by including a constant term in this regression, we have assumed that the constant terms in the yearly regressions are not identical. It is interesting to note that the constant is positive and highly significant (and remains so in all the estimates). Among other things, this term may be controlling for changes in both tax and nontax factors that affected the

22. We can also calculate a weighted elasticity that reflects the effects of the trade restrictions. Adjusting the elasticity by trade regime using the 1992 real capital stocks as weights gives a slightly lower tax elasticity of 2.64.

23. To test the significance of the 1984 rate we ran the same regression as in equation (3) but with $\log(1 - t_{i,92})$ instead of $\log(1 - t_{i,84})$ entered separately. The result is presented in the last row of table 1.2.

24. Although our estimation results strongly indicate that the tax elasticities are not the same in our two sample years, we also estimated the fixed effects model that constrains the tax elasticities to be equal in 1984 and 1992. To do this we simply dropped the 1984 tax term $\log(1 - t_{i,84})$ from the right-hand side of equation (3). The coefficient on the tax term in this regression was 2.1 (which is the average of the 1984 and 1992 estimated elasticities in column [4] of table 1.2) and was statistically different from zero at the 1 percent confidence level. The estimated coefficients and standard errors on the trade-tax interaction term and the population and GDP variables changed insignificantly. Dropping the trade-tax interaction variable from the constrained model (regressing the difference in capital stocks on a constant term, the difference in the tax terms, the difference in population, and the difference in GDP) lowered both the magnitude and the significance of the tax coefficient (from 2.1 and statistically significant at the 1 percent level to 1.3 and statistically significant at the 10 percent level), had little impact on the size or significance of the population coefficient estimate, and increased both the size and significance of the GDP coefficient estimate.

attractiveness of the United States relative to other countries as a location for investment.

Apart from globalization, another possible explanation for the increased tax sensitivity of investment after 1984 is the change in companies' excess foreign tax credit expectations as a result of the Tax Reform Act of 1986, which lowered the U.S. rate from 46 to 34 percent. If there were no changes in behavior by companies or reactions by foreign governments, the number of companies with excess foreign tax credits would have expanded dramatically. If a company moves into an excess credit position, its effective tax burden in a high-tax country goes up because repatriations do not provide a bonus in terms of usable tax credits, while the effective tax burden in low-tax countries declines because there is no residual U.S. tax. Therefore, a large increase in the proportion of parent companies in excess credit positions could be responsible for the increase in the sensitivity of investment decisions to after-tax returns over our time period. However, research using data from the tax returns of U.S. multinationals shows about the same proportion of foreign source income associated with parents in excess credit positions in 1992 as in 1984. Grubert, Randolph, and Rousslang (1996) report that although the fraction of foreign source income associated with parents in excess credit positions increased from 33 percent in 1984 to 66 percent in 1990, it was only 35 percent by 1992.[25] Although there may have been a temporary effect on investment abroad, it is unlikely that the decrease in the U.S. statutory tax rate plays an important role in explaining our results.[26] In fact, recent research reported in Grubert and Mutti (1999) suggests that repatriation taxes play no role in explaining investment location decisions.

1.3.3 Alternative Specifications of the Difference Regression

We experimented with a few different specifications of this regression that are not reported in the table. As was the case in the previous formulation, including the difference in inflation rates in this regression had no effect on the tax elasticities. We also tested whether the trade-tax interaction term is different in the two time periods by adding the 1984 trade-tax term. This additional variable had no impact on the tax effects and was

25. The foreign tax credit is calculated separately for different types ("baskets") of foreign source income. These figures refer to the percentage of foreign source income in the general basket associated with excess credit parents. This basket, which accounted for more than 80 percent of foreign source income in 1992, contains income earned through the active conduct of business abroad. For further details, see Grubert, Randolph, and Rousslang (1996).

26. As mentioned in n. 16, Grubert, Randolph, and Rousslang (1996) conclude from their investigation of multinational tax returns that decreases in country average tax rates are largely responsible for the somewhat surprisingly small increase in the portion of foreign source income held by firms in excess credit positions. The United States was one of many countries that enacted corporate tax–lowering reforms in the late 1980s. For example, as reported in n. 17, we found that statutory tax rates fell by more than 14 percentage points between 1984 and 1992.

not significantly different from zero. In addition, we dropped the trade-tax interaction terms from the regression to determine whether our results are sensitive to their inclusion.[27] Without the trade-tax term, the 1984 elasticity loses its significance (at conventional levels) and the magnitude of both elasticities diminishes slightly: 2.18 for 1992 and .87 for 1984. However, the 1992 elasticity and the difference between the elasticities remain highly significant at above the 5 percent level.

