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NO PLACE LIKE HOME: TAX INCENTIVES AND THE LOCATION OF R&D BY AMERICAN MULTINATIONALS

James R. Hines, Jr.

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ABSTRACT

This paper analyzes the effects of the U.S. tax treatment of the R&D activities of American multinationals. Recent evidence indicates that the level of R&D spending is highly sensitive to its after-tax cost. The U.S. Tax Reform Act of 1986 reduced the tax deductions that many American firms can claim for their R&D expenses incurred in the U.S., and on this basis, observers predicted that American firms would react to the tax change by significantly increasing the fraction of their R&D that they perform abroad. Aggregate data indicate that this fraction instead stayed roughly constant, at around 10%. An important reason why U.S. firms did not move more of their total R&D activity offshore is that U.S. tax law provides quite generous treatment of R&D performed in the U.S. for use abroad by firms with excess foreign tax credits, and the Tax Reform Act of 1986 significantly increased the number of American firms with excess foreign tax credits. Hence, the 1986 tax change increased the cost of U.S.-based R&D for some American firms, and reduced it for others, with little impact on the overall fraction of R&D spending that U.S. firms do abroad. One consequence of the tax law changes of the late 1980s is that, by 1991, the tax treatment of foreign-source royalties received by American firms with excess foreign tax credits has five times the revenue impact of the Research and Experimentation Tax Credit.

James R. Hines, Jr.
John F. Kennedy School of Government
Harvard University
79 John F. Kennedy Street
Cambridge, MA 02138
and NBER

1. Introduction.

The US government expends considerable effort, on a regular cycle, to consider and reconsider the tax treatment of research and development (R&D). The Research and Experimentation (R&E) Tax Credit, introduced in 1981, is the most widely discussed tax policy tool directed at R&D. The original R&E credit was temporary - designed to expire in 1985 - but since 1985 the credit has been sequentially extended on a temporary basis. As a consequence, the R&E credit has been extensively discussed, and changed several times, over the period 1985-1993. The same is true of several other tax provisions that affect R&D. For example, President Clinton's budget proposal of February 1993 included numerous recommended changes in the tax treatment of R&D activities, with special attention devoted to R&D performed by multinational corporations. The Omnibus Budget Reconciliation Act of 1993, passed by Congress and signed by the President in August 1993, contains many of the features of the President's proposal of February 1993, but does not embody the sweeping reforms of the taxation of the R&D activities of multinational corporations recommended by the President.

Congress has struggled for years to design an approach to taxing R&D that is consistent with its tax revenue needs and also its desire to encourage R&D. Concern over the responsiveness of R&D to tax rates is most acute in the case of multinational firms, since they have the ability, and often the incentive, to shift domestic operations to overseas locations in reaction to tax changes. Over the years, Congress has been particularly concerned that American firms might shift their R&D activities to offshore locations in response to tax changes that make it more expensive to undertake R&D in the United States. This concern is motivated in part by the belief that R&D in the United States generates valuable external benefits for the US economy, and in part by a sense of

in the 1980s, peaking at 2.8% in 1985-1987. Over the same time period, France and the UK had steady (and somewhat lower) R&D/GNP ratios, while Germany and Japan exhibited growing R&D intensity.

It is not difficult to see in Table 1 the trends that motivated Congress to enact more generous tax treatment of R&D in 1981. Falling US R&D intensity, at the same time that the German and Japanese economies were becoming more R&D-intensive, drew the attention of those with concerns about maintaining US technological leadership. Whether due to policy changes or to other factors, the end of the 1970s was a turning point for US R&D.

The aggregate numbers displayed in Figure 1 mask two significant developments in R&D activity in the 1980s: variations in the amount of R&D performed by US firms abroad, and the growing fraction of R&D in the US performed by foreign-owned firms. The first of these two has been of particular concern to Congress in designing R&D tax policy. In spite of the difficulty firms have in finding cost-effective ways of doing R&D projects in certain foreign locations, Congress was concerned that the foreign share of the total R&D expenditures of American companies might rise along with the general trend to globalize American business.[3]

The available data do not indicate that American firms moved a large fraction of their R&D activities to foreign countries over the period of the 1980s, in spite of the period's substantial growth in the activity level and profitability of the foreign operations of US firms relative to their domestic operations.[4] Figure 1 plots the ratio of offshore R&D to total US R&D over the 1977-1990

[3]The US Congress, Joint Committee on Taxation (1992, p. 49) reports that the "principal reason" behind changing the R&D allocation rules in 1981 was Congress's feeling that the regulations then in force "encouraged multinational businesses to shift research activities abroad."

[4]See Hines (1991b) for a discussion of the growing share of US corporate profits attributable to the foreign operations of US corporations.

time period.[5] In 1977, US firms performed 9.7% of their R&D abroad. This ratio grew to 10.7% by 1979, but fell steadily to 6.4% in 1985. The foreign share of total R&D grew after 1985, but was only 10.4% by 1990.

There are several considerations that can complicate the interpretation of the data presented in Figure 1. Tax changes roughly coincide with turning points in the fraction of US R&D performed aborad, but so do other changes in the economic and scientific environment. One of the most obvious economic factors that might influence the ratio presented in Figure 1 is the value of the US dollar relative to foreign currencies. If real foreign and domestic expenditures on R&D do not change between two years, but the dollar weakens, then the dollar-denominated value of foreign R&D will rise relative to the value of domestic R&D. In order to examine the degree to which exchange rate movements might influence the ratio presented in Figure 1, Figure 2 plots an adjusted ratio in which the foreign R&D figure in the numerator is deflated by the trade-weighted value of the US dollar (taking the 1977 value of the dollar against foreign currencies to be unity). The locus pictured in Figure 2 looks similar to that in Figure 1, with the difference that its cyclical swings now show diminished amplitude, since, for example, the dollar's strength in 1984-1985 coincides with a relatively small foreign share of total R&D expenditures.

A second complication to the interpretation of Figure 1 is that some of the R&D activity in the United States represents expenditures by the US subsidiaries of foreign multinationals. The fraction of US-based R&D performed by foreign firms rose markedly over the 1980s: in 1980,

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[5]The data on which Figures 1-3 are based come from a National Science Foundation (1993) survey of virtually all firms in the US with annual R&D expenditures of $1 million or more. The survey is directed at R&D performed in the United States, and partly for that reason has a somewhat disappointing response rate to its question about R&D performed by foreign affiliates. There are other omissions as well; Cohen and Levin (1989) note that R&D reported in Compustat files is 12% greater than R&D reported in the NSF survey, and there is a view that the Compustat figures are the more reliable ones. Nevertheless, the NSF surveys cover the foreign R&D undertaken by the largest firms, and appear to capture the important aggregate trends in R&D activity.

foreign-owned firms were responsible for 4.0% of the R&D in the United States, while in 1990, R&D spending of foreign-owned firms was 10.2% of the total. Figure 3 presents a variant of Figure 2, in which the denominator is adjusted to include only the US-owned component of R&D performed in the United States.[6] The shape of Figure 3 is quite similar to the shape of Figure 2, reflecting the rather modest (though growing) foreign-owned share of total US R&D expenditures. It follows that the fraction of total US R&D activity performed abroad is roughly constant over the 1977-1990 period, and its constancy is robust to an exchange-rate correction and adjustment for foreign R&D activity in the US.

3. The Tax Treatment of R&D.

This section reviews the tax treatment of R&D by US corporations, with particular emphasis on the tax treatment of firms earning international income.[7] The section starts with the general treatment of R&D in US tax law, followed by a description and analysis of the R&E credit. Then the section describes in general terms the US tax treatment of foreign income earned by US corporations, and analyzes its interaction with the tax treatment of R&D. The section ends by considering the impact of these rules on firms' incentives to undertake R&D.

General Treatment of R&D

Expenditures on research and development by firms in the United States are

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[6]Data on the R&D activities of foreign investors in the United States are reported in the US Department of Commerce, Bureau of Economic Analysis series ***Foreign Direct Investment in the United States*** (various issues).

[7]This section contains some tax law description that is excerped from Hines (1993).

deductible for income tax purposes.[8] Since a firm's stock of R&D usually has the character of a capital good, in that it generates revenues both currently and over a number of future years, immediate expensing of R&D is an attractive tax feature.[9] By contrast, physical capital such as plant and equipment is depreciated for tax purposes, and, despite occasional inducements such as the investment tax credit has always been tax-disfavored relative to R&D.[10] Generally speaking the effective rate of tax on R&D is zero, since firms will choose R&D expenditures that equate the (after-tax) marginal product of R&D to the (after-tax) cost of R&D. Since the same tax rate applies to both the marginal product of R&D and the marginal cost, the tax rate should not influence the level of R&D.

The R&E Credit

The research and experimentation (R&E) credit was introduced in 1981 to stimulate additional R&D activity in the United States.[11] The R&E credit initially offered a 25% tax credit for R&D expenditures above a base level, determined by the average of a firm's previous three years'

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[8]An exception is that expenditures for the acquisition or improvement of depreciable property, or land, used in conjunction with research, are not deductible. Assets other than land can be depreciated for tax purposes at rapid rates (for example, the Tax Reform Act of 1986 classifies equipment used for research as five-year recovery property). Special rules apply to certain industries.

[9]Ravenscraft and Scherer (1982) find that the profitability of the firms in their sample appeared to be influenced by their R&D expenditures lagged four to six years. Griliches and Mairesse (1984) estimate firm productivity to be a function of the stock of accumulated R&D capital, which they take to depreciate at a rate of 15% per year; Jaffe (1986) also uses 15% as the exponential rate of depreciation for the R&D stock. In their study of patent renewals Pakes and Schankerman (1984) find evidence of a somewhat higher depreciation rate for R&D capital, 25% per year, but one that is much below the 100% rate that is implied in the tax law.

[10]See Auerbach (1983) for a historical survey of the effective tax rates on investments in plant and equipment.

[11]There are some small distinctions between activities that qualify for the R&E credit and R&D that is deductible but must be allocated according to §1.861-8. The Tax Reform Act of 1986 tightened the definition of R&D that is eligible for the tax credit.

worth of R&D expenditures. The idea behind the design of the credit was to offer an incentive for marginal research activities, but one that did not subsidize inframarginal research. Of course, in practice matters are not so simple, and the R&E credit could often have the perverse effect of discouraging research and development, or of providing only trivial incentives to undertake marginal R&D. The reason is that, by undertaking additional R&D activities today, a firm may reduce the credit it would otherwise receive in future years. Furthermore, various limits built into the credit reduce the incentive it provides in certain cases.[12]

The R&E credit came under fire from various arguments that implied that it was not a cost-effective way of stimulating R&D.[13] Partly in response, the Tax Reform Act of 1986 reduced the R&E credit to 20% and tightened some of the definitions of R&D eligible for the credit. The 1988 tax act further reduced the subsidy afforded by the R&E credit by making half of the credit amount taxable income, and the 1989 tax act made the credit amount 100% taxable. In addition, the 1989 act changed the way that the base is calculated, with the intention that, starting in 1990, additional R&D expenditure in one year does not reduce a firm's tax credit in subsequent years.

