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February 1985

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

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THE EFFECTS OF THE R&D TAX CREDIT ON ENERGY R&D EXPENDITURES: AN ECONOMETRIC ANALYSIS

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ABSTRACT

This report was prepared by Pacific Northwest Laboratory for the Department of Energy, Office of Industrial Programs (OIP). The objective of the study documented in this report was to estimate the effects on industrial energy research and development (R&D) expenditures of the R&D Tax Credit component of the Economic Recovery Tax Act of 1981.

This objective was achieved by performing two tasks. The first task was to collect data on industrial R&D expenditures, sales, oil prices, and price deflators. The R&D expenditure data were obtained from the National Science Foundation; other data were collected from Commerce Department and Department of Energy publications. The second task was to perform an econometric analysis of the effects of the tax credit on industrial R&D expenditures. Equations relating 1) total and 2) energy-related R&D expenditures to sales, oil prices, and a variable representing the availability of the tax credit were estimated, using data for each of seven manufacturing industries and eleven years. The analysis showed that the tax credit caused real total industrial R&D expenditures to be 9.1 percent greater than they would have been without the credit, but caused real energy industrial R&D expenditures to be 13.8 percent less than they would have been without the tax credit.

EXECUTIVE SUMMARY

Pacific Northwest Laboratory (PNL) has prepared this report for the Department of Energy, Office of Industrial Programs (OIP). The report documents the activities and findings of a project whose objective was to evaluate the effects on industrial energy research and development (R&D) expenditures of the R&D Tax Credit component of the Economic Recovery Tax Act of 1981.

This objective was achieved by performing two tasks. The first task was to collect and assemble data on U.S. industrial R&D expenditures, sales, oil prices, and price deflators. R&D expenditure data were collected from the National Science Foundation (NSF), Office of Industrial Studies. The NSF data base contains information on R&D expenditures for each of the years 1972-1982, by two- and three-digit Standard Industrial Code (SIC), and by R&D type (total, energy, and energy conservation).

The NSF defines R&D as either basic investigatory research, without commercial objectives; applied research with commercial objectives; or technical activities concerned with creating or developing new products or processes. Energy R&D is any R&D activity concerned with investigating or developing new uses of energy. Energy conservation R&D, a subset of energy R&D, is any R&D activity concerned with investigating or developing new energy-saving products or processes.

The NSF data cover the expenditures for R&D performed by private industry, including 1) R&D that is both financed and performed by private industry and 2) R&D that is financed by the government (federal, state, and/or local) but performed by the private sector. The data do not cover expenditures for R&D that was actually performed by the government (such as research performed by the National Institutes of Health or the National Bureau of Standards). Although the NSF has recently released this data to the public in a report entitled R&D in Industry: 1982 Detailed Statistical Tables, to our knowledge the data has not yet been used to perform an analysis of the type reported in this paper.

Data on annual industrial sales by SIC were collected from the Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations, published by the Census Bureau, Department of Commerce. Data on oil prices were obtained from the 1983 Annual Energy Review, published by the Energy Information Administration, Department of Energy. Data on the Gross National Product (GNP) implicit price deflator, which were used to deflate the R&D expenditure and oil price data from nominal dollars to real, 1972 dollars, were collected from the 1984 Economic Report of the President. Finally, data an SIC-specific price deflators, which were used to deflate the industrial sales data from nominal dollars to real, 1972 dollars, were obtained from various issues of the Statistical Abstract of the United States, also published by the Census Bureau.

The second task was to statistically analyze the effects on R&D expenditures of the R&D Tax Credit, a component of the Economic Recovery Tax Act of 1981. The R&D tax credit was enacted in response to the growing concern that U.S. industry was (and is) not spending enough resources on basic R&D and that, as a result, future industrial productivity increases would continue to be quite small, or even negative. The R&D tax credit took effect in July, 1981 and expires in December, 1985; its extension is currently being considered by the Congress. It offers a 25 percent tax credit to each company in the United States for R&D expenditures above a company-specific base level (equal to the average of the company's R&D expenditures during the previous three years). Although designed to stimulate R&D spending, because of the way that each company's base level is calculated, it is possible that the tax credit could have an adverse (i.e., negative) effect on R&D expenditures. One of the primary interests of this study was therefore to estimate whether the tax credit had a positive or negative effect on R&D expenditures, as well as the magnitude of its effect.

To assess the effects of the tax credit on R&D expenditures, a simple econometric analysis was performed. Data for seven manufacturing industries were used in the analysis: chemicals, petroleum, primary metals, machinery, electrical equipment, aircraft and missiles, and professional and scientific instruments. The annual data for real total R&D, real energy R&D, real total sales, and the real oil price for each of these seven industries and for each

of the years 1972-1982 was "pooled" into a single data set. This data set contained 77 observations (seven industries, eleven years for each industry). A dummy variable representing the availability of the tax credit was also included in the data set. The tax credit dummy variable was equal to zero for each of the years 1972-1980, 0.5 for the year 1981 (the tax credit was only available for half of the year), and one in 1982.[a]

Using this data set, an equation relating real total industrial R&D expenditures to real sales and the tax credit dummy variable was econometrically estimated. Sophisticated statistical methods were employed to account for the pooled cross-section/time-series nature of the data set. The equation showed that, after accounting for changes in real total R&D expenditures caused by changes in industrial sales, the R&D tax credit caused real total R&D expenditures to be 9.1 percent greater in 1982 (the first full year of the tax credit) than they would have been in the absence of the tax credit.

A second equation relating real energy R&D expenditures to real sales, the real oil price, and the tax credit dummy variable was also estimated, using the same statistical techniques employed to estimate the first equation. This equation showed that, after accounting for changes in real energy R&D expenditures caused by changes in industrial sales and the price of oil, the R&D tax credit caused real energy R&D expenditures to be 13.8 percent less in 1982 than they would have been in the absence of the tax credit.

Although it is possible that the tax credit would have a negative impact on R&D expenditures, as stated above, we are unable to explain why it would have a positive impact on real total R&D expenditures but a negative impact on real energy R&D expenditures. However, energy markets in the United States are very complex, and it is difficult to capture this complexity in an econometric analysis of this type. We believe qualitatively different estimates of the effects of the tax credit on real energy R&D expenditures may have been obtained if a more complete econometric analysis that captured

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(a) A similar econometric analysis was not performed for energy conservation R&D expenditures because expenditure data was not available for enough 1) years and 2) industries.

these complexities had been performed.

The analysis performed in this task as well as the results of the analysis are subject to two important limitations. First, the data sample covers a relatively short time period (eleven years) and, more importantly, only covers the first 1-1/2 years of the period in which the tax credit was in effect. Data for a longer time period and/or covering more of the period in which the tax credit was in effect might result in different impact estimates. Second, the scope of this study was limited to investigating the effects of the R&D tax credit on R&D expenditures. A more rigorous, complete econometric analysis of all of the determinants of R&D expenditures was outside of the scope of this study. A number of factors that may influence industrial R&D expenditures, such as interest rates, effective tax rates, the availability of federal government financing, and the likely returns from investments in R&D, were therefore not included in the estimated econometric equations. Including such variables and treating those variables that were considered (e.g., sales, oil prices) in a more complex fashion might result in different estimates of the effects of the R&D tax credit on industrial R&D expenditures.

CONTENTS

TABLES

1.0 INTRODUCTION

This report was prepared by Pacific Northwest Laboratory for the U.S. Department Energy, Office of Industrial Programs (OIP). The study analyzes the effects of the R&D tax credit on industrial expenditures for research and development (R&D) of energy-using and energy-saving devices and methods.

