Volume Title: The Effects of Taxation on Multinational Corporations

Volume Author/Editor: Martin Feldstein, James R. Hines Jr., R. Glenn Hubbard

Volume Publisher: University of Chicago Press

Volume ISBN: 0-226-24095-9

Volume URL: http://www.nber.org/books/feld95-2

Conference Date: January 13-15, 1994

Publication Date: January 1995

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Chapter Author: Jason Cummins, R. Glenn Hubbard

Chapter URL: http://www.nber.org/chapters/c7742

Chapter pages in book: (p. 123 - 152)

5 The Tax Sensitivity of Foreign Direct Investment: Evidence from Firm-Level Panel Data

Jason G. Cummins and R. Glenn Hubbard

5.1 Introduction

Understanding the determinants of foreign direct investment is important for analyzing capital flows and the industrial organization of multinational firms. Most empirical studies of foreign direct investment, however, have focused on case studies of nontax factors in overseas investment decisions or on discerning reduced-form relationships between some measure of direct investment and variables relating to nontax and tax aspects of the investment decision. These studies (which we review in section 5.2) have helped to assess the qualitative effects of changes in underlying determinants on firms' overseas investment activities. It is more difficult, we argue below, to infer structural links between tax parameters and foreign direct investment in existing studies. Our interest in investigating those structural links stems both from a desire to extend models of foreign direct investment and from a concern that policymakers' consideration of using tax instruments to influence foreign direct investment requires a more formal empirical analysis.

At one level, this task is straightforward. A number of authors have related tax parameters in "home" (residence) and "host" (source) countries to financial variables such as the cost of capital or Tobin's q. Given such relationships, one could extend and exploit conventional neoclassical investment models devel-

Jason G. Cummins is assistant professor of economics at New York University and John M. Olin Fellow at Columbia University. R. Glenn Hubbard is the Russell L. Carson professor of economics and finance at the Graduate School of Business of Columbia University and a research associate of the National Bureau of Economic Research. Cummins acknowledges the financial support of the Center for International Business Education and the Chazen Institute at Columbia University.

The authors are grateful to Rosanne Altshuler, Debbie Compton, Martin Feldstein, Trevor Harris, David Hartman, Kevin Hassett, James Hines, Donald Kirk, James Poterba, and the conference participants for helpful comments and suggestions.

oped to explain firms' domestic investment decisions to estimate effects of tax parameters on outbound or inbound foreign direct investment.

In practice, this exercise is not so easy. Studies of effects of tax parameters on (generally inbound) U.S. foreign direct investment have relied on aggregated (by country) data on investment flows calculated by the Bureau of Economic Analysis. Because these data do not distinguish between new capital investment and acquisitions of existing assets, it is difficult to use them in tests of formal models of investment decisions. Given our interest in the effects of tax policy on foreign direct investment, this definitional problem is a significant one. In particular, Auerbach and Hassett (1993) have noted that the consequences of neglecting the different tax treatments of the two forms of U.S. inbound foreign direct investment are substantial.

In this paper, we examine the effects of taxation on foreign direct investment using previously unexplored (for this purpose) panel data on outbound foreign direct investment by subsidiaries of U.S. multinational firms collected by Compustat's Geographic Segment file project. These firm-level data contain information on new capital investment overseas, which enable us to measure tax influences on foreign direct investment more precisely and allow us to focus on structural models of subsidiaries' new investment decisions. The paper is organized as follows. Section 5.2 reviews the existing empirical literature on the determinants of foreign direct investment. Our model of the effect of tax and nontax factors on firms' foreign direct investment decisions is presented in section 5.3. Section 5.4 describes the panel data on multinational parent firms and their foreign subsidiaries that we use to estimate the model. We analyze empirical results for U.S. outbound foreign direct investment in section 5.5 and discuss in section 5.6 implications of those results for analyzing the role of tax policy in firms' overseas investment decisions. Section 5.7 concludes.

5.2 Empirical Literature on FDI

Existing empirical studies of foreign direct investment (FDI) reflect researchers' interest in industrial organization or taxation.[1] Industrial organization inquiries have generally ignored tax considerations and analyzed FDI as being governed by firms' desire to exploit the value of ownership-specific assets (such as valuable intangibles) or location-specific advantages (related to sourcing or marketing). Empirical research has centered on reduced-form, cross-sectional tests of FDI in a particular sector as a product of proxies for ownership-specific and location-specific variables (see, e.g., the studies in Dunning 1985).[2] Public finance inquiries have focused on the role of differen-

1. An exception is the survey in Caves (1982), which discusses both considerations.

2. Two other "industrial organization" approaches have also appeared in the literature. Wilson (1993) has used case studies to examine the roles played by nontax and tax considerations in

tial tax treatment as determining the source and location of FDI, holding constant nontax determinants.[3]

A significant body of empirical research by public finance economists has emphasized effects of taxation on FDI into the United States. This literature has generally examined reduced-form relationships between capital flows and measures of after-tax rates of return or effective tax rates on capital income.

Several studies have used annual aggregate data for FDI financed by subsidiary earnings and parent company transfers of funds, following Hartman's (1981, 1984, 1985) contributions.[4] Hartman used as a theoretical benchmark the "tax capitalization" approach to analyzing firms' dividend and investment decisions (see the derivation in King 1977; Auerbach 1979; Bradford 1981).[5] In that approach, dividend payouts are a residual in firm decisions. Payout ratios do not affect firms' required rate of return on equity, and permanent changes in individual tax rates do not affect dividend payouts or the cost of capital. In the context of FDI, these implications permit Hartman to ignore effects of (at least permanent changes in) home-country tax parameters on FDI in "mature" subsidiaries—that is, those paying dividends to their parent firms.[6] We return to this issue in section 5.3.

Hartman (1984) estimated the effects of U.S. inbound FDI of changes in the after-tax rates of return received by foreign investors in U.S. inbound FDI and by investors in U.S. capital generally, with the intent of measuring impacts of shifts in returns to new FDI. He also includes as an explanatory variable the tax rate on U.S. capital owned by foreign investors relative to that owned by U.S. investors.[7] His estimated models do not incorporate measures of U.S. withholding taxes, foreign income taxes, or rates of return on non-U.S. investments.

location decisions. In a different vein, Froot and Stein (1991) study the influence of capital-market imperfections on the source of FDI.

3. Theoretical analyses in this vein include Gersovitz (1987) and Alworth (1988). We review empirical studies below. For overviews of systems for taxing income from FDI, see Ault and Bradford (1990), Frisch (1990), Hines and Hubbard (1990), U.S. Joint Committee on Taxation (1990, 1991), and U.S. Department of the Treasury (1993).

4. Hartman used data on FDI for 1965–79, provided by the Bureau of Economic Analysis (BEA); the data are separated according to whether investment was financed by subsidiary retained earnings or transfers from foreign parent companies.

5. Sinn (1984) also demonstrated that retention-financed investments by subsidiaries are independent of home-country tax parameters. The work of Hartman and Sinn built on the earlier work by Horst (1977), who maintained that a subsidiary's cost of capital depended on both home- and host-country tax parameters when profits are remitted.

6. This prediction is more suitably applied to firm-level data than to aggregate FDI data, of course. The tax capitalization approach suggests that a mature subsidiary's investment financed by retained earnings is unaffected by the home-country tax rate. This suggestion is not equivalent to a claim that aggregate investment out of retained earnings will not be affected by the home-country tax rate.

7. Hartman intends this last variable to proxy for effects on asset valuation of taxes applying only to U.S. investors. (Changes in the valuation of assets affect the cost of investing for potential foreign investors.)

Using the log of the ratio of FDI to U.S. GNP as the dependent variable,[8] Hartman's results indicate that the FDI-GNP ratio increases as the after-tax rates of return rise and decreases as the relative tax rate on foreigners rises. The variables have the expected sign, though explanatory power was much better for investment financed by subsidiary retained earnings. These suggestive findings indicate that taxes are an important determinant of FDI.

Hartman's study provoked many subsequent rounds of replication and refinement. Employing the rate-of-return series calculated by Feldstein and Jun (1987), Boskin and Gale (1987) reestimate Hartman's model using data over the period 1956–84. While their results vary across specifications and time periods, they are qualitatively consistent with Hartman's original findings.

In his dissertation, Newlon (1987) reconsiders and extends the earlier analyses of Hartman and of Boskin and Gale (1987). After correcting miscalculations in the FDI data from the BEA (for the years 1965–73), Newlon reestimates the specifications used by earlier authors and finds that the model relating the log of the FDI-GNP ratio to after-tax rates of return on transfers of funds fits better, though the model for investment financed by retained earnings fits more poorly. When Newlon uses data over the 1956–84 period, his results depart from those of Hartman and Boskin and Gale. He finds no statistically significant estimated coefficient that explains FDI financed by transfers of funds.