As in Hines and Rice (1994), we also entered our average effective tax rate variables in the linear form. When average effective tax rates appear on the right-hand side instead of the log of 1 minus the average effective tax rate, the coefficients on the 1992, 1984,and difference in tax terms are −4.23, −2.63, and 1.60, respectively. All three terms are statistically different from zero at the 5 percent level or better. At the mean tax rates for 1992 and 1984 given in table 1.1, these coefficients imply that a 1 percent increase in after-tax returns in a country would increase the real capital stock held by U.S. affiliates in that country by 3.2 percent in 1992 and 1.7 percent in 1984. When squared tax terms are added, their coefficients are positive, not negative as would be expected if the logarithm specification is exactly correct, but they are not statistically significant. There seems to be greater tax sensitivity at low tax rates than would be suggested by the log specification, but in any case, there does not seem to be much substantive difference between the double log and semilog specifications. Given this fact, we prefer the log specification because it yields coefficients that can be directly interpreted as elasticities.

1.3.4 Sensitivity Analysis

The remaining two tables test the robustness of the results in column (4) to differences in the tax variables (table 1.3) and the sample (table 1.4) used. In particular, we focus on the significance of the two elasticities and the difference between them. The results are generally consistent with those just presented, although the 1984 tax elasticity is not always statistically significant.

In the first column of table 1.3, we replace the three-year average effective tax rates with lagged effective tax rates. This eliminates the noise contained in the 1984 tax rates, but by eliminating the averaging of tax rates over three years it may also increase the noise in the tax rate variable. Using lagged tax rates yields a slightly smaller tax coefficient for 1992. Although the difference between the two tax coefficients is smaller, it is still statistically different from zero at a 5 percent confidence level. One pos-

27. We also ran the regression using only the twenty-two countries for which the trade variable equaled zero. While the difference between the two estimated elasticities remains larger than one, the magnitude of the two elasticities decreases slightly. Both the 1992 tax coefficient and the coefficient on the difference between tax rates remain significant at conventional levels. However, the 1984 tax coefficient loses significance at the 10 percent level.

Table 1.3 **Sensitivity of Results of Regressions in Differences to Changes in the Measure of Tax Rates**

	Dependent Variable: Log of Capital in 1992 − Log of Capital in 1984		
	OLS	OLS	IV
Tax variables are lagged effective tax rates (ETR)			
$\text{Log}(1-\text{ETR}_{1990}) - \text{log}(1-\text{ETR}_{1982})$	2.40**		
	(.825)		
$\text{Log}(1-\text{ETR}_{1982})$	.869**		
	(.424)		
$\text{Trade}*[\text{log}(1-\text{ETR}_{1990}) - \text{log}(1-\text{ETR}_{1982})]$	−.874**		
	(.401)		
Tax variables are statutory tax rates (t)			
$\text{Log}(1-t_{1992}) - \text{log}(1-t_{1984})$		1.87**	2.49
		(.734)	(1.58)
$\text{Log}(1-t_{1984})$		1.07**	1.27**
		(.319)	(.591)
$\text{Trade}*[\text{log}(1-t_{1992}) - \text{log}(1-t_{1984})]$		−.840**	−.539
		(.352)	(.576)
$\text{Log GDP}_{1992} - \text{log GDP}_{1984}$	.445**	.490**	.560**
	(.165)	(.150)	(.184)
$\text{Log population}_{1992} - \text{log population}_{1984}$	−.227*	−.248**	−.316
	(.129)	(.096)	(.297)
Constant	.775**	1.02**	.847**
	(.196)	(.204)	(.277)
Adjusted R^2	.309	.315	.265
N	58	58	58
1992 Tax Elasticity	2.40**	1.87**	2.49
	(.825)	(.734)	(1.58)
1984 Tax Elasticity	1.53**	.795	1.21
	(.640)	(.585)	(1.54)

Note: Columns (1) and (2) report estimated OLS coefficients. Column (3) reports estimated coefficients from an instrumental variables regression in which statutory tax rates are used as instruments for country average effective tax rates (ETRs). The trade regime variable, "TRADE," runs from 0 (most open) to 3 (most restrictive). The bottom panel reports tax elasticity estimates from each regression. White-corrected standard errors for the coefficient estimates in the first two columns are in parentheses. The standard errors in the third column are not White-corrected.

*Denotes significance at the 10 percent level.

**Denotes significance at the 5 percent level.

sible reason for the decrease in the magnitude of the difference in elasticities is that the 1988 rates no longer receive any weight in the analysis. Table 1.1 shows that the big drop in rates occurred between 1988 and 1990. Averaging in 1988 with 1990 and 1992 may have led to an underestimation of the tax rate change between 1984 and 1992 and an overestimate of the responsiveness of investment to the change.