1.1 BACKGROUND

Due to the relatively small productivity increases and the slowdown in real R&D spending growth experienced during the 1970s, concern about industrial R&D activity has dramatically increased in recent years. Output per man hour increased 32.2 percent between 1960 and 1970, but increased only 14.6 percent between 1970 and 1980, and actually fell in 1979 and 1980. Similarly, although real R&D spending increased 23 percent between 1973 and 1981, this rate of increase was less than half the growth rate of 51 percent experienced in real R&D spending in the 1963-1971 period. Such a reduction in the rate of growth of R&D investment may reduce long-term technological progress, and, in turn, endanger future productivity increases. Such a slowdown in technological progress may, over time, diminish our potential for continued economic strength.

Much less attention has been paid to recent trends in energy-related R&D expenditures and the impact of such expenditures. Research and Development expenditures relating to energy affect the U.S. economy by enhancing energy efficiency as well as the productivity of labor and equipment. An increase in energy-related R&D expenditures and the resulting technological improvements facilitate the development of energy-saving devices and methods. These tools and capabilities enable industries to make better use of the energy they consume and reduce the amount of energy actually required. In addition, such R&D expenditures lead to development of devices and methods that generally increase industrial productivity and that lead to new consumer and industrial products.

1.2 OBJECTIVES

The objective of the study documented in this report was to assess the impacts of the R&D Tax Credit component of the Economic Recovery Tax Act of 1981 on industrial energy R&D expenditures. As discussed in Chapter 4.0, the R&D Tax Credit was enacted to help arrest the slowdown in R&D spending that took place during the 1970's.

1.3 OVERVIEW OF REPORT

The remainder of this report is organized as follows. Chapter 2.0 presents conclusions and recommendations of the study. Chapter 3.0 discusses the data used in the analysis. Chapter 4.0 discusses the effects of the 1981 Economic Recovery Tax Act on total and energy R&D expenditures.

2.0 CONCLUSIONS AND RECOMMENDATIONS

In brief, the study yielded the following conclusions:

- Simple econometric analysis shows that the R&D Tax Credit, a component of the Economic Recovery Tax Act of 1981, caused real total R&D expenditures to be 9.1 percent higher in 1982 than they would otherwise have been.
- Simple econometric analysis shows that the tax credit caused real energy R&D expenditures to be 13.8 percent lower in 1982 than they would otherwise have been.
- We are unable to explain why the tax credit would have a positive impact on an real total R&D expenditures while having a negative impact on real energy R&D expenditures, but believe that different results may have been obtained if a more rigorous, complex econometric analysis had been performed.

Based upon these conclusions, the following recommendations are made:

- Tax-based incentives do not appear to have "helped" in stopping the decline in energy R&D expenditures. More direct policies may be required to reverse the recent decline in energy R&D expenditures, should such a reversal be deemed desirable.
- Further statistical research should be performed analyzing all of the determinants of R&D expenditures, particularly energy R&D expenditures. Research on the effects of R&D expenditures on industrial productivity and industrial energy use should also be performed. It is important that such research be consistent with economic and econometric theory and standard research practices.

3.0 DATA DEVELOPMENT

This chapter describes the data used in the econometric analysis presented in Chapter 4.0 The sources of this data are described in Section 3.1. The data are described in detail in Section 3.2.

3.1 DATA SOURCES

Two general types of data were used in the analyses presented in the remainder of this chapter and in Chapter 4.0. First, data on annual industrial R&D expenditures by industry and R&D type were used. Second, more general economic statistics, such as industrial sales and Gross National Product (GNP) price deflators, were used.

All industrial R&D expenditures data were obtained from the National Science Foundation survey, R&D in Industry: 1982 Detailed Statistical Tables. The data from this survey is collected and compiled by the Bureau of the Census, Department of Commerce.

Industrial sales data were obtained from the Quarterly Financial Report for Manufacturing, Mining and Trade Corporations (QFR), published by the Economic Surveys Division, Bureau of the Census, Department of Commerce.

Data on the GNP deflator and industry-specific price deflators were obtained from the 1984 Economic Report of the President, published by the Council of Economic Advisers, Executive Office of the President, and the 1984 Statistical Abstract of the U.S., published by the Census Bureau. Data on oil prices were obtained from the Annual Energy Review 1983, published by the Energy Information Administration, Department of Energy.

3.2 DATA DESCRIPTION

The two types of data used in the analysis are described in greater detail below.

3.2.1 Description of R&D Expenditure Data

The NSF survey of industrial R&D consists of annual R&D data for the years 1972 to 1982. The industrial R&D data is organized according to Standard Industrial Classification codes for 15 manufacturing industries: Food and Kindred Products; Textiles and Apparel; Lumber; Wood Products and

Furniture; Petroleum Refining and Related Industries; Rubber Products; Stone, Clay, and Glass Products; Primary Metals; Fabricated Metal Products; Machinery; Motor Vehicles and Motor Vehicles Equipment; Other Transportation Equipment; Aircraft and Missiles; Professional and Scientific Instruments; and Other Manufacturing. Data for nonmanufacturing industries and a total for all industries are also provided.

For several industry groupings, the NSF reported data as unavailable. This occurred when there was: 1) an extremely high sampling error; 2) a high rate of interpolation (over 50 percent); 3) a failure of a company to supply data; 4) disclosure of an individual company; and/or 5) inconsistency for inclusion in time series. Because of this, complete time series for the 1972-1982 period were not available for all 15 manufacturing industries listed above. To perform the econometric analysis described in Chapter 4.0, therefore, total and energy R&D expenditures for the 1972-1982 period were aggregated into seven industrial categories: Chemical and Allied Products; Petroleum Refinery and Related Industries; Primary Metals; Machinery; Electrical Equipment; Aircraft and Missiles; and Professional and Scientific Instruments. The Food and Kindred Products; Textiles and Apparel; Lumber; Wood Products and Furniture; Rubber Products; Stone, Clay, and Glass Products; Fabricated Metal Products; Motor Vehicles; and Other Transportation Equipment industries were excluded from the analysis because of incomplete data series. The "Other Manufacturing" and Non-manufacturing industries were excluded because of the difficulty of defining "sales" in these industries and obtaining sales-related data.

The NSF reports data by R&D type, for three types of R&D: total, energy, and energy conservation.[a] Total R&D is defined as the total of all expenditures on R&D activities for a given year. R&D is defined by NSF as basic and applied research in sciences and engineering and the design and development of prototypes and processes. Research is differentiated as basic and applied research on the basis of original investigation. Basic research means an original investigation, one that has no commercial objective;

(a) However, an econometric analysis of energy conservation R&D expenditures could not be performed because the data on such expenditures comprise very short time series and are incomplete.

otherwise the research is classified as applied. Development is defined by NSF as nonroutine technical activities concerned with creating products or processes from research findings.

Energy R&D is defined by the Organization for Economic Cooperation and Development (OECD) as R&D performed "in support of the supply, production, and conservation and distribution of all forms of energy (except means of propulsion for vehicles and rockets"). The NSF uses this definition as well.

The data include expenditures for all R&D activities performed by private industry. The source of financing of the activity is not considered: both R&D activity financed by industry and that financed by government (federal, state, and/or local) but performed by industry are included. R&D actually performed by the government, however, was not included.

R&D data are collected and compiled for approximately 11,500 companies. These companies are chosen primarily from two sources; the FY81 Standard Statistical Establishment List and the Enterprise Statistical Multiunit File, which are compiled by the Bureau of the Census. Table A.1 of Appendix A presents R&D expenditure data (in nominal dollars) for the years 1972 to 1982 for the seven industries analyzed.

3.2.2 Description of Economic Data

The QFR publishes income statements and balance sheets for 34 different industry groupings, including twenty-two manufacturing industries. These financial statements are reported by two-digit SIC classification codes. The source of these financial statements is a survey of corporations. The QFR includes in its sample nearly all corporations whose assets exceed $50 million; it also includes nearly all corporations whose assets are between $10 million and $50 million and whose receipts exceed the average for a corporation with $25 million in assets in its industry. In addition, a proportion of corporations with assets less than $10 million are sampled. Each corporation surveyed provides a breakdown of gross receipts by source industry. These receipts are reported within the appropriate industrial classifications in order to create industrial financial statements. Sales data are reported as the sum of sales, receipts and other operating

revenues. All financial data are reported on a quarterly basis and are aggregated here for this analysis to an annual basis.

