Re-examining the Cost-Effectiveness of the Research and Experimentation Tax Credit

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June 1995

ESA/OPD 95-1

ABSTRACT

This paper evaluates several well-known empirical studies of the cost-effectiveness of the research and experimentation (R&E) tax credit. Studies of the credit's effect during 1981-85 generally find weak evidence of cost-effectiveness. However, more recent studies focusing on a longer period conclude that the tax credit has induced an increase in R&E spending by an amount that is significantly greater than the foregone tax revenue. The independent analyses in the latter studies appear empirically well founded and their results are robust. Their individual conclusions that the R&E tax credit was cost-effective during the 1980s converge toward the same value—roughly $2.00 of induced R&E spending per dollar of revenue loss.

I. INTRODUCTION

Research indicates that the social rate of return to R&D far exceeds the private rate of return (Mansfield, *et. al.*, 1977; Griliches, 1980; Bernstein and Nadiri, 1988; Griliches, 1991). However, the level of R&D investment by individual firms depends on each firm's estimate of its own expected return. Left to themselves, therefore, individual firms are likely to invest less than is desirable from society's perspective. The research and experimentation (R&E) tax credit is intended to induce private industry to increase R&D spending toward the socially optimal level.

The R&E credit allows firms to reduce their tax liabilities through R&E investments. The credit amount equals the statutory marginal credit rate times incremental R&E spending (i.e., current year qualified R&E expenditures less a base amount). [1] The law defines R&E as the subset of R&D expenditures devoted to the discovery of new scientific knowledge that need have no immediate commercial application. R&E expenditures generally cover basic and applied research of a technological nature, but not product development.[2] Qualified R&E excludes work done outside the United States, research in the humanities or social sciences,

[1] These terms are more precisely defined in the appendices. Appendix A outlines the history of the R&E tax credit. Appendix B shows that beginning in 1989 the tax saving a firm can receive is less than the credit amount.

[2]The distinction blurs, however, in specific instances. There are product development costs in software and pharmaceuticals, for example, that could qualify for the R&E tax credit.

and research funded by another person or government agency. First enacted in 1981, and extended six times since then—with the last extension expiring June 30, 1995.

This paper evaluates several well-known empirical studies of the cost-effectiveness of the R&E credit. Section II estimates the tax saving effects of the credit's successive formulations from 1981 to the present. Section III outlines a general framework for determining cost-effectiveness and evaluates the major empirical studies. Section IV offers concluding observations.

II. TAX SAVING INCENTIVE EFFECTS OF THE AMENDMENTS

Amendments to the R&E credit since 1981 have narrowed the definition of qualified expenditures, changed the formula for computing the base amount, reduced the credit rate, and increased the portion of the credit amount to be deducted from allowable expenses. The net effect of these changes has been to reduce the statutory maximum tax saving a firm can receive per dollar of incremental R&E spending from $0.25 in 1982-85 to $0.13 in 1991 (Table 1, column 5).

Table 1: Maximum Tax Saving Per Dollar of Incremental R&E Spending, 1981-91

Year	Statutory Credit Rate	Corporate Tax Rate	Portion of Credit Amount to be Deducted From Allowable Expenses	Statutory Maximum Tax Saving Per Dollar of Incremental R&E Spending
(1)	(2)	(3)	(4)	(5)
1981	0.25	0.48	0.00	0.25
1982	0.25	0.46	0.00	0.25
1983	0.25	0.46	0.00	0.25
1984	0.25	0.46	0.00	0.25
1985	0.25	0.46	0.00	0.25
1986	0.20	0.34	0.00	0.20
1987	0.20	0.34	0.00	0.20
1988	0.20	0.34	0.00	0.20
1989	0.20	0.34	0.50	0.17
1990	0.20	0.34	1.00	0.13
1991	0.20	0.34	1.00	0.13

Sources: U.S. Tax Code and Appendix B.

