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THE EFFECT OF TAXES ON INVESTMENT AND INCOME SHIFTING TO PUERTO RICO

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ABSTRACT

The income of Puerto Rican affiliates of U.S. corporations is essentially untaxed by either Puerto Rico or the U.S. This lowers the tax penalty on real investment there, and also makes it attractive to shift reported taxable income from the U.S. parent corporation to the Puerto Rican affiliate. Because the ability to shift income is affected by the presence of real operations, the true marginal effective tax rate on investment in Puerto Rico depends on the income shifting opportunities.

This paper investigates these two avenues of impact of taxation by first developing a structural econometric model of the joint decisions regarding investment and income shifting, and estimating the model using firm-level data on U.S. corporations' activity in Puerto Rico. The empirical results suggest that the income shifting advantages are the predominant reason for U.S. investment in Puerto Rico.

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1. Motivation

The worldwide pattern of tax rates and tax systems can have two conceptually distinct impacts on multinational corporations. First, it can affect the relative return to conducting real operations in different jurisdictions, and therefore the location of real activity. Second, given the location of real activity, taxes can affect to which jurisdiction taxable income is reported; through the careful use of intra-corporate transfer prices and financial policy, multinationals can reduce their worldwide tax burden by shifting taxable income into countries whose marginal tax rate is relatively low. The ability to shift income is itself affected by the pattern of real operations, so that the two impacts of taxation are interrelated.

This paper investigates these two avenues of impact of taxation in the context of U.S. corporate investment in Puerto Rico. This investment is essentially tax-free, providing an incentive for investment and income shifting that is estimated to have cost the U.S. Treasury $2.33 billion in 1987. The paper proceeds by first developing a structural econometric model that will allow the estimation of the effect on capital investment and income shifting of policies which affect both aspects of multinationals' choice. The model is then estimated with firm-level data on U.S. corporations' investment and income shifting to Puerto Rico. The empirical results suggest that the income shifting advantages are the predominant reason for U.S. investment in Puerto Rico.

2. Review of Related Literature

Each of the two decisions--location of real activity and income shifting--has been investigated separately. In what follows we briefly review the empirical literature on each of these questions.

2.1 The Effect of Taxes on Real Investment Location

Most of the research on this topic has focused on the effect of taxation on foreign direct investment (FDI) to and from the United States, using time-series data. No consensus has been reached on the magnitude or significance of the effect. The pioneering study of Hartman (1984) used annual data from 1965 to 1979 to estimate the response of FDI, separately for investment financed by retained earnings and by transfers from abroad, to three variables: the after-tax rate of return realized by foreign investors in the United States, the overall after-tax rate of return on capital in the United States, and the tax rate on U.S. capital owned by foreigners relative to the tax rate on U.S. capital owned by U.S. investors. He found both a positive association of the after-tax rate of return variables with FDI financed by retained earnings as a ratio to U.S. GNP, and a negative association of the FDI-GNP ratio with the relative tax rate on foreigners compared to domestic residents. The model did not explain transfers from abroad as well as it does retained earnings.

Boskin and Gale (1987) reestimated Hartman's equation using updated tax rate and rate of return series, extended the sample forward to 1984 and, in some cases, backward to 1956, and experimented with a variety of alternative explanatory variables and functional forms. They concluded that, although the results are somewhat sensitive to sample period and specification, the qualitative conclusions of Harman are fairly robust. Newlon (1987) discovered that the rate of return series used in the earlier papers had been miscalculated from the original Bureau of Economic Analysis data for the years 1965-73. Using the corrected series and extending the sample period to range from 1956 to 1984, Newlon's results differ significantly from those of Hartman and those of Boskin and Gale. In particular, the equation explaining transfers of funds fits poorly, and no estimated coefficient is significant. Slemrod (1990) updates and extends Hartman's aggregated analysis, and concludes, contrary to the earlier studies, that U.S. tax rules are more successful in explaining transfers of funds than in explaining retained earnings by foreign investors. It also disaggregates inward FDI by the seven major investing countries, and

fails to support the proposition, which follows from simple conceptual models, that FDI from countries that exempt foreign-source income from domestic taxation should be more sensitive to U.S. taxation compared to FDI from countries that tax worldwide income and offer a foreign tax credit to mitigate double taxation.

2.2 The Effect of Taxes on Income Shifting

Differences in tax rates across countries also provide an incentive for transactions that are designed to reduce worldwide tax liability by shifting income out of high-tax jurisdictions to low-tax jurisdictions. For multinational corporations this can be accomplished either by financial structure or by the pricing of cross-border but intra-firm transactions.

There is considerable anecdotal evidence concerning tax-motivated income shifting by U.S. multinationals. Wheeler (1988) describes U.S. tax court cases where income was apparently shifted for tax reasons. In one example, in 1975 the U.S. pharmaceutical company G. D. Searle had an average return on employed assets of -42.3% in the U.S. compared to +119% in Puerto Rico--a zero effective tax rate jurisdiction which is the focus of the empirical analysis below. Of course, anecdotal evidence does not establish the economy-wide prevalence of income shifting.