The oil price used in the analysis was the average U.S. price per barrel. The GNP implicit price deflator was used to deflate all R&D expenditures into real, 1972 dollars. This deflator was also used to deflate the oil price. The GNP price deflator is an index equal to 100 in 1972. It is a measure of the economy-wide price level, similar to the more-familiar Consumer Price Index (CPI). It indexes the general price level of all of the goods and services produced in the United States, not just the price level of a typical "market basket" of consumer-purchased goods and services (as in the CPI).

All industrial sales data were deflated using the corresponding industry-specific implicit price deflators. These deflators, which all equal 100 in 1982, are similar to the GNP implicit price deflator, but measure the general price level of all of the goods and/or services produced in a specific industry.

Data on current-dollar sales and the implicit price deflator for each industry are presented in Table A.2 of the Appendix. The current-dollar oil price and the GNP price deflator are presented in Table A.3. Data on real total R&D expenditures, real energy R&D expenditures, and real sales by industry are presented in Table A.4, as are data on the real oil price.

4.0 R&D TAX CREDIT

Due to concerns about slowdowns in the rate of increase of industrial R&D expenditures, the Congress in 1981 established a tax credit for R&D expenditures as part of the Economic Recovery Tax Act of 1981. The tax credit is a temporary measure scheduled to terminate on December 31, 1985, and the Congress is currently considering bills to extend the credit. One of the issues in this debate is whether the tax credit has in fact caused industrial R&D expenditures to increase and, if so, if the increase has been large enough to "justify" the lost tax revenues.

This chapter is divided into three sections. In Section 4.1, the concerns that led to enactment of the R&D tax credit are briefly reviewed. The basic features of the R&D tax credit are described in Section 4.2. A simple econometric analysis of the effects of the R&D tax credit on total and energy R&D expenditures by industry is presented in Section 4.3.

4.1 BACKGROUND

Although real R&D expenditures by all industries increased 23 percent between 1973 and 1981, the increase during this eight-year period was less than half the increase that occurred during the 1963-1971 period, during which such expenditures increased 51 percent. This slowdown led to concerns that future industrial productivity increases would decrease, or even that productivity would fall. Concerns were also expressed that such an R&D spending slowdown would threaten U.S. leadership in high-technology industries, such as electronics, as well as in "basic" industries such as primary metals. In these latter industries, productivity increases based on development of new processes and products are believed to be required to keep the industries competitive with their foreign (particularly Third World) counterparts.

These concerns are, in fact, supported by recent trends in industrial productivity. Industrial output per man hour increased at much slower rates during the 1970s than during the 1960s, and in fact decreased during several years in the late 197Ds. Although these productivity increase slowdowns and eventual reductions cannot be attributed solely or even primarily to the R&D spending slowdown, there are reasons to believe that the two phenomena are

related, and that reversing the former trend might require first reversing the latter one.

It is interesting to note that expenditures for energy, and particularly, energy conservation R&D, were not of major concern during the early 1980s. Due in part to rapidly increasing energy prices during the 1970s, R&D expenditures in these two categories increased rapidly during that decade. Spurred in part by such R&D expenditures, a large number of energy-saving devices were developed during this period, and energy use per unit of industrial output actually fell in the late 1970s. A number of devices that used energy in new ways was also developed during this period (i.e., developments that result from the part of energy R&D that is not also energy conservation R&D).

4.2 LEGISLATIVE RESPONSE

In response to the concerns about R&D expenditures discussed in Section 4.1, the Congress in 1981 enacted the R&D Tax Credit. The tax credit is a component of the Economic Recovery Tax Act of 1981, the major piece of tax legislation passed during the first Reagan Administration, whose main features were a 25 percent reduction in individual tax rates and several provisions designed to increase business investment.

The R&D tax credit provides a 25 percent credit to a company for R&D expenditures in excess of a base level. The base level is defined in the legislation as the company's average annual R&D expenditures for the previous three years. The amount of the credit (25 percent of the firm's incremental R&D expenditures) can be subtracted directly from a firm's tax liabilities. For the purposes of the legislation, a number of restrictions were placed on what constitutes "R&D activity" that is eligible for the credit. These restrictions are highlighted in Appendix B, in which the full text of the R&D Tax Credit component of the Economic Recovery Tax Act of 1981 is reproduced. Another interesting aspect of the tax credit is that for the year 1981, the credit was only applied to expenditures occurring after July 1, because the legislation went into effect on that date.

The tax credit works in the following manner. Suppose that a firm spent $1 million on R&D in 1979, $2 million in 1980, and $3 million in 1981. For

1982, its base level is the average of these three years' expenditures, or $2 million. Suppose in 1982 the firm spent $3 million on R&D. The excess of the firm's expenditures over its base level is $1 million ($3 million minus $2 million). The firm would then be eligible for a tax credit of $250,000 (25 percent of $1 million). Suppose that in the absence of the tax credit the firm would owe federal taxes of $600,000. After subtracting the $250,000 tax credit, its tax liabilities would be reduced to $350,000.

The purpose of the tax credit was to increase R&D spending by reducing the effective price that firms have to pay for R&D. For every dollar above the base level that a firm "buys" of R&D, it only has to pay 75 cent, because the federal government "pays" the remaining 25 cents. With such a reduction in the "price" of R&D, it was hoped that firms would "purchase" more of it. In order to prevent subsidizing R&D that would have taken place even in the absence of the tax credit, the credit can only be applied to expenditures above the base level. This aspect of the legislation may lead firms to actually reduce R&D expenditures in a particular year so that the base level relevant for the following year will be smaller, and the total amount of the tax credit in the following year larger. Thus, there is some question about whether or not the R&D tax credit has had a positive or negative impact on industrial R&D in the United States.

4.3 ANALYSIS OF IMPACT ON R&D EXPENDITURES

To estimate the impacts of the R&D tax credit on real total and energy R&D expenditures by industry, a simple econometric analysis was performed. Equations relating real total R&D expenditures and real energy R&D expenditures to real sales, the real oil price, and whether or not the tax credit was in effect were estimated using standard econometric techniques and data for each of seven industries and eleven years. The methodology employed in the analysis is described in Section 4.3.1, while the results of the analysis are presented in Section 4.3.2.

4.3.1 Methodology

The methodology employed in this analysis is an extension of simple regression analysis. In such an analysis, "methodology" encompasses three

features: 1) model specification, or selection of variables to be included in the estimating equations; 2) data; and 3) statistical techniques.

Model Specification

R&D expenditures by a firm are an investment, similar to purchase of a building or a piece of equipment. Ideally, then, an analysis of the determinants of R&D expenditures by a firm would begin with the economic theory of investment, such as that developed by Jorgenson (1963). In the first half of his paper, a theoretical analysis of the determinants of investment, Jorgenson began with the premise that firms maximize profits, and make investments in order to increase profits. He found that the amount of capital investment that a firm undertakes is determined by 1) the "gross" price of the capital (i.e., the amount paid to the supplier), 2) the effective tax rate, 3) the productivity of the capital, 4) the expected price of future output to be manufactured with the capital, 5) the interest rate, and 6) a number of other variables. Using data on the prices of machinery and buildings, past prices of output, and other variables, Jorgenson was able to implement this theory econometrically in the second half of the paper.

Unfortunately, analysis of the determinants of R&D investments have not typically been able to achieve the level of theoretical rigor attained by Jorgenson and other analysts of investment in "physical" capital. A major reason for this shortcoming is the difficulty in defining the "key" variables, such as the "price" of the investment, the productivity of the investment, and the expected price of future output associated with the R&D investment. A second reason is the difficulty of obtaining data on these variables, should one be successful in defining them.