Notes: The 1991 values are still in effect. Appendix B shows that the statutory maximum tax saving per dollar of *total* R&E expenditures in each year varies—depending on the ratio of the base amount to total R&E—but is at most one-half of the tax saving per dollar of *incremental* R&E spending in column (5).

The R&E credit can only be used to offset tax liabilities. A firm with no tax liabilities in a current year may claim the credit against tax liabilities incurred over the previous 3 years—the carry back period—or over the next 15 years—the carry forward period. The credit is also limited by a cap on the tax liabilities that can be offset.[3] In 1982-85, the tax saving per dollar of *incremental* R&E spending received by firms, on average, ranged from $0.13 to $0.20 (Table 2, column 6). This saving was below the statutory maximum because of the limitations and caps which prevent some firms from using the full credit in the current year. During 1982-85,

[3]Since 1986, the R&E tax credit has been a part of the general business credit (GBC), which comprises seven separate credits. GBC is subject to a yearly cap. The excess GBC in the current year becomes an unused business credit eligible for carry back and carry forward.

the average tax saving per dollar of *total* qualified R&E spending ranged from $0.03 to $0.05 (Table 2, column 5) for those firms claiming the credit. This saving rate is well in excess of the rate resulting from a flat rate R&E credit with an equivalent revenue cost, since all firms—not just those increasing their R&E spending—would be eligible for a flat rate credit.[4]

Table 2: Total Qualified R&E, Incremental R&E Spending and Tax Saving, U.S. Industry, 1982-91

Year	Total Qualified R&E Spending	Incremental R&E Spending	Total Foregone Revenue or Tax Saving	Tax Saving Per Dollar of Total Qualified R&E Spending	Tax Saving per dollar of Incremental R&E Spending
	(Million 1991 $)	(Million 1991 $)		(4)/(2) ($)	(4)/(3) ($)
(1)	(2)	(3)	(Million 1991 $) (4)	(5)	(6)
1982	37158	9044	1180	0.03	0.13
1983	38799	10041	1726	0.04	0.17
1984	40731	10329	2057	0.05	0.20
1985	43497	10291	2032	0.05	0.20
1986	NA	NA	1571	NA	NA
1987	NA	NA	1241	NA	NA
1988	NA	NA	1448	NA	NA
1989	NA	NA	1456	NA	NA
1990	NA	NA	1610	NA	NA
1991	NA	NA	1585	NA	NA

Source: Internal Revenue Service, *Statistics on Income, Corporation Income Tax Returns* (SOI), annual issues, 1982-91.

Notes: The GDP implicit price deflators for the calendar years were used to convert the original values in current year dollars to 1991 dollars. Table 2 begins in 1982,—the first full year of the R&E tax credit. NA means there are no available data because SOI stopped providing data on qualified R&E spending and base period spending beginning in 1986, when the R&E credit became part of the general business credit. The latest available annual issue of SOI is for 1991.

The current year values corresponding to the 1991 $ values in column (4) were reported in SOI as "research credit" (1982-85) and "total allowable research credit" (1986-91). These data are not strictly comparable. Research credit is the amount actually claimed by all firms in the year, after adjusting for credit carried back and forward. Allowable credit is the maximum that could be claimed by all firms, if all previously unused credits were claimed in that year.

[4]An incremental credit has the advantage of providing a more powerful incentive to increase R&E spending per dollar of tax credit than a flat credit; it provides no subsidy for the base amount of R&E spending. The incremental credit, however, is somewhat more complicated to calculate. The flat credit is more equitable in that it reduces the gap between private and social returns on all R&E expenditures—not just those in excess of the base. A flat rate credit with a revenue cost equal to that of the current incremental creditwould be quite small.

III. DETERMINING COST-EFFECTIVENESS

General Framework

To estimate cost-effectiveness, it is necessary to determine the incremental R&E spending induced solely by the credit and to filter out the influence of other market forces. Once the induced component is known, the next step is to calculate the corresponding foregone tax revenue. Cost-effectiveness is then determined by dividing the induced incremental R&E spending by the foregone tax revenue.