There have been three recent empirical attempts to uncover systematic, albeit indirect, evidence of income shifting. Grubert and Mutti (1991), using data on U.S. multinationals' affiliates aggregated by host country, regressed two measures of affiliate profitability in 1982 against the host country's statutory corporate income tax rate (or tax holiday rate if one is generally available). They find a significant and large negative relationship between either measure of foreign taxes and either measure of reported foreign affiliate profitability or, in other words, that firms declare more income in low-tax jurisdictions. This is consistent with income shifting, and inconsistent with the usual presumption that, in order to equalize after-tax returns, higher tax rates will require higher pre-tax rates of return. Moreover, the magnitude of the estimated effect is large, such that a drop in the host country statutory tax rate from 40% to 20%

is associated with an increase in the ratio of host country after-tax profits to sales from 5.6 to 12.6 percent, and an increase in the after-tax rate of return on equity from 14.2 percent to 20.7 percent. Clearly, these results imply that a lower tax rate is associated with a higher pre-tax rate of return, and do not simply reflect a smaller slice taken by taxation out of an unchanging level of profitability.

Hines and Rice (1990) also analyze country-level aggregate data from 1982 on U.S. non-bank majority-owned foreign affiliates. They investigate the effect of host country tax rates on the location of U.S. multinationals' pre-tax non-financial profits, pre-tax financial profits (i.e., net interest income), total profits, and factors of production. Using regression analysis, they find a negative relation between all of these variables and host country average tax rates.

The results in both Grubert and Mutti (1991) and Hines and Rice (1990) are consistent with the hypothesis that the reported income of U.S. multinationals' foreign affiliates tends to appear in those countries with low corporate income tax rates. However, neither paper provides a measurement of the extent of income shifting between the U.S. and other countries, an important policy issue in its own right and necessary for a more complete picture of income shifting by U.S. multinationals.

That task was begun in Harris, Morck, Slemrod and Yeung (1993), who performed a regression analysis of a five-year panel of data for two hundred large U.S. manufacturing firms. They found that U.S. tax liability as a fraction either of U.S. sales or U.S. assets (the "tax ratio") is related to the location of foreign subsidiaries in a way that is consistent with tax-motivated income shifting. Having a subsidiary in a tax haven, Ireland, or one of the "four dragon" Asian countries--all characterized by low tax rates--is associated with lower U.S. tax ratios, having a subsidiary in a high-tax region is associated with higher U.S. tax ratios. These results suggest that U.S. manufacturing companies shift income out of high-tax countries into the U.S., and from the U.S. to low-tax countries. Such behavior certainly lowers worldwide tax liabilities for larger U.S. manufacturing companies and appears to significantly lower their U.S. tax liabilities as well.

A critical assumption of the Harris et al. paper is that the location of foreign subsidiaries is exogenous to the income shifting activities that occur for any given configuration of multinational operations. That exogeneity assumption is, strictly speaking, incorrect. For example, one of the attractions of Ireland as a place to locate manufacturing activity is the potential to shift income from high-tax countries into low-tax Ireland. More generally, the presence of real activity in a jurisdiction facilitates the placing of accounting profits there. To the extent that the placement of real capital in Ireland allows additional shifting, this is an implicit subsidy to investment. Clearly, then, the income shifting and real investment location decisions are joint.

In this paper we develop a simple theoretical model of the joint capital location and income shifting decision for a U.S. corporation considering locating a subsidiary in a low-tax country, and then estimate the model using firm-level tax-return panel data on a sample of U.S. corporations, a subsample of which have operations in Puerto Rico, a low-tax jurisdiction favored by many U.S. multinational corporations. Before beginning these tasks, we next discuss the institutional framework and the data used in the analysis.

3. Some Background on Tax Aspects of Puerto Rican Operations

The U.S. levies tax on the worldwide income of its resident corporations, although the income of foreign subsidiaries, but not branches, is taxed only upon the repatriation of income to the U.S. parent corporation. In order to mitigate potential "double" taxation by both the source and home countries, the U.S. offers a credit against U.S. tax liability (the "foreign tax credit") for income and withholding taxes levied by foreign governments, as long as these taxes do not exceed the U.S. tax liability on the foreign-source income. Although the actual tax system is much more complicated than this description suggests, in essence the income earned abroad by subsidiaries of U.S. multinationals is taxed by foreign governments, and the U.S. may impose a residual tax upon repatriation equal to the difference between the U.S. tax rate and the host country tax rate.

Income earned in Puerto Rico by U.S. multinationals is a striking exception to this general rule. The basic elements of Puerto Rico's special tax treatment, called the possessions tax credit, go back to the Revenue Act of 1921, when it applied mainly to the Philippines, then a U.S. possession. The current version of the possession exemption dates from the introduction of Section 936 in the Tax Reform Act of 1976, with significant changes in 1982 and 1986. If a U.S. corporation, usually the affiliate of a larger U.S. parent, elects to be a "936 corporation," it obtains a full credit against the U.S. income tax of the tax that would otherwise be due on its active business income in Puerto Rico and on the financial income originating from retained earnings reinvested there. Thus, income earned in Puerto Rico is in effect completely exempt from U.S. corporate taxation.[1] In order to qualify for the credit, 80 percent of the corporation's income in the most recent three years must be possession source and 75 percent must be active business income.