This analysis continues the latter tradition, primarily for the reasons mentioned in the previous paragraph, but also because of the lack of resources available to perform the analysis. In the equations described below, it is hypothesized that an industry's total R&D expenditures are determined by its sales and the availability of the tax credit. Energy R&D expenditures are hypothesized to be determined by these two variables as well as the price of oil. More than anything else, sales represents a "scale" variable; holding all other things equal, one would expect the

larger of two industries to expend more on R&D. Of course, all other things are not equal, and no attempt was made in this analysis to include variables (such as the price of R&D to individual industries, the productivity of R&D in individual industries, and the expected future price of the associated output in individual industries) that would permit such an interpretation. The availability of the tax credit in part represents the effective tax rate; however, it does so in a very simplistic manner, because effective tax rates on R&D expenditures vary over time and between industries for reasons other than the R&D tax credit. Finally, the price of oil represents the expected future returns from investments in energy R&D.

Data

As discussed in the preceding paragraphs, data on the following variables are required to estimate the econometric equations relating total and energy R&D expenditures to their determinants: real industrial total R&D expenditures, real industrial energy R&D expenditures, real industrial sales, the real oil price, and a variable representing the availability of the R&D tax credit. Data for the first four of these variables are available in published sources, as described in Chapter 3.0. The R&D tax credit variable was created in the following manner. For all years in the 1972-1980 period, the tax credit variable had a value of zero, because the R&D tax credit was not in effect. In 1981, the R&D tax credit was in effect for the second half of the year, so the tax credit variable was given a value of 0.5. For 1982, the tax credit variable was given a value of one. The tax credit variable is thus a typical categorical (0-1) or dummy variable with a "twist" to account for the half year that the credit was in effect in 1981. For each of these variables, data for each of seven industries (chemicals, petroleum, primary metals, machinery, electrical equipment, aircraft and missiles, and professional and scientific instruments) and for each of eleven years (1972-1982) was "pooled" into a single data set with 77 observations (seven industries, eleven years per industry). This pooled, cross-section/time-series data set formed the data sample used for the econometric analysis.

Prior to estimation of the econometric equations, two transformations of the data were made. First, as discussed in Chapter 3.0, the R&D

expenditures (both total and energy), sales, and oil price for each observation were converted from current, nominal dollars to real, inflation-adjusted, 1972 dollars.

Second, the real expenditures, sales, and oil price variables were transformed into natural logarithms. Thus, the estimating equations are:

(4.1) $\text{Log (Total R\&D Expenditures)} = a_1 + c_1 \text{ Log (Sales)} + c_1 \text{ Tax Credit}$

and,

(4.2) $\text{Log (Energy R\&D Expenditures)} = a_2 + b_2 \text{ Log (Sales)} + c_2 \text{ Log (Oil Price)} + d_2 \text{ Tax Credit}$

where all dollar amounts are measured in real 1972 dollars and where a_1, b_1, c_1, a_2, b_2, c_2, and d_2 are the coefficients to be estimated. Transformation of these variables to natural logarithms permits the coefficients b_1, b_2, and c_2 to be interpreted as elasticities: a one percent increase in real annual sales of an industry causes a b_1 percent increase in real total R&D expenditures in the industry (similarly for b_2 and real annual energy R&D expenditures), while a one percent increase in the real price of oil causes a c_2 percent increase in real annual energy R&D expenditures. Transformation to natural logarithms also allows the coefficients (c_1, d_2) of the tax credit dummy variable to be interpreted in the following manner: fully implementing the tax credit (changing the value of the tax credit dummy variable from zero to one) causes real annual total R&D expenditures to increase in an industry by:

(4.3) $(e^{c_1} - 1) \times 100$

percent, where "e" is Euler's constant (2.7183) and c^1 is the estimated coefficient in equation 4.1, and causes real annual energy R&D expenditures to increase in an industry by:

(4.4) $(e^{d_2} - 1) \times 100$

percent, where d_2 is the estimated coefficient in equation 4.2. The final data set (in logarithmic form) used in the econometric analysis is presented in Table A.5 of Appendix A.

Statistical Techniques

With the data sample just described, equations 4.1 and 4.2 can be estimated using ordinary least squares (OLS), the most basic of regression techniques. The "pooled" cross-section/time-series nature of the sample suggests, however, that more sophisticated econometric techniques may provide coefficient estimates that are more reliable or accurate. These "improvements" can be obtained because autocorrelation, heteroscedasticity, and contemporaneous correlation of residuals are frequently generated by pooled samples, and OLS coefficient estimates in the presence of these problems are inefficient. Other econometric techniques that "correct" these residuals problems have been developed. As discussed by Kmenta (1971), these methods generate coefficient estimates with lower variances (i.e., greater reliability, accuracy, and efficiency).

In fact, OLS was used to estimate equations 4.1 and 4.2, and the three residuals problems (i.e., autocorrelation, etc.) did appear, in a chronic fashion. The econometric technique to "correct" these problems was therefore employed to generate the results reported in the next section.

4.3.2 Impact Estimates

As discussed in section 4.3.1, two equations were econometrically estimated in the analysis. The first equation related the natural logarithm of real total R&D expenditures (by industry and year) to the natural logarithm of real sales and a dummy variable representing the availability of the R&D tax credit.

Coefficient estimates for this equation are presented in Table 4.1. The coefficient on the sales variable is 0.0642, so that a ten percent increase in real industrial sales, holding the tax credit variable constant, causes a .642 percent (ten times .0642) increase in real total R&D expenditures. The coefficient on the tax credit variable, 0.0869, implies that full implementation of the tax credit (i.e., changing the tax credit variable from zero to one), holding real sales constant, causes a 9.08

TABLE 4.1. The Effects of Sales and The Tax Credit on Total R&D Expenditures: Econometric Results

Log (Real Total R&D Expenditures) = 7.1471* + 0.0642* Log (Real Sales)
(0.2487) (0.0200)

+ 0.0869** Tax Credit
(0.0480)

Degrees of Freedom = 74
R2 = .978
R2 = .978
F = 1690.37

Standard errors in parentheses.
* Statistically significant from zero at 95 percent confidence level.
** Statistically significant from zero at 90 percent confidence level.

percent increase in real total R&D expenditures. The first of these coefficients is significantly different from zero, in a statistical sense, at the 95 percent confidence level; the second of these coefficients is significant at the 90 percent confidence level. The equation explain 97.8 percent of the variation in the dependent variable (as demonstrated by R2). The value of the F-statistic, 1690.37, is much greater than the critical point at the 99 percent confidence level, so that at the 99 percent confidence level the coefficients, taken as group, are statistically different from zero.

Coefficient estimates for the second equation are presented in Table 4.2. Overall, the equation performs quite well, explaining 97.3 percent of the variation in the dependent variable. The F-statistic again shows that the coefficients as a group are statistically significant from zero at the 99 percent confidence level. As expected, the coefficients on the real sales and real oil price variables are positive, and are statistically different from zero at the 95 percent confidence level. These two coefficients imply that a ten percent increase in real sales causes a 5.34

TABLE 4.2. The Effects of Sales, the Oil Price, and the Tax Credit on Energy R&D Expenditures: Econometric Results

Log (Real Energy R&D Expenditures) =	2.2286*	+ 0.5343* Log (Real Sales)	
	(1.1539)	(0.1059)	
	+ 0.4062* Log (Real Oil Price)		- 0.1488*** Tax Credit
	(0.0995)		(0.0933)

Degrees of Freedom = 73

R2 = .974

R2 = .973

F = 907.85

Standards errors in parentheses.
* Statistically significant from zero at 95 percent confidence level.
** Statistically significant from zero at 90 percent confidence level.
*** Statistically significant from zero at 85 percent confidence level.

percent increase in real energy R&D expenditures, while a ten percent increase in the current real oil price causes a 4.06 percent increase in real R&D energy expenditures.