Models measuring the incremental R&E spending induced by the credit can take many forms. Regardless of the specific formulation, however, such models should contain the following general features:

- To explain changes in R&E expenditures, data should be available from before the enactment of the R&E tax credit in 1981.[5] Whenever possible, the model should use disaggregated data. Firm-level data are preferable to industry aggregates for capturing the differences in the responses between firms in adjusting their R&E spending to changes in the credit and in the other explanatory variables. Disaggregation to the firm level also allows identification of firms that could not take advantage of the credit and, therefore, should be excluded. Longer time spans and later data are desirable to enhance the credibility of the statistical results.

- To determine the change in R&E spending induced by the tax credit, the first step is to estimate a "baseline" to explain R&E spending in the absence of the tax credit.

[5]This is not necessary if the effect of the tax credit is measured by comparing the R&E spending of a "control" group of firms, comprised of firms not able to take advantage of the R&E tax credit, with the R&E spending of otherwise similar firms that were able to take advantage of the credit.

- To isolate the effect of the tax credit, several statistical techniques are possible. The simplest is to introduce a categorical variable that indicates the *absence* or *presence* of the tax credit. Categorical variables may, however, inadvertently reflect the influence of other variables explicitly excluded from the model.[6] Other formulations of the tax credit variable could combine changes in the statutory tax rate, corporate tax rate, and deductibility of allowable expenses in a non-categorical or "continuous" variable — e.g., tax saving per dollar of incremental R&E spending (Table 1, column 5).

- The model should account for variations of the tax credit. For example, additional categorical variables may be added to measure the effects of the absence or presence of specific amendments to the tax credit, unless these are embodied in a continuous tax credit variable.

In the end, the explanation of changes in incremental spending induced by the R&E tax credit depends on the particular model specification. Different model specifications may, however, arrive at the same qualitative conclusion and converge toward the same quantitative estimate.

Evaluation of Cost-Effectiveness Estimates

Studies by Eisner, Albert, and Sullivan (1984), Mansfield (1986), and Altshuler (1988) of the effects of the R&E tax credit during the early 1980s conclude that the credit had a negligible or indiscernible effect on R&D spending. The General Accounting Office (GAO, 1989) estimates a range of roughly $0.15 to $0.36 in induced R&D spending per dollar of lost tax revenue (Table 3).[7] Tillinger (1991) classifies firms based on Tobin's *q*—marginal *q* is the ratio of the

[6]The tax credit categorical or "dummy" variable has a value of "1" when the credit was in effect or "0" when not. Thus, this variable was 0 for all years before 1981 and 1 for all years starting in 1981. Some explanatory variables are excluded from a model because the researcher lacks awareness of their theoretical relevance, lacks the data, or both. In this case, their combined effect on the variable being explained (the dependent variable) is to some extent captured by the "intercept" (the constant term) and by the residual of the estimated model. When a categorical variable is introduced, part of the old intercept is shifted to the estimated coefficient of this variable. For this reason, it is possible that the categorical variable could be picking up the effects of excluded variables.

[7]The estimated induced research spending was $0.2 billion to $0.5 billion per year during 1981-85 at a cost of about $1.4 billion per year, on average, in foregone tax revenue.

increase in the value of a firm from acquiring an additional unit of capital to its net-of-tax purchase cost. Her estimates of induced spending per dollar of foregone revenue (during 1981-85) are \$0.08 for firms with $q > 1$, \$0.33 for firms with $q < 1$, and up to \$0.42 for firms with $q = 1$.[8]

Table 3: "Induced" Incremental R&E Spending Per Dollar of Foregone Revenue From Various Studies, 1981-89

Period	GAO	Tillinger	Berger	Baily & Lawrence	Hall
(1)	2)	(3)	(4)	(5)	(6)
1981 - 85	\$0.15 - \$0.36	\$0.08, \$0.33, \$0.42			
1982 - 85			\$1.74		
1982 - 89				\$2.00	\$2.00

Sources: Baily and Lawrence (1987 and 1992), General Accounting Office (1989), Tillinger (1991), Hall (1992), and Berger (1993).