Note that the possessions tax credit is only valuable if the Puerto Rican government grants an exemption from its corporate tax as well. In fact Puerto Rico does grant full or partial exemptions to companies in manufacturing and in some tourist-oriented industries. (In 1987, 97 percent of all possessions credits were received by companies in the manufacturing sector.) Although Puerto Rico also collects a tollgate tax on repatriations, the sum of tollgate taxes plus any corporate taxes attributable to a less-than-full exemption amounted in 1989 to only four percent of aggregate possessions corporation net income.

Because of the exemption of Puerto Rican source income, a critical issue is how to determine what part of a multinational's income can be attributed to Puerto Rico. In the absence of careful rules, a corporation could locate high-margin manufacturing activities in Puerto Rico and, by allocating to the U.S. parent the cost of R&D and other intangible-creating activities, report large amounts of (untaxed) income in Puerto Rico; recall the case of G. D. Searle cited in

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[1] Although any dividends paid by the 936 corporation to its U.S. parent qualify for a full dividends received deduction, the dividends enter into recipient's adjusted current earnings for the purpose of the alternative minimum tax (AMT) and thus may be taxed at the margin when received by companies facing the AMT.

Section 2.2. The Tax Equity and Fiscal Responsibility Act of 1982 (TEFRA) introduced the basic scheme now used for determining how much income can be sourced in Puerto Rico. Under TEFRA, a corporation can elect either of two methods for the determination of income--"cost sharing" or the "50-50 profit split." Under cost sharing, the 936 corporation makes a cost-sharing payment to its parent and in return is treated as the owner of any manufacturing intangible (such as a patent) associated with the possessions product. This kind of cost-sharing arrangement could not apply to marketing intangibles such as a brand name, and the guidelines that govern transfer pricing (in Section 482 of the tax code) therefore applied in these cases. From TEFRA until the Tax Reform Act of 1986 (TRA), the required cost sharing payment was based on a formula, equal to Puerto Rican sales multiplied by the ratio of worldwide R&D to worldwide sales in the product area. Because 936 corporations could put their most profitable products in Puerto Rico, the cost-sharing payment could be small compared to the income that was shifted. TRA specified that the cost-sharing payment must be no less than the arms-length royalty for the intangible.

Under the 50-50 profit split method, the possessions corporation reports 50 percent of the combined taxable income earned by it and its U.S affiliates from the sales of the possessions product to third parties. Income derived from manufacturing and marketing intangibles are not distinguished and are both included in the combined pool. Furthermore, any allocation of R&D expenses to the combined income pool is still based on a mechanical formula, now 120 percent of the worldwide ratio of R&D to sales. Under current rules companies that rely primarily on marketing intangibles tend to choose the 50-50 profit split method. In 1989, 62 percent of possessions sales were under the profit split.

Because of the special rules that apply to the sourcing of income to Puerto Rican possessions corporations, income shifting to Puerto Rico and the other possessions is different from the shifting of intangible income to other foreign locations. In particular, under the 50-50 profit split method, income shifting is sanctioned by the Internal Revenue Code; one remaining

area of dispute between the companies and the Internal Revenue Service is the proper allocation of expenses to the pool of combined taxable income.

In the presence of these rules, U.S. companies have apparently been able to shift substantial amounts of intangible-asset-related income to Puerto Rico. The U.S. Treasury Department (1991) has estimated that in 1987 tax benefits per worker were $16,835, or about 95 percent of labor compensation. In some sectors, the tax cost per job was particularly large, e.g., $70,788 in pharmaceuticals.

Another indicator of the amount of intangible income shifted to Puerto Rico can be obtained by looking at the reported operating rate of return of possessions corporations, defined as the ratio of net taxable income plus interest paid and less interest received to the sum of inventories, depreciable assets before depreciation, land and depletable assets. Table 1 presents the 1987 operating rate of return of possessions corporations for the major industry categories in Puerto Rico. The average annual return in manufacturing was 98.5 percent and, as expected, was very high in high technology industries such as drugs and electronics. It was even 56.4 percent in apparel, which would normally be considered a mobile industry with relatively few significant intangibles. These data suggest that some sort of intangible, whether manufacturing or marketing, is significant for almost all companies that move to Puerto Rico.[2]

4. Data Used in the Analysis

The basic data source is a 1987 file of four hundred and nineteen Section 936 companies in manufacturing. These comprise all of the manufacturing companies claiming a possessions credit with fiscal years ending from July 1, 1987 to June 30, 1988. The file includes information from the corporation's basic corporate tax return as well as from forms specific to possessions corporations that give the details on how possession income is determined. The possessions

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[2] One reason that actual rates of return, and the related tax saving, have to be so high is that operating costs may be much higher than on the mainland or alternative offshore location. Under the Jones Act, goods shipped between Puerto Rico and the mainland have to use U.S. flag vessels. In addition, Puerto Rico is subject to U.S. minimum wage legislation, even though productivity is much lower than on the mainland (per capita income is about one-quarter of the U. S. average).

corporations' tax return data were then linked to tax return data of their parent corporations.[3] Finally, the data on all possessions corporations owned by a given parent were aggregated. This procedure produced a sample of 214 corporations owning possessions corporations, and accounted for 96 percent of all possession credits claimed in 1987.