The surprising result in this equation is that the coefficient on the tax credit is negative, and statistically significant from zero at the 85 percent confidence level. This coefficient implies that full implementation of the tax credit causes a 13.83 percent reduction in real industrial expenditures on energy R&D, holding real sales and the real oil price constant. In other words, after accounting for the lower real sales and real oil price that occurred in 1982 (vis-a-vis 1980 and 1981), real energy R&D expenditures were 13.8 percent lower in 1982 than they would have been in the absence of the R&D tax credit.

This result is puzzling. We are unable to develop any "reasonable" explanation for the tax credit having a negative impact on energy R&D expenditures while having a positive impact on total R&D expenditures.

Misspecification of the estimating equation, leading to biased estimates, is one possible explanation. If the equation is misspecified, it could be for one of two reasons: 1) the "right" variables were included, but not in the correct manner (e.g., natural logarithms should not be used, or the square of the oil price should also be included); or 2) a number of relevant variables were "left out" of the equation. A number of alternative functional forms were attempted, using the same set of variables; for example, real expenditures was regressed on real sales, the real oil price, and the tax credit, without the logarithmic transformation. Nearly all such attempts led to similar results, and all such equations had lower explanatory power (i.e., lower R^2). This causes one to reject, or at least suspect, the first potential source of misspecification, leaving the second as the suspected culprit. The discussion of the "ideal" model specification presented above supports this suspicion; from a theoretical standpoint, it would appear that a number of variables that probably do in fact influence energy R&D expenditures were not included in the estimated equation, due primarily to the lack of research resources.

REFERENCES

Council of Economic Advisers. 1984. Economic Report of the President. United States Government Printing Office, Washington, D. C.

Jorgenson, D. W. 1963. "Capital Theory and Investment Behavior." American Economic Review. 53(2): 247-259.

Kmenta. J. 1971. Elements of Econometrics. McMillan, New York.

National Science Foundation (NSF). 1984. R&D in Industry: 1982 Statistical Tables. NSF84-325. Washington, D. C.

U. S. Bureau of the Census. 1984. Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations. Second Quarter, 1984. Series QFR-84-2. U.S. Government Printing Office, Washington, D. C.

U. S. Bureau of the Census. 1978. Statistical Abstract of the United States: 1977. (98th edition.) Washington, D. C.

U. S. Bureau of the Census. 1984. Statistical Abstract of the United States: 1983. (104th edition.) Washington, D. C.

U. S. Department of Energy (DOE). 1984. Annual Energy Review 1983. DOE/EIA-0384(83). United States Government Printing Office, Washington, D. C.

APPENDIX A

DATA FOR ECONOMETRIC ANALYSIS

TABLE A.1. Total and Energy R&D Expenditures, by Industry (Millions of Current Dollars)

YEAR	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
CHEMICALS											
TOTAL	1930	2116	2450	2727	3017	32D2	3580	4038	4636	5625	6588
ENERGY	52	47	71	102	121	148	157	220	257	312	346
PETROLEUM											
TOTAL	469	499	623	693	767	918	1060	1262	1552	1748	1934
ENERGY	285	310	371	405	440	536	648	776	845	1067	1183
PRIMARY METALS											
TOTAL	276	308	358	443	507	538	560	634	728	878	1005
ENERGY	10	17	22	27	33	51	49	72	78	80	101
MACHINERY											
TOTAL	2159	2525	2984	3196	3487	3880	428	4825	5901	6818	7879
ENERGY	8	11	16	23	40	61	80	83	108	127	194
ELECTRICAL EQUIPMENT											
TOTAL	4680	4901	5011	5105	5636	5886	6507	7824	9175	10329	11925
ENERGY	194	318	389	464	585	650	714	843	917	908	873
AIRCRAFT AND MISSILES											
TOTAL	4948	5053	5324	5713	6339	7033	7536	8041	9198	11968	14045
ENERGY	65	111	142	134	110	165	283	372	446	412	352
PROFESSIONAL AND SCIENTIFIC INSTRUMENTS											
TOTAL	839	961	1075	1173	1331	1571	1998	2505	3029	3614	4047
ENERGY	12	13	14	14	10	17	27	28	45	53	76

SOURCE: National Science Foundation. 1984. R&D in Industry: 1982 Detailed Statistical Tables.

FROM: Pacific Northwest Laboratory. 1985. The Effects of the R&D Tax Credit on Energy R&D Expenditures: An Econometric Analysis.

TABLE A.2. General Economic Indicators by Industry and Year
(GNP, Sales and Profits in Millions of Current Dollars;
Oil Prices in Current Dollars per Barrel; Deflators are 1972=100)

YEAR	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
CHEMICALS											
IND. GNP DEFL.	100	106	104	124	129	134	139	144	159	178	197
SALES	69912	79332	86805	87629	101521	113389	124874	143947	162373	183189	181700
PETROLEUM											
IND. GNP DEFL.	1D0	118	135	148	186	179	190	217	244	244	305
SALES	78476	88153	117112	122985	137454	161708	180324	242595	326694	376232	341845
PRIMARY METALS											
IND. GNP DEFL.	1D0	107	139	147	151	165	183	196	217	237	239
SALES	52212	65814	79917	66869	76110	835D3	101644	121857	124178	135084	108375
MACHINERY											
IND. GNP DEFL.	100	103	118	126	130	143	149	158	170	177	184
SALES	42926	95183	89105	99371	104397	118826	139703	163539	174678	194503	182387
ELECTRICAL EQUIPMENT											
IND. GNP DEFL.	100	102	113	117	121	133	135	137	147	155	158
SALES	77387	87760	87227	78903	90654	100798	113749	131749	144307	156025	155443
AIRCRAFT AND MISSILES											
IND. GNP DEFL.	100	101	111	123	135	133	144	155	169	192	217
SALES	24948	28860	31324	118494	143517	161857	183202	195314	184183	203954	202120
PROFESSIONAL AND SCIENTIFIC INSTRUMENTS											
IND. GNP DEFL.	100	105	122	141	152	164	180	199	223	248	262
SALES	19517	20415	24603	23512	27060	30344	34158	37688	42796	47146	49183

SOURCES: U.S. Bureau of Census. 1984. Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations. Second Quarter, 1984. Series QFR-84-2. U.S. Government Printing Office, Washington, D.C.

U.S. Bureau of the Census. 1978. Statistical Abstract of the United States: 1977. (98th edition.) Washington, D.C.

FROM: Pacific Northwest Laboratory. 1985. The Effects of the R&D Tax Credit on Energy R&D Expenditures: An Econometric Analysis.

TABLE A.3. Oil Prices and GNP Implicit Price Deflator, by Year (Current Dollars; Index is 1972=100)

Year	Oil Price	Deflator
1972	3.67	100.00
1973	4.17	105.75
1974	7.17	115.08
1975	10.50	125.79
1976	13.48	132.34
1977	14.53	140.05
1978	14.57	150.42
1979	21.27	163.42
1980	33.89	178.64
1981	37.05	195.51
1982	33.55	207.23

SOURCES: Council of Economic Advisers. 1984. Economic Report of the President.

U.S. Department of Energy/Energy Information Administration. 1984. 1983 Annual Energy Review.

FROM: Pacific Northwest Laboratory. 1985. The Effects of the R&D Tax Credit on Energy R&D Expenditures: An Econometric Analysis.