The 1989 changes in the R&E credit illustrate some of the complications that accompany efforts to subsidize marginal R&D activities while not expending tax revenue to pay for

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[12]For example, R&D expenditures in excess of 200% of the base amount were eligible for only half the credit rate, even though they raise the base for future years. Furthermore, firms must have taxable profits (or the potential to carry credits forward or back against taxable profits) to benefit from the credit. See Eisner, Albert and Sullivan (1984), Altshuler (1988), and Hall (1993) for analyses of the effective rates of subsidy provided by the R & E credit. Eisner, Albert and Sullivan estimate the average effective credit rate for 1981 to be zero and for 1982 to be 4%. Altshuler, using a slightly different methodology, finds the effective credit rate for 1981 to be between 1% and 2%. Hall finds the effective credit rate to be 3.0% in 1981 and 5.1% in 1982; she reports that the credit rate subsequently jumped from 2% in 1989 to 7.7% in 1990 and 7.5% in 1991.

[13]See, for example, Mansfield (1986), who argues that the R&E credit had only a very small effect on R&D in the United States, and that it reduced tax collections by an amount equal to three times the additional R&D it generated. Wozny (1989) and the US General Accounting Office (1989) report similar findings for a study of the R&E credit conducted by GAO.

inframarginal R&D. Taxpayers in each year are eligible for the R&E credit to the extent that their R&D expenditures exceed that year's firm-specific "base amount." The "base amount" is the product of the taxpayer's average gross receipts for the preceeding four years *and* the taxpayer's "fixed base percentage." For firms with sales and R&D expenditures during at least three of the years 1984-1988, the "fixed base percentage" is the ratio of its R&D expenditures to its sales over that period. The idea behind this formula is to use data from the 1984-1988 period to construct firm-specific R&D targets, based on sales, that the firm might be expected to meet in the absence of a credit. Firms then receive R&E credits for their R&D expenditures in excess of the targets.[14]

Serious problems can arise in defining these firm-specific targets, since firms need not remain identical over time: they are born, grow, die, merge, and do other things that change the character of the entity that existed during 1984-1988. The 1989 law provides that firms without sales and R&D in at least three years over the 1984-1988 period are assigned "fixed base percentages" of 0.03. Special rules apply to firms that merge. The difficulty that lies behind the design of these rules is that any adjustment of the "fixed-base percentage" that is itself a function of current-year R&D efforts will often distort firms' incentives to undertake R&D in the current year, typically giving firms incentives to reduce their current R&D expenditures.

Disagreement over budgetary issues in general, and the appropriate treatment of R&D in particular, prevents Congress from designing a permanent approach to taxing R&D. The R&E credit was extended for one year by the Omnibus Budget Reconciliation Act of 1990, and for six months by the Tax Extension Act of 1991, until it expired on 30 June 1992. The R&E credit was reinstated (and made retroactive to 30 June 1992) by the August 1993 passage of the Omnibus Budget Reconciliation Act of 1993. Under the terms of the 1993 Act, the R&E credit is now due to expire

[14]The amount of R&E eligible for the credit is capped at 100% of the base amount. In addition, the maximum allowable "fixed-base percentage" is 0.16.

on 30 June 1995. In addition, the 1993 Act provides a formula whereby the "fixed-base percentages" of start-up firms will slowly adjust from the statutory 3% to their average R&D/sales ratios over a period of years.

The scope of the corporate Alternative Minimum Tax (AMT) was greatly expanded by the Tax Reform Act of 86, including some provisions that bear on the tax cost of undertaking R&D. Firms paying the AMT are ineligible for the R&E credit, though AMT firms are permitted to carry their R&E credits forward (for up to 15 years), and can use them when out of AMT status. In addition, the foreign tax credit calculation under the AMT differs from the foreign tax credit calculation under the regular corporate tax, thereby influencing the after-tax cost of R&D for certain multinational firms.[15]

Some of the important R&D tax changes of the 1980s concern the taxation of US firms with foreign income. In order to analyze these tax changes, it is necessary to consider some of the international features of the US tax system.

US Taxation of Foreign Income[16]

The United States taxes income on a "residence" basis, meaning that American corporations and individuals owe taxes to the US government on all of their worldwide income, whether earned in the United States or not. The top US corporate tax rate is now 35 percent. Since foreign profits are usually taxed in host countries, US law provides a foreign tax credit for income taxes (and related taxes) paid to foreign governments, in order not to subject American multinationals to double taxation. The foreign tax credit mechanism provides that a US corporation earning $100 in

[15]See Lyon and Silverstein (1993) for a description of AMT rules and analysis of their behavioral incentives. They report that 30.7% of firms with assets over $500 million were subject to the AMT in 1990.

[16]Parts of this brief description of the tax system are excerpted from Hines (1991a).

a foreign country with a 12 percent tax rate (and a foreign tax obligation of $12) pays only $23 to the US government, since its US corporate tax liability of $35 (35 percent of $100) is reduced to $23 by the foreign tax credit of $12. The foreign tax credit is, however, limited to US tax liability on foreign income; if, in the example, the foreign tax rate were 50 percent, then the firm pays $50 to the foreign government but its US foreign tax credit is limited to $35. Hence a US firm receives full tax credits for its foreign taxes paid only when it is in a "deficit credit" position, i.e., when its average foreign tax rate is less than its tax rate on domestic operations. A firm has "excess credits" if its available foreign tax credits exceed US tax liability on its foreign income. Firms average together their taxable incomes and taxes paid in all of their foreign operations in calculating their foreign tax credits and the foreign tax credit limit.[17]

Deferral of US taxation of certain foreign earnings is another important feature of the US international tax system. A US parent firm is taxed on its subsidiaries' foreign income only when returned ("repatriated") to the parent corporation. This type of deferral is available only to foreign operations that are separately incorporated in foreign countries ("subsidiaries" of the parent) and not to consolidated ("branch") operations. The US government taxes branch profits as they are earned, just as it would profits earned within the United States.

The deferral of US taxation may create incentives for firms with lightly-taxed foreign

[17]In order to qualify for the foreign tax credit, firms must own at least 10% of a foreign affiliate, and only those taxes that qualify as income taxes are creditable. Furthermore, income is broken into different functional "baskets" in the calculation of applicable credits and limits. Income earned and taxes paid in the conduct of most types of active foreign business operations are grouped in one "basket;" petroleum industry income is grouped in a separate "basket;" and there are separate "baskets" for items such as passive income earned abroad. The "basket" distinctions imply that a firm might simultaneously have excess foreign tax credits in the petroleum "basket" (which is common, since foreign tax rates on oil income are typically quite high) and deficit foreign tax credits in the active income "basket." Such a firm would have to pay some US tax on its active foreign income, even though it has excess foreign tax credits on its petroleum income.

earnings to delay repatriating dividends from their foreign subsidiaries.[18] This incentive arises in those cases in which firms expect never to repatriate their foreign earnings, or if they anticipate that future years will be more attractive for repatriation (either because domestic tax rates will be lower, or because future sources of foreign income will generate excess foreign tax credits that can be used to offset US tax liability on the dividends).[19] It appears that, in practice, US multinationals choose their dividend repatriations selectively, and generally pay dividends out of their more heavily taxed foreign earnings first.[20] Consequently, the average tax rate that firms face on their foreign income need not exactly equal the average foreign tax rate faced by their branches and subsidiaries abroad.

Branch earnings and dividends from subsidiaries represent only two forms of foreign income for US income tax purposes. Interest received from foreign sources also represents foreign income, though foreign interest receipts are often classified within their own "basket" and hence are not averaged with other income in calculating the foreign tax credit. Royalty income received from foreigners, including foreign affiliates of US firms, is also foreign source income. Foreign governments often impose moderate taxes on dividend, interest, and royalty payments from foreign affiliates to their American parent companies; these withholding taxes are fully creditable against a US taxpayer's US tax liability on foreign income.

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[18]The incentive to defer repatriation of lightly taxed subsidiary earnings is attenuated by the Subpart F provisions, introduced in US law in 1962, that treat a subsidiary's passive income, and income invested in US property, as if it were distributed to its American owners, thereby subjecting it to immediate US taxation. The Subpart F rules apply to controlled foreign corporations, which are foreign corporations owned at least 50% by US persons holding stakes of at least 10% each. Controlled foreign corporations that reinvest their foreign earnings in active businesses can continue to defer their US tax liability on those earnings. See Hines and Rice (forthcoming) and Scholes and Wolfson (1991) for the behavioral implications of these rules.

[19]It is interesting to note that the deferral of US tax liability does not itself create an incentive to delay paying dividends from foreign subsidiaries, since the US tax must be paid eventually. See Hartman (1985).

[20]See the evidence presented in Hines and Hubbard (1990).

Interaction of R&D and Foreign Income Rules

US firms with foreign income are generally not permitted to deduct all of their R&D expenditures in the United States against their domestic taxable incomes. Instead, the law provides for various methods of allocating R&D expenses between domestic and foreign income. The intention of the law is to retain the relatively generous treatment of R&D, but only for that part of a firm's R&D expenditures that is devoted to production for domestic markets. R&D-performing firms with foreign sales and foreign income are presumed to be doing at least some of their R&D to enhance their foreign profitability.

From the standpoint of taxpaying firms, the US tax law's distinction between domestic and foreign R&D deductions is potentially quite important. If an R&D expense is deemed to be domestic, then it is deductible against the taxpayer's US taxable income. Alternatively, if it is deemed to be foreign, then the R&D expense reduces foreign taxable income *for the purposes of US income taxation only*. Foreign governments do not use US methods of calculating R&D deductions, and generally do not permit US firms to reduce their taxable incomes in foreign countries on the basis of R&D undertaken in the United States. Consequently, an R&D expense deduction allocated against foreign income is valuable to a US firm only if the firm has deficit foreign tax credits. If the firm has deficit credits, then the firm pays some US tax on its foreign income, and any additional dollar of R&D deduction allocated against foreign income reduces the firm's US taxable income by a dollar.[21] Hence, firms with deficit foreign tax credits are indifferent between allocating R&D expenses against foreign income and allocating them against domestic income.[22] By contrast, firms with excess

[21]Curiously, the law is written so that the additional dollar of R&D deduction reduces taxable income without reducing the foreign tax credits available for foreign income taxes paid.