In addition, the basic 1987 corporate tax file was used to provide the universe of "nonparents," i.e., U.S. corporations who could potentially have located in Puerto Rico. All companies in manufacturing on the Treasury corporate file with total assets in excess of $1 million were included in the group of potential movers; this amounted to about 8,000 corporations. At this stage it was necessary to limit the analysis only to parents that had filed a consolidated tax return, as unconsolidated returns would not give a true picture of the parent's profitability and activities. For example, in some cases a possessions corporation was owned by an unconsolidated U.S. affiliate of the parent that was used as a holding company for offshore operations. The U.S. affiliate might perform little R&D on its own, even though the parent has a large research program. The elimination of non-consolidated companies left approximately 4,000 potential "movers" and 150 parents with possessions corporations. The latter account for 88 percent of all possession credits and 85 percent of the operating assets of possessions corporations in Puerto Rico.

One of the relevant variables on the corporate file is qualified R&D for the purpose of the R&D tax credit. However, in some cases no qualified R&D is listed, even though the company in fact had substantial R&D expenditures; for one of several reasons, the company may not be claiming a research credit in a given tax year. Accordingly, Compustat data for 1987 was used to correct this problem. From the companies that had positive R&D in Compustat and positive qualified R&D in the tax file, we found that qualified R&D was on average 50 percent of the Compustat entry. (Some types of R&D do not qualify for purposes of the credit.) Thus, for those companies for which positive R&D was given in Compustat and no qualified R&D was

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[3] In some cases this link could be performed by computer using the parent's identifying number provided by the possessions corporation. In other cases it was necessary to use financial directories of corporate ownership.

listed in the tax file, an R&D value of one-half of the Compustat entry was substituted in the tax file.[4]

The analysis that follows makes use of several variables used to indicate the relative profitability of locating real operations in Puerto Rico. One is a measure of transportation costs by industry (denoted TRANA), for which the basic source is Rousslang and To (1993). For U.S. imports, they provide both the international freight costs, taken from customs declarations, and domestic transport expense from the 1977 input-output table. These transportation expenses are expressed as a percent of the consumer's price. But since sales price enters the denominator, this may pick up the influence of intangibles. For example, one can imagine the invention of a new drug that sells for a very high price but is otherwise the same as old ones in physical appearance and weight. The Rousslang-To measure of transportation costs would decline, although this change is attributable solely to the invention. Accordingly, their transportation cost variable is adjusted by dividing it by the ratio of cost of goods and depreciation expense to sales. Thus, if prices increase but manufacturing costs per unit remain constant, the variable would be unchanged.

Industry hourly wage rates of production workers published by the Bureau of Labor Statistics in Employment and Earnings (denoted EARN) are used as an indicator of the skill requirements for workers in the potential Puerto Rican operation. The emphasis is on production workers because research, marketing and other headquarters functions can still be performed by the parent. A dummy variable denoted DSTART, equal to one only if the parent was incorporated within the last ten years, is used to account for the possibility that new operations may have a lower actual rate of return than otherwise. Finally, the ratio of cost of goods sold (as reported on the corporate tax return) to operating capital (the sum of gross depreciable assets, before depreciation, inventories, gross depletable assets, and land) denoted COS, is used to

[4]For those companies with listed qualified R&D, a regression of it on Compustat R&D and a constant produces a coefficient of 0.507 on the former, and a t-statistic of 62.3. In order to test the importance of this imputation, the basic estimating equations reported below were also run using only those observations for which no R&D imputation was required. The results, including the coefficient on the R&D variable itself, were very similar to those based on the entire sample, and so are not reported here.

measure the importance of manufacturing costs per unit of capital. Note that among the expense items not included in cost of goods sold are advertising and marketing expenses, R&D, and other general and administrative expenses.

We also analyze the effect of three indicators of the importance of intangible assets. They are denoted RD, the ratio of the parent's R&D expenditures to the parent's sales; AD, the ratio of the parent's advertising expenditures to its sales, and PK, the ratio of consolidated gross profits (sales less cost of goods sold) to operating capital. This last variable is intended to reflect the pool of income that can potentially be shifted to Puerto Rico per unit of operating capital.

Table 2 presents the mean values of these parent firm characteristics, separately for parents with Puerto Rican affiliates and those without. The indicators of intangible intensity, RD, AD, and PK, are clearly higher for those firms that maintain operations in Puerto Rico. These firms also feature lower transportation costs, slightly higher average hourly wage rates, and lower manufacturing costs per unit of capital.