As previously discussed, a potential problem with the average effective

Table 1.4 **Sensitivity of Results of Regressions in Differences to Changes in Sample Selection**

	Dependent Variable = Log of Capital in 1992 − Log of Capital in 1984			
	Include Only Countries with Populations Greater Than 1 Million	Include Only Countries with Changes in AETRs Between .35 and −.10	Include Only Countries with Changes in Log of Capital Stocks between 2 and −.5	Include Only CFCs of Parent Companies in Both the 1984 and 1992 Samples
$\text{Log}(1-\text{Ave ETR}_{1988-92}) - \log(1-\text{Ave ETR}_{1980-84})$	2.78**	2.48**	2.00**	2.410**
	(.746)	(.870)	(.574)	(.676)
$\text{Log}(1-\text{Ave ETR}_{1980-84})$	1.19**	1.20**	.855**	.873**
	(.346)	(.355)	(.258)	(.406)
$\text{Trade}*[\log(1-\text{Ave ETR}_{1988-92}) - \log(1-\text{Ave ETR}_{1980-84})]$	−.507	−.544	−.130	−.119
	(.441)	(.531)	(.283)	(.444)
$\text{Log GDP}_{1992} - \text{log GDP}_{1984}$	.585**	.558**	.605**	.454**
	(.165)	(.173)	(.135)	(.152)
$\text{Log population}_{1992} - \text{log population}_{1984}$	−.310	−.304**	−.311**	−.276
	(.200)	(.137)	(.144)	(.181)
Constant	.759**	.795**	.679**	.651**
	(.141)	(.210)	(.160)	(.214)
Adjusted R^2	.314	.293	.404	.251
N	56	55	53	58
1992 Tax Elasticity	2.78**	2.48**	2.00**	2.41**
	(.746)	(.870)	(.574)	(.676)
1984 Tax Elasticity	1.59**	1.28	1.06*	1.54**
	(.737)	(.808)	(.607)	(.608)

Note: "$\text{Ave ETR}_{1988-92}$" is the country average effective tax rate averaged over 1988, 1990, and 1992. "$\text{Ave ETR}_{1980-84}$" is the country average effective tax rate averaged over 1980, 1982, and 1984. The trade regime variable, "TRADE," runs from 0 (most open) to 3 (most restrictive). The last column excludes the CFCs of parents that were not in both the 1984 and 1992 samples. This screen eliminated about one-third of our parent companies. The bottom panel reports tax elasticity estimates from each regression. The columns report estimated OLS coefficients. White-corrected standard errors are in parentheses.

*Denotes significance at the 10 percent level.

**Denotes significance at the 5 percent level.

tax rates is that they are endogenous to investment decisions. The effective tax rate in a country may be low in one year because of a recent increase in investment activity in that country. Using statutory tax rates eliminates this potential endogeneity problem. At the same time, though, statutory rates do not capture the effects of tax base differences across countries. The second column shows that our qualitative results are unaffected by this measure of taxes—both the 1992 tax elasticity and the difference in elasticities are positive and significant. However, the 1984 elasticity is no longer statistically significant. Notice that the magnitude of the tax coefficients decreases, suggesting that investment location decisions are more responsive to differences in average effective tax rates than to differences in statutory rates.

An alternative way of addressing the endogeneity problem is to use an instrumental variables approach. In column (3), we present estimates that use statutory tax rates as instruments for average effective tax rates. Using instrumented tax rates had little effect on our coefficient estimates but increased our standard errors significantly. In fact, column (3) shows that neither elasticity was significantly different from zero at standard levels. These results suggest that the statutory rates do not adequately capture the variation in the component of effective tax rates that explain location choices.

Table 1.4 shows the results of a series of experiments in which we restrict the sample in different ways. To test whether outliers played a significant role in our regressions we restricted the sample to include only countries with populations greater than 1 million (fifty-six countries), eliminated countries for which the difference of three-year average effective tax rates was greater than 0.35 and less than −0.10 (three countries), and deleted countries for which the difference in the log of the capital stocks between 1992 and 1984 was greater than 2 or less than −0.5 (this eliminates the five countries in which capital stocks grew more than 700 percent or contracted by more than 40 percent). Column (1) shows that our main findings are not the result of activities in tax havens. The elasticities and the difference between them change little in magnitude or statistical significance. Removing countries with large changes in average effective tax rates from the sample decreases the magnitude and significance of the tax coefficients, although the 1992 elasticity and the difference between the two elasticities remain significant at the 5 percent level or better (see column [2]). Countries experiencing large changes in the real capital stocks of U.S. manufacturing affiliates have an impact on the magnitude of our tax elasticity estimates and the difference between them. However, all three coefficients are still significant at the 10 percent level or better.

Finally, in the last column we report results from the linked panel, which contains the same parents in both years. This panel contains about two-thirds of the parents in our unlinked data. Both the 1984 and 1992 elastici-

ties and the difference between them are large and statistically highly significant in this panel.