TABLE A.4. Research and Development Expenditures and Sales by Industry and Type of R&D, and Oil Prices (Millions of 1972 Dollars; Oil Prices in 1972 Dollars per Barrel)

YEAR	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
CHEMICALS											
TOTAL	1932	1996	2130	2164	2321	2287	2387	2477	2604	2885	3137
ENERGY	52	44	62	81	93	106	105	135	144	160	165
SALES	69912	74841	83466	70783	78698	84682	89837	100242	102057	103022	92280
PETROLEUM											
TOTAL	468	470	541	550	590	656	707	774	872	896	921
ENERGY	285	292	333	321	338	383	432	476	475	547	563
SALES	78476	74706	86750	82874	74059	89988	95057	111641	133672	154130	111970
PRIMARY METALS											
TOTAL	277	290	311	352	390	384	373	389	409	450	479
ENERGY	10	16	19	21	25	36	33	44	44	41	48
SALES	52212	61508	57494	45489	50404	50608	55513	62299	57172	56997	45326
MACHINERY											
TOTAL	2158	2405	2596	2537	2682	2771	2850	2960	3315	3496	3752
ENERGY	8	10	14	18	31	44	53	51	61	65	92
SALES	42926	92411	75513	78991	80429	83037	93572	103244	102631	109579	99123
ELECTRICAL EQUIPMENT											
TOTAL	4680	4625	4357	4052	4335	4204	4338	4800	5154	5297	5679
ENERGY	194	300	338	368	450	464	476	517	515	466	416
SALES	77387	86039	77192	67094	74859	75674	84134	96308	98369	100726	98444
AIRCRAFT AND MISSILES											
TOTAL	4950	4766	4590	4534	4876	5024	5024	4933	5167	6137	6688
ENERGY	65	105	123	106	85	118	189	228	251	211	168
SALES	24948	28574	28219	95947	105917	121150	127135	125523	108407	106060	92971
PROFESSIONAL AND SCIENTIFIC INSTRUMENTS											
TOTAL	838	907	935	931	1024	1122	1332	1537	1702	1853	1927
ENERGY	12	12	12	11	8	12	18	17	25	27	36
SALES	19517	19443	20232	21872	23695	25781	27239	28487	27433	28453	28512
OIL PRICES	3.67	3.93	6.24	6.66	6.80	6.82	7.07	8.75	13.61	17.61	14.87

SOURCES: Tables A.1, A.2, and A.3.

FROM: Pacific Northwest Laboratory. 1985. The Effects of the R&D Tax Credit on Energy R&D Expenditures: An Econometric Analysis.

TABLE A.5. Data Set for Econometric Analysis
(R&D Expenditures in Logarithms of Millions of 1972 Dollars;
Oil Prices in Logarithms of 1972 Dollars per Barrel)

YEAR	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
CHEMICALS											
TOTAL	3.286	3.300	3.328	3.335	3.336	3.359	3.378	3.394	3.416	3.460	3.497
ENERGY	1.716	1.647	1.791	1.908	1.969	2.024	2.020	2.130	2.160	2.204	2.217
SALES	4.845	4.874	4.921	4.850	4.896	4.928	4.953	5.001	5.009	5.013	4.965
PETROLEUM											
TOTAL	2.670	2.672	2.733	2.740	2.771	4.870	2.849	2.889	2.940	2.952	2.964
ENERGY	2.455	2.466	2.509	2.507	2.530	2.583	2.635	2.678	2.676	2.738	2.751
SALES	4.895	4.873	4.938	4.918	4.870	4.954	4.978	5.048	5.126	5.188	5.049
PRIMARY METALS											
TOTAL	2.442	2.462	2.493	2.546	2.591	2.585	2.572	2.590	2.612	2.653	2.680
ENERGY	1.000	1.205	1.232	1.331	1.404	1.561	1.514	1.645	1.642	1.613	1.682
SALES	4.718	4.789	4.759	4.658	4.702	4.704	4.744	4.794	4.757	4.756	4.656
MACHINERY											
TOTAL	3.334	3.331	3.411	3.404	3.429	3.443	2.455	3.471	3.521	3.544	3.574
ENERGY	0.903	1.016	1.143	1.261	1.488	1.639	1.727	1.707	1.783	1.814	1.966
SALES	4.633	4.966	4.878	4.898	4.905	4.919	4.971	5.014	5.011	5.040	4.996
ELECTRICAL EQUIPMENT											
TOTAL	3.670	3.665	3.639	3.608	3.637	3.624	3.637	3.681	3.712	3.724	3.754
ENERGY	2.288	2.477	2.529	2.566	2.653	2.667	2.678	2.714	2.712	2.668	2.619
SALES	4.889	4.935	4.887	4.827	4.874	4.879	4.925	4.984	4.993	5.003	4.993
AIRCRAFT AND MISSILES											
TOTAL	3.695	3.673	3.662	3.656	3.688	3.701	3.701	3.693	3.713	3.788	3.825
ENERGY	1.813	2.020	2.092	2.027	1.927	2.071	2.276	2.384	2.399	2.325	2.224
SALES	4.397	4.456	4.451	4.982	5.025	5.083	5.104	5.099	5.035	5.026	4.968
PROFESSIONAL AND SCIENTIFIC INSTRUMENTS											
TOTAL	2.923	2.957	2.971	2.969	3.010	3.050	3.125	3.187	3.231	3.268	3.285
ENERGY	1.079	1.088	1.085	1.046	0.886	1.084	1.255	1.235	1.403	1.434	1.559
SALES	4.290	4.288	4.306	4.340	4.375	4.411	4.435	4.455	4.438	4.454	4.455
OIL PRICES	0.565	0.594	0.795	0.921	1.016	1.016	0.987	1.124	1.280	1.279	1.204

SOURCE: Table A.4.

FROM: Pacific Northwest Laboratory. 1985. The Effects of the R&D Tax Credit on Energy R&D Expenditures: An Econometric Analysis.

APPENDIX B

EXCERPTS FROM THE ECONOMIC RECOVERY TAX ACT OF 1981

97TH CONGRESS, 1st Session | HOUSE OF REPRESENTATIVES | REPORT No. 97-215

ECONOMIC RECOVERY TAX ACT OF 1981

AUGUST 1, 1981.—Ordered to be printed

Mr. ROSTENKOWSKI, from the committee of conference, submitted the following

CONFERENCE REPORT

(To accompany H.R. 4242)

The committee of conference on the disagreeing votes of the two Houses on the amendment of the Senate to the bill (H.R. 4242) to amend the Internal Revenue Code of 1954 to encourage economic growth through reductions in individual income tax rates, the expensing of depreciable property, incentives for small businesses, and incentives for savings, and for other purposes, having met, after full and free conference, have agreed to recommend and do recommend to their respective Houses as follows:

That the House recede from its disagreement to the amendment of the Senate and agree to the same with an amendment as follows:

In lieu of the matter proposed to be inserted by the Senate amendment insert the following:

SECTION 1. SHORT TITLE; TABLE OF CONTENTS; AMENDMENT OF 1954 CODE.

(a) SHORT TITLE.—This Act may be cited as the "Economic Recovery Tax Act of 1981".

(b) TABLE OF CONTENTS.—

TITLE VIII—MISCELLANEOUS PROVISIONS

Subtitle A—Extensions

Subtitle B—Tax-Exemption Obligations

Subtitle C—Excise Taxes

(c) AMENDMENT OF 1954 CODE.—Except as otherwise expressly provided, whenever in this Act an amendment or repeal is expressed in terms of an amendment to, or repeal of, a section or other provision, the reference shall be considered to be made to a section or other provision of the Internal Revenue Code of 1954.

Subtitle C—Incentives for Research and Experimentation

SEC. 221. CREDIT FOR INCREASING RESEARCH ACTIVITIES.

(a) GENERAL RULE.—Subpart A of part IV of subchapter A of chapter 1 (relating to credits allowable) is amended by inserting after section 44E the following new section:

"SEC. 44F. CREDIT FOR INCREASING RESEARCH ACTIVITIES.

"(a) GENERAL RULE.—There shall be allowed as a credit against the tax imposed by this chapter for the taxable year an amount equal to 25 percent of the excess (if any) of—

"(1) the qualified research expenses for the taxable year, over

"(2) the base period research expenses.