5. Empirical Model and Estimation Results

5.1 The Location Decision

We begin with a simple model in which the scale of the prospective Puerto Rican investment is predetermined. The firm makes only two choices: whether or not to locate in Puerto Rico and, if it does locate there, what rate of return to report. We further assume that the firm's total reported profits sum to its total actual profits, so that profits cannot be hidden from tax authorities, just moved between Puerto Rico and the U.S. The after-tax profit from operating in Puerto Rico, net of the opportunity cost of capital, has four components: the return if profits were sourced according to economic principles, (plus) the tax saving from shifting U.S. earnings to Puerto Rico, (less) the cost of shifting income and the opportunity cost of capital:

$$\Pi_p = f_p K_p + (t_s - u_s)(r_p K_p - f_p K_p) - C(r_p, f_p, K_p) - iK_p, \qquad (5.1)$$

where f_p is the actual pre-tax average product of capital in Puerto Rico, K_p is capital in Puerto Rico (assumed for now to be predetermined), t_s and u_s are the statutory tax rates, respectively, in the U.S. and Puerto Rico, r_p is the reported rate of return in Puerto Rico, i is the opportunity cost of capital, and C is a function representing the cost of shifting income. C can be thought of as the expected penalties imposed by the tax authorities on any income shifting termed ex post to be illegal, plus any internal costs of income shifting, such as those associated with keeping two sets of books or with the disruption of optimal internal decisions caused by tax-driven transfer prices.[5]

Note that f_p is not observable by either the tax authorities or by ourselves. To operationalize this concept, we allow it to depend on a vector X_1 of observable variables, as follows:

$$f_p = A_1 X_1. \tag{5.2}$$

The total cost of income shifting is presumed to be proportional to K_p, and be a quadratic function of the difference between the reported rate of profit and the actual rate of return on capital. We also posit that the cost of shifting is inversely proportional to a linear function of an indicator of the importance of intangible assets, here denoted Q. Recall that the presence of intangible assets decreases the cost of income shifting. A critical assumption of this model is that, while Q affects the cost of income shifting, it is not a factor in the relative attractiveness of locating real investment in Puerto Rico. This seems a highly plausible assumption, as little investment in intangibles such as R&D occurs in Puerto Rico. Our parameterization of the cost of income shifting is

$$C(r_p, f_p, K_p) = \frac{K_p (r_p - f_p)^2}{2(b + BQ)}. \tag{5.3}$$

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[5]Some of the cost of shifting may be deductible from taxable income. We have chosen to assume that any such costs are subtracted from Puerto Rican income, which is untaxed. Allowing some of the cost of shifting to be deductible from the parent's taxable income would complicate the model without changing its qualitative implications.

The form of the C function is a key element of the model. As is shown in Slemrod (1994), what is critical are $\frac{\partial C}{\partial K_p}$, income shifting (defined as S, equal to $(f_p - r_p) K_p$) held constant, and $\frac{\partial C}{\partial S}$, K_p held constant. In the formulation of (5.3), $\frac{\partial C}{\partial K_p}$ is negative, because a given amount of shifting is less costly when K_p increases and $(f_p - r_p)$ declines to keep S constant. The value of $\frac{\partial C}{\partial K_p}$ is an implicit subsidy to K_p that lowers the effective cost of capital.[6] That $\frac{\partial C}{\partial K_p}$ is negative is plausible because the amount of allowable income shifting to Puerto Rico is certainly related to the real operating capital located there. The particular functional form is a simple version which captures the critical relationship that increased real capital reduces the cost of a given amount of shifting; other functional forms which retain this feature will likely yield qualitatively similar results.

The firm has a two-stage decision process. First, it must calculate the optimal rate of return to report, r_p, conditional on locating in Puerto Rico. Then it calculates net profit, given the optimal r_p. If net profit is positive, it locates in Puerto Rico; if it is negative, is does not locate there.

Optimal r_p, denoted r_p^*, is found by deriving the appropriate first-order condition from (5.1), which is

$$(t_s - u_s) = \frac{(r_p - f_p)}{b + BQ}, \tag{5.4}$$

so that

$$r_p^* = (b + BQ)(t_s - u_s) + f_p. \tag{5.5}$$

Substituting this expression for r_p into the after-tax profit, per unit of K_p, yields

$$\frac{\Pi_p}{K_p} = f_p + (b + BQ)(t_s - u_s)^2 - \frac{(b + BQ)}{2}(t_s - u_s)^2 - i. \tag{5.6}$$

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[6]Note that if $\frac{\partial C}{\partial K_p}$, holding S constant, is zero, then the benefits of income shifting are inframarginal and do not affect the marginal reward to increasing K_p.

$$= f_p - \left(i - \frac{(b + BQ)(t_s - u_s)^2}{2} \right).$$

The first term here represents the actual after-tax profitability of operations, the second term represents the gross return to the optimal amount of income shifting, and the third term represents the cost of that income shifting. Due to the simple quadratic cost function, the cost of that income shifting is exactly half of the gross benefit, so that the net benefit is one-half the gross benefit.