In contrast, studies of the credit's effect over a longer period are more encouraging. Baily and Lawrence on two separate occasions (1987 and 1992), Hall (1992), and Berger (1993) estimate ranges of \$1.74 to \$2.00 in induced R&D spending per dollar of lost revenue.

Explanations for Divergent Findings

Studies that focus on the 1981-85 period—Eisner, Albert, and Sullivan (1984), Mansfield (1986), Altshuler (1988), GAO (1989), and Tillinger (1991)—may underestimate the costs and

[8]Eisner, *et. al.* (1984) analyzed data for 592 firms from 1980 to 1982 obtained from *Compustat*, McGraw-Hill, and from Office of Tax Analysis, Treasury Department tabulations of R&D tax credit returns for 1981. These firms accounted for around 80 percent of private industrial R&D. Altshuler (1988) studied 5042 nonfinancial public corporations with assets greater than \$10 million 1982 dollars during 1977-84, using data from the Treasury Department's Corporate Tax Model. The corporations in Altshuler's study accounted for around 80 percent of total R&D as in Eisner's study. GAO analyzed income tax return data during 1981-85 for a sample of 800 nonfinancial corporations with assets over \$250 million, from the same source as Altshuler's study. While the companies in the GAO study are much larger than those in Altshuler's sample, the GAO study accounted for a slightly lower percentage of total R&D expenditure. Tillinger (1991) used *Compustat* data to analyze a broad sample of 506 firms that did research and development over the 1981-85 period.

benefits of the R&E tax credit for a variety of reasons. Most important, the brevity of the observation period and data series seriously complicates the problem of separating the effects of the credit from other influences on R&E spending. Except for Tillinger, in fact, these studies do not use statistical techniques to filter out the effects of other variables from the effects of the credit in explaining R&E spending.

Eisner, *et. al.* (1984) grouped the firms in their study by size of R&D spending and compared the growth of R&D spending between the firms that were eligible for the credit and those that were not. The authors found no difference in the growth of R&D between those firms eligible and those not eligible in 1981. Despite finding a higher R&D growth for firms that were eligible in 1982, they concluded that, on the whole, they could find no reliable evidence of positive effects. They attributed this result partly to the credit's design—i.e., the fact that the law defined the "base" amount for computing the credit in any tax year as a moving average of the firm's qualified R&D for the three preceding years. This feature tended to dilute the incentive effect of the credit for firms that were increasing their R&D spending, since these firms experienced rising base amounts and smaller eligible incremental expenditures than might have resulted from a different formula.

Mansfield (1986) asked a random sample of R&D, financial, and tax executives, and corporate CEOs to assess the effects of the R&D tax incentive on their individual firm's R&D spending. On the basis of their responses, he estimated that the amount of additional spending induced by the credit equaled about a third of the credit's revenue cost. Mansfield, too, attributed this modest result partly to the credit's "base" formula. Altshuler (1988) devised a cross-sectional

time-series simulation to test another of the credit's design characteristics—the carry forward provision. She concluded that the provision tended to mute the credit's incentive effect on firms moving between non-taxable and taxable status during 1981-84.

GAO's (1989) analysis begins with a calculation of the average effective credit rate for sample firms to obtain an estimate of the percentage reduction in the cost of R&D.[9] Using a plausible range of price elasticities, the authors then estimate the amount of R&D induced by the credit by multiplying the price elasticities by the average percentage reduction in the cost of R&D provided by the credit. They conclude that the amount of R&D spending induced by the credit in 1981-85 was less than the foregone tax revenue (Table 3). Along with Eisner, *et. al.* and Mansfield, they suggest modifications of the base period formula to increase the credit's incentive power.