[22]This statement, along with much of the analysis described in the paper, abstracts from the ability of firms to carry excess foreign tax credits backward two years and forward five years. Firms that can exploit carryforwards or carrybacks may (depending on specific circumstances) face incentives that are intermediate between those of deficit credit and excess credit firms.

foreign tax credits pay no US tax on their foreign income, and therefore have no use for R&D deductions allocated against foreign income. Consequently, firms with excess foreign tax credits lose the value of any R&D deductions allocated against foreign income.

The tax law governing the allocation of R&D expenses was for years rather vague, but was codified by U.S. Treasury Regulation §1.861-8 in 1977. The 1977 rules provide for several stages in allocating R&D expenditures for tax purposes. R&D in the US that is undertaken to meet certain legal requirements (such as R&D devoted to meeting pollution standards) can be 100% allocated against domestic income. Firms that perform more than half of their [other than legally required] R&D in the United States are permitted to allocate 30% of that R&D against US income. The remaining 70% is then to be allocated between domestic and foreign sources on the basis of sales (including the sales of controlled foreign corporations). R&D is generally allocated according to activities within product lines (defined similarly to two-digit SIC codes), so that a corporation need not allocate part of its chemical R&D against foreign income simply because the electronics part of its business has foreign sales.

There are several options available to taxpayers who are unsatisfied with the outcome of the R&D allocation method just described. Firms are permitted to apportion more than 30% of their domestic R&D against US income if they can establish that it is reasonable to expect the R&D so apportioned to have very limited application outside of the country; the remaining portion of its R&D expenses are then allocated on the basis of sales. Alternatively, firms are permitted to allocate their R&D on the basis of total foreign and domestic income (though without the 30% initial allocation to US source), so that firms with foreign operations that generate sales but not income (relative to domestic operations) might prefer the income allocation method. There is, however, a limit to the income allocation method: firms are not permitted to reduce their R&D allocation to foreign source to less than 50% of the allocation that would have been produced by the sales method

(including the 30% initial apportionment).

The Economic Recovery Tax Act in 1981 changed these rules by permitting US firms to allocate 100% of their R&D performed in the United States against US income. This change was intended to be temporary (two years), in order to offer strong R&D incentives while affording Congress the opportunity to rethink its R&D policy. At the end of that time the US Department of the Treasury produced a study (1983) concluding that the tax change offered a small R&D incentive to US firms, and was desirable on that basis.[23] In 1984 and 1985 the Congress extended the temporary change permitting 100% deductibility of US R&D expenses against US income, so these rules remained in place until the end of the 1986 tax year.

The Tax Reform Act of 1986 removed the 100% deductibility of US R&D expenses, replacing it with a new, and again temporary, system of R&D expense allocation.[24] Under the 1986 Act, 50% of US R&D expense (other than R&D to meet regulations, which was 100% allocated to domestic source) was allocated to domestic source, with the remaining 50% allocated on the basis of sales or of income, at the taxpayer's choice. There was no limit imposed on the degree to which allocation on the basis of gross income could reduce foreign allocation relative to the sales method. These rules, it turned out, were in effect only for 1987.

The Technical and Miscellaneous Revenue Act of 1988 greatly complicates the

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[23]The Treasury study (1983) based its conclusions on a range of assumed elasticities of R&D with respect to price changes; there was no attempt made to ascertain how firms responded to the changes introduced in 1981. The Treasury study is a very careful analysis of firm-level tax return data and the significant issues involved in the §1.861-8 change. On the other hand, the Treasury study uses the average price reduction introduced by the 1981 tax law change, rather than the changes in marginal prices of R&D and other inputs, to estimate the effects of the law.

[24]The Tax Reform Act of 1986 also introduced a number of other changes relevant to R&D investment decisions, including reducing the statutory corporate tax rate from 46% (the tax rate from 1979-1986) to 40% in 1987 and 34% for 1988 and subsequent years. The 1986 Act also removed a number of investment incentives such as accelerated depreciation of capital assets and the investment tax credit for new equipment purchases.

analyst's task of understanding the incentives to undertake R&D in 1988. For the first four months of the year firms were permitted to allocate 64% of US R&D expense against US domestic income, with the remaining 36% allocated between foreign and domestic sources on the basis of either sales or income (at the taxpayer's choice). The 1988 Act further provides that if the 36% were allocated on the basis of income, then the R&D allocation against foreign income must equal at least 30% of the foreign allocation that would have been produced by the sales method. For the remaining eight months of the year, taxpayers were required to use the allocation method described in §1.861-8 as of 1977 (and described above).

The Omnibus Budget Reconciliation Act of 1989 again changed the R&D allocation rules, this time reintroducing the same rules that applied for the first four months of 1988. The Omnibus Budget Reconciliation Act of 1990 and the Tax Extension Act of 1991 extended this treatment of R&D expenses until a date that depends on a taxpayer's choice of fiscal year, but in no case later than 1 August 1992. Consequently, 64% of domestically-performed R&D in 1989-1992 could be allocated against domestic income, with the remaining 36% allocated either on the basis of sales or of income (though use of the income method could not reduce foreign source allocation to less than 30% of the foreign source allocation that would have been produced by the sales method).

The expiration of the R&D expense allocation legislation in the summer of 1992 motivated an extensive reconsideration of the issue of the appropriate tax treatment of R&D expenditures by multinational firms. In June 1992, the Treasury temporarily suspended its §1.861-8 allocation rules (the 1977 regulations), replacing them with an 18-month moratorium in which taxpayers could continue to use the system embodied in the legislation covering the years 1989-1992 (64% place-of-performance allocation, with the remaining deductions allocated on the basis of sales). The idea was that the Treasury would reexamine its §1.861-8 regulations during the 18-month period. The rationale for the moratorium was "to provide taxpayers with transition relief and to minimize

audit controversy and facilitate business planning during the conduct of the regulatory review."[25] Some contemporaneous observers noted that the extension of the R&D allocation rules through Treasury moratorium instead of Congressional legislation made the rules less costly from the standpoint of federal budget targets, since regulatory changes are exempt from the budget agreement limits. What role, if any, such considerations played in the decision to suspend the §1.861-8 rules is not clear. In any case, the Treasury moratorium did not run its full course, being supplanted in 1993 by new legislation.

President Clinton's budget proposal of February 1993 recommended a major change in the allocation of R&D expenditures and treatment of royalty receipts by US-based multinational corporations. The President proposed that US firms deduct 100% of their US R&D expenditures against US income, but that the same firms no longer be permitted to use foreign tax credits generated by their active foreign operations to reduce US tax liabilities on royalty income from foreign sources. Instead, firms would be required to allocate foreign-source royalty income to the "passive basket" in determining their foreign tax credit limits. The idea behind the change was to limit severely the ability of US firms to use excess foreign tax credits to wipe out their US tax liabilities on foreign-source royalty income. Very few firms have excess foreign tax credits in the "passive basket." Consequently, the overall effect of the proposal would have been to raise the deductions that firms with excess foreign tax credits receive for R&D performed in the US, but to include - as income fully taxed by the United States - the royalties they receive from foreign sources. Congress chose not to include this proposal in the legislation passed in August 1993.

Instead, the Omnibus Budget Reconciliation Act of 1993 (OBRA 93) continues the pattern of allowing US-based multinational firms to deduct only a fraction of their US R&D expenses against US income, and, at the same time, permits firms to use excess foreign tax credits to eliminate

[25]United States Congress, Joint Committee on Taxation (1993), p. 55.

US tax liabilities on foreign-source royalty income. OBRA 93 permits firms to allocate 50% of US-based R&D expenses to domestic source, with the remaining 50% allocated between domestic and foreign source based either on sales or on income, at the taxpayer's option (subject to the restriction that income-based allocation not reduce foreign source allocation to less than 30% of that produced by the sales method). The allocation rules under OBRA 93 are temporary, expiring one year after they take effect. As in earlier years, many observers attribute the temporary nature of the allocation rules to the mechanics of compliance with federal budget targets: if Congress were to pass permanent legislation covering the R&D allocation rules, then the "cost," to the current-year budget, of any treatment more generous than the 1977 regulations must include "costs" incurred in future years. By instead passing temporary legislation, Congress incurrs budgetary "costs" only for the current year. Of course, budgetary "costs" need not bear any relation to the economic consequences of permanent legislation covering the allocation of R&D expenses.[26]

The US R&D expense allocation rules are intricate, subtle, and subject to frequent changes. For the purposes of analyzing the effects of legislative changes, however, a clear pattern emerges. All US firms could deduct their R&D expenses against domestic income from 1981-1986. Starting in 1987, multinational firms with excess foreign tax credits are able to use only some of their R&D deductions, since part of their R&D deduction is allocated against foreign income (and thereby does not reduce their overall tax liabilities). For firms with deficit foreign tax credits, however, the period since 1987 is just as attractive as was 1981-1986, since, even though some of their R&D expenses are allocated against foreign income, this foreign allocation reduces their US tax liabilities by just as much as would an allocation against domestic income.

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[26]There are some with strong feelings that permanent legislation would create a more predictable environment for businesses and make the US a more attractive location for R&D. Turro (1993, p. 436) quotes one tax practitioner, who describes the Cogress's decision to make the OBRA 93 R&D allocation rules temporary an "absurd tax policy decision."

Incentives Created by the Tax Treatment of R&D

The tax treatment of R&D encourages firms to undertake R&D in the United States, at least relative to a system in which R&D is capitalized and depreciated according to the lifetimes that researchers usually find to be commensurate with the time periods over which it enhances firm productivity. In addition to encouraging firms to undertake R&D, the law introduces some - largely unintended - incentives to alter the behavior of firms with significant R&D expenditures.

Many of the incentives introduced by the old (pre-1989) R&E credit have been extensively analyzed elsewhere.[27] Since only some firms were eligible for the credit, and among the eligible firms many reduced their future credits by performing R&D in the current year, the R&E credit was not thought to have a significant impact on R&D spending levels. The R&E credit changes introduced in 1989 appear to offer firms stronger marginal incentives to undertake R&D, but (on average) had only a modest effect on the the after-tax cost of R&D.