1.4 Conclusion

Measuring the extent to which host-country taxes affect the allocation of multinationals' foreign direct investment across foreign jurisdictions has been an active area of research in international taxation. The most recent studies indicate that taxes exert a strong influence on location decisions. Our estimates, using two years of data from the U.S. Department of the Treasury tax files, provide additional evidence that the foreign investment of manufacturing firms is sensitive to differences in host-country tax rates. Unlike in previous estimates, however, in ours we control for any (permanent) differences in nontax features of countries that may be correlated with host-country tax rates.

Our estimates with country fixed effects produce tax elasticities that are large in magnitude and generally precisely estimated. Our basic estimates yield an elasticity of real capital to after-tax rates of return of close to 3 in 1992 and about 1.5 in 1984; both are significant at standard levels. Comparing these elasticities to those estimated from a model in which the two years of data are simply pooled together without controlling for country fixed effects shows the importance of taking these effects into account. Both the 1984 and 1992 elasticities increase in magnitude and in significance.

The increase of more than one in the estimated elasticities from 1984 to 1992 also suggests that the allocation of real capital held in manufacturing affiliates abroad by manufacturing parents may have become more sensitive to differences in host-country taxes in recent years. This would be consistent with increasing international mobility of capital and globalization of production. Controlling for fixed effects is again important, since the difference between the 1984 and 1992 elasticities is statistically significant when country fixed effects are taken into account, but not otherwise.

Appendix

Table 1A.1 Country Average Effective Tax Rates by Year

	1980	1982	1984	1986	1988	1990	1992
Argentina	0.2121	0.1185	0.0377	0.1134	0.2434	0.0483	0.1539
Australia	0.3715	0.4071	0.4070	0.3718	0.3426	0.3451	0.3222
Austria	0.3548	0.2868	0.3933	0.2347	0.7289	0.2859	0.3258
Belgium	0.4023	0.3457	0.3724	0.3789	0.2895	0.2235	0.2594
Bermuda	0.0904	0.0841	0.0333	0.0221	0.0099	0.0482	0.0706
Brazil	0.3077	0.3004	0.3140	0.2892	0.3297	0.2335	0.1289
Canada	0.3907	0.3594	0.3720	0.3850	0.3434	0.3159	0.3538
Chile	0.3181	0.4124	0.3849	0.1167	0.0900	0.0470	0.0978
China	0.2352	0.2059	0.1640	0.0073	0.1170	0.0529	0.0573
Colombia	0.3100	0.3110	0.3534	0.3526	0.2581	0.2929	0.2912
Costa Rica	0.2718	0.3984	0.3184	0.3465	0.3189	0.0969	0.1203
Denmark	0.3503	0.2244	0.3583	0.4288	0.4478	0.3181	0.3104
Dominican Republic	0.2234	0.3345	0.3099	0.3287	0.0936	0.1582	0.1196
Ecuador	0.1639	0.1895	0.2453	0.2300	0.2851	0.1008	0.1714
Egypt	0.3181	0.3181	0.3239	0.2169	0.1310	0.1948	0.1638
El Salvador	0.2635	0.2427	0.3138	0.2899	0.3194	0.2342	0.2168
Finland	0.4354	0.4701	0.4331	0.3558	0.2214	0.3187	0.1584
France	0.3958	0.4511	0.4367	0.3955	0.3775	0.2977	0.2283
Greece	0.1947	0.3541	0.3422	0.2247	0.2488	0.2570	0.3338
Guatemala	0.3620	0.3183	0.2087	0.2906	0.3845	0.2838	0.1828
Honduras	0.3735	0.3980	0.4396	0.3815	0.4615	0.3538	0.4187
Hong Kong	0.1338	0.1422	0.2032	0.0936	0.1390	0.1178	0.1011
India	0.5629	0.5691	0.5764	0.4029	0.3919	0.3118	0.4364
Indonesia	0.3651	0.3478	0.3695	0.3476	0.2632	0.3105	0.3516
Ireland	0.0800	0.0295	0.0293	0.0342	0.0261	0.0324	0.0579
Israel	0.1814	0.1687	0.0960	0.3299	0.2016	0.0820	0.1021
Italy	0.2861	0.3368	0.3739	0.3623	0.3396	0.3505	0.3256
Jamaica	0.3767	0.3497	0.3245	0.3508	0.3387	0.2744	0.2621
Japan	0.4571	0.5134	0.5265	0.5050	0.5693	0.5201	0.5027
Kenya	0.4106	0.4662	0.4683	0.4592	0.4899	0.4010	0.3585
Luxembourg	0.3363	0.4036	0.4957	0.3380	0.4313	0.2871	0.2160
Malaysia	0.1314	0.1355	0.1717	0.2674	0.0758	0.1394	0.0814
Mexico	0.4346	0.3805	0.3589	0.3011	0.3291	0.3177	0.2766
Morocco	0.5226	0.5029	0.5421	0.4041	0.4908	0.3460	0.4094
Netherlands	0.2997	0.2623	0.1962	0.2012	0.2480	0.2107	0.1789
New Zealand	0.4306	0.4064	0.3926	0.4380	0.3702	0.2094	0.2867
Nigeria	0.4052	0.4006	0.3131	0.4391	0.2855	0.2676	0.1301
Norway	0.2860	0.4188	0.3747	0.3618	0.1703	0.1352	0.2904
Pakistan	0.5365	0.6144	0.4559	0.4397	0.4761	0.4430	0.4367
Panama	0.1527	0.1125	0.2599	0.0763	0.0622	0.0603	0.0918
Peru	0.4170	0.4887	0.4876	0.4131	0.5914	0.1483	0.1544
Philippines	0.3405	0.3345	0.3618	0.3499	0.3499	0.3257	0.3347
Portugal	0.2867	0.3263	0.2519	0.2421	0.2664	0.2849	0.2530
Singapore	0.1705	0.1734	0.0842	0.0256	0.0402	0.0537	0.0565
South Africa	0.2767	0.3703	0.5021	0.2886	0.4361	0.4175	0.4183
South Korea	0.3112	0.4347	0.2062	0.2986	0.3489	0.4477	0.2575
Spain	0.1947	0.2615	0.2836	0.2757	0.2277	0.2669	0.2533