Alone among the principal studies of the R&E tax credit during 1981-85, Tillinger's analysis employs a statistical model using firm-level cross-sectional time-series data to filter out non-credit influences on R&D spending. The variables in Tillinger's baseline model—i.e., the equation without the tax credit variable—are sales, lagged R&D expenditures, tax preference for capital (book depreciation divided by pre-tax income), a categorical variable defining the status of the firm in terms of Tobin's *q*, and another categorical variable to identify a particular year. She models the tax credit itself as a categorical variable determined by a relation between the firm's R&D spending to its base R&D.

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[9]GAO's approach is much like that reflected above in Table 2, column (5).

Tillinger's analysis is limited, however, to a very specific sample of firms—those that increased their R&D by more than twice the base amount are not included. Her finding that the credit was not cost-effective (Table 3) may not general. Moreover, it is unclear whether her analysis, or any assessment of the credit's effectiveness during 1981-85 remains relevant in later years given that the credit has been amended four times since 1985.

In contrast to evaluations focused on 1981-85, later studies covering periods between pre-1981 to 1991—Baily and Lawrence (1987 and 1992), Hall (1992), and Berger (1993)—find the credit cost-effective. In part, these results reflect the analysts' access to more extensive data. They also reflect the application of modeling techniques aimed at distinguishing effects of the credit from the effects of other factors. Baily and Lawrence (1987), for example, specify a baseline model in which the level of R&D spending depends on the current year's industry or aggregate output, the previous year's output, and the past level of R&D spending. The tax credit is incorporated (as a categorical variable) by adjusting the baseline according to whether or not the credit was in effect.

The authors, however, use industry-level data (mostly at the two-digit SIC level), which opens their finding to the criticism that their results mask differences in eligible firms' responses to the credit. More important, the aggregations may include firms for which the credit is irrelevant, either because the firms had current R&D expenditures equal to or less than the base R&D (i.e., zero or negative incremental R&D) or because they had no tax liabilities against which to apply the credit.

Furthermore, despite their specification of other influences on R&E spending, Baily and Lawrence model the credit as a categorical variable instead of a continuous variable. As a result, their model remains vulnerable to the problem of separating the effects of the tax credit from the influence of other market factors and is less powerful for explaining the behavior of R&D spending than it might have been if the authors had used a continuous variable representation of the tax credit.

In their 1992 study, Baily and Lawrence corrected one of the problems in their 1987 analysis by replacing the categorical variable representation of the tax credit by a "variable that tracks the changing incentives from the credit...after 1986." The later study also uses a longer data series. Their improved model reflects the decline in the tax saving per dollar of incremental R&E spending.[10] Nonetheless, the model's estimate of $2.00 of induced R&D spending per dollar of foregone tax revenue is the same as the finding of their 1987 analysis. The similarity of their 1992 and 1987 results confirms the robustness of both findings.

Independent estimates by Hall and Berger add support to the Baily-Lawrence analysis. Hall uses firm-level data that are more recent than the industry-level data in the Baily-Lawrence work.[11] She also employs a "tax price of R&D" continuous variable representation of the R&E

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[10]Baily and Lawrence estimate this decline at 7 perent during 1982-85, 5.6 percent in 1986, 5.1 percent in 1987, 4.6 percent in 1988, and 3.8 percent in 1989. While they do not give the exact formula, their calculations take into account the same factors as the calculations in Table 1—e.g., the fall in the statutory credit rate and corporate tax rate, as well as the deduction disallowance.

[11]The studies by Baily and Lawrence used aggregate industry level R&D data from the National Science Foundation from the 1960s to 1989. In contrast, Berger used R&D data of 263 firms from *Compustat* during 1975-89. Hall also used R&D data from a large sample of manufacturing firms drawn from the 1980-91 *Compustat* (Standard and Poor 1992) files.

credit to filter out non-credit influences on R&E spending. Other explanatory variables in Hall's model include the sales-R&D capital ratio, R&D investment rate, and lagged values of these variables to control for the effects of non-tax factors. She finds that during 1982-89, the credit induced $2.00 of incremental spending per dollar of tax revenue loss. In addition, she forecasts that induced spending in 1990-91 could be as high as $5.00 but believes that this high estimate is "almost too large to be credible...and deserves further investigation as more data become available."[12]