The impact of the tax treatment of R&D-performing multinational firms has received comparatively less attention. Here the issue is complicated in part by the nature of the lines of business for which the R&D is undertaken.

The simplest case is one in which a US multinational firm performs R&D in the United States with the intention of using the research results in a US market. Ignoring the R&E credit for the moment, the firm obtains full deductions for its R&D expenditure only when it has deficit foreign tax credits. If the firm has excess foreign tax credits, then the allocation of a fraction of its R&D deductions against foreign-source income makes this allocated fraction effectively valueless. Consequently, the R&D allocation rules affect differently the incentives of two otherwise-identical firms that perform R&D in the US for use in the US, making the effective cost of R&D

[27]See, for example, Eisner, Albert, and Sullivan (1984), Altshuler (1988), Wozny (1989), and Hall (1993).

higher for a firm with excess foreign tax credits than for a firm with deficit foreign tax credits. The difference arises because the law treats all US-based R&D expenses as though they enhance worldwide sales, unless the taxpayer can demonstrate otherwise.

There is a second, and more subtle, effect of the R&D allocation rules, in which firms with excess foreign tax credits and large R&D expenditures (as fractions of their overall businesses) are encouraged by the tax system to increase their ordinary business activities in the US and reduce their foreign business activities. The reason is that greater US sales permit more of their US-based R&D deductions to be allocated against US taxable income, while greater foreign sales have the opposite effect. This consideration then influences R&D expenditure decisions, since R&D spending generates additional sales. US-based R&D that enhances US sales permits firms to increase the allocation of their inframarginal R&D deductions against US income, thereby ameliorating some of the disincentive effects of the allocation rules for domestic R&D by those firms that are particularly R&D-intensive.

If, instead, a firm undertakes R&D in the US intending to use it to enhance the sales of one of its foreign affiliates, then the tax system's incentives depend very much on whether the firm has excess foreign tax credits or deficit foreign tax credits. Foreign affiliates are required to pay royalties to their US parent firms based on the market value of any technology they use to enhance their sales offshore. A firm with deficit foreign tax credits takes full advantage of its R&D deductions, but the royalties it receives from using its technology abroad are subject to overall taxation at the US tax rate. A firm with excess foreign tax credits cannot make effective use of all of its R&D deductions, but the royalties that the firm receives are effectively exempt from US tax, since the excess foreign tax credits can be applied against the US tax liability generated by the royalties. As a consequence, firms with excess foreign tax credits face a very attractive tax environment when undertaking R&D in the US for use abroad: the R&D expense is partially deductible while the royalty

income is exempt from tax.[28]

This analysis presumes that foreign affiliates pay royalties to the US for the use of technology developed in the US, as American and most foreign laws require. It is not always in the interest of a firm to pay royalties equal to the market value of the technology transferred from a related party. For example, the attractiveness of foreign royalty income to US firms with excess foreign tax credits gives some firms incentives to maximize the payment of royalties from their own affiliates in high-tax foreign locations, in order to obtain tax deductions against taxable income in foreign countries. Kopits (1976) offers evidence that is consistent with behavior of this type. Tax authorities are aware of this problem, but it can be very difficult to establish market prices for technologies transferred to related foreign affiliates. In such an environment, firms often have the ability to report royalty charges that (within reasonable ranges) reduce their tax liabilities. There is, however, a limit to the degree to which royalty payments can deviate from reasonable amounts without generating activity from tax-enforcement agencies.

Some firms have incentives to adjust royalty payments for tax purposes, and some royalties are paid for the use of business know-how that may not be the product of R&D; nevertheless, in practice, R&D performance is highly correlated with royalty receipts. Data on the behavior of the foreign affiliates of US corporations in 1989, as reported by the Bureau of Economic Analysis of the US Department of Commerce (1992), indicate a close association between R&D activity and royalty receipts. Table 2 reports estimated coefficients from regressions in which the

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[28]Two additional considerations influence the attractiveness of R&D undertaken in the US for use abroad. The first is that certain foreign governments impose withholding taxes on royalty payments to US corporations; these withholding taxes are costly to American firms with excess foreign tax credits, since those firms are over the foreign tax credit limit and cannot use the additional foreign tax payments to reduce their US tax liabilities. Foreign withholding tax rates on royalties are typically quite low, however, on the order of 5%. The second consideration is that R&D that generates foreign sales affects the allocation of inframarginal R&D deductions between domestic and foreign income, raising the cost of that type of R&D when undertaken by firms for whom R&D deductions are large relative to sales.

dependent variable is the ratio of royalties received by US affiliates in foreign countries to local sales of US affiliates, each observation representing aggregate US activity in one of the 50 countries for which data are available. The estimated coefficients imply that R&D/sales has a significant effect on royalty receipts/sales, even controlling for local GDP/sales.[29] R&D/sales influences both total royalty receipts (reported in columns 1 and 2), and royalties received from unrelated parties only (reported in columns 3 and 4), the latter being arguably less subject to manipulation for tax purposes. BEA suppresses some of the royalty reports for confidentiality reasons; the results of regressions in which the suppressed observations are dropped (columns 1 and 3) are quite similar to those in which the suppressed observations are included as zero royalties (columns 2 and 4). Table 3 reports means and standard deviations for the variables used in the regressions.

US firms that perform R&D abroad are subject to the tax rules of their host foreign countries. Foreign country tax rules differ, but most industrialized countries permit something like immediate deduction of R&D expenses, and a few have credit schemes that are similar to the US R&E credit. American tax rules can also influence the cost of undertaking R&D abroad for use abroad, though the effect is subtle, since it comes primarily through its effect on the calculation of applicable foreign tax credits on dividends received from affiliates that do R&D.[30] If US firms perform their offshore R&D through foreign branches, or have explicit cost-sharing arrangements with their foreign subsidiaries (for the fraction of their R&D expected to generate US-source income), then they are able to allocate a fraction of their foreign R&D costs against US taxable income, subject to rules that are analogous to those that allocate US-based R&D expenses.

Table 4 offers illustrative calculations of the tax incentives embodied in pre-1986 and

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[29]The results reported in Table 2 were very similar when re-run without the GDP/sales variable on the right side.

[30]See Hines (1988) for an analysis of the importance of the US rules that determine foreign income used in the calculation of applicable foreign tax credits.

post-1986 US law. For the purposes of these calculations, the pre-1986 US tax rate is taken to be 46% and the post-1986 US tax rate is 34%, the firm is assumed to have an R&D/sales ratio of 5%, 35% of the firm's sales are assumed to be foreign, the foreign withholding tax rate on royalties is assumed to be 5%, and US law is assumed to provide a 64% place-of-performance allocation of R&D expenses, followed by sales allocation of the remaining 36%.[31] Firms are assumed to be ineligible for the US R&E credit, and ineligible for R&D-related credits provided by foreign governments; foreign governments are, however, assumed to permit immediate deduction of all R&D expenses. Foreign R&D is assumed to be conducted by wholly-owned subsidiaries. The table reports the before-tax productivities of marginal R&D expenditures under different tax regimes.[32]

Table 4 indicates that the after-tax cost of R&D rose for firms with excess foreign tax credits after 1986. The required marginal productivity of $1 of R&D performed in the US for use in the US rose from $1 to $1.06, while the required marginal productivity of $1 of R&D performed in the US for use abroad rose from $0.57 to $0.74. It is this second change that prompted concern over the possibility that R&D directed at foreign markets might move offshore. The change from $0.57 to $0.74 represents the outcome of two aspects of the tax law that changed in 1986: after 1986, firms were required to allocate some of their R&D deductions against foreign income, and in addition, the value of R&D tax deductions fell (relative to the effectively untaxed foreign-source royalty income of US firms with excess foreign tax credits) as the US corporate tax rate fell from 46% to 34%. Together, these features of the Tax Reform Act of 1986 reduced noticeably the attractiveness of R&D performed in the US for use abroad by firms with excess foreign tax credits.

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[31]Hines (1993) reports that a sample of 116 R&D-performing US multinationals had an average of 35.4% foreign sales in 1989. The same study calculates the weighted-average foreign withholding tax rate on royalties received in the US (using 1984 weights) to be 4.9%. See also Table 8, in which the average foreign withholding tax rate on royalties received by US manufacturing firms in 1986 is 5.7%.

[32]See Hines (1993) for a derivation of these required productivities of marginal R&D expenditures.

4. Evidence on the Effectiveness of Tax Policy in Influencing R&D.

There is a widely-held view that R&D tax incentives are important to maintaining the US competitive position in world markets. Implicit in this argument is the premise that the level of R&D activity responds significantly to tax incentives. Until recently, the academic literature did not provide strong support for the proposition that the real after-tax price of R&D significantly influences the level of business R&D activity.[33] The reason may have to do with the difficulty of finding exogenous price changes. Earlier researchers typically use time series variation in the real cost of R&D, making it impossible to exploit firm-specific variations, and raising a number of problems related to omitted variables and the endogeneity of the cost of R&D.

Three recent studies challenge the conventional wisdom that the elasticity of demand for R&D is small. Baily and Lawrence (1992) estimate time-series regressions of R&D expenditures, using industry-level data to examine the after-tax price variation introduced over time by the introduction of the R&E credit and changes in the R&D cost allocation rules. They find that tax policy significantly influences R&D spending, as a quick perusal of Table 1 might suggest: the R&D intensity of the US economy began rising at around the same time that the R&E credit and full domestic deductibility of R&D expenditures were introduced. Baily and Lawrence report that the elasticity of R&D spending with respect to its after-tax cost is approximately one. The difficulty that

[33]See, for example, Bernstein and Nadiri (1989), who estimate R & D price elasticities to lie between -0.4 and -0.5 for a sample of manufacturing firms, while Nadiri and Prucha (1989) find the R & D price elasticity to be much closer to zero for the U.S. Bell System. In a study of Canadian firms Bernstein (1985) reports estimated R & D price elasticities of between -0.1 and -0.4. Mansfield (1986), Hall (1993), and the GAO study (1989) summarize the earlier literature with the conclusion that the consensus range of price elasticities is -0.2 to -0.5. The price elasticity one expects may be a matter of judgement, but many observers find the -0.2 to -0.5 range to be unreasonably close to zero. Certainly firms *claim* to be influenced by after-tax prices; Brown (1984) reports that, in a Conference Board survey conducted in 1984, two-thirds of the executives surveyed anticipated that tax incentives would influence their R & D expenditures over the next 1-3 years.

this study encounters is that the regressions pick up the effects of tax changes and all other time-specific factors that influence R&D, attributing all of the effects to the tax changes. The advantage of the study is that it examines the aggregate effects of the credit.