These studies are important advances in our understanding of the effects of taxation on FDI. A number of concerns arise, however. An obvious one relates to problems of inference using reduced-form models and highly aggregated data; we return to this in section 5.3 and 5.4. A second relates to the omission of home-country tax rates from the analysis (see, e.g., Slemrod 1990, discussed below). Third, nontax determinants of FDI are not explicitly modeled. Fourth, Newlon (1987) and others have noted a problem in interpreting the coefficient on the rate of return on FDI financed by retained earnings. As long as the home-country taxes worldwide income using a foreign tax credit and deferral, a subsidiary is likely to finance investment first by using retained earnings. In this case, when the subsidiary's desired investment exceeds its retained earnings, the subsidiary will retain all of its income; that is, required earnings and income will be equal. This could lead to a spurious correlation between investment financed out of retained earnings and the rate of return (where the numerator of the latter is effectively retained earnings).[9] Finally, the FDI data supplied by the BEA suffer two drawbacks, even accepting their level of

8. Young (1988) relaxes the assumption that the GNP elasticity of U.S. inbound FDI is unity. With this modification, and using revised data over the 1956–84 period, he estimates a smaller (though still statistically significant) response of FDI financed by retained earnings to the after-tax rate of return, confirming Hartman's result. Young finds no evidence that taxes affect FDI financed by transfers of new funds.

9. The problem is even more general; the spurious correlation can arise even in cases where the subsidiary follows any fixed rule for determining dividend payments out of current earnings, as noted by Newlon (1987).

aggregation: (1) as noted in the introduction, they measure financial flows rather than new capital investment per se;[10] and (2) they are based on periodic benchmark surveys, raising the possibility that FDI flows are more mismeasured the further is the observation from a benchmark year.[11]

Slemrod (1990) addresses some of these concerns, while still relying on the data on FDI provided by the BEA.[12] He disaggregates the data on FDI into the United States by seven countries—Canada, France, Italy, Japan, the Netherlands, the United Kingdom, and (the former) West Germany. He also makes three departures from the approaches used by earlier authors. First, he controls for a richer set of nontax variables, including the ratio of U.S. GDP to the combined GDP of the seven investing countries (to capture impacts of changing market sizes), the prime-age-male unemployment rate in the United States and the weighted average of the unemployment rates in the seven investing countries (to capture impacts on FDI of business cycles), the real effective exchange rate of the U.S. dollar against the GDP-weighted average of the currencies of the seven investing countries (to capture impacts of changes in relative costs of production), and adjustments to address potential measurement error in FDI (see n. 11 above).

Second, he uses measures of effective tax rates on corporate investment in the United States (calculated by Auerbach and Hines 1988) instead of measures of after-tax returns. Third, he includes lagged as well as contemporaneous measures of this tax rate concept (appealing to "time to build" arguments).

Slemrod's principal findings are as follows. Considering the seven countries together, he concludes that: (1) the marginal effective tax rate in the United States has a negative and statistically significant effect on total FDI and transfer-financed FDI; (2) these estimated impacts of the marginal effective tax rate are not robust to the inclusion of the weighted-average foreign unemployment rate (which is itself positively related to FDI into the United States);

10. As constructed by the BEA, FDI includes purchases of existing assets by foreign investors, while it excludes investment raised in the host country or in third countries. The analysis in Auerbach and Hassett (1993) suggests that a significant proportion of U.S. inbound FDI is related to acquisitions.

11. Slemrod (1990) attempts to address the concerns about the official FDI data. To adjust for potential measurements error in FDI on account of the benchmark procedure, he includes in models of FDI (described below) two dummy variables. The first represents the difference between the year for which the data are provided and the year in which the most recent benchmark survey was conducted. The second relates to the post-1974 period as a proxy for once-and-for-all modifications of definitions and concepts relating to FDI carried out by the BEA in 1974.

12. Using aggregate data on FDI over the 1956–84 period considered by earlier authors, Slemrod first reestimates existing models. He then explores effects of pretax rates of return and tax rates separately. For FDI financed by retained earnings, he finds that the estimated coefficients on tax terms are insignificantly different from zero; for FDI financed by transfers of funds, the estimated coefficients on tax terms have the expected sign and are significantly different from zero. These results are the opposite of those in Hartman (1984). When Slemrod uses the marginal effective corporate tax rate on investment calculated by Auerbach and Hines (1988) (instead of the average tax rate), he finds that the marginal effective tax rate has a statistically significant effect on transfer-financed FDI but not on retention-financed FDI.

(3) of the nontax variables, the relative GDP measures, the U.S. unemployment rate, and the FDI measurement adjustment have no statistically significant impact on FDI; and (4) the real effective dollar exchange rate has a negative and statistically significant impact on inbound FDI.[13] When he groups the countries into those with worldwide (foreign tax credit) and those with territorial (exemption) systems, Slemrod's results fail to support predictable differences in the tax sensitivity of FDI between the two groups.[14]

While Slemrod's contribution addresses some of the concerns raised in the empirical literature, it raises others. For example, there are questions about the merits of Slemrod's approach to the problem of spurious correlation between retention-financed FDI and after-tax rates of return (see Hartman 1990). Second, as noted earlier, the BEA data do not allow one to distinguish new investment and acquisitions in FDI. Finally, the approach does not suggest a structural model, which could be used for policy inference.

In the next section, we develop a simple structural model to study new FDI by individual firms. As the reader will likely note in that section and in the following section describing the firm-level panel data we use, our approach also requires many simplifying assumptions. In our view, however, the application of standard, theoretical investment models to firms' decisions offers the best hope of assessing effects of home-country and host-country tax systems on FDI.[15]

5.3 Modeling Effects of Taxes on FDI

5.3.1 Basic Issues

In a world of ideal data, assessing the impact of taxation on firms' FDI decisions would be straightforward.[16] In the q-theory approach, for example, investment I of parent firm i in subsidiary j at time t relative to that subsidiary's capital stock K, under certain conditions,[17] depends linearly on that subsidiary's marginal q, appropriately adjusted for tax considerations.[18] That is,

13. While possibly consistent with the low-relative-production-cost explanation offered by Slemrod (see also Pugel 1985), this result is also considered with the capital-market-imperfection explanation offered by Froot and Stein (1991): a low value of the dollar increases the dollar value of foreign investors' net worth, enabling them to offer more collateral and obtain more funds to finance investment in the United States.

14. Such apparent insensitivity could reflect problems in the specification or the tax rate measure, or, in addition, the use of techniques for intertemporal tax minimization.

15. This exercise is similar in spirit to the study of subsidiary dividend repatriation decisions in Hines and Hubbard (1990) and Altshuler, Newlon, and Randolph (chap. 9 in this volume).

16. For the purpose of this analysis, we are ignoring some cost considerations associated with the choice of capacity.

17. The necessary assumptions include perfect competition, constant returns to scale technologies, and quadratic adjustment costs; see, e.g., Hayashi (1982) and Summers (1981).

18. There is nothing special about the q-formulation of the investment demand equation; one could use the cost of capital formulation as well (see, e.g., Cummins, Hassett, and Hubbard 1994). Altshuler and Fulghieri (1990) illustrate the effects of home- and host-country tax parameters and the parent's tax status on a subsidiary's cost of capital.

$$\frac{I_{ijt}}{K_{ij,\,t-1}} = a_{ij} + bq_{ijt} + \varepsilon_{ijt},$$

where a and b are parameters to be estimated and ε is an expectational error.

Home-country and host-country tax parameters have been incorporated in theoretical definitions of the subsidiary's marginal q by Alworth (1988), Altshuler and Fulghieri (1994), Jun (1990), and others, under different assumptions about the taxing regime, dividend policy, and foreign tax credit status of the parent (in countries with worldwide tax systems). In this abstraction, we could estimate a and b, thereby permitting a calculation of elasticities of investment demand with respect to various tax parameters influencing multinational firms' FDI decisions. We could also compare the reasonableness of estimates of a and b with parameters estimated from firm-level data on domestic investment by similarly situated firms in home and host countries.

Unfortunately, this ideal is not particularly useful as a practical guide to estimating effects of taxation on the level of firms' FDI. First, it is difficult to develop a proxy for marginal q under the best of circumstances.[19] For FDI, a further complication arises because location-specific effects on the subsidiary's q cannot be captured by using available data to construct the parent's q, and values of subsidiary-specific q's are not observable.

To reduce these problems, while using the same basic structural strategy as that just described, we use the Euler equation approach to estimate the responsiveness of investment to tax parameters (see, e.g., Abel 1980; Hubbard and Kashyap 1992). As we discuss below, this approach has fewer informational requirements than the conventional q-theory representation used in the empirical investment literature. Nonetheless, it permits estimation of the same structural parameters in the foregoing example so that we can still ask: Given a change in a tax parameter, how does a subsidiary's marginal q change, and how does FDI change? The approach also permits consideration of expounded models in which "net worth" changes can affect FDI (see, e.g., Gertler and Hubbard 1988; Froot and Stein 1991).