(*continued*)

Table 1A.1 (continued)

	1980	1982	1984	1986	1988	1990	1992
Sri Lanka	0.3643	0.5563	0.2963	0.5465	0.5164	0.4409	0.4054
Sweden	0.4404	0.5075	0.5734	0.5550	0.5166	0.2024	0.1669
Switzerland	0.2206	0.2121	0.2062	0.1838	0.1126	0.1538	0.1387
Thailand	0.3843	0.3254	0.3194	0.2828	0.3134	0.1795	0.2465
Turkey	0.5839	0.5628	0.4194	0.4378	0.4223	0.3164	0.2295
United Kingdom	0.2749	0.2713	0.3224	0.3713	0.2664	0.2126	0.1929
Uruguay	0.1837	0.2318	0.3099	0.0809	0.2762	0.1926	0.1897
Venezuela	0.2796	0.2826	0.3376	0.2990	0.3630	0.2211	0.1973
West Germany	0.4409	0.5049	0.5034	0.4793	0.3281	0.3242	0.2893
Zambia	0.4495	0.3950	0.4728	0.3799	0.0842	0.2804	0.2793
Zimbabwe	0.3312	0.3943	0.5231	0.1984	0.5262	0.4092	0.1203

Note: The table reports country average effective tax rates for U.S. manufacturing subsidiaries. Average effective tax rates in each country are calculated by dividing the total income taxes paid by controlled foreign corporations in the manufacturing sector by their total earnings and profits. Information on total income taxes paid and earnings and profits comes from the Form 5471 portion of the U.S. Department of the Treasury corporate tax files.

Table 1A.2 **Real Capital Stock by Year**

	Capital Stock (in millions)			Capital Stock (in millions)	
	1984	1992		1984	1992
Argentina	1,536.7	2,101.7	Kenya	54.7	37.9
Australia	4,174.4	8,314.9	Luxembourg	225.3	710.6
Austria	477.3	834.8	Malaysia	493.5	1,587.0
Belgium	2,017.6	6,288.6	Mexico	3,293.0	6,821.4
Bermuda	132.3	533.2	Morocco	30.2	69.2
Brazil	5,091.2	11,288.7	Netherlands	3,735.1	10,566.1
Canada	15,276.0	36,573.3	New Zealand	1,315.9	605.1
Chile	103.1	984.6	Nigeria	58.3	61.5
China	206.7	494.2	Norway	131.4	785.2
Colombia	429.2	975.5	Pakistan	63.7	118.1
Costa Rica	60.5	143.5	Panama	259.4	630.2
Denmark	254.3	725.9	Peru	255.7	108.2
Dominican Republic	12.5	25.5	Philippines	368.5	699.1
Ecuador	91.3	101.9	Portugal	201.1	912.5
Egypt	25.7	96.3	Singapore	719.8	3,598.9
El Salvador	11.3	61.5	South Africa	1,023.7	464.2
Finland	78.3	290.5	South Korea	258.1	1,721.3
France	5,631.0	19,710.1	Spain	4,153.8	7,207.5
Greece	90.2	270.7	Sri Lanka	10.0	11.0
Guatemala	117.9	77.3	Sweden	385.7	2,290.5
Honduras	56.9	86.9	Switzerland	935.0	2,489.0
Hong Kong	242.6	635.6	Thailand	183.9	1,385.3
India	221.5	361.6	Turkey	125.0	584.2
Indonesia	138.2	279.6	United Kingdom	12,632.0	32,970.4
Ireland	470.4	1,513.2	Uruguay	78.5	136.4
Israel	197.8	504.3	Venezuela	946.2	1,138.0
Italy	2,871.4	12,983.0	West Germany	15,176.3	28,909.4
Jamaica	15.6	47.6	Zambia	10.7	15.1
Japan	8,053.9	14,918.9	Zimbabwe	43.8	30.6

Source: Form 5471 information from the U.S. Department of the Treasury tax files.