The value of Π_p is not observable. We do, though, observe which firms choose to locate in Puerto Rico, which indicates that Π_p is positive. To operationalize the model, we assume that X_1 consists of the variables EARN, TRANA, COS, and DSTART, defined in Section 4, plus a scale variable, LNK, which is the logarithm of consolidated operating capital. Q, the indicator of the presence of intangibles, is posited to be a linear function of the three measures of the importance of intangibles discussed in Section 4—RD, AD, and PK. Furthermore, we set the statutory tax rates in Puerto Rico, u_s, equal to zero.[7]

With these assumptions, the right-hand side of expression (5.6) consists of a constant term (which includes i), the variables in X_1 (EARN, TRANA, COS, DSTART and LNK), a constant times t_s^2, and the variables in Q (RD, AD, and PK) multiplied by t_s^2. Unfortunately, t_s, the statutory tax rate in the U.S. is the same for all firms. The only possible source of tax differentiation is that, for firms with nonpositive taxable income, the current tax rate for an additional dollar of income is zero. However, because losses can be carried forward (without interest), the real tax rate is probably nonzero, although it differs across firms depending on their expected future loss position. In what follows we include a variable, denoted TS, which is equal to one except for firms with a net operating loss, in which case it is equal to zero. We have also estimated, though do not report, a version where the variables RD, AD, and PK were multiplied by TS. These results were not qualitatively different from those reported below, although the fit

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[7] In expression (5.1) we have already implicitly set to zero the average effective tax rate in Puerto Rico. In fact the Puerto Rican tax rate is positive but small; these assumptions greatly simplify the analysis, however.

of the equation declined, suggesting that the TS variable does not capture the tax incentives for shifting income.

The results of the probit estimation of equation (5.6) are displayed in Column (1) of Table 3. Note that, as the theory suggests, there is a positive coefficient on each of the indicators of Q; each coefficient estimate is also statistically significantly different from zero at a 95% confidence level. We can use the probit estimates to simulate the effect of removing the tax benefit of income shifting, while retaining the effective tax rate of zero on actual income earned in Puerto Rico by setting t_s equal to u_s. Because $t_s - u_s$ multiplies Q in the probit equation, this is equivalent to setting not only TS but also RD, AD and PK to zero. The first column of Table 4 shows, by industry, the simulated impact of this policy on the number of U.S. firms that would continued to operate in Puerto Rico.[8] The simulations suggest that nearly half of all U.S. firms in Puerto Rico are there solely for the income shifting benefits, with the fraction rising to 80% for pharmaceutical companies.

5.2 Scale of Operation

The simulations of Section 5.1 assumed that the scale of operations of U.S. possessions corporations is determined independently of tax policy. In this section we generalize that assumption by allowing K_p to be a choice variable of the firm. We make optimal scale determinate by positing that each firm's Puerto Rican investment has diminishing returns, so that

$$f_p = A_1 X_1 - A_2 K_p. \tag{5.7}$$

The firm's two-step decision process is slightly modified. It must first decide on optimal r_p and K_p, conditional on operating at all in Puerto Rico. It then decides whether to go to Puerto Rico at all, depending on whether its net addition to profits would be positive.

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[8]This result, and all of the simulation results in Table 4, are point estimates only, and are subject to error because of the imprecision of the parameter estimates. Note, though, that the parameter estimates for the variables in the Q vector are large relative to their standard errors. On the other hand, the simulations refer to values of the independent variables which are far from their means, increasing the variance of any prediction.

Because both the marginal costs and marginal benefits of income shifting have been assumed to be proportional to K_p, allowing it to be endogenous does not change the condition for optimal r_p, as shown in expression (5.5). The optimal value for K_p is as follows

$$K_p^* = \frac{A_1 X_1 - \left(i - \frac{(b+BQ)}{2}(t_s - u_s)^2\right)}{2A_2}. \tag{5.8}$$

According to (5.8), the optimal size of the operation in Puerto Rico is positively related to the potential gain from income shifting, just as is the potential profit from being there. Note that the numerator of (5.8) is identical to the right-hand side of (5.6). This follows from the assumption that the costs of income shifting are proportional to K_p. The large bracketed item in the numerator can be thought of as an "income shifting adjusted cost of capital" (ISACC), because it shows the effective cost of capital considering the net of cost income shifting gain per unit of capital, at the optimal amount of shifting.

We next estimate (5.8) as a Tobit equation, utilizing the same right-hand side variables as the probit equation above. The results of this procedure are displayed in column (2) of Table 3. Note that for each variable the estimated coefficient has the same sign in this equation and in the probit equation, a result which is consistent with the sample model outlined here.

The second and third columns of Table 4 repeats the simulation exercise of eliminating any benefit to income shifting, making use of the Tobit coefficient estimates. In calculating the impact on employment, we assume that the ratio of employment to operating capital in Puerto Rico is the same as that of the parent in the U.S. In fact, this is approximately true for the companies actually in Puerto Rico. These simulations show an even larger negative impact of this policy, because not only do many firms cease operations completely, but also most of those that stay reduce the size of their operations.

5.3 The Impact of a Wage Subsidy

The simulation results of the previous section suggest that, in the long run, a major exodus of U.S. companies would follow an elimination of the benefits of income shifting. Some have suggested that, in place of these benefits, a wage subsidy should be instituted. For example, President Reagan's 1985 tax reform proposal provided for a permanent possessions wage credit of 60 percent of wages up to the federal minimum wage plus 20 percent of wages above the minimum wage up to four times the minimum wage.