"(b) QUALIFIED RESEARCH EXPENSES.—For purposes of this section—

"(1) QUALIFIED RESEARCH EXPENSES.—The term 'qualified research expenses' means the sum of the following amounts which are paid or incurred by the taxpayer during the taxable year in carrying on any trade or business of the taxpayer—

"(A) in-house research expenses, and

"(B) contract research expenses.

"(2) IN-HOUSE RESEARCH EXPENSES.—

"(A) IN GENERAL.—The term 'in-house research expenses' means—

"(i) any wages paid or incurred to an employee for qualified services performed by such employee,

"(ii) any amount paid or incurred for supplies used in the conduct of qualified research, and

"(iii) any amount paid or incurred to another person for the right to use personal property in the conduct of qualified research.

"(B) QUALIFIED SERVICES.—The term 'qualified services' means services consisting of—

"(i) engaging in qualified research, or

"(ii) engaging in the direct supervision or direct support of research activities which constitute qualified research.

If substantially all of the services performed by an individual for the taxpayer during the taxable year consists of services meeting the requirements of clause (i) or (ii), the term 'qualified services' means all of the services performed by such individual for the taxpayer during the taxable year.

"(C) SUPPLIES.—The term 'supplies' means any tangible property other than—

"(i) land or improvements to land, and

"(ii) property of a character subject to the allowance for depreciation.

"(D) WAGES.—

"(i) IN GENERAL.—The term 'wages' has the meaning given such term by section 3401(a).

"(ii) SELF-EMPLOYED INDIVIDUALS AND OWNER-EMPLOYEES.—In the case of an employee (within the meaning of section 401(c)(1)), the term 'wages' includes

the earned income (as defined in section 401(c)(2)) of such employee.

"(iii) EXCLUSION FOR WAGES TO WHICH NEW JOBS OR WIN CREDIT APPLIES.—The term 'wages' shall not include any amount taken into account in computing the credit under section 40 or 44B.

"(3) CONTRACT RESEARCH EXPENSES.—

"(A) IN GENERAL.—The term 'contract research expenses' means 65 percent of any amount paid or incurred by the taxpayer to any person (other than an employee of the taxpayer) for qualified research.

"(B) PREPAID AMOUNTS.—If any contract research expenses paid or incurred during any taxable year are attributable to qualified research to be conducted after the close of such taxable year, such amount shall be treated as paid or incurred during the period during which the qualified research is conducted.

"(c) BASE PERIOD RESEARCH EXPENSES.—For purposes of this section—

"(1) IN GENERAL.—The term 'base period research expenses' means the average of the qualified research expenses for each year in the base period.

"(2) BASE PERIOD.—

"(A) IN GENERAL.—For purposes of this subsection, the term 'base period' means the 3 taxable years immediately preceding the taxable year for which the determination is being made (hereinafter in this subsection referred to as the 'determination year').

"(B) TRANSITIONAL RULES.—Subparagraph (A) shall be applied—

"(i) by substituting 'first taxable year' for '3 taxable years' in the case of the first determination year ending after June 30, 1981, and

"(ii) by substituting '2' for '3' in the case of the second determination year ending after June 30, 1981.

"(3) MINIMUM BASE PERIOD RESEARCH EXPENSES.—In no event shall the base period research expenses be less than 50 percent of the qualified research expenses for the determination year.

"(d) QUALIFIED RESEARCH.—For purposes of this section the term 'qualified research' has the same meaning as the term research or experimental has under section 174, except that such term shall not include—

"(1) qualified research conducted outside the United States,

"(2) qualified research in the social sciences or humanities, and

"(3) qualified research to the extent funded by any grant, contract, or otherwise by another person (or any governmental entity).

"(e) CREDIT AVAILABLE WITH RESPECT TO CERTAIN BASIC RESEARCH BY COLLEGES, UNIVERSITIES, AND CERTAIN RESEARCH ORGANIZATIONS.—

"(1) IN GENERAL.—65 percent of any amount paid or incurred by a corporation (as such term is defined in section 170(e)(4)(D)) to any qualified organization for basic research to be performed by such organization shall be treated as contract research ex-

penses. The preceding sentence shall apply only if the amount is paid or incurred pursuant to a written research agreement between the corporation and the qualified organization.

"(2) QUALIFIED ORGANIZATION.—For purposes of this subsection, the term 'qualified organization' means—

"(A) any educational organization which is described in section 170(b)(1)(A)(ii) and which is an institution of higher education (as defined in section 3304(f)), and

"(B) any other organization which—

"(i) is described in section 501(c)(3) and exempt from tax under section 501(a),

"(ii) is organized and operated primarily to conduct scientific research, and

"(iii) is not a private foundation.

"(3) BASIC RESEARCH.—The term 'basic research' means any original investigation for the advancement of scientific knowledge not having a specific commercial objective, except that such term shall not include—

"(A) basic research conducted outside the United States, and

"(B) basic research in the social sciences or humanities.

"(4) SPECIAL RULES FOR GRANTS TO CERTAIN FUNDS.—

"(A) IN GENERAL.—For purposes of this subsection, a qualified fund shall be treated as a qualified organization and the requirements of paragraph (1) that the basic research be performed by the qualified organization shall not apply.

"(B) QUALIFIED FUND.—For purposes of subparagraph (A), the term 'qualified fund' means any organization which—

"(i) is described in section 501(c)(3) and exempt from tax under section 501(a) and is not a private foundation,

"(ii) is established and maintained by an organization established before July 10, 1981, which meets the requirements of clause (i),

"(iii) is organized and operated exclusively for purposes of making grants pursuant to written research agreements to organizations described in paragraph (2)(A) for purposes of basic research, and

"(iv) makes an election under this paragraph.

"(C) EFFECT OF ELECTION.—

"(i) IN GENERAL.—Any organization which makes an election under this paragraph shall be treated as a private foundation for purposes of this title (other than section 4940, relating to excise tax based on investment income).

"(ii) ELECTION REVOCABLE ONLY WITH CONSENT.—An election under this paragraph, once made, may be revoked only with the consent of the Secretary.

"(f) SPECIAL RULES.—For purposes of this section—

"(1) AGGREGATION OF EXPENDITURES.—

"(A) CONTROLLED GROUP OF CORPORATIONS.—In determining the amount of the credit under this section—

"(i) all members of the same controlled group of corporations shall be treated as a single taxpayer, and

"(ii) the credit (if any) allowable by this section to each such member shall be its proportionate share of the increase in qualified research expenses giving rise to the credit.

"(B) COMMON CONTROL.—Under regulations prescribed by the Secretary, in determining the amount of the credit under this section—

"(i) all trades or businesses (whether or not incorporated) which are under common control shall be treated as a single taxpayer, and

"(ii) the credit (if any) allowable by this section to each such person shall be its proportionate share of the increase in qualified research expenses giving rise to the credit.

The regulations prescribed under this subparagraph shall be based on principles similar to the principles which apply in the case of subparagraph (A).

"(2) ALLOCATIONS.—

"(A) PASSTHROUGH IN THE CASE OF SUBCHAPTER S CORPORATIONS, ETC.—Under regulations prescribed by the Secretary, rules similar to the rules of subsections (d) and (e) of section 52 shall apply.

"(B) ALLOCATION IN THE CASE OF PARTNERSHIPS.—In the case of partnerships, the credit shall be allocated among partners under regulations prescribed by the Secretary.

"(3) ADJUSTMENTS FOR CERTAIN ACQUISITIONS, ETC.—Under regulations prescribed by the Secretary—

"(A) ACQUISITIONS.—If, after June 30, 1980, a taxpayer acquires the major portion of a trade or business of another person (hereinafter in this paragraph referred to as the 'predecessor') or the major portion of a separate unit of a trade or business of a predecessor, then, for purposes of applying this section for any taxable year ending after such acquisition, the amount of qualified research expenses paid or incurred by the taxpayer during periods before such acquisition shall be increased by so much of such expenses paid or incurred by the predecessor with respect to the acquired trade or business as is attributable to the portion of such trade or business or separate unit acquired by the taxpayer.