Table 1A.3 **Tax Rate Regression Showing Noise in 1984 Effective Tax Rate**

	Dependent Variable	
	ETR 1986	ETR 1990
Constant	.010	.011
ETR	(.034)	(.032)
1980	.297	.037
	(.199)	(.194)
1982	.426	.288
	(.197)	(.195)
1984	.157	−.019
	(.145)	(.144)
1986		.140
		(.133)
1988		.289
		(.095)
Adjusted R^2	.604	.553
N	58	58

Note: The columns report estimated ordinary least squares (OLS) coefficients. Standard errors are in parentheses. ETR = effective tax rate.

Table 1A.4 **Means and Standard Deviations for Variables in the Difference Regressions**

Variable	Mean	Standard Deviation
Log capital, 1992 − log capital, 1984	0.812	0.684
Log(1 − Ave ETR for 1980–84)	−0.421	0.178
Log(1 − Ave ETR for 1988–92)	−0.315	0.159
Log(1−Ave ETR for 1988–92) − log(1−Ave ETR for 1980–84)	0.106	0.126
Log population, 1992 − log population, 1984	0.153	0.255
Log GDP, 1992 − log GDP, 1984	0.660	0.484
TRADE	1.160	1.150
TRADE∗[log(1−Ave ETR for 1988–92) − log(1−Ave ETR for 1980–84)]	0.155	0.270

Note: "Ave ETR" is the country average effective tax rate. "Ave ETR for 1988–92" is equal to the country average effective tax rate averaged over 1988, 1990, and 1992. "Ave ETR for 1980–84" is equal to the country average effective tax rate averaged over 1980, 1982, and 1984. The trade regime variable, "TRADE," runs from 0 (most open) to 3 (most restrictive).

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Comment Jack M. Mintz

A Eulogy for the Use of Average Tax Rates in Investment Equations

In recent years, there has been considerable effort to model the impact of taxation on the location of investment. These efforts have included

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country cross section and time series studies looking at how taxes impact the investment decisions of firms. Two examples of quite different approaches include Cummins, Hassett, and Hubbard (1996) and Hartman (1984) (see also the survey by Hines 1996). The first uses publicly available data but models the capital decision of the firm based on a cost of capital—taxes are incorporated following the Jorgenson-Hall approach. The second example uses reduced-form equations that look at capital decisions on a more aggregated level (by country), with decisions being related to proxies for the return on capital and the average rate of tax (taxes divided by profits of the firm).

The paper by Altshuler, Grubert, and Newlon is an ambitious study that follows the approach of Grubert and Mutti (1997). It has the advantage of using a rich source of data that provide values of capital, taxes, and profits of U.S. manufacturing subsidiaries operating in close to sixty countries, spanning the years 1980 to 1992. The authors regress investment on average tax rates that are measured as corporate income taxes divided by book profits. In my comments I will provide a brief overview of the econometric model and, thereafter, a critique of the use of average tax rates in investment equations.

The Basic Econometric Model

The econometric model presented in the paper is a parsimonious fixed effects model. It involves regressing the aggregated manufacturing capital stock of a country on tax rate variables, a single-year measure of the openness of the economy, GDP, and regional dummies. Most of the variables had their expected effects on the location of capital.

Rather than try to estimate the impact of taxes on each firm, the authors choose to aggregate data to the country level. It should be noted, however, that it is somewhat unclear whether a link exists between GDP and manufacturing capital stock if industrial structure differs across countries. To the extent that GDP is a poor proxy of the output effect on the demand for manufacturing capital, this may give the average tax rate variable a greater role in the results than appropriate. Moreover, the concentration on manufacturing is a bit unfortunate since, in many countries, resource and service sectors are quite important and country tax systems reflect a particular industrial structure.

The variable capturing openness of the economy is not significant. I suspect that this results from the use of one year of data derived from a World Bank study when many countries throughout the 1980s and early 1990s substantially improved their openness, particularly in Latin America. Another approach would have been to use the difference in a real rate of interest comparable to the U.S. real rate (for example, bank loan rates that are obtainable from International Monetary Fund publications). This variable could be viewed as a measure of risk or credit market inefficiencies.