Hall (1993) also finds a close to unit elastic responsiveness of R&D to the after-tax price of undertaking R&D, and does so using a methodology that differs significantly from that of Baily and Lawrence. She uses annual firm-level data on more than 700 of the largest US firms, covering the period 1980-1991, to see if firms in the most tax-advantaged positions perform more R&D (as reported by Compustat) than do other firms. The great advantage of her procedure is that annual events, such as the dramatic technological developments that characterized R&D-intensive fields in the 1980s, are subsumed for all firms in year-specific effects. Consequently, she examines only the firm-specific considerations that affect the real cost of R&D. The difficulty that this procedure encounters is that it is not always clear exactly why some firms find themselves in tax-advantaged positions and others do not. The statistical procedure she uses conditions the current variables that determine firms' tax positions on their own lagged values, so she is able to check whether, for example, a firm with low R&D expenditures in the past, and consequently a low "fixed-base percentage," responds more sharply to the 1989 tax law change than do other firms with average past R&D expenditures. The evidence indicates that they do.

Hines (1993) uses an alternative source of price variation to examine the effect of after-tax prices on the volume of R&D undertaken by US multinational corporations. This study compares the post-1986 growth of R&D expenditures by two groups of US-based multinationals: the first, a group with excess foreign tax credits, and the second, a group with deficit foreign tax credits. The change in the R&D cost allocation rules introduced by the Tax Reform Act of 1986 raises the post-1986 after-tax cost of R&D for firms with excess foreign tax credits and significant foreign income and sales. The data indicate that this group of firms exhibited slower growth of post-1986

R&D spending than did the deficit credit firms for whom the R&D allocation rule change should have had little effect.

Table 5 presents estimates of the responsiveness of R&D spending to its changing after-tax cost in the 1980s, as reported in Hines (1993). The coefficients in the first row of the table represent own-price [ln(PR)] demand elasticities; the estimates indicate that the own-price elasticity lies between -1.2 and -1.8, depending on specification.[34] This represents a considerable responsiveness of R&D spending to the tax changes of the 1980s. The firms used in the sample represent the 40 Compustat firms for which sufficient tax and R&D information was available, and was restricted to those with no significant merger activity over the 1984-1989 period. When the same regressions were re-run on an expanded sample including 76 additional firms with significant but not major merger activity, the estimated elasticities are half the size of the estimates obtained from the smaller sample. Of course, the advantage of using a small sample of nonmerging firms is that the R&D activities of these firms are not directly affected by merger-driven changes in firm sizes; the disadvantage is that smaller sample sizes are usually associated with less precise estimates.

5. Why Do American Firms Perform So Little R&D Abroad after 1986?

The responsiveness of R&D to its after-tax price raises the question of why American firms, whose R&E credit is now less generous than it was earlier in the 1980s, and many of whom are no longer able to obtain full tax deductions for their R&D expenses, do not choose to locate a

[34]Coefficients in the second line of Table 5 report the estimated elasticity of domestic R&D that enhances domestic sales with respect to the associated cost [ln(PI)] of changing the allocation of deductions for inframarginal R&D. Coefficients in the third line of Table 5 report the estimated elasticity of domestic R&D that enhances foreign sales with respect to its tax cost [ln(PR*)], and coefficients in the fourth line report the estimated elasticity of domestic R&D that enhances foreign sales with respect to the associated cost [ln(PI*)] of changing the allocation of deductions for inframarginal R&D. In addition, the regressions include firm-specific effects, year dummies, and foreign sales fractions as explanatory variables. The point estimates of all of the cost terms in Table 5 have the predicted signs.

greater fraction of their R&D activities in foreign countries. This section analyzes this question.

R&D Performed Abroad for Use in the US

There are two possible uses to which R&D performed abroad might be put. The first is to enhance sales abroad. The second is to provide valuable inputs to a firm's US operations, and, by so doing, to enhance sales in the US. The two uses are not necessarily separate, since a particular R&D project might serve both purposes, but the tax treatment of the two uses differs significantly.

Firms with excess foreign tax credits faced higher costs after 1986 of doing R&D in the US to promote sales in US markets. The effects of these higher costs were somewhat ameliorated for firms that could benefit from the changes in the R&E credit after 1989, but there remains the possibility that some firms might move their R&D directed at US markets to foreign locations.

There appears to be extremely little behavior of this type. American multinational firms virtually never use foreign locations to perform R&D for the American market. Table 6 reports various data items relevant to R&D performed for foreign markets, including the figures that, in 1982, US multinationals paid only $36 million in royalties to their foreign affiliates; these royalty payments in 1989 were $54 million. These represent very small sums, even when compared to expenditures on R&D performed abroad by the same affiliates. It is possible that some of the R&D performed abroad is intended to enhance sales in US markets, and, either because the R&D has not yet been fruitful, or for other reasons, royalties have not yet been paid, but the extremely small value of annual royalties indicate that the "headquarters effect" discussed by Hufbauer (1992) - that firms undertake their major R&D efforts in proximity to their headquarters - is quite strong, at least insofar as it pertains to R&D directed at the US market.

There is a powerful tax reason why US firms do very little R&D abroad when intending to exploit the R&D in the US market. Firms performing R&D abroad and using the

technology it generates in the US are required to pay a royalty from the US to the foreign affiliate. The royalty is taxable income in the foreign country. The royalty payment also generates a tax deduction for the US firm making the payment, but at the same time is treated as US "Subpart F" income (since special provisions apply to related-party royalty income) and is, therefore, taxed immediately in the US. Under American tax law, the source of the royalty income is the location in which the technology is used; in this case, the royalty income is US-source income. Since the royalty income has US source, foreign tax credits cannot be used to reduce the US tax liability generated by the royalty. The overall result of R&D performed by a foreign affiliate for use by a parent firm in the US is that the parent firm's tax deduction for its royalty payment is offset by the US-source income generated by the royalty. At the same time, the foreign affiliate pays foreign taxes on the royalty it receives. This transaction is extremely expensive from a tax standpoint, so it is not surprising that it seldom occurs.

Effects of the Tax Reform Act of 1986

The 1986 tax changes might also prompt US multinationals to move their R&D directed at foreign markets to closer proximity to foreign markets. Since US firms tend to perform their offshore R&D in the same locations in which they sell their goods, one outcome of the 1986 tax change could be to intensify this process. The regressions reported in Table 7 indicate that local sales represent powerful determinants of local R&D activity for US multinationals in 1989. The table reports estimated coefficients from regressions in which the dependent variable is R&D expenditures by US affiliates in foreign countries, each observation representing aggregate US activity in one of the 52 countries for which data are available. The regressions indicate that local sales have a significant effect on R&D expenditures, even controlling for local GDP. Estimates in columns 2 and 4 include interactions of local sales and GDP with country R&D intensity as reported by the National Science

Foundation (1991); the estimates again imply that local sales, now interacted with R&D intensity, strongly influence R&D activity. BEA suppresses some of the R&D data for confidentiality reasons; the results of regressions in which the suppressed observations are dropped (columns 1 and 2) are quite similar to those in which the suppressed observations are included as zero R&D (columns 3 and 4).[35]

In spite of the usefulness of R&D in locations in which firms have significant sales, US multinationals did not move their R&D offshore to a significant degree after 1986. Table 4 indicates one reason why they did not do so. While it is true that, for firms continually in excess credit status, the cost of US-based R&D directed at foreign markets rose after 1986, it is also true that, for firms with deficit foreign tax credits prior to 1986 and excess foreign tax credits after 1986, the after-tax cost of R&D performed in the US and directed at foreign markets fell significantly. For firms with deficit foreign tax credits prior to 1986 and excess foreign tax credits after 1986, the required marginal productivity of $1 of R&D directed at foreign markets fell from $1 before 1986 to $0.74 after 1986. One of the major effects of the reduction in the US statutory tax rate from 46% in 1986 to 34% by 1988 was greatly to increase the number of firms with excess foreign tax credits. These firms would have stronger incentives to keep their foreign-directed R&D in the US in 1988 than they did in 1986.

Unfortunately, it is not possible to assess directly the magnitude of the R&D expenditures of firms that moved from deficit foreign tax credit status to excess foreign tax credit status after the tax rate reduction in 1986, since such data are not available. It is, however, possible to use indirect evidence to estimate the importance of the R&D spending of firms that were in this

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[35]Table 3 reports means and standard deviations for the variables used in the regressions. The regressions ignore the endogeneity of local sales to local R&D activity, and should, therefore, be viewed only as suggestive. The results reported in Table 7 are consistent with those reported by Mansfield, Teece and Romeo (1979) in their study of the offshore R&D activities of a sample of 20 US firms in 1970 and 1974.

situation. In a US Department of the Treasury study, Goodspeed and Frisch (1989) estimate that US parent firms with excess foreign tax credits received 50% of the foreign-source income of US manufacturing firms in 1984, and projected that the 1986 tax changes would increase this figure to 78%.

Foreign-source income includes many items other than royalties, but it is reasonable to assume that firms with foreign-source royalty income from US R&D activities are typical of all US firms receiving foreign-source income. Table 8 offers some evidence on this point from US corporate tax returns for 1986. The table presents an industrial breakdown of total foreign-source income, foreign-source rents, royalties, and license fees, and foreign tax credits claimed in 1986. The average foreign tax rate for all industries, calculated as the ratio of total foreign tax credits to total foreign-source income, was 33.8% in 1986. The average foreign tax rate for manufacturing industries (other than petroleum, which has its own foreign tax credit "basket") was 33.6%. A weighted average of foreign tax rates that uses foreign-source rents, royalties, and license fees as weights is 33.2%, which closely approximates the other two averages. From this rough test it appears that the foreign tax credit positions of firms in industries that generate substantial foreign-source royalties are unlikely to differ significantly from firms in other industries.

Applying the figures from Table 4 and the estimates from Goodspeed and Frisch (1989) to R&D-performing firms,[36] it follows that the Tax Reform Act of 1986 was repsonsible for lowering the required marginal productivity of R&D performed in the US for use abroad by $0.26 (the difference between $1.00 and $0.74) for the 28% of all firms (the difference between 78% and

[36]The estimates reported in Goodspeed and Frisch (1989) could overstate the fraction of foreign-source income received by US firms with excess foreign tax credits after 1986, since several foreign countries reduced their own tax rates after passage of the Tax Reform Act in the US, and many American firms had new incentives to minimize their foreign tax liabilities. Data from US corporate tax returns for 1990, reported in Lyon and Silverstein (1993), suggest that the 78% figure reported by Goodspeed and Frisch may be somewhat too high, though additional information is needed in order to draw a firm conclusion.