Consider a subsidy of s per unit of labor, so that the cost to the firm is reduced from w to w(1-s). Assume that the capital-labor ratio is fixed for each firm, so that the equivalent subsidy per unit of capital is sk, where k is the ratio of wage payments to operating capital; the term $-skK_p$ must be added to the expression for profit in (5.1). This is the effective reduction in the cost of capital.

The empirical difficulty is that the estimated equations do not provide a direct measure of the impact of a change in the cost of capital on either the probability of locating in Puerto Rico or on the size of operation, conditional on being in Puerto Rico. We can obtain an estimate of the first of these magnitudes, however, by rearranging (5.6) and substituting using the expression for r_p^* in expression (5.5), yielding

$$\frac{\Pi_p}{K_p} = f_p + \frac{1}{2}(r_p^* - f_p)(t_s - u_s) - i + sk. \tag{5.9}$$

The second term in (5.9), $\frac{1}{2}(r_p^* - f_p)(t_s - u_s)$ is the net benefit, in dollars, per unit of capital of the opportunity to shift income to Puerto Rico. If we could form an expression for this, its coefficient in the probit equation will enable us to predict the impact of an effective subsidy of sk. To obtain such an expression, we first estimate the following equation, with the appropriate sample selection correction based on the probit equation discussed above, over the sample of Puerto Rican possessions corporations:

$$r_p = A_1 X_1 + (b + BQ)(t_s - u_s), \tag{5.10}$$

where r_p is the ratio of reported operating profits to operating capital. The results are reported in Column (3) of Table 3.[9]

We then form, for each firm, an estimate of $\left(r_p^* - f_p\right)$, equal to $\left(\hat{b} + \hat{B}Q\right)\left(t_s - u_s\right)$ or, using an empirical approximation: (4.13 RD - 0.912 AD + 1.15 PK - 0.442 TS). Using this, we reestimate the probit equation as a function of a constant, the vector X_1, and this estimate, denoted RPFIT. These results are reported in Column (4) of Table 3.

The RPFIT coefficient has the expected positive sign, and is statistically significant. We then proceed to use its estimated coefficient to simulate the effect of a wage subsidy. Consider, as an example, a wage subsidy of 50%, so that s = 0.5. For a firm with a ratio of labor costs to operating capital of 0.4, sk = 0.2. The estimated impact of the wage subsidy on the probability of locating in Puerto Rico is then calculated as follows. According to Column (4), a unit change in RPFIT increases the probability of locating in Puerto Rico by $0.241 \cdot \phi$, where ϕ is the value of the standard normal density function. Setting t_s at 0.40, its value in 1987, and u_s to zero, we note that the impact of a unit change in $\frac{1}{2}(r_p^* - f_p)(t_s - u_s)$ is estimated to be $0.241 \cdot \phi/(0.2)$. It follows that a wage subsidy where sk = 0.2 is estimated to increase the probability of location by $(0.2)(0.241) \cdot \phi/(0.2)$.

The fourth column of Table 4 shows the results of simulating an elimination of income shifting combined with a 50% wage credit. Note that, for pharmaceuticals, the wage subsidy does not nearly offset the effect of losing income shifting, but it comes much closer to so doing for other industries. In fact, the apparel sector is simulated to expand under this combination of policies, reflecting a relatively high ratio of labor use to benefit due to income shifting.

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[9] Note that the positive sign of the estimated coefficient on LAMBDA is plausible, because it suggests that the unobservable factors which make locating in Puerto Rico attractive are positively correlated with the unobservable factors which increase the rate of return that can be reported there.

We can follow the same procedure for estimating the effect of a wage subsidy on the scale of operation by noting that the expression for the optimal capital stock in Puerto Rico becomes

$$K_p^* = \frac{A_1 X_1 + \left(\frac{1}{2}(r_p^* - f_p)(t_s - u_s) - i + sk\right)}{2A_2}. \tag{5.11}$$

We reestimate the Tobit equation for K_p using RPFIT instead of the Q vector. This yields the results displayed in Column (5) of Table 3.

The results of simulating the effect of the combined policies using this equation are presented in the fifth and sixth columns of Table 4. The patterns evident in the third panel are generally accentuated for operating capital, with the losing sectors shrinking not only in presence but also in size. The response of payrolls is striking; because this combination of policies is attractive to labor-intensive firms, all sectors except pharmaceuticals gain in total payroll in the simulation. However, the pharmaceutical sector, so dependent on the benefits of income shifting, still is simulated to shrink substantially.

6. Conclusions

A country's tax structure affects both the attractiveness of real investment and the incentive of multinational corporations to report income in the jurisdiction. For a firm these decisions are interrelated, because the opportunity to shift income into a low-tax jurisdiction makes real investment more attractive than otherwise.