The general result, that capital is affected by the average tax rate with elasticities of more than 2, is rather surprising, given the level of aggregation. Studies that tend to aggregate data in the cost of capital literature often tend to find lower numbers, if at all significant. I believe that the strong tax effects on investment obtained from these studies result from unwelcome dependency of average tax rates on investment.

Endogeneity of Average Tax Rates

I have been critical of the use of average tax rates for investment equations in the past because the tax rates are endogenous to the investment decision. Higher investment or growth in capital stocks result in lower average tax rates, assuming that the statutory tax rate is greater than the average tax rate and that tax writeoffs for capital are greater than the economic costs of replacing capital. Therefore, in periods of sustained growth rates for firms, industries, or countries, average tax rates tend to fall when investment increases provided the previous two assumptions hold (and vice versa if the converse holds). The authors wisely anticipated this criticism and therefore used a number of proxies to avoid this endogeneity—these proxies included the statutory tax rates and a tax rate averaged for a period.

These attempts to deal with the limitations of average tax rates are important. Nonetheless, as discussed below, the average tax rates measured for a host country still are truly limited in application, and I will now discuss these issues more fully.

Complexities of Tax Systems and Limitations for the Use of Average Tax Rates

Trying to understand the corporate tax system for one country is difficult enough. Capital is affected not only by corporate income taxes but by a host of other taxes on capital—asset or net worth taxes (as is Canada, Germany, and Italy, for example), sales taxes on capital inputs (Canada and the United States), property taxes, and minimum taxes on profits, assets, turnover, or dividends. Although research has concentrated on the corporate income tax in that it is the largest tax, this is not the case in many countries. For example, in Canada, businesses in 1995 paid close to $19 billion in capital and property taxes and $18 billion in corporate income taxes.

Tax provisions require taking into account rates of tax and detailed aspects of the base, including the treatment of inventory costs, depreciation, interest expense (such as thin capitalization ratios), and losses. The treatment of losses for tax purposes is very important—a profitable corporation may not be paying tax at a point in time because of either current fast writeoffs in the tax system or of using up a bank of past losses reflecting past policies and economic circumstances. Thus, the average tax rate, once

aggregated across firms, depends not only on current but also on past tax policy.

More complicated is the relationship between tax systems at the international level. A host country's tax rate influences not only U.S. investments but also the U.S. tax regime. Some of the prominent features include the following:

- The average tax rate for a particular country is not independent of other tax systems because U.S. tax considerations will affect the timing and source of remissions. A U.S. corporation pays tax on income remitted to the United States net of foreign tax credits abroad, and the average tax rate plays a role in determining the amount of the foreign tax credit. Although the United States uses a global tax credit and allows companies to aggregate sources of remitted income and foreign tax credits, restrictions are in place that limit the degree to which this is available, as in the case of interest from high-tax countries. These restrictions apply differently across countries and are further complicated by withholding tax regimes and thin capitalization and other rules in the host country. Generally, however, a firm can manipulate its credits by changing its remissions of types of income to the parent from abroad (Altshuler and Newlon [1993]). For example, when remitting dividends with excess credits, the parent can simultaneously remit other charges deductible from income in the host country to eliminate excess tax credits and to avoid paying U.S. tax on income.
- Average tax rates will depend on past and current policies to remit income from subsidiaries to the U.S. parent. Prior to 1986, the foreign average tax rate could be blown up in years of remitting income by avoiding certain deductions (for example, losses, discretionary capital cost allowances, or tax credits) that would result in lower average tax rates during that year. The following year, the deductions would be claimed if no income was to be remitted, thereby lowering the average tax rate. After 1987, eligible earnings and profits and the foreign tax credit became related to accumulated earnings and taxes paid over time, thereby reducing the scope for manipulating tax credits and average tax rates in this manner.
- An average tax rate in the host country does not capture the full impact of a subsidiary's decision on the taxes paid by the multinational. United States laws are complicated by allocation rules that could result in the allocation of certain costs to foreign source income—especially interest expense—thereby affecting the amount of U.S. tax paid on income earned in the United States. These rules, which require companies to allocate interest expense according the share of foreign to worldwide assets, became more stringent after 1986. Under alloca-

tion, an investment decision by a subsidiary can affect the average tax rate in the host country as well as the U.S. tax rate on domestic income, as has been discussed (Altshuler and Mintz 1994).

- Average tax rates of a host country will also depend on the tax planning decisions of multinationals that link foreign tax considerations across a number of countries. Multinationals often use planning techniques, especially with respect to interest expense "double dipping," that can result in a reduction of both foreign and U.S. taxes. With multiple deductions for interest and other expenses, both U.S. and foreign taxes can be reduced, resulting in a lower effective tax rate in both host and home countries. Some of these arrangements have been facilitated by such past U.S. actions as the provision of limited liability partnership status. On the other hand, the United States in the past few years has aggressively limited some of these schemes that result in the reduction of U.S. and foreign taxes. Recent changes to the treatment of active and passive income, including the new "check-the-box" rules, will have a different impact on tax planning that is not yet fully known.