Berger's model specification is guided by previous empirical studies that have identified the relevant variables explaining firms' R&D spending. He represents the tax credit with a categorical variable—dubbed the "R&D credit usability variable." However, he reduces the danger that this variable may pick up the effects of excluded or unknown variables by including numerous explanatory variables in his firm-level R&D spending model. These variables include sales (as a source for discretionary expenditures such as R&D); industry R&D spending (to account for inter-industry competition); and internal funds (because external funds may be rationed or extremely expensive).[13]

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[12]Hall (1992), footnote 18, page 31.

[13]Other variables in Berger's model include: lagged R&D spending (because firms that have identified potentially profitable innovation tend to spend more on R&D each year); real GNP (because technological progress in the economy at large may influence firm investments in R&D); Tobin's *q* (in place of the marginal *q*, the average *q* is used), to capture the effects of the firms's long-term market value; and R&D credit usability variable (to distinguish firm-years when a firm is able to use the R&D credit if it decides to increase qualified incremental spending).

In contrast to the Baily and Lawrence models (1987 and 1992), Berger's tax credit variable equals "1" not only because the credit was in effect, but because the year was after 1980 *and* tax liability existed against which the credit could be used or carried back. The latter condition is specific to the firm and is thus more likely than an industry-level variable (e.g., Baily-Lawrence) to isolate the effect of the credit from the effect of other variables.

In relation to the criteria for model specifications set out earlier, these independent analyses appear to be empirically sound. Moreover, their individual conclusions that the R&E tax credit was cost-effective during the 1980s are mutually supportive since they converge toward the same value—roughly $2.00 of induced investment per dollar of revenue loss.

Caveats

Several measurement problems are common to all of the above studies. One such problem is using R&D expenditure data in place of "qualified" R&E spending. Berger and Hall, for example, note that their estimates are subject to measurement error from using *Compustat* firm level data on R&D expenditures as a proxy for qualified R&E spending. Hall also observes that available firm data do not provide information on the portion of total R&D spending that corresponds to qualified R&E expenditures; nor do the data provide information on the tax status of firms.

In addition, Hall notes that while the intent of the law is to shift research spending in "technological" directions, it is difficult to investigate this shift without access to confidential data. She also notes that while the R&E tax credit has increased the publicly reported R&D

spending of U.S. firms, it is unclear "whether this spending truly reflects increased spending of the sort envisioned by Congress (research and experimentation in the laboratory or technological sense), or merely a relabeling of related expenses as research...."[14]

IV. CONCLUSIONS AND FURTHER CONSIDERATIONS

Various studies have addressed the questions of (a) whether the R&E tax credit has induced more R&E investment than would otherwise have occurred and (b) whether the induced increase justifies the credit's revenue cost. Studies of the credit's effect in the early 1980s generally found weak evidence of cost-effectiveness. However, more recent studies covering a longer period have concluded that the tax credit has induced an increase in R&E spending by an amount that is significantly greater than the foregone tax revenue.

In addition, at least two considerations suggest that these findings could understate the R&E credit's full effectiveness. One is that the credit's legislative history is marked by frequent amendment and impermanence. Typically, a long delay separates the basic research that the R&E credit is intended to promote and any expected returns. The impermanence of the tax

[14]Hall (1992), 32. Hall does observe, however, that although firms may have tried to claim some unqualified expenditures under the credit, the total amounts disallowed in audits by the Internal Revenue Service remain fairly small. Also, since there has always been a tax incentive to relabel investment expenses as R&D, relabeling is already in the base level of R&D. Thus, reported changes in total R&D expenditures to a large extent reflect real changes in total R&E spending.

credit has probably added to uncertainty about such returns and limited the credit's stimulative impact.[15]

A second reason why recent studies probably understate the credit's full cost-effectiveness is that they focus on research induced and revenues foregone *only* in the years of induced research spending and related revenue loss. Tax revenues resulting from related long-term improvements in company performance and from spillover effects that enhance productivity and increase output in the economy at large are thus omitted from the cost-benefit calculation.