5.3.2 Euler Equation Approach

Analyzing investment demand begins with an expression for the value to the parent i of the foreign subsidiary j.[20] The after-tax return to the parent firm at time t reflects capital appreciation and current dividends.[21] In equilibrium, this return equals the return ρ_{ijt}:

$$(1)\qquad \rho_{ijt} = \frac{(1 - t^{\mathrm{c}}_{it})[E_t(V_{ij,t+1} - S_{ij,t+1}) - V_{ijt}] + (1 - t^{\mathrm{d}}_{it})E_t D_{ij,t+1},}{V_{ijt}}$$

19. See the discussion in Hayashi (1982) and Hubbard and Kashyap (1992).

20. The derivation herein expands on Hubbard and Kashyap (1992) and Hubbard, Kashyap, and Whited (1995).

21. For simplicity, we consider one majority-owned subsidiary per parent; we are thereby abstracting from tax-minimizing strategies available to parent firms with multiple subsidiaries. We are also abstracting from parent investment through third-party conduits located in neither the parent's country nor the subsidiary's country.

where V is the value of the subsidiary at time t, S denotes the value of parent equity transfers, t^r is the effective tax rate on subsidiary earnings retained and invested abroad, and E_t is the expectation operator conditional on information known at time t. (The after-tax capital gain to the parent firm thus consists of the change in the value of the subsidiary less the component of this change due to parent transfers.) Subsidiary j's dividends to its parent i at time $t + 1$ are $D_{ij,t+1}$, and t^d is the tax rate on those dividends. This derivation follows the tax capitalization view of the dividend decision (see the discussion in section 5.2), in which the required rate of return for equity investment in the subsidiary is independent of the subsidiary's dividend policy.

In the absence of any bubbles, solving equation (1) forward yields the following expression for the subsidiary's value at time zero, where β_{ijt} is the appropriate one-period discount factor:

$$(2) \qquad V_{ij0} = E_0 \sum_{t=0}^{\infty} \left(\prod_{j=0}^{t-1} \beta_{ijt} \right) \left[\left(\frac{1 - t^d_{ijt}}{1 - t^r_{ijt}} \right) D_{ijt} - S_{ijt} \right].$$

The subsidiary maximizes equation (2) subject to five constraints.[22] The first is the capital stock accounting identity:

$$(3) \qquad K_{ijt} = I_{ijt} + (1 - \delta) K_{ij,t-1},$$

where K_{ijt} is the capital stock of subsidiary j at time t, I_{ijt} is its investment at time t, and δ is the (assumed constant) rate of economic depreciation.

The second constraint defines dividends. Cash inflows include sales, parent equity transfers, and net borrowing, while cash outflows consist of dividends, variable factor and interest payments, and investment expenditures:

$$(4) \qquad D_{ijt} = (1 - \tau_{jt}) \left[F(K_{ij,t-1}, N_{ijt}) - w_{jt} N_{ijt} - \psi (I_{ijt}, K_{ij,t-1}) - i_{ij,t-1} B_{ij,t-1} \right] + S_{ijt} + B_{ijt} - (1 - \pi^e_{jt}) B_{ij,t-1} - p_{ijt} (1 - k_{jt} - \tau_{jt} z_{jt}) I_{ijt},$$

where

N_{ijt} = a vector of variable factors of production for subsidiary j at time t;

w_{jt} = a vector of real factor prices for subsidiary j at time t;

B_{ijt} = the real value of net debt outstanding for subsidiary j at time t;[23]

i_{ijt} = nominal interest rate paid on subsidiary j's debt at time t;

π^e_{jt} = expected rate of inflation at time t (in currency in which subsidiary j borrows);

p_{ijt} = subsidiary j's price of capital goods at time t relative to the price of output at time t;

22. We are assuming that the parent firm has a controlling interest in the subsidiary.

23. This setup implicitly assumes that the subsidiary's debt can be obtained on identical terms from different sources and that the parent cannot successfully disguise repatriation of profits interest.

τ_{jt} = corporate income tax rate in the host country for subsidiary j at time t;

k_{jt} = investment tax credit in the host country applying to subsidiary j at time t;

z_{jt} = present value of one dollar of depreciation allowances in the host country applying to subsidiary j at time t;

$F(K_{ij,t-1}, N_{ijt})$ = subsidiary's real net revenue function ($F_K > 0$, $F_{KK} < 0$); and

$\psi(I_{ijt}, K_{ij,t-1})$ = real cost of adjusting the capital stock ($\psi_I > 0$, $\psi_{II} > 0$, $\psi_K < 0$, $\psi_{KK} < 0$).

The third and fourth constraints restrict dividends and parent equity transfers, respectively, to be nonnegative:

$$D_{ijt} \geq 0 \tag{5}$$

and

$$S_{ijt} \geq 0. \tag{6}$$

The fifth constraint is a transversality condition that prevents the firm from borrowing an infinite amount to pay dividends:

$$\lim_{T\to\infty}\left(\prod_{s=t}^{T-1} \beta_{ijs}\right) B_{ijT} = 0, \text{ for all } t. \tag{7}$$

Let λ_{it} be the series of Lagrange multipliers associated with the constraint (5), and let m_{ijt} represent the ratio $(1 - t^{d}_{ijt})/(1 - t^{r}_{ijt})$. Substituting equation (4) into equation (2) for D_{ijt}, and using equation (3) to eliminate I_{ijt} from the problem, the first-order condition for the subsidiary's capital stock (K_{ijt}) can be expressed as

$$\begin{aligned} E_t\beta_{ijt}\left(\frac{m_{ij,t+1} + \lambda_{ij,t+1}}{m_{ijt} + \lambda_{ijt}}\right) \Bigg\{ F_K(K_{ijt}, N_{ij,t+1}) - \psi_K(I_{ij,t+1}, K_{ijt}) \\ + (1 - \delta)\left[\psi_I(I_{ij,t+1}, K_{ijt}) + p_{ij,t+1}\left(\frac{1 - k_{j,t+1} - \tau_{j,t+1}z_{j,t+1}}{1 - \tau_{j,t+1}}\right)\right]\Bigg\} \\ = \psi_I(I_{ijt}, K_{ij,t-1}) + p_{ijt}\left(\frac{1 - k_{jt} - \tau_{jt}z_{jt}}{1 - \tau_{jt}}\right). \end{aligned} \tag{8}$$

To obtain an equation for investment, it is necessary to parameterize the adjustment cost function, $\psi(I_{ijt}, K_{ij,t-1})$. The tradition in the q-theory literature has been to specify adjustment costs that are linearly homogenous in investment and capital, so that marginal and average q are equal (see Hayashi 1982). A convenient parameterization adhering to these constraints is

$$\psi(I_{ijt}, K_{ij,t-1}) = \frac{\alpha}{2}\left(\frac{I_{ijt}}{K_{ij,t-1}} - \upsilon_i\right) I_{ijt}, \tag{9}$$

where the bliss point in the adjustment cost function is given by υ_i. By differentiating equation (9) with respect to I_{ijt} and K_{ijt}, and substituting these results into (8), we obtain

$$(10)\quad \begin{aligned} E_t\beta_{ijt}\Bigg\{&\left(\frac{m_{ij,t+1}+\lambda_{ij,t+1}}{m_{ijt}+\lambda_{ijt}}\right)F_K(K_{ijt},N_{ij,t+1}) + \frac{\alpha}{2}\left(\frac{I_{ij,t+1}}{K_{ijt}}\right)^2 \\ &+(1-\delta)\left[\alpha\left(\frac{I_{ij,t+1}}{K_{ijt}}\right) + p_{ij,t+1}\left(\frac{1-k_{j,t+1}-\tau_{j,t+1}z_{j,t+1}}{1-\tau_{j,t+1}}\right) - \upsilon_i\right]\Bigg\} \\ &= \alpha\left(\frac{I_{ijt}}{K_{ij,t-1}}\right) + \frac{p_{ijt}(1-k_{jt}-\tau_{jt}z_{jt})}{1-\tau_{jt}} - \upsilon_i. \end{aligned}$$

We assume that expectations are rational and allow for an expectational error, $e_{i,t+1}$, where $E_t(e_{i,t+1}) = 0$ and $E_t(e^2_{i,t+1}) = \sigma^2_e$. The error is uncorrelated with any information known at time t, thereby allowing us to reexpress equation (10) as

$$(11)\quad \begin{aligned} &\tilde{\beta}_{ijt}F_K(K_{ijt}, N_{ij,t+1}) + \left(\frac{\alpha}{2}\right)\tilde{\beta}_{ijt}\left(\frac{I_{ij,t+1}}{K_{ijt}}\right)^2 + \alpha(1-\delta)\,\tilde{\beta}_{ijt}\left(\frac{I_{ij,t+1}}{K_{ijt}}\right) \\ &+(1-\delta)\tilde{\beta}_{ijt}\left[\frac{p_{ij,t+1}(1-k_{j,t+1}-\tau_{j,t+1}z_{j,t+1})}{1-\tau_{j,t+1}} - \upsilon_i\right] - \alpha\left(\frac{I_{ijt}}{K_{ij,t-1}}\right) \\ &-\frac{p_{ijt}(1-k_{jt}-\tau_{jt}z_{jt})}{1-\tau_{jt}} + \upsilon_i = e_{ij,t+1}, \end{aligned}$$

where

$$(12)\quad \tilde{\beta}_{ijt} = \beta_{ijt}\left(\frac{m_{ij,t+1}+\lambda_{ij,t+1}}{m_{ijt}+\lambda_{ijt}}\right).$$

For the cases mentioned below, we will use the generalized method of moments (GMM) to test for misspecification of equation (11). With a set of instrumental variables that are orthogonal to the error term, the orthogonality conditions should not be rejected for equation (11).