The Pitfalls of Using Average Tax Rates for Empirical Work

The previous discussion illustrates only some of the complications in the foreign and U.S. tax regimes that make one skeptical about using average corporate income tax rates in a host country to determine the impact of tax on investment. More specifically, I would suggest that the results in the paper by Altshuler, Grubert, and Newlon may be overstated for the following possible reasons:

1. Investment depends on other features of a host country's tax system besides the corporate income tax. One does not know if the inclusion of other taxes might have resulted in better or less precise estimates (elasticities could be lower in value as a result). For example, there is not a significant difference between U.S. and Canadian manufacturing corporate income tax provisions—the corporate income tax rates and the present value of tax depreciation rates are similar. However, Canadian average tax rates on manufacturing are higher than those found in the United States, once capital taxes, sales tax on capital inputs, and property taxes are included in the comparison.

2. The average corporate income tax rate for a host country does not take into account the impact of the subsidiary's decisions on corporate income taxes paid by the United States on investments abroad or in the United States. As remarked earlier, the interest allocation rules alone and international double-dipping arrangements are examples whereby the subsidiary's investment decision can impact other taxes paid, not just those to the host country. Also, when the parent is in a deficient tax credit position, the parent's taxes on remitted income will be affected by the subsid-

iary's decisions. In principle one should be measuring a total average tax rate that incorporates the effects of both host and other taxes paid by the U.S. multinational. The bias introduced by leaving out the impact of subsidiary decisions on the overall taxes paid by the multinational is not clear.

3. There seems to be no incorporation of the dramatic changes in the U.S. treatment of foreign income since 1986, including interest allocation rules and foreign tax credit limitations. One would have expected these rules to result in a reduction of foreign tax credits as indicated by the data. I would suspect that parents with excess credits in 1986 would have responded differently and tried to reduce their average tax rates abroad. This and other factors such as leveraged buyouts in the United States could have resulted in a divestment of capital investment and remissions to the parent (thereby resulting in an increasingly negative correlation between average tax rates and capital). Moreover, prior to 1986, many companies, when remitting income back to the U.S. parent, often reduced their reliance on capital investment abroad and blew up their average tax rates in those years. The average corporate income tax rate measure for a host country therefore may overstate the negative correlation between capital investment and taxes.

4. The aggregation of taxes and profits in a country masks the role of tax losses in affecting investment decisions. Since losses have a value in reducing taxes at some point through loss carryforwards (assuming that carrybacks have already been reflected in tax payments), the average tax rate may be overstated in a particular year because taxes should be reduced by the reduced taxes of other years. This is particularly important for cycles—during downturns, when investment slows down, average tax rates aggregated across firms tend to rise, and during upturns, average tax rates tend to be lower when losses are being written off. Although the authors use time-averaged or lagged effective tax rates, it would seem that the 1982, 1990, and 1992 effective tax rates are somewhat high and that a bias may be introduced exaggerating the effects of taxes on investment.

5. Many studies of foreign investment suggest that the anticipated changes in exchange rates can have a significant impact on investment. If a host country's exchange rate is expected to devalue, investment decisions could be discouraged while an anticipated revaluation would attract more capital. If a country's exchange rate declines, a parent may choose to reduce capital expenditures and remit more dividends out of the country for several years—average tax rates may rise during a period when income is remitted.

Conclusion

As I have tried to illustrate, the use of average corporate income tax rates for a host country in an investment equation may result in a biased estimate of the impact of taxes on investment. The foremost problem is

that the average tax rate depends on current and past investment decisions that tend to overstate the impact of taxes on investment. Moreover, many institutional features of the tax system are not incorporated in the measure of the average tax rate. These include the impact of losses in affecting the value of taxes paid in the host country or abroad, the effect of timing of remissions to the parent on average tax rates, and other tax-planning schemes.

The alternative for investment studies is to use the effective tax rate on marginal investments, which may be defined as the amount of tax paid on income earned by the last unit of capital held by the firm. Marginal effective tax rates, in principle, can be derived from a theoretical model that incorporates most of the important features of corporate tax systems, including minimum taxes, tax losses, capital taxes, and home-country taxes on remitted earnings. Theoretically, the marginal effective tax rate is a superior measure because it better characterizes the effect of taxes on capital decisions. However, one could criticize this tax rate measure since it is often difficult to obtain data to incorporate important institutional features in estimates of marginal effective tax rates; yet one should not jump to the conclusion that average tax rates are necessarily any better than marginal effective tax rates. If a complete set of data were available, it would seem that the marginal effective tax rate is clearly the appropriate statistic to use in an investment equation.

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