[15]Penner, Smith, and Skanderson (1994) assess the negative effect of the credit's legislative history.

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APPENDIX A

HISTORY OF THE R&E TAX CREDIT

Since its original enactment as part of the *Economic Recovery Tax Act of 1981*, the R&E tax credit has been modified four times and extended six times. The original act contained the following provisions:

- The credit was 25 percent of incremental R&E spending or the excess of qualified R&E expenditures in the current year over a base period amount.
- Qualified research excluded research done outside of the United States, research in the humanities or social sciences, and research funded by another person or government agency.
- The base period amount equaled the average expenditures for the previous three years or 50 percent of the current year's qualified expenditures, whichever was larger.
- If the credit amount was not fully applicable to current year tax liabilities, the unused portion could be carried back 3 years or carried forward 15 years.
- The credit was effective from July 1, 1981 to December 31, 1985.

The *Tax Reform Act of 1986* modified the R&E tax credit as follows:

- The credit was reduced to 20 percent of incremental R&E spending.
- The definition of qualified R&E expenditures was narrowed to research of a "technological" nature and excluded expenses on leasing personal property.
- A separate tax credit was established in the amount of 20 percent of payments to a university for basic research.

- The R&E tax credit was made part of the General Business Credit (GBC) and, thus, made subject to a yearly cap.[16]

- The credit was effective from January 1, 1986 to December 31, 1988.

The *Technical and Miscellaneous Revenue Act of 1988* provided for the following:

- The credit was extended for 1 year.

- The deduction allowed for qualified research expenses was reduced by 50 percent of the credit amount.[17]

Up to this point, the computation of the base amount remained the same as it was in the original act. However, it was argued that the 3-year moving average formula reduced the incentive for companies to undertake incremental R&E spending, because the amount spent on R&E in a given year became part of the base in the following 3 years. Therefore, an increase in R&E spending also increased the future base, thereby decreasing the amount of incremental R&E spending and, hence, also decreasing the amount of credit. Thus, the *Omnibus Budget Reconciliation Act of 1989* provided that:

- The base amount is the larger of 50 percent of the current year's qualified expenditures or the amount determined by the ratio of total qualified research expenditures to total

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[16]The GBC combines seven individual tax credits, namely, investment credit, jobs credit, alcohol fuels credit, low-income housing credit, disabled access credit, enhanced oil recovery credit, and R&E tax credit. The purpose of the GBC was to provide a uniform limitation on the amount that could be used to reduce tax liability and to establish uniform carry back and carry forward rules.

Effective for the tax years beginning after December 31, 1985, the GBC reduced the tax liability to the extent of 100 percent of the first $25,000 of net tax liability and 75 percent of the net tax liability exceeding $25,000. An additional limitation was also imposed on the GBC as a result of the alternative minimum tax introduced by the Tax Reform Act of 1986. If the GBC exceeds the above limitations, the excess became an unused business credit. An unused business credit could be carried back to the 3 years preceding the unused credit year and forward to the 15 years following that year.

[17]Section 174 of the Internal Revenue Code offers two ways of treating investments in R&E activities. One is to capitalize these investments and write them off over a minimum 5-year period and the other is to deduct from income the costs of R&E expenses on a current year basis.

gross receipts for the period 1984-88 (the "fixed base percentage") multiplied by the average of the gross receipts for the preceding 4 years. However, the fixed base percentage cannot exceed 16 percent.

- The credit was made available to start-up companies, those that did not have gross receipts in at least 3 years during 1984-1988. These companies were assigned a fixed base percentage of 3 percent for each of their first 5 taxable years after 1993 in which they incur qualified research expenditures.[18]

- The deduction allowed for qualified research expenses was reduced by 100 percent of the credit amount.