Our strategy is as follows. We estimate the model in equation (11) using data on FDI in foreign subsidiaries of U.S. firms (described below) and proceed in two steps, producing GMM estimates of the underlying parameters under alternative assumptions that tax variables are omitted from or included in the model. Assuming that we have appropriately modeled the subsidiary's investment decision (and chosen appropriate instrumental variables), if tax considerations are important, parameter estimates should be implausible in the "no tax" version, and the model's orthogonality conditions should be rejected. On the other hand, we expect more plausible parameter estimates when tax considerations are properly specified, and the model's orthogonality conditions should not be rejected. Successful estimation of the model's parameters then enables us to return to the q-theoretic experiment suggested in section 5.3: What is the predicted effect on outbound FDI of changes in domestic and foreign tax parameters?

5.3.3 Econometric Estimation

Two general issues arise in the estimation of equation (11). First, the model is nonlinear in both the parameters and the ratio of investment to the capital stock. Moreover, there is a simultaneity problem because of the presence of the expected marginal product of capital in the model. These two considerations argue for GMM estimation.[24]

Second, given the industrial organization considerations discussed in section 5.2, we want to allow for the possibility of firm-specific and time-specific effects. We include year dummies to deal with the latter. Because of the presence of the lagged dependent variable in equation (11), the standard practice of accounting for firm-specific effects by removing the means from the variables in the model will violate the orthogonality conditions used to identify the model. Instead, we first-difference equation (11) and then use twice-lagged instruments, which will still be orthogonal to the moving-average error that the differencing creates.

5.4 The Data

5.4.1 Panel Data on FDI

The data set is constructed from the Compustat Geographic Segment file. Approximately 6,500 companies report information from their foreign operations, segregated by geographic segment. Both U.S.- and foreign-incorporated firms report sales, operating income, and fixed assets. Up to four geographic regions are reported for seven years at a time. We combine two seven-year panels to obtain a data set extending from 1980 to 1991. There is no requirement by either the Financial Accounting Standards Board (FASB) or the SEC regarding the groupings for geographic areas. As a result, the degree of specificity among company reports varies. For example, consider two companies operating in the same countries. Company A might report four different geographic areas: France, Germany, Canada, and Asia. Company B might report two different geographic areas: France and Europe, and "other foreign."

The accounting literature stresses that considerable caution should be exercised in making inferences about data reported for regions and for groups of countries (see, e.g, Pointer and Doupnik 1993). No conclusions about their relative importance can be made from the data. Consider company B again. It is not necessarily the case that one can isolate its French operations since it

24. The GMM technique minimizes a quadratic objective function that has an optimal weighting matrix based on initial parameter estimates. The model will be overidentified as long as the number of instrumental variables used exceeds the number of parameters to be estimated. The test is formulated as follows: Under the null hypothesis of orthogonality of the instruments and the error terms, the product of the minimized value of the objective function and the number of observations is distributed as a χ^2 statistic with n degrees of freedom, where n is the difference between the numbers of instruments and parameters. The overidentifying restrictions are rejected if the χ^2 value is higher than a critical value.

reports them first and aggregates all its other European operations. In constructing the panel, we minimize this problem by taking the most conservative course. We include only geographic segments when a single country is reported. While this strategy reduces the number of observations, it increases data quality and accuracy.

A second pitfall in using geographic segment data is that it is sometimes impossible to obtain data in a manner consistent with official definitions because of a company's method of reporting. This is, of course, a problem in constructing any firm-level panel data; it deserves special mention here because companies have more than the usual latitude in what they include in the data. For example, excise taxes might be included in sales, or the value of intangibles might be included in fixed assets. We mitigate the problem by isolating discrepancies from data footnotes. Nevertheless, we emphasize that care is required in constructing variables from these data.

The data are better understood by knowing their genesis. Geographic segment disclosures are mandated by *Statement of Financial Accounting Standards No. 14—Financial Reporting of Segments in a Business Enterprise* (SFAS 14), issued in 1976.[25] SFAS 14 was designed to provide information useful for evaluating the nature of the firm's investment and production decisions but to allow discretion in defining reportable segments and in employing coarse definitions. SFAS 14 requires firms to disclose information about foreign sales, income, and fixed assets if foreign operations account for 10 percent or more of a firm's revenues or assets. The directive became effective for companies with fiscal years ending after December 15, 1976. Two notes should be made about data extending to 1976. Segment data through fiscal years ending in 1979 contain many classification adjustments consistent with a learning process. Moreover, there appears to be little gain from extending samples before 1979, because of the paucity of data. As a result of these considerations, we begin our sample in 1980.

In addition to the pitfalls considered above, two more subtle issues arise in using the geographic segment data. First, as we noted in the introduction, to understand properly the effect of taxes on FDI, the "new investment" component must be separated from the "mergers and acquisitions" component. This is a potentially serious problem in these data, since reporting requirements are broad and data definitions are coarse. While practitioners' advice mitigated our concern,[26] we took two additional steps in the data construction to minimize any potential contamination. First, as is typical in the investment literature, we deleted major capital stock changes to eliminate clear discontinuities in the identity of the firm. Second, the geographic segment file provides a foot-

25. See, e.g., the discussions in Senteney and Bazaz (1992) and Pointer and Doupnik (1993).

26. In a private communication, Donald Kirk, chairman of the FASB when SFAS 14 was promulgated, explained to us that firms usually do not record the acquisition of capital through mergers and acquisitions in their geographic segment report. Debbie Compton, senior data manager at Standard & Poor's Compustat, confirmed that Compustat geographic segment data typically do not reflect the results of merger-and-acquisition activity.

note if the data reflect the results of a merger or acquisition; we deleted firms recording this footnote.

A second potential problem is that geographic segment data are reported in U.S. dollars. Since currency fluctuations could misrepresent the value of the foreign subsidiary's data, it is necessary to determine when geographic segment data are converted to dollars. For the purposes of SFAS 14, firms typically convert the data when balance sheets are prepared at fiscal year end.[27]

5.4.2 Constructing Variables Used in the Estimation

We construct the variables used in the econometric estimation as follows. The subsidiary's sales are defined as reported net sales for that geographic segment. The subsidiary's cash flow is defined as the sum of its operating profit and, if available, its depreciation; gross investment is the change in the gross stock of tangible fixed assets. Each of the above variables is divided by the beginning-of-period value of tangible fixed assets. We assume that the subsidiary's capital stock depreciation rate and nominal cost of borrowing is equal to those of its parent firm, which we calculated elsewhere, in Cummins, Hassett, and Hubbard (1994). Host-country tax variables (investment tax credit, depreciation allowances, corporate income tax rate, and withholding tax rate) are taken from Cummins, Harris, and Hassett (chap. 7 in this volume). A detailed discussion of their construction is provided therein with accompanying tables. The price of capital goods is the host country's investment price deflator. All variables are deflated by the host country's GDP deflator.

Tables 5.1–5.4 summarize our data on U.S. firm's outbound FDI; the construction of variables is described therein and below.

Table 5.1 indicates the number of U.S. foreign subsidiaries reporting information in the Compustat data. Countries for which Compustat reports data are Canada, the United Kingdom, (the former West) Germany, France, Japan, and Australia. Data are available over the time period 1980–91. While the number of subsidiaries reporting information varies from year to year (generally growing over the period), we are able to obtain investment and operating information on 282–632 U.S. foreign subsidiaries.

Tables 5.2–5.4 report summary statistics for subsidiary investment, operating income, and sales, respectively. The entries in table 5.2 represent the mean value for year t of the ratio of investment (I_t) to beginning-of-period capital stock (K_{t-1}).[28] The means are calculated using the values of the subsid-

27. We thank Donald Kirk for explaining this point to us. Debbie Compton again confirmed that Compustat believes that the data are converted in this way.

28. Since the geographic segment file data are reported in U.S. dollars, one must confront the issue of exchange rate shifts in calculating gross investment as the first-difference in the dollar-valued capital stock. One approach—which is used to generate the estimated results reported in section 5.5—is to construct I/K data from the dollar-valued capital stock data. Alternatively, one could convert the capital stock data into year-end foreign-currency equivalents in constructing I/K. As we describe below in n. 35, our empirical results are not significantly affected by this change. Neither approach is precisely correct because, in principle, investment should be valued in foreign-currency terms as it is made over the year.