50%) with deficit foreign tax credits before 1986 and excess foreign tax credits afterward. At the same time, the required marginal productivity of R&D performed in the US for use abroad rose by $0.17 (the difference between $0.74 and $0.57) for the 50% of all firms with excess foreign tax credits both before and after 1986. Taking a simple weighted average of these changes yields an aggregate effect of [$0.17(50%) - $0.26(28%)] = $0.0122.

The aggregate effect of the tax change is equivalent to raising the required marginal productivity of R&D performed in the US for use abroad by 1%. This aggregate figure masks a considerable amount of heterogeneity between firms in the degree to which the 1986 tax change affects their incentives to do R&D in the United States; nevertheless, it should not be surprising that, under these circumstances, the fraction of American-controlled R&D performed in foreign markets did not increase greatly after 1986. R&D performed in the US for use abroad is the category of R&D expenditure that is most likely to move offshore in response to changing tax incentives. The 1986 tax change did not influence the cost of performing R&D abroad for use abroad, and only mildly (6%) increased the required marginal productivity of R&D performed in the US for use in the US by firms with excess foreign tax credits. Since the United States continues to tax heavily R&D performed abroad by American-owned affiliates for use in the US market, the 6% rise in the effective cost of R&D performed in the US for use in the US is unlikely to generate a substantial outflow of R&D to foreign countries. Instead, the tax change is likely to reduce mildly the US R&D expenditures of the 78% of all firms that are affected.

Forms of Technology Exports

The attractive tax treatment of foreign-source royalty income received by US firms with excess foreign tax credits is, in part, responsible for the forms in which American firms typically export their technologies to foreign countries. Table 9 compares annual foreign-source royalties

received by Americans to total R&D performed outside the US by American companies over the years 1985-1991. Royalties reported in this table are restricted to categories of foreign-source receipts that are most likely to be related to R&D activities in the United States.[37] Table 9 reveals that, in every year since 1985, American firms export more of their technology by licensing it abroad than they do by performing R&D in foreign countries. By 1991, R&D spending by American firms outside the US ($8.7 billion) was less than half of Americans' foreign-source technology-related royalty receipts ($17.8 billion).

US operations in individual foreign countries reflect the tax treatment of R&D performed in the US for use abroad. Table 10 presents a country-level breakdown of the R&D activity of majority-owned US affiliates in foreign countries in 1989. All 22 countries in which US affiliates spend $10 million or more on R&D are included in Table 10; countries are ranked in order of the R&D-intensity (measured as the ratio of R&D expenditures to ownership of property, plant, and equipment) of local US operations. The table reports royalty payments by US affiliates to their parent US firms; as the last column of Table 10 indicates, local R&D expenditures are smaller than *these* royalty payments in all but five countries.[38]

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[37]Royalties reported in Table 9 include receipts from all foreign sources "for the use or sale of intangible property rights, including patents, industrial processes, trademarks, copyrights, franchises, designs, know-how, formulas, techniques, and manufacturing rights." This category of technology-related gross royalty receipts is reported by the U.S. Department of Commerce for years starting in 1985. A comparison of royalty receipts for 1986 in the second line of Table 9 with 1986 royalty receipts in the first line of Table 8 indicates the restrictiveness of the technology-related category of royalty receipts: Table 9 reports royalty receipts of $6.9 billion for 1986, while Table 8 reports royalties of $11.9 billion.

[38]The five countries are Germany, the United Kingdom, Brazil, Belgium, and Israel. A comparison of the ranks in column 2 and column 8 shows that R&D-intensive foreign operations are also often royalty-intensive, which suggests that US and foreign R&D might be complementary at country levels of aggregation. The existence of this kind of complementarity at the firm level would challenge the traditional view of the effect of higher R&D costs at home on the movement of R&D offshore.

Revenue Cost of Foreign-Source Royalty Treatment

One final indicator of the importance of the tax treatment afforded foreign-source royalties is the tax revenue that the US government would collect, absent any behavioral responses, if royalties received from foreign payors were treated as US-source income. Table 11 presents this calculation. The first column of Table 11 reports Americans' foreign-source technology-related royalty receipts for 1985-1991. The second column reports the additional tax revenue these royalties would generate if they had US source for tax purposes, assuming that taxpayers receiving the royalties are subject to prevailing US statutory corporate tax rates and that the figures from Goodspeed and Frisch (1989) accurately represent the foreign tax credit status of royalty recipients.[39]

The estimates reported in Table 11 indicate that the revenue cost of the US tax system's treatment of foreign-source royalty income changed dramatically between 1985 and 1991: the cost rose from $1.3 billion in 1985 to $4.7 billion in 1991. This change reflects the growing volume of foreign-source royalty receipts over the 1985-1991 period, and the increased fraction of US firms with excess foreign tax credits after 1986, which much more than outweigh the impact of lower US corporate tax rates after 1986. One way to gauge the size of this revenue cost is to compare it to the total revenue cost of the R&E credit, as reported by Hall (1993) and presented in column 3 of Table 11. By 1991, the cost of the R&E credit was $900 million, or less than one-fifth of the cost of allowing firms to use excess foreign tax credits to reduce their US tax liabilities on foreign-source royalty income. Of course, the intent of the R&E credit is to encourage marginal R&D projects without subsidizing inframarginal R&D, while the treatment of foreign-source royalties draws no such distinction, and may treat favorably royalties generated by activities other than R&D. Nevertheless,

[39]The estimates in column two of Table 11 are obtained by applying the average fraction of foreign-source income accruing to manufacturing firms with excess foreign tax credits (50% in 1985 and 1986; 64% [the mean of 50% and 78%] in 1987; 78% in 1988-1991) to foreign-source royalties, and multiplying by the statutory US corporate tax rate (46% in 1985 and 1986; 40% in 1987; 34% in 1988-1991).

the difference between $4.7 billion and $900 million reflects the importance of foreign-source royalty treatment to American firms undertaking R&D in the United States.

6. Conclusion.

The responsiveness of R&D activity to its tax treatment carries many implications for the design of tax policy toward R&D, particularly insofar as multinational firms are concerned. American multinationals adjust their R&D spending levels sharply in response to tax changes, but in spite of the frequent changes in US tax law in the 1980s, American firms moved very little of their R&D out of the US and into foreign centers. Part of the explanation for the continued importance of the United States as a home to R&D lies in the favorable tax treatment of foreign-source royalty income received by US firms with excess foreign tax credits.

US tax law encourages firms with excess foreign tax credits to perform R&D in the United States and license the resulting technology abroad. From a national standpoint, this policy has the effect of maintaining R&D at home, where it may generate valuable economic spillovers, and does so for that segment of R&D activity that is otherwise most likely to be performed in foreign locations that are close to users of the technology it produces. Interestingly, US tax law has this effect on only those firms with excess foreign tax credits; firms with deficit foreign tax credits do not receive the same advantageous tax treatment of their foreign-source royalty receipts. It is this distinction that is responsible for the heterogeneous incentives created by the Tax Reform Act of 1986, and the failure of the 1986 Act to change dramatically the fraction of R&D performed abroad by American firms.

The US government's practice, in the 1980s and 1990s, of enacting only temporary rules governing the tax treatment of R&D activity reflects both the effect of self-imposed budgetary rules and a lack of consensus over the appropriate treatment of R&D. Part of the reason that a

consensus has not emerged may have to do with the complexity, and relative obscurity, of some of the tax provisions that affect the incentives multinational firms have to do R&D in the US and abroad. In spite of their obscurity, these provisions have important consequences, as indicated by the far greater revenue impact of the tax treatment of foreign-source royalty income than the revenue cost of the R&E tax credit. It is worth bearing in mind the incentives currently provided by US tax law when evaluating proposed alternative tax treatments of R&D.

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Figure 1

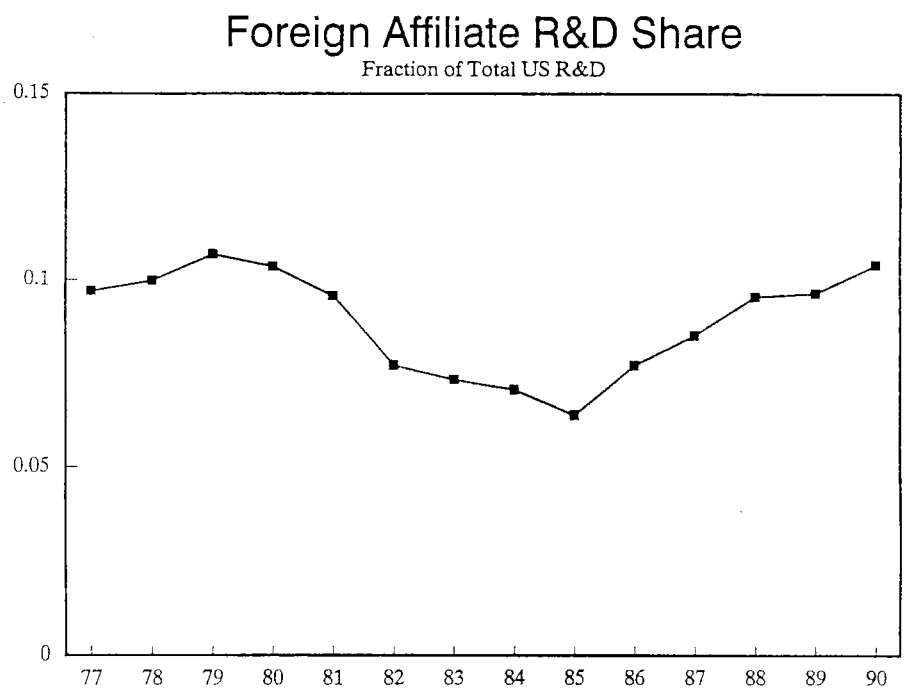
Foreign Affiliate R&D Share
Fraction of Total US R&D
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Figure 2