- The act effectively extended the credit for 9 months by prorating qualified expenses incurred before January 1, 1991.

The *Omnibus Budget Reconciliation Act of 1990* extended the credit to December 31, 1991 and repealed the special provision prorating qualified expenses incurred before January 1, 1991. The *Tax Extension Act of 1991* extended the credit to June 30, 1992. Finally, the *Omnibus Budget Reconciliation Act of 1993* made the credit effective retroactively from July 1, 1992 to June 30, 1995 and also modified the fixed base percentage for start-up firms.

[18]The base percentage is gradually increased during the 6th through the 10th taxable years after 1993 in which the start-up company incurs qualified research expenditures. After the 10th year, the fixed base percentage is the actual ratio of qualified research expenditures to gross receipts for 5 years selected by the company from the 5th through the 10th taxable years (GAO, 1994; Mazur, 1994).

APPENDIX B

THE STATUTORY MAXIMUM TAX SAVING FROM THE R&E TAX CREDIT

According to the law, in the current year:

(1) Incremental R&E Expenditures = Total R&E Expenditures - Base Amount.

In turn, the law states that:

(2) Credit Amount = (Statutory Credit Rate) x (Incremental R&E Expenditures).

Moreover, a portion of the credit amount is required to be deducted from allowable expenses. This portion was zero before 1989, 50 percent in 1989, and 100 percent beginning in 1990 (Table 1). Hence, beginning in 1989, the tax saving will be less than the credit amount because a reduction in deductions increases taxes through the effect of the corporate tax rate. Formally,

(3) Tax Saving = (Credit Amount) - **[**(Corporate Tax Rate) x (Portion of Credit Amount to be Deducted) x (Credit Amount)**]**.

By combining the above equations, it can be seen that:

(4) Tax Saving = **[**1 - (Corporate Tax Rate) x (Portion of Credit Amount to be Deducted)**]** x (Statutory Credit Rate) x (Incremental R&E Expenditures).

Therefore, the tax saving per dollar of incremental R&E spending, the "marginal" credit rate, is given by:

$$(5) \quad \frac{\text{(Tax Saving)}}{\text{(Incremental R\&E Expenditures)}} = \text{[1 - (Corporate Tax Rate) x (Portion of Credit Amount to be Deducted] x (Statutory Credit Rate).}$$

The tax saving per dollar of total R&E expenditures, the "average" credit rate, may be computed as follows. For this purpose, rewrite equation (1) as:

(6) Incremental R&E Expenditures = **[**1 - (Base Amount/Total R&E Expenditures)**]** x (Total R&E Expenditures).

Substitute the right-hand of (6) into the right-hand side of (4) and then divide both sides by Total R&E Expenditures to obtain:

$$(7) \quad \frac{\text{(Tax Saving)}}{\text{(Total R\&E Expenditures)}} = \text{[1 - (Corporate Tax Rate) x (Portion of Credit Amount to be Deducted] x (Statutory Credit Rate) x [1 - (Base Amount/Total R\&E Expenditures)]}$$

The law provides a formula to compute the base amount. The law stipulates, however, that the computed base amount may be no less than 50 percent of the current year total qualified R&E expenditures. Otherwise, 50 percent of the total is used as the base. Hence, by comparing the right-hand sides of (5) and (7), the tax saving per dollar of *total* R&E expenditures equals the tax saving per dollar of *incremental* R&E spending multiplied by **[**1 - (Base Amount/Total R&E Expenditures)**]**. Therefore, the average credit rate is at most one-half of the marginal credit rate because the (Base Amount/Total R&E Expenditures) ratio is at least 0.50.

The above formulas give the statutory "maximum" tax saving per dollar of incremental R&E in (5) or per dollar of total R&E in (7) received by a firm in a given year. The actual amount of credit claimed may be less if firms carry the credit forward because of the various limitations or greater if they are able to claim previously unused credits. Therefore, in practice, the actual or effective credit rates could be lower or higher than the statutory maximum values from these formulas.