Table 5.1 **Number of U.S. Foreign Subsidiaries in Sample**

Year	Canada	United Kingdom	Germany	France	Japan	Australia	Total
1980	225	25	12	3	4	13	282
1981	224	36	12	4	5	12	293
1982	242	45	11	5	7	14	324
1983	254	54	10	5	10	13	346
1984	272	58	13	6	15	14	378
1985	307	81	16	10	19	18	451
1986	320	94	19	11	23	24	491
1987	346	105	22	11	26	23	533
1988	362	104	21	11	24	24	546
1989	394	113	20	11	25	26	589
1990	403	121	32	15	29	32	632
1991	366	119	29	17	25	26	582

Source: Authors' calculations.

Table 5.2 **Mean I_t/K_{t-1} of U.S. Foreign Subsidiaries**

Year	Canada	United Kingdom	Germany	France	Japan	Australia	Total
1981	.142	.124	.018	.072	.093	.152	.136
1982	.077	.101	.021	.339	.046	.128	.080
1983	.108	.077	.019	.013	.220	.211	.110
1984	.069	.120	.016	.306	.163	.056	.077
1985	.122	.327	.309	.213	.224	.321	.170
1986	.125	.248	.320	.283	.412	.066	.179
1987	.181	.351	.451	.497	.344	.296	.253
1988	.202	.193	.149	.082	.270	.318	.208
1989	.145	.135	.135	.222	.136	.201	.146
1990	.117	.195	.195	.275	.222	.138	.168
1991	.084	.130	.138	.138	.249	.109	.119

Source: Authors' calculations.
Note: I_t is gross investment.

iary capital stocks as weights. The "operating income" entries in table 5.3 represent the (capital-stock-weighted) mean values of the ratio of operating income to the beginning-of-period capital stock for the various years and countries. The "sales" entries in table 5.4 represent the (capital-stock-weighted) mean values of the ratio of sales to the beginning-of-period capital stock for the various years and countries.

We used three alternative approaches to constructing $\tilde{\beta}$. First, we assumed that $\beta = 0.95$, that is, an implicit real after-tax annual required rate of return of 5.3 percent. (Setting β equal to 0.90 or 0.99 did not significantly affect our

Table 5.3 **Mean *Cash Flow*$_t$/K_{t-1} of U.S. Foreign Subsidiaries**

Year	Canada	United Kingdom	Germany	France	Japan	Australia	Total
1981	.141	.029	.032	.012	.120	.199	.123
1982	.122	.098	.125	.021	.022	.188	.118
1983	.127	.105	.064	.086	.087	.115	.119
1984	.133	.143	.044	.454	.128	.055	.131
1985	.130	.078	.078	.463	.370	.124	.134
1986	.131	.125	.255	.102	.092	.030	.128
1987	.169	.131	.152	.113	.167	.450	.170
1988	.168	.157	.014	.270	.364	.134	.171
1989	.107	.096	.041	.110	.246	.133	.112
1990	.102	.109	.092	.355	.276	.091	.111
1991	.073	.087	.063	.431	.221	.053	.091

Source: Authors' calculations.
Note: Cash flow$_t$ is the sum of operating profit and, if available, depreciation.

Table 5.4 **Mean *Sales*$_t$/K_{t-1} of U.S. Foreign Subsidiaries**

Year	Canada	United Kingdom	Germany	France	Japan	Australia	Total
1981	1.55	1.37	1.40	1.50	.808	1.23	1.51
1982	1.29	1.52	1.42	1.33	1.59	1.54	1.34
1983	1.44	1.48	1.49	.476	1.63	1.30	1.43
1984	1.49	1.38	1.61	1.15	1.96	1.08	1.47
1985	1.46	1.46	1.82	2.03	2.19	1.12	1.50
1986	1.57	1.71	2.09	1.47	1.97	1.27	1.62
1987	1.60	1.50	1.69	1.29	1.85	.935	1.57
1988	1.55	1.33	1.43	1.88	2.07	1.38	1.53
1989	1.46	1.62	1.96	1.69	1.68	1.31	1.52
1990	1.38	1.71	1.76	2.03	1.72	.992	1.47
1991	1.36	1.44	1.23	1.80	1.80	.948	1.37

Source: Authors' calculations.
Note: Sales$_t$ is net sales.

results.) Second, we used data on firms' interest rates, aggregate surveys of expected inflation, and corporate tax rates to construct data on β. Finally, we treated β as a parameter to be estimated.

Because the data we used contain no information about subsidiary dividend repatriations, we begin by assuming that subsidiaries are repatriating dividends, so that $\lambda = 0$. We also examine separately a subset of subsidiaries in the data over the entire period (as a proxy for "mature" subsidiaries, for which our "$\lambda = 0$" assumption may be more innocuous).

Finally, to construct m, we use values for the tax on current repatriations t^d

Table 5.5 Tax Rate on Repatriations of Overseas Earnings from U.S. FDI, t^d

Tax System[a]	t^d
Classical	
Excess limit parent	$(\tau_{US} - \tau_j)/(l - \tau_j)$
Excess credit parent	w_j
Split-rate	
Excess limit parent	$(\tau_{US} - \tau_j)(l - \tau_j) + \tau_d - \tau_u + d\,(\tau_d - \tau_u)\,(l - \tau_{US})/(l - \tau_j)^2$
Excess credit parent	$\tau_d - \tau_u + w_j$
Imputation	
Excess limit parent	$(l + a_j)\,\{(\tau_{US} - \tau_j)/[l - \tau_j - a_j d_j(l - \tau_{US})]/(l - \tau_j)^2\} - a_j$
Excess credit parent	$(l + a_j)\,w_j - a_j$

Notes: τ_{US} = U.S. corporate tax rate, τ_j = corporate tax rate in host country j, w_j = withholding tax rate in host country j, d_j = dividend payout rate for subsidiary in host country j, τ_u = tax rate on undistributed profits in host country j, τ_d = tax rate on distributed profits in host country j, a_j = tax credit given for advanced corporation tax in host country j.

[a]For the purpose of this grouping, Canada has a classical system, because benefits of corporate tax integration are not extended to controlling U.S. shareholders. The United Kingdom, under its imputation system, provides a partial credit to controlling U.S. shareholders for payment of its "advanced corporation tax." The German corporate tax system is a mixture of imputation and split-rate systems. Germany does not grant an imputation credit to U.S. shareholders, so we treat the German system as a split-rate system in constructing the tax price of individual repatriations. Under France's imputation credit system, the imputation credit (*avoir fiscal*) is not refundable to controlling U.S. shareholders. Japan had a split-rate tax system until 1989, at which time it switched to a classical system. In its imputation system, Australia does not impose a withholding tax on dividends that have borne the (statutory) Australian corporate tax. For a summary of the corporate tax systems in the countries in our sample, see U.S. Department of the Treasury (1992, appendix B).

implied by the tax prices of repatriations summarized in table 5.5 (see also Altshuler and Newlon 1993).[29] The value of t^d depends on whether the U.S. parent is in an excess limit or excess credit position. Parent firms in an excess limit position owe U.S. corporate tax if the U.S. corporate tax rate exceeds the applicable foreign tax rate. Parent firms in an excess credit position owe no U.S. corporate tax. Because we do not have access to the parents' U.S. income tax returns, we cannot describe precisely whether the foreign tax credit limitation is binding. Instead, we assume that firms with average foreign tax rates above the U.S. corporate tax rate have excess foreign tax credits; firms with average foreign tax rates less than or equal to the U.S. corporate tax rate are assumed to be in an excess limit position.[30] We assume that the accrual-

29. In principle, this measure should reflect the *expected* tax price, because, in particular, parent firms may expect to transit between excess limit and excess credit status in the next period. (Evidence on the empirical significance of such transitions is presented in Altshuler et al. [chap. 9 in this volume].) With data on parent firms' stocks of foreign tax credits, one could attempt to approximate the likelihood of a transition between credit states, with attendant effects on the tax price of repatriations. Lacking parent tax return data, we were unable to do this, however.

30. This assumption is quite imperfect in practice, as shown in the comparison with tax data in Altshuler and Newlon (1993).

Table 5.6 **FDI Euler Equation Models (full sample)**

Model	Adjustment Cost Parameter α Fixed β	Adjustment Cost Parameter α Variable β	Test of Overidentifying Restrictions χ^2_9 Fixed β	Test of Overidentifying Restrictions χ^2_9 Variable β
No-tax model	.422	.254	24.36	32.63
	(.395)	(.406)	(.004)	(.001)
Tax model	2.01	1.86	10.23	10.61
	(.612)	(.628)	(.332)	(.303)

Notes: The fixed β is set equal to 0.95; the variable β is defined in the text. Standard errors, in parentheses, are computed from a heteroskedastic-consistent matrix. Significance levels of Hansen's test of overidentifying restrictions are in parentheses beneath the statistic.