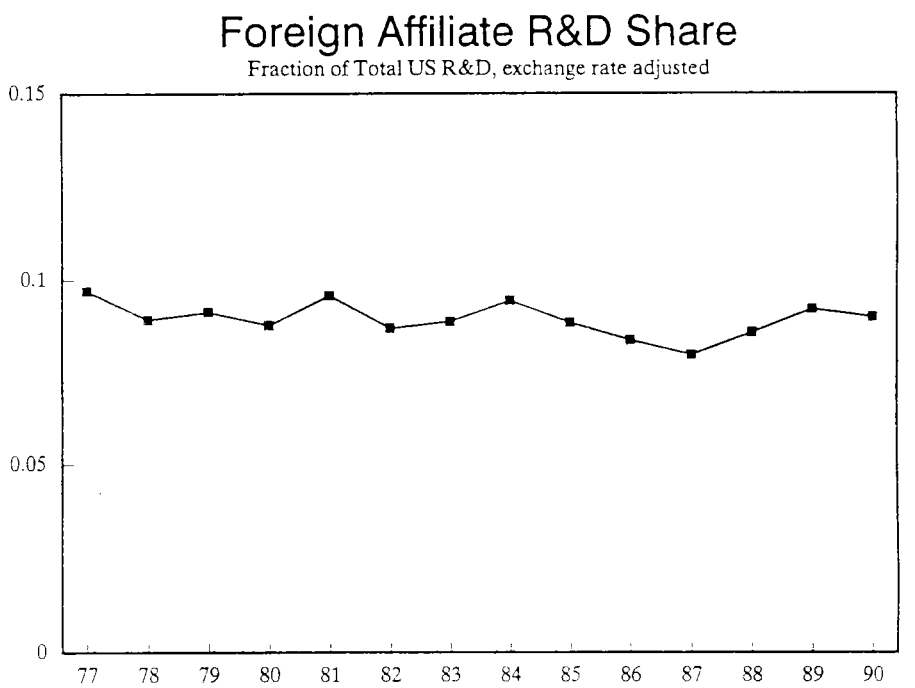
Foreign Affiliate R&D Share
Fraction of Total US R&D, exchange rate adjusted
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Figure 3

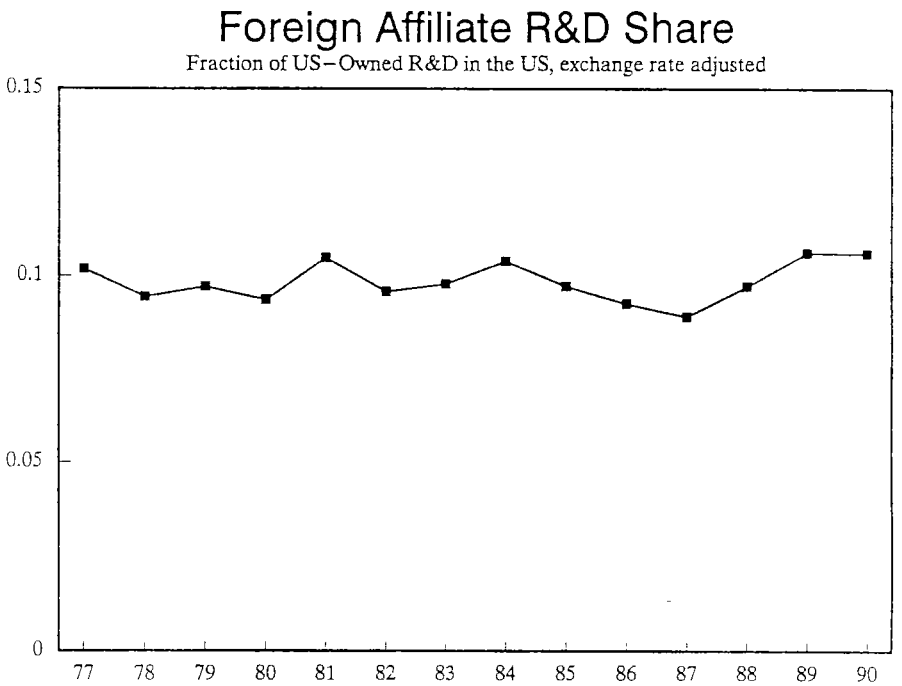
Foreign Affiliate R&D Share
Fraction of US−Owned R&D in the US, exchange rate adjusted
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Table 1

R&D Expenditure as a Percentage of GNP, 1961-1989

	France	West Germany	Japan	United Kingdom	United States
1961	1.4	-	1.4	2.5	2.7
1962	1.5	1.2	1.5	-	2.7
1963	1.6	1.4	1.5	-	2.8
1964	1.8	1.6	1.5	2.3	2.9
1965	2.0	1.7	1.6	-	2.8
1966	2.1	1.8	1.5	2.3	2.8
1967	2.2	2.0	1.6	2.3	2.8
1968	2.1	2.0	1.7	2.2	2.8
1969	2.0	1.8	1.7	2.3	2.7
1970	1.9	2.1	1.9	-	2.6
1971	1.9	2.2	1.9	-	2.4
1972	1.9	2.2	1.9	2.1	2.4
1973	1.8	2.1	2.0	-	2.3
1974	1.8	2.1	2.0	-	2.2
1975	1.8	2.2	2.0	2.1	2.2
1976	1.8	2.1	2.0	-	2.2
1977	1.8	2.1	2.0	-	2.2
1978	1.8	2.2	2.0	2.2	2.1
1979	1.8	2.4	2.1	-	2.2
1980	1.8	2.4	2.2	-	2.3
1981	2.0	2.5	2.3	2.4	2.4
1982	2.1	2.6	2.4	-	2.5
1983	2.1	2.6	2.6	2.2	2.6
1984	2.2	2.6	2.6	-	2.7
1985	2.3	2.8	2.8	2.3	2.8
1986	2.3	2.8	2.8	2.4	2.8
1987	2.3	2.9	2.8	2.3	2.8
1988	2.3	2.9	2.9	2.2	2.7
1989	2.3	2.9	3.0	2.0	2.7

Note: French data are based on Gross Domestic Product (GDP); consequently, percentages may be slightly overstated compared to GNP. Omissions (-) indicate that R & D data are unavailable.

Source: National Science Board (1991).

Table 2

Royalty Receipts and R&D Intensity, Foreign Affiliates of US Corporations, 1989

Dependent Variable: Royalty Receipts/Sales				
	Total Royalties		Royalties from Unrelated Parties	
Constant	-0.0002 (.0004)	-0.0009 (0.0005)	-0.0006 (0.0003)	-0.0010 (0.0004)
R&D/Sales	0.2201 (0.0492)	0.1959 (0.0532)	0.1258 (0.0329)	0.1328 (0.0418)
GDP/Sales	-0.0616 (0.0265)	-0.0404 (0.0269)	-0.0265 (0.0204)	-0.0339 (0.0233)
Suppressed Obs. Included	No	Yes	No	Yes
$\hat{\sigma}$	0.0012 (0.0002)	0.0015 (0.0003)	0.0007 (0.0002)	0.0009 (0.0003)
log L	74.129	63.660	39.553	35.164
n	42	50	40	50

Note: The columns report coefficients from Tobit regressions in which the dependent variable is the ratio of affiliate royalty receipts to total affiliate sales (in 1989). R&D represents local R&D performed by US-owned affiliates. Observations are country-level aggregates of the behavior of all US-owned affiliates. GDP/Sales is the ratio of host-country GDP to sales by US affiliates located in the host country. The equations reported in columns 1 and 3 were run on only those observations for which BEA does not suppress R&D figures; colums 2 and 4 report regressions in which all observations are included (and suppressed R&D amounts are treated as zeros). Standard errors are in parentheses.

Table 3

Variable Means and Standard Deviations

Variable	Mean	Standard Deviation	No. Obs.
Royalties/Sales	0.00047	0.00086	42
Unrelated Royalties/Sales	0.00015	0.00042	40
R&D/Sales	0.00358	0.00550	50
GDP/Sales (divided by 10^3)	0.05820	0.21455	50
Local R&D ($ millions)	155.78	388.79	50
GDP ($ billions)	229.07	463.62	50
Sales ($ millions)	19,194.8	37,671.6	50
(R&D intensity)	0.01102	0.00927	42
GDP*(R&D intensity) ($ billions)	5.3780	13.934	42
Sales*(R&D intensity) ($ millions)	413.876	849.235	42

Note: Variables represent local activities of US-owned affiliates and characteristics of their host (foreign) countries in 1989. Data on the activities of US-owned affiliates are reported in US Department of Commerce, Bureau of Economic Analysis (1992). All variables are measured in $ millions, except GDP, which is measured in $ billions. Royalties/Sales represents the ratio of royalty receipts of US-owned affiliates to local sales of US affiliates. Unrelated royalties are royalty receipts from unrelated parties. R&D is local R&D by US-owned affiliates. The variable (R&D intensity) represents country R&D/GDP ratios reported by the National Science Foundation (1991). Observations are country-level aggregates of the behavior of all US-owned affiliates.

Table 4

Required Marginal Productivity of $1 of R&D by US Multinationals

		Firms with Deficit Foreign Tax Credits		Firms with Excess Foreign Tax Credits	
		pre-1986	post-1986	pre-1986	post-1986
1.	R&D in the US for use within the US	1.00	1.00	1.00	1.06
2.	R&D in the US for use outside the US	1.00	1.00	0.57	0.74
3.	R&D in foreign countries for use in foreign countries	1.00	1.00	1.00	1.00

Note: These calculations illustrate the tax-induced changes in the required marginal productivity of R&D that arise as consequences of US tax law. The figures analyze the incentives facing firms whose US R&D is 5% of total sales, and for whom 35% of total sales arise in foreign markets. The foreign withholding tax rate on royalty income is assumed to be 5%, the pre-1986 US corporate tax rate is assumed to be 46% and the post-1986 US tax rate to be 34%, and US tax law is assumed to provide a 64% place-of-performance allocation of R&D deductions. Firms are assumed to be ineligible for the US R&E credit, and ineligible for R&D-related credits provided by foreign governments; foreign governments are, however, assumed to permit immediate deduction of all R&D expenses. For the purposes of these calculations, the foreign tax credit status of a US multinational is assumed to be permanent, and the firm repatriates its foreign earnings immediately.