This paper presents a theoretically consistent and empirically tractable model of the joint investment location and income shifting decisions of a multinational firm. The model is applied to micro-level data for 1987 on U.S. corporations and their investments in Puerto Rico. The model fits the data well, confirming that, ceteris paribus, investment in Puerto Rico is attractive to those firms which can take advantage of the income shifting opportunities offered by the ownership of intangible assets. Simulations based on the statistical results suggest that a large

fraction of U.S. investment in Puerto Rico is due to the income shifting opportunities. Replacing the current tax treatment with a wage subsidy would radically change the composition of investment toward more labor-intensive and less intangible-intensive firms.

Although the tax treatment of U.S. possessions corporations is unique, the model developed here is general enough to apply to the joint investment and income shifting choices faced by all multinationals. We look forward to future work along these lines.

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TABLE 1

Operating Rate of Return* of Puerto Rican Possessions Corporations, 1987 (in percent)

All Manufacturing	98.5
Food	71.8
Apparel	56.4
Drugs	138.6
Electronic Equipment	114.0
Instruments	89.1
Other	46.4

*Operating income is defined as net income less interest received plus interest paid. Operating assets are inventories, gross depreciable and depletable assets, and land.

Source: Tabulations by the Statistics of Income Division of the IRS provided to the U.S. Treasury Department.

TABLE 2

Mean Values of Parent Firm Characteristics, By Whether They Have Puerto Rican Affiliates

Variable	Parents With Puerto Rican Affiliates	Parents Without Puerto Rican Affiliates
RD	0.02117	0.00853
AD	0.0369	0.0134
PK	0.918	0.756
TS	0.705	0.558
LNK	12.93	9.99
EARN	10.31	10.03
TRANA	9.87	11.62
COS	1.260	1.663
DSTART	0.204	0.365
KP ($ millions)	34.69	n.a.
RP*	1.086	n.a.
R	11.0	10.6

*Refers to Puerto Rican corporation rather than U.S. parent.

Variable definitions:

P:	Dummy variable equal to one if the firm operates a possessions corporation; zero otherwise.
KP:	Capital in Puerto Rico ($ tens of millions).
RP:	Reported rate of return in Puerto Rico.
R:	Operating return of the parent corporation.
RPFIT:	Estimated value of RP, described in text.
RD:	Ratio of parent's R&D expenditures to the parent's sales.
AD:	Ratio of parent's advertising expenditures to its sales.
PK:	Ratio of consolidated gross profits to operating capital of the parent.
TS:	Dummy variable equal to one if parent firm had positive operating profit; zero otherwise.
LNK:	Logarithm of consolidated operating capital of parent.
EARN:	Industry hourly wage rate in the U.S.
TRANA:	Industry average measure of transportation costs; defined in text.
COS:	Ratio of parent's cost of goods sold to operating capital.
DSTART:	Dummy variable equal to one if parent was incorporated within last ten years; zero otherwise.

TABLE 3

Estimation Results
(Standard Errors in Parentheses)

	(1)	(2)	(3)	(4)	(5)
Estimation Procedure	Probit	Tobit	OLS	Probit	Tobit
Dependent Variable		KP	RP		KP
Independent Variables					
RPFIT				0.241 (0.031)	1.99 (0.26)
RD	5.38 (1.62)	50.4 (11.5)	4.13 (11.5)		
AD	6.13 (1.05)	47.5 (7.6)	-0.912 (13.1)		
PK	0.23 (0.039)	1.66 (0.31)	1.15 (0.52)		
TS	0.059 (0.237)	1.34 (1.76)	-0.442 (0.611)		
LNK	0.335 (0.026)	2.70 (0.236)	0.214 (0.731)	0.345 (0.026)	2.97 (0.26)
EARN	-0.091 (0.026)	-0.518 (0.191)	-0.0973 (0.209)	-0.0856 (0.0251)	-0.504 (0.199)
TRANA	-0.035 (0.0074)	-0.227 (0.054)	-0.0702 (0.0827)	-0.0360 (0.0068)	-0.267 (0.054)
COS	-0.0252 (0.0434	-0.124 (0.323)	-0.143 (0.167)	-0.0794 (0.0464)	-0.716 (0.387)
DSTART	-0.282 (0.104)	-2.78 (0.78)	-0.0517 (0.660)	-0.283 (0.101)	-2.48 (0.81)
LAMBDA			0.342 (2.706)		
Intercept	-4.62 (0.36)	-39.3 (3.4)	-1.33 (12.0)	-4.50 (0.36)	-40.5 (3.7)
Log Likelihood	-470.2	-801.1	-237.6	-452.0	-829.8
N	4099	4099	152	4099	4099

TABLE 4

Simulation Results
(% Change From Estimated Existing Levels)

	Repeat of Section 936			Substitute 50% Wage Credit		
	Number of Firms	Total Operating Capital	Total Payroll	Number of Firms	Total Operating Capital	Total Payroll
All Sectors	-49.7	-71.5	-72.2	-7.7	-11.3	+49.2
Pharmaceuticals	-78.1	-98.6	-97.8	-33.2	-61.9	-59.7
Apparel	-47. 6	-77.5	-73.6	+2.5	+8.0	+62.8
Electronics	-53.7	-80.6	-80.6	-13.9	-24.0	+6.9
Other	-44.9	-61.9	-66.2	-4.2	-2.6	+69.4