The sample contains 1,047 firms. The number of parent firms which report for one subsidiary is 786, for two subsidiaries is 109, for three subsidiaries is 13, and a single parent reports for four subsidiaries.

The instrument set used for estimates above is: $(I/K)_{t-3}$, $(I/K)_{t-4}$, $(I/K)_{t-5}$, $(I/K)^2_{t-3}$, $(I/K)^2_{t-4}$, $(I/K)^2_{t-5}$, $(sales/K)_{t-2}$, $(cash\ flow/K)_{t-2}$, $(k + \tau z)_{t-2}$, $(k + \tau z)^2_{t-2}$. The instruments $(I/K)_{t-2}$, and $(I/K)^2_{t-2}$ are excluded from the set because both were found to be correlated with the error term. Estimates are robust to the exclusion of lags of (I/K) and $(I/K)^2$ dated before $t - 3$ and to the exclusion of $(cash\ flow/K)_{t-2}$. Estimates are robust to the inclusion of further lags of those instruments dated $t - 2$.

Estimation of β and α in the tax model using the instrument set above produced a point estimate on β of 0.699 with standard error 0.212 and on α of 1.97 with standard error 0.568. The significance level for the test of overidentifying restrictions was 0.390. Estimation of the no tax model (with variable β) using an instrument set without tax terms produced a point estimate on α of 0.155 with standard error of 0.496. The significance level for the test of overidentifying restrictions was 0.002.

equivalent tax rate on (overseas) reinvested earnings, t^r, is constant over time, allowing us to focus on changes in t^d.[31]

5.5 Estimation Results

Our estimates of the adjustment cost parameter α and the tests of the model's overidentifying restrictions are reported in table 5.6. Four sets of results are reported in the table, according to whether the home-country and host-country tax parameters are included in the model in equation (11), and according to whether we hold β constant ("fixed β") or use data to construct β ("variable β"). In all cases, the model is estimated using the panel data on investment by U.S. subsidiaries in Canada, the United Kingdom, Germany, France, Australia, and Japan described earlier.[32] The instrumental variables used are described in the table notes.

31. We also estimated the model assuming that $t^r = t^d/2$ and obtained results similar to those reported below.

32. The results presented in table 5.6 are robust to dividing the sample into Canadian and non-Canadian subsamples.

The first row reports the results under the assumption that "taxes don't matter"—that is, all of the home-country and host-country tax parameters are set equal to zero.[33] The estimated values of α of 0.42 (fixed-β case) and 0.25 (variable-β case) are not statistically different from zero, implying implausibly small costs of adjusting the capital stock. Moreover, the model's overidentifying restrictions are rejected at less than the 1 percent level.[34]

The second row reports the results when the tax parameters are included in the estimation equation. In contrast to the results just discussed, the estimated values of α are now 2.01 (fixed-β case) and 1.86 (variable-β case) and are statistically significantly different from zero. The point estimates are qualitatively similar to those reported in studies using Euler equation models to study U.S. investment (see, e.g., Hubbard and Kashyap 1992; Hubbard et al. 1995) and to those reported by Cummins et al. (chap. 7 in this volume) for domestic investment in a set of European countries. Also in contrast to the "taxes don't matter" case, the complete model's overidentifying restrictions are not rejected. We interpret the improvement in estimating the model as evidence of the importance of tax considerations in U.S. firms' outbound FDI decisions. Estimation of β and α in the tax model (using the same set of instruments) produces a point estimate of β of 0.699, with a standard error of 0.212, and a point estimate of α of 1.97, with a standard error of 0.568. The significance level for the test of overidentifying restrictions is 0.390.

Table 5.7 reproduces the results presented in table 5.6 for the subsample of subsidiaries in the sample for all years. The estimated values of α are similar to those reported for comparable cases for the full sample in table 5.6; the standard errors are larger owing to the much smaller sample of subsidiaries. Estimation of β and α in the tax model (using the same set of instruments) produces a point estimate of β of 0.665, with a standard error of 0.250, and a point estimate of α of 1.56, with a standard error of 0.753. The significance level for the test of overidentifying restrictions is 0.120. Hence, our results are supportive of the basic model derived in section 5.3.[35]

33. This test analyses whether host-country cost-of-capital terms (i.e., $(1 - k_j - \tau_j z_j)/(1 - \tau_j)$ and "international tax" parameters (i.e., $m_{ij,t+1}/m_{ijt}$) jointly matter. When we set $m_{ij,t+1}/m_{ijt}$ equal to unity—in order to examine consequences of ignoring only the "international tax" parameters—the estimated value of the adjustment cost parameter α is 1.88 (with a standard error of 0.701), and the p-value for the test of overidentifying restrictions is 0.222. Given that our calculations of m are necessarily approximations (since, without access to tax data, we are unable to verify the foreign tax credit status of parent firms), the failure to reject the model's overidentifying restrictions in this experiment is not surprising.

34. One must exercise some caution in relying solely on Hansen's (1982) J-test to judge the adequacy of the Euler equation representation of the investment problem. Newey (1985), Ghysels and Hall (1990), and Oliner, Rudebusch, and Sichel (1993) have offered other diagnostic tests. These alternatives have generally addressed the issue of structural stability of coefficient estimates in time-series models. Applying these tests in the panel-data context is a topic on which we are currently working in this research program.

35. Following up on n. 28, we also estimated the model converting the capital stock data into foreign-currency equivalents to construct I/K. In this case (using the fixed-β assumption in the

Table 5.7 FDI Euler Equation Models (balanced panel sample)

	Adjustment Cost Parameter α		Test of Overidentifying Restrictions χ^2_9	
Model	Fixed β	Variable β	Fixed β	Variable β
No-tax model	.339	.253	12.08	12.48
	(.401)	(.338)	(.209)	(.188)
Tax model	1.49	1.31	9.40	9.97
	(.611)	(.598)	(.405)	(.353)

Notes: The fixed β is set equal to 0.95; the variable β is defined in the text. Standard errors, in parentheses, are computed from a heteroskedastic-consistent matrix. Significance levels of Hansen's test of overidentifying restrictions are in parentheses beneath the statistic.

The sample contains 103 firms. The number of parent firms which report for one subsidiary is 93, and for two subsidiaries is 5.

The instrument set for the tax model is the same as for the full sample. Estimates are robust to the exclusion of lags of (I/K) and $(I/K)^2$ dated before $t - 3$ and to the exclusion of $(cash\ flow/K)_{t-2}$. Estimates are robust to the inclusion of further lags of those instruments dated $t - 2$.

Estimation of β and α in the tax model using the instrument set above produced a point estimate on β of 0.665 with standard error 0.250 and on α of 1.56 with standard error 0.753. The significance level for the test of overidentifying restrictions was 0.120.

5.6 Discussion

The estimation results presented in section 5.5 offer two implications for analysis of tax policy beyond the simple conclusion that firms take tax incentives into account in the way suggested by standard economic theory in making their investments. The first implication relates to the usefulness of models such as equation (11) in measuring effects of home- and host-country tax changes on firms' FDI. The second addresses the debate over whether the U.S. system of taxing corporate foreign-source income satisfies capital-export neutrality or capital-import neutrality.

5.6.1 Measuring Tax Effects on FDI

Using the assumptions about adjustment costs associated with new investment employed in deriving equation (11), we can return to the initial experiment posed in section 5.2: How do changes in tax parameters affect FDI through their impact on the tax-adjusted q associated with that investment? While we cannot observe the marginal q's to estimate this effect directly, we can infer the coefficient on marginal q (in a regression of I/K on q) from the results summarized in table 5.6. In particular, the coefficient on marginal q in such a regression can be interpreted as the reciprocal of the adjustment cost

taxes-included case), the estimated value of the adjustment cost parameter α is 1.62 (with a standard error of 0.640), and the p-value for the test of overidentifying restrictions is 0.516.

parameter α; the point estimate for α of about 2 implies a "q-coefficent" of about 0.5. That is, an increase in a subsidiary's q of 0.10 would increase the contemporaneous (foreign direct) investment-capital ratio by 0.05, a significant effect given the mean values for the investment-capital ratio summarized in table 5.2.