Table 5

R&D Price Responsiveness, US Multinational Firms, 1984-1989

	Dependent Variable: ln (R&D stock)		Dependent Variable: ln (R&D flow)	
	OLS	IV	OLS	IV
ln(PR)	-1.2947	-1.2670	-1.6874	-1.7954
	(0.3982)	(0.4167)	(0.5595)	(0.5845)
ln(PI)	-22.3221	-12.8442	-63.2821	-59.0972
	(11.4838)	(12.3754)	(16.1359)	(17.3570)
ln(PR*)	-0.2881	-0.3166	-0.4250	-0.4605
	(0.1501)	(0.1511)	(0.2110)	(0.2119)
ln(PI*)	-10.1741	-6.5294	-37.1077	-35.5633
	(6.8583)	(7.0852)	(9.6367)	(9.9373)
Y85(S*/S)	-0.0666	-0.0665	-0.0452	-0.0503
	(0.1215)	(0.1218)	(0.1707)	(0.1709)
Y86(S*/S)	-0.0732	-0.0705	0.0452	0.0473
	(0.1211)	(0.1214)	(0.1701)	(0.1703)
Y87(S*/S)	-0.0641	-0.0373	0.2410	0.2601
	(0.1313)	(0.1322)	(0.1845)	(0.1854)
Y88(S*/S)	-0.0591	-0.0249	0.3367	0.3608
	(0.1334)	(0.1346)	(0.1874)	(0.1887)
Y89(S*/S)	-0.0192	-0.0025	0.4644	0.4770
	(0.1259)	(0.1264)	(0.1769)	(0.1773)
firm dummies	yes	yes	yes	yes
year dummies	yes	yes	yes	yes
# firms	40	40	40	40
$\hat{\sigma}$	0.1359	0.1362	0.1909	0.1911

Note: Values in parentheses are standard errors. PR and PI are the two domestic tax prices relevant to R&D, while PR* and PI* are their foreign counterparts [and are premultiplied by (S*/S)]. PR reflects the effect of the allocation of R&D tax deductions on the required marginal product of R&D. PI is the effect of R&D tax rules on demand for R&D that arises from the desire on the part of (some) firms to expand their domestic output and thereby allocate greater R&D deductions against domestic income. PR* reflects the effect of the R&D deduction allocation *and* the treatment of foreign-source royalties on the desired level of US-based R&D spending designed to enhance sales in foreign markets. PI* reflects the part of the effect of tax rules on US-based R&D designed to enhance sales in foreign markets that arises from the desire on the part of (some) firms to reduce their foreign output.

Source: Calculations reported in Hines (1993).

Table 6

R&D and Royalty Activity of Foreign Affiliates of US Multinationals

Year	1982	1989
R&D expenditures, total	$ 3,851	$ 7,922
R&D by affiliate for itself	3,073	6,307
R&D by affiliate for others	778	1,615
Royalty receipts, total	435	1,461
Receipts from US parents	36	54
Receipts from other foreign affiliates	193	656
Receipts from unaffiliated Americans	26	97
Receipts from unaffiliated foreigners	180	654
Royalty payments, total	4,308	12,472
Payments to US parents	3,663	9,839
Payments to other foreign affiliates	354	1,488
Payments to unaffiliated Americans	102	660
Payments to unaffiliated foreigners	189	485

Note: Dollar amounts are millions of current dollars. Data cover majority-owned foreign affiliates of US multinational firms.

Source: US Department of Commerce, Bureau of Economic Analysis (1985, 1992).

Table 7

R&D and Local Sales, Foreign Affiliates of US Corporations, 1989

Dependent Variable: Local R&D ($ millions) Performed by US-Owned Affiliates

	Suppressed Observations Excluded		Suppressed Observations Included	
GDP (billions)	0.2302 (.0617)	-0.0783 (0.1890)	0.2283 (0.0620)	-0.0947 (0.1890)
Sales (millions)	0.0072 (0.0008)	0.0000 (0.0016)	0.0072 (0.0008)	0.0001 (0.0016)
GDP* (R&D intensity)		6.1607 (7.0382)		6.7207 (7.0462)
Sales* (R&D intensity)		0.4388 (0.0787)		0.4369 (0.0790)
$\hat{\sigma}$	167.252 (19.587)	103.425 (12.545)	168.195 (19.738)	103.774 (12.605)
log L	251.471	210.825	253.222	211.714
n	50	41	52	42

Note: The columns report coefficients from Tobit regressions in which the dependent variable is local R&D performed by US-owned affiliates. The interaction variable (R&D intensity) represents country R&D/GDP ratios reported by the National Science Foundation (1991). Observations are country-level aggregates of the behavior of all US-owned affiliates. The equations reported in colunms 1 and 2 are run on only those observations for which BEA does not suppress R&D figures (and for which GDP and R&D intensity data are available); colums 3 and 4 report regressions in which all observations are included (and suppressed R&D amounts are treated as zeros). Standard errors are in parentheses.

Table 8

Royalty Receipts and Foreign Tax Credit Status, by Industry, 1986

Industry	Foreign-source Rent, Royalty, License Fees	Foreign Tax on Royalties	Total Foreign Income	Foreign Tax Credits	FTC ÷ Income
All industries	$11,901	$809	$65,809	$22,261	33.8%
Agriculture	28	2	89	13	14.6
Mining	631	204	1,475	619	42.0
Construction	21	2	204	82	40.2
Manufacturing	9,158	518	48,809	18,094	37.1
Food	367	22	2,030	763	37.6
Tobacco	219	14	643	269	41.8
Textiles	20	1	90	29	32.2
Apparel	37	3	47	7	14.9
Lumber	1	1	107	42	39.3
Furniture	7	1	41	9	22.0
Paper	233	15	768	276	35.9
Printing	116	6	401	130	32.4
Chemicals	1,406	90	7,744	3,071	39.7
Petroleum	162	10	16,000	7,071	44.2
Rubber	81	9	539	136	25.2
Leather	9	1	60	21	35.0
Glass prod.	113	10	621	230	37.0
Primary metal	165	11	426	119	27.9
Fabricated metal	113	7	784	303	38.6
Nonelec. mach.	4,930	231	9,597	3,092	32.2
Electrical equip.	700	58	5,459	1,498	27.4
Motor vechicles	182	8	2,169	591	27.2
Transport. equip.	40	3	547	211	38.6
Instruments	208	13	608	181	29.8
Miscellaneous	49	2	128	44	34.4
Transportation	139	12	1,702	232	13.6
Wholesale Trade	458	16	1,856	642	34.6
F.I.R.E.	271	8	10,620	2,262	21.3
Services	1,196	48	1,043	317	30.4

Note: Coverage includes all US corporations with total assets of $250 million or more that file Form 1118 for 1986.

Source: Redmiles (1990).

Table 9

Form of US Technology Exports, 1985-1991

Year	US Royalty Receipts	R&D performed outside the US	Difference
1985	$ 5,823	$ 3,650	$ 2,173
1986	6,862	4,642	2,238
1987	9,039	5,226	3,819
1988	10,735	6,295	4,440
1989	11,815	6,814	5,001
1990	15,291	7,727	7,564
1991	17,799	8,690	9,109

Note: Dollar amounts are millions of current dollars. Royalties include receipts from all foreign sources "for the use or sale of intangible property rights, including patents, industrial processes, trademarks, copyrights, franchises, designs, know-how, formulas, techniques, and manufacturing rights." R&D performed outside the US represents R&D activities of majority-owned foreign affiliates of US multinational corporations.

Source: National Science Foundation (1993) and Survey of Current Business, various issues.

Table 10

R&D and Royalty Intensity of U.S. Affiliates in Foreign Countries, 1989

Country	(Rank)	R&D (millions)	PPE	R&D / PPE	Royalties (millions)	Royalties / PPE	(Rank)	R&D-Royalty
Japan	(1)	$1,000	$12.79 b	7.8%	$1,435	11.2%	(1)	$-435
Ireland	(2)	156	3.10	5.0	216	7.0	(5)	-60
Israel	(3)	29	0.59	4.9	3	0.5	(19)	26
Germany	(4)	1,726	46.26	3.7	1,166	2.5	(14)	660
Italy	(5)	393	10.88	3.6	652	6.0	(5)	-259
Belgium	(6)	313	9.58	3.3	267	2.8	(12)	46
France	(7)	521	20.83	2.5	993	4.8	(6)	-472
UK	(8)	1,717	75.09	2.3	1,487	2.0	(15)	230
Netherlands	(9)	367	16.18	2.3	635	3.9	(9)	-268
Sweden	(10)	31	1.41	2.2	133	9.5	(2)	-102
Switzerland	(11)	58	3.52	1.7	259	7.4	(3)	-201
Taiwan	(12)	24	1.67	1.4	66	4.0	(8)	-42
Australia	(13)	190	17.58	1.1	341	1.9	(16)	-151
Canada	(14)	975	97.81	1.0	1,011	1.0	(18)	-36
Austria	(15)	16	1.95	0.8	71	3.6	(10)	-55
Spain	(16)	58	7.96	0.7	249	3.1	(11)	-191
Singapore	(17)	23	3.64	0.6	158	4.3	(7)	-135
Brazil	(18)	92	16.80	0.5	1	0.0	(22)	91
Mexico	(19)	38	6.95	0.5	113	1.6	(17)	-75
Argentina	(20)	10	3.56	0.3	10	0.2	(21)	0
Hong Kong	(21)	11	4.27	0.3	108	2.5	(13)	-97
Norway	(22)	18	11.31	0.2	55	0.5	(20)	-37

Note: R&D denotes total R&D expenditures of all US majority-owned foreign affiliates in each country in 1989. PPE denotes book values of property, plant, and equipment owned by US majority-owned foreign affiliates. Royalties represent royalty payments by US majority-owned foreign affiliates to their US parent companies. Countries are ranked (in the second column) in order of their R&D/PPE intensities; they are ranked (in the eighth column) in order of their royalty/PPE intensities. The table includes all countries with US R&D expenditures of $10 million or more.

Source: Calculations based on data reported in US Department of Commerce, Bureau of Economic Analysis (1992).

Table 11

Foregone Tax Revenue from Sourcing of Royalties vs. R&E Credit, 1985-1991

Year	US Royalty Receipts (Foreign Sources)	Additional Tax Revenue, from Domestic Sourcing	Estimated Revenue Cost of R&E Credit
1985	$ 5,823	$ 1,339	$ 1,793
1986	6,862	1,578	1,208
1987	9,039	2,314	1,183
1988	10,735	2,847	1,429
1989	11,815	3,133	1,272
1990	15,291	4,055	857
1991	17,799	4,720	922

Note: Dollar amounts are millions of current dollars. Royalties include receipts from all foreign sources "for the use or sale of intangible property rights, including patents, industrial processes, trademarks, copyrights, franchises, designs, know-how, formulas, techniques, and manufacturing rights." Additional tax revenue is calculated by applying the average fraction of foreign-source income accruing to manufacturing firms with excess foreign tax credits (50% in 1985 and 1986; 64% in 1987; 78% in 1988-1991) to foreign-source royalties, and multiplying by the statutory US corporate tax rate. See Hall (1993) for estimates of the revenue cost of the R&E credit.