Tax-induced changes in the subsidiary's q reflect changes in host-country tax rates and investment incentives and home-country tax parameters to the extent that the subsidiary is expected to change its dividend-paying status or the parent's foreign tax credit position (i.e., excess credit or excess limit) is expected to change. The marginal q for new investment by a mature (dividend-paying) subsidiary of a parent in a stationary foreign tax credit position will not be affected by permanent changes in home-country tax parameters.[36]

5.6.2 Assessing Capital-Export-Neutral and Capital-Import-Neutral Features of the U.S. System

The failure to reject the investment model derived under the assumptions of the tax capitalization analysis of subsidiaries' dividend policy suggests that we can use that analysis to study effects of home- and host-country tax parameters on the cost of capital for FDI.[37] In that regard, we can offer some observations for equity-financed investments in mature subsidiaries. First, if the home-country tax system is based on the residence principle with a foreign tax credit subject to a limitation and deferral of tax on earnings retained overseas (as in the case for the United States), the home-country tax on repatriations has no effect on subsidiaries' investments financed out of retained earnings—as long as the parent's foreign tax credit position does not change.[38] This relationship

36. This is not strictly true if the definition of taxable income differs across countries or if the home-country tax authority can tax pure profits earned abroad through effective policing of royalty payments and transfer-pricing arrangements (see Leechor and Mintz 1993; and Hines 1994).

37. For analysis of the implications of the tax capitalization approach for subsidiaries' dividend repatriations, see Hines and Hubbard (1990), Altshuler and Newlon (1993), and Altshuler et al. (chap. 9 in this volume). Because Altshuler et al. used panel data from tax returns, they were able to test for differences in the responsiveness of repatriations to temporary and permanent changes in the home-country tax price on repatriations. They find that dividend repatriations are significantly more responsive to temporary tax price changes than to permanent tax price changes, a result consistent with Hartman's application of the tax capitalization approach.

38. To see this, note that the cost of capital $\rho_{ijt}/(1-\tau_j)$ for a marginal investment by parent i in mature subsidiary j at time t solves

$$(1-\tau_{jt})F_{K,ijt} = \rho_{ijt},$$

where

$$\rho_{ijt} = \left(\frac{m_{ijt}}{m_{ij,t-1}}\right)\beta_{ijt}^{-1} - 1.$$

Under the assumption used in section 5.5 that t^r is expected to be constant, if the home- and host-country tax rates and the parent's foreign tax credit position do not change, $m_{ijt} = m_{ij,t+1}$, and the cost of capital is independent of the home-country tax rate.

corresponds to capital-import neutrality for investments by mature subsidiaries of U.S. parent firms. In its most basic form, this result was first noted by Hartman (1981, 1984, 1985); Altshuler and Fulghieri (1994) generalized it to incorporate the possibility of changes over time in parents' foreign tax credit positions. Second, the capital-import neutrality implication does not carry over to the case of expected changes in foreign tax credit status. If, on the one hand, the parent firm expected to make a once-and-for-all transition from excess limit status to excess credit status, the subsidiary's cost of capital rises or falls relative to the stationary credit case according to whether $\tau_{US} < \tau_j$ or $\tau_{US} > \tau_j$, respectively.[39] If, on the other hand, the parent firm is expected to make a once-and-for-all transition from excess credit status to excess limit status, the cost of capital (ignoring withholding taxes) is independent of host-country tax parameters, a capital-export-neutral result.[40] Hence, the U.S. residence-based tax system with a foreign tax credit is capital-export neutral in those examples only in a very limited case—for mature subsidiaries that pay no withholding taxes on dividend repatriations and whose parent firms are in an excess limit position in the period in which an investment is made and in an excess credit position thereafter.

One can present similar examples (again assuming all equity finance) for "immature" subsidiaries, those financing initial investment using parent equity transfers. If the subsidiary eventually repatriates dividends, its cost of capital depends in part on the parent's expected future foreign tax credit status when the repatriation occurs. If the parent is in an excess credit position at that time, the home-country tax rate does not affect investment, a capital-import-neutral result. If the parent is in an excess limit position at that time, the cost of capital will depend on both home- and host-country tax parameters.

While these examples are only illustrative (see also the more detailed cases considered by Altshuler and Fulghieri 1990), they suggest the potential usefulness of firm-level panel data to test the appropriateness of the tax capitalization approach's predictions about the responsiveness of subsidiary dividend and investment decisions to tax changes.

39. To see this, note that the cost of capital (under the assumptions described in n. 38) is given by

$$(1-\tau_{jt})^{-1}\rho_{ijt} = (1-\tau_{jt})^{-1}\left[\left(\frac{m_{ijt}}{m_{ij,t+1}}\right)\beta_{ijt}^{-1}\right] - 1 = (1-\tau_{jt})^{-1}\left[\left(\frac{1-\tau_{US,t}}{1-\tau_{jt}}\right)\beta^{-1}{}_{ijt}\right] - 1.$$

Hence, if $\tau_{US} > \tau_j$, the cost of capital falls relative to the stationary credit case; if $\tau_{US} < \tau_j$, the cost of capital rises relative to the stationary credit case. For example, given the increase in the likelihood of parents' moving from an excess limit position to an excess credit position after the cut in τ_{US} in the Tax Reform Act of 1986, U.S. FDI would be expected to increase in high-tax countries and decrease in low-tax countries, ceteris paribus.

40. To see this, note the cost of capital (under the assumptions described in n. 38) is given by

$$(1-\tau_{jt})^{-1}\,\rho_{ijt} = (1-\tau_{jt})^{-1}\left[\left(\frac{1-\tau_{jt}}{1-\tau_{US,t}}\right)\beta_{ijt}^{-1}\right] - 1,$$

which is independent of the host-country tax rate.

5.7 Conclusions

This paper represents a first step in a research program to use microdata on multinational firms' overseas investment decisions to study the determinants of FDI, especially those related to tax policy. In that sense, our exercise is in the spirit of an attempt to use microdata to test models of the effects of tax parameters on subsidiaries' dividend repatriation decisions. The panel data that we use on FDI of subsidiaries of U.S. firms permit us to focus on "new investment," something not possible with the more commonly studied aggregate data. These data also allow us to test structural models of investment decisions, thereby giving us potentially informative estimates of the effects of tax parameters on FDI.

We believe we have been successful in two respects. First, we have extended conventional investment models to accommodate a wide range of tax influences on FDI decisions. Second, our empirical results cast significant doubt on the simplest notion that "taxes don't matter" for U.S. firms' FDI decisions. Tax parameters influence FDI in precisely the ways indicated by neoclassical models. Our results also lend support to the application of the tax capitalization model to the study of dividend repatriation and FDI decisions.

Much work remains, however. First, because of data limitations, we were forced to make a number of simplifying assumptions in estimating our model. In future work, we plan to test the sensitivity of our findings to plausible alternative assumptions. Second, we are working to extend our analysis to study effects of tax policy on U.S. inbound FDI. Third, we plan to test whether shifts in the host-country currency value of firms' investments affect firms' FDI, holding constant other determinants of FDI. Finally, we would like to incorporate imperfect competition and intangible assets in our approach.

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Comment David G. Hartman

When asked to comment on this ambitious paper, which I like very much, I had to first decide whether to comment as the author of Hartman (1984), to which these authors were very generous in their discussion, or in my 1994 role as an advisor to companies in setting global business strategy. I chose the latter, at the expense of the former. I intend to point out some puzzles in the data and then provide some (I hope, realistic) parables about business decisions that might explain the puzzles. In doing so, I aim to cast doubt on the strength of the empirical results, but any criticism will reflect badly on my own previous work. Finally, I will discuss the possibility that exchange rate translation is driving the paper's empirical results.

As introduction, I want to make a point about the very simple short-time-series analysis of Hartman (1984) and the "subsequent rounds of replication and refinement" cited by the authors. In the 1970s only a few economists, including Robert Lipsey and Martin Feldstein at NBER, were interested in foreign direct investment (FDI). That was not surprising, since FDI was small, and though growing was doing so only moderately. Most particularly, it was plausible at that time that the historical pattern in FDI was the result of an equilibrium process of some kind. Around the end of the time periods I was researching, a quite different dynamic took over. FDI, both inward and outward, grew at an extraordinary pace, culminating in the situation in 1994 of nearly every company seeing global expansion as its key to growth. It should have been anticipated that the empirical literature, which takes as its point of departure responses to changes in the marginal profitability of international operations, would be unsuccessful in linking this later period of incredible growth with the earlier period of small and relatively stable FDI. In other words, history provides one major discontinuity to explain, and the existing models provide little hope of explaining it. I sometimes wonder whether in-

David G. Hartman is executive vice president of ICF Kaiser International Consulting. Previously he was executive director of the National Bureau of Economic Research.

cluding a time series of the number of times "globalization" appears in *Business Week* might be the answer.

That brings me to the distinction between the paper's conceptual model and some business decisions that I believe are incorporated in the data. The paper's model describes a rather simple world. This is a world in which FDI increases or declines as companies adjust to a new equilibrium rate of return available in a specific location.

Alternatively, one can view the foreign investment decision as a lumpy process of one-time strategic decisions on how to serve an emerging market or change the locus of production. Since the data the authors carefully construct look like the aggregation of a series of investment surges, one must be concerned about just this kind of issue. If the empirical investigation deals with firms observed in their startup phase or in a major building phase, the predicted relationship between investment and observed rates of return should be quite different. But before getting into details, I want to comment on some of the puzzles raised by the data.

Puzzles

To explain why I think that a more "realistic" model of a start-up foreign subsidiary is needed, I refer to the volatility and the timing of the data included in the paper. Even looking at averages by country, we find that it is not uncommon for the capital stock to grow by 10 percent one year and 40+ percent the next, or for the cash flow as a fraction of invested capital to go from 10 to 30+ percent and then back to 10 percent over three years. This volatility is puzzling unless these data reflect start-up operations, or unless some other phenomenon (such as a foreign exchange effect) is at work, a point I will return to later.

The timing of movements in the data, even at a crude aggregate level, is even more puzzling. For example, the aggregate of the German subsidiaries included in the data had a great year in 1982, a recessionary year and a time of poor performance across a broad range of indigenous German companies. While it is not a fair criticism to take the authors' model literally, it seems legitimate to question why, in an equilibrium model of investment, U.S.-owned companies would in aggregate have a pattern of return and investment so dissimilar to that of indigenous German firms.

It is also interesting that in nearly all of the countries examined, the naked eye can tell from a simple graph that aggregate sales lead aggregate investment, usually by a year (see fig. 5C.1). I have trouble thinking of the traditional investment model being consistent with this pattern when the changes in sales are so large. In the neoclassical model, improved sales increase capacity utilization and encourage investment, but it is hard to imagine stretching capacity so far. The answer, of course, is that the German subsidiary is only a part of the company's operation and sales in Germany can easily increase without extra production in Germany. In light of the voltality of the data, it is easy to speculate that the company is deciding to serve a rapidly growing market by in-

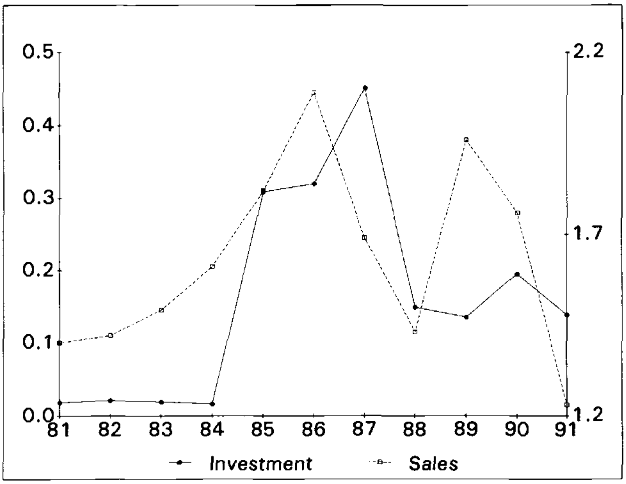

Fig. 5C.1 Investment and sales: German subsidiaries
Source: Cummins and Hubbard (chap. 5 in this volume, tables 5.2 and 5.4).

vesting to establish a substantial local presence for the first time or to dramatically increase its size. This phenomenon might be consistent with what the authors are hoping to capture, though a more appropriate model would be one that weighs the cash-flow effects of producing in different locations, rather than treating the German subsidiary in isolation. Most important is whether this calls into question the empirical conclusions about taxes. That depends critically on how a company making such strategic moves would report its investment and cash flow in the "separate, new" market, as I will discuss.

Parables

One possible conclusion is that the data are describing a set of investment surges representing new operations or major increases in the size of existing foreign operations. We would expect most truly new foreign ventures to begin with an unprofitable investment period, quite probably lasting for years, followed by a payback period. If that is what we are observing, we should be surprised not to get perverse results from regressions of investment on profitability or cash flow.

To see how the "confirming" results reported here could arise, we can turn to several business parables. In one fairly common situation, a "separate, new" foreign operation might be set up to provide better service to an established base of sales. As opposed to our expectation of an initial period of losses in a true start-up operation, we would not necessarily be surprised to see this type of FDI accompanied by high rates of return, as the existing sales base is assigned to a subsidiary that supports a partially independent set of company functions. This would also be consistent with the fact that sales lead investment.

Similarly, successful managers are often given responsibility for a wider geographic area. Thus, on average a profitable operation tends to be assigned responsibility for making and managing new investments. With a sample so limited in detail about a firm's multiple operations in a region, this possibility is difficult to evaluate.

We could continue to speculate but the point is that there are many possibilities besides the phenomenon being modeled here to explain the association of profitability and investment, and they might do better in explaining some of the puzzles in the data.

Foreign Exchange

A more straightforward concern is the impact of exchange rates. The authors have addressed whether the companies' translation of subsidiary data into dollars was done at consistent points in time. But the much more important question is whether the act of translating into dollars has itself produced a spurious association between investment and cash flow.

The dollar was of course highly volatile in the decade of the 1980s, apparently having had a major impact on the observations used in this paper. Looking at table 5.2, for example, we see the dollar-denominated capital stock in Germany staying flat as the dollar soared in the early 1980s, surging as the dollar plunged during 1985–87, and growing at a reasonable, modest pace thereafter as the dollar stabilized. We would need to know more than we or the authors do about the original currency of denomination of the companies' books and the details of their operations to be certain, but this series has all the earmarks of a capital stock that grew steadily at just about 15 percent per year in deutsche marks. That is, virtually all of the year-to-year change in the capital stock (i.e., the variation in investment) could apparently have been produced by exchange rate changes.

The authors indicate in footnote 35 that they have been able to address the most obvious problem—creating an investment series by differencing capital stocks already translated into dollars. Though the authors' alternative estimates are not described in detail, it would appear that foreign exchange effects could still be driving the investment data. Changing the dollar-reported capital stock into "foreign-currency equivalents" before differencing it to construct investment is a good check, since it should reduce the potential for the most extreme spurious volatility in investment caused by the dollar. But even translating a perfect deutsche mark–denominated *investment* series into dollars would still incorporate the dollar's movement in measured investment. In addition, any adjustment back to foreign currencies of figures that are reported in dollars by the companies is dangerous, since we have little information about their translation process. The data also provide only general guidance about where the capital is located and where the profits are earned (firms report the country in which the "subsidiary is located"). So, any currency adjustment undertaken by researchers in constructing investment series is highly problematic.

Knowing how exchange rates affect the cash flow of these operations is even more of a question. We cannot tell the difference even between the two extremes: a subsidiary that incurs local costs to produce products sold in the United States and a subsidiary that sells locally those products produced in the United States. It is at least plausible, though, that translating cash flow in deutsche marks into dollars has created a spurious pattern of movement closely related to a spurious pattern of movement in investment.

I would conclude that the set of results in the main body of the text shows distinct signs of being driven by exchange rate translation. As I have noted, the authors report some additional work done to mitigate the most obvious problem, but I would hardly call the case closed. That having been said, the problem is the common one of trying to make the most of very crude data; I can only admire the authors' clever leveraging of the poor information available and applaud their attempts to verify their results.

Taxes

So far none of my comments relate to the most striking part of the paper: that the measures incorporating taxes work, and work significantly better than those without. This lends support to the importance of taxes and to the tax capitalization model that is so near to my heart.

Much as I support the authors' strategy of plunging ahead with limited information, the tax measures are obviously crude. First, they are country specific but in large measure neither industry nor financing specific. Previous work has shown tax rates to vary far more by industry and by financing method than by country (or, for that matter, through time for most countries). It is remarkable, then, that rather crude measures (again, however, the best that can be done with the data available) are so successful in explaining company behavior.

Is there any obvious alternative explanation of why these measured tax rates "work"? Without seeing the detail of the tax rates, it is hard to speculate, but we do know some things. First, 1986 was the big event in terms of variation in rates over time. The U.S. tax reform made a striking change toward excess credit status for most firms. That year also coincided with major exchange rate realignments, so there is a superficial plausibility to some coincident exchange rate effect having been captured by taxes. To carry speculation further, the tax change was least significant for operations in Canada, where tax rates followed the U.S. rates down in the 1980s. Canada was also the only country with only minor exchange rate changes.

The more important point is that even before reading the paper we knew that the 1986 tax change did indeed coincide with the beginning of a big surge in U.S. investment abroad. But it also coincided with the beginning of a *worldwide* surge in foreign investment that has been the subject of a great deal of speculation and little convincing explanation. That global surge was clearly unconnected with the U.S. tax reform. It is a mystery that if solved might shed some light on whether there is some other phenomenon at work here . . . one that simply coincides with the U.S. tax reform.

The final comment is that my criticisms are directed toward the specific period under study and the potential problems related to the time-series aspects of the analysis. In fact, this work is an important beginning with firm-level panel data that has potential to bring a qualitative improvement in our understanding of the foreign investment process. Additional tests may prove that the time-series dimension of the data (especially exchange rate changes and the maturing of subsidiaries) is not driving the results. I hope that it does. In any event, this promising line of work is extremely time consuming but also path breaking, in a field that has been focused on simple time-series models. Previous simple time-series analysis cannot hope to shed light on this phenomenon that has obviously undergone some dramatic and little-understood shift during the interval of observation. This paper makes real progress toward better understanding.

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