"(B) DISPOSITIONS.—If, after June 30, 1980—

"(i) a taxpayer disposes of the major portion of any trade or business or the major portion of a separate unit of a trade or business in a transaction to which subparagraph (A) applies, and

"(ii) the taxpayer furnished the acquiring person such information as is necessary for the application of subparagraph (A),

then, for purposes of applying this section for any taxable year ending after such disposition, the amount of qualified research expenses paid or incurred by the taxpayer during periods before such disposition shall be decreased by so much of such expenses as is attributable to the portion of such trade or business or separate unit disposed of by the taxpayer.

"(C) INCREASE IN BASE PERIOD.—If during any of the 3 taxable years following the taxable year in which a disposition to which subparagraph (B) applies occurs, the disposing taxpayer (or a person with whom the taxpayer is required to aggregate expenditures under paragraph (1)) reimburses the acquiring person (or a person required to so aggregate expenditures with such person) for research on behalf of the taxpayer, then the amount of qualified research expenses of the taxpayer for the base period for such taxable year shall be increased by the lesser of—

"(i) the amount of the decrease under subparagraph (B) which is allocable to such base period, or

"(ii) the product of the number of years in the base period, multiplied by the amount of the reimbursement described in this subparagraph.

"(4) SHORT TAXABLE YEARS.—In the case of any short taxable year, qualified research expenses shall be annualized in such circumstances and under such methods as the Secretary may prescribe by regulation.

"(5) CONTROLLED GROUP OF CORPORATIONS.—The term 'controlled group of corporations' has the same meaning given to such term by section 1563(a), except that—

"(A) 'more than 50 percent' shall be substituted for 'at least 80 percent' each place it appears in section 1563(a)(1), and

"(B) the determination shall be made without regard to subsections (a)(4) and (e)(3)(C) of section 1563.

"(g) LIMITATION BASED ON AMOUNT OF TAX.—

"(1) LIABILITY FOR TAX.—

"(A) IN GENERAL.—Except as provided in subparagraph (B), the credit allowed by subsection (a) for any taxable year shall not exceed the amount of the tax imposed by this chapter reduced by the sum of the credits allowable under a section of this part having a lower number or letter designation than this section, other than the credits allowable by sections 31, 39, and 43. For purposes of the preceding sentence, the term 'tax imposed by this chapter' shall not include any tax treated as not imposed by this chapter under the last sentence of section 53(a).

"(B) SPECIAL RULE FOR PASSTHROUGH OF CREDIT.—In the case of an individual who—

"(i) owns an interest in an unincorporated trade or business,

"(ii) is a partner in a partnership,

"(iii) is a beneficiary of an estate or trust, or

"(iv) is a shareholder in an electing small business corporation (within the meaning of section 1371(b)),

the credit allowed by subsection (a) for any taxable year shall not exceed the lesser of the amount determined under subparagraph (A) for the taxable year or an amount (separately computed with respect to such person's interest in such trade or business or entity) equal to the amount of tax attributable to that portion of a person's taxable income which is allocable or apportionable to the person's interest in such trade or business or entity.

"(2) CARRYBACK AND CARRYOVER OF UNUSED CREDIT.—

"(A) ALLOWANCE OF CREDIT.—If the amount of the credit determined under this section for any taxable year exceeds the limitation provided by paragraph (1) for such taxable year (hereinafter in this paragraph referred to as the 'unused credit year'), such excess shall be—

"(i) a research credit carryback to each of the 3 taxable years preceding the unused credit year, and

"(ii) a research credit carryover to each of the 15 taxable years following the unused credit year,

and shall be added to the amount allowable as a credit by this section for such years. If any portion of such excess is a carryback to a taxable year beginning before July 1, 1981, this section shall be deemed to have been in effect for such taxable year for purposes of allowing such carryback as a credit under this section. The entire amount of the unused credit for an unused credit year shall be carried to the earliest of the 18 taxable years to which (by reason of clauses (i) and (ii)) such credit may be carried, and then to each of the other 17 taxable years to the extent that, because of the limitation contained in subparagraph (B), such unused credit may not be added for a prior taxable year to which such unused credit may be carried.

"(B) LIMITATION.—The amount of the unused credit which may be added under subparagraph (A) for any preceding or succeeding taxable year shall not exceed the amount by which the limitation provided by paragraph (1) for such taxable year exceeds the sum of—

"(i) the credit allowable under this section for such taxable year, and

"(ii) the amounts which, by reason of this paragraph, are added to the amount allowable for such taxable year and which are attributable to taxable years preceding the unused credit year."

(b) TECHNICAL AMENDMENTS RELATED TO CARRYOVER AND CARRYBACK OF CREDITS.—

(1) CARRYOVER OF CREDIT.—

(A) Subparagraph (A) of section 55(c)(4) (relating to carryover and carryback of certain credits) is amended by striking out "section 44E(e)(1)" and inserting in lieu thereof "section 44F(g)(1), 44E(e)(1)".

(B) Subsection (c) of section 381 (relating to items of the distributor or transferor corporation) is amended by adding at the end thereof the following new paragraph:

"(28) CREDIT UNDER SECTION 44F.—The acquiring corporation shall take into account (to the extent proper to carry out the purposes of this section and section 44F, and under such regulations as may be prescribed by the Secretary) the items required to be taken into account for purposes of section 44F in respect of the distributor or transferor corporation."

(C) Section 383 (relating to special limitations on unused investment credits, work incentive program credits, new employee credits, alcohol fuel credits, foreign taxes, and capital losses), as in effect for taxable years beginning after June 30, 1982, is amended—

(i) by inserting "to any unused credit of the corporation under section 44F(g)(2)," after "44E(e)(2),"; and

(ii) by inserting "RESEARCH CREDITS," after "ALCOHOL FUEL CREDITS," in the section heading.

(D) Section 383 (as in effect on the day before the date of the enactment of the Tax Reform Act of 1976) is amended—

(i) by inserting "to any unused credit of the corporation which could otherwise be carried forward under section 44F(g)(2)," after "44E(e)(2),", and

(ii) by inserting "RESEARCH CREDITS," after "ALCOHOL FUEL CREDITS," in the section heading.

(E) The table of sections for part V of subchapter C of chapter 1 is amended by inserting "alcohol fuel credits, research credits," after "new employee credits," in the item relating to section 383.

(2) CARRYBACK OF CREDIT.—

(A) Subparagraph (C) of section 6511(d)(4) (defining credit carryback) is amended by striking out "and new employee credit carryback" and inserting in lieu thereof "new employee credit carryback, and research credit carryback".

(B) Section 6411 (relating to quick refunds in respect of tentative carryback adjustments) is amended—

(i) by striking out "or unused new employee credit" each place it appears and inserting in lieu thereof "unused new employee credit, or unused research credit";

(ii) by inserting "by a research credit carryback provided in section 44F(g)(2)," after "53(b)," in the first sentence of subsection (a);

(iii) by striking out "or a new employee credit carryback from" each place it appears and inserting in lieu thereof "a new employee credit carryback, or a research credit carryback from"; and

(iv) by striking out "work incentive program carryback)" and inserting in lieu thereof "work incentive program carryback, or, in the case of a research credit carryback, to an investment credit carryback, a work incentive program carryback, or a new employee credit carryback)".

(c) OTHER TECHNICAL AND CLERICAL AMENDMENTS.—

(1) Subsection (b) of section 6096 (relating to designation of income tax payments to Presidential Election Campaign Fund) is amended by striking out "and 44E" and inserting in lieu thereof "44E, and 44F".

(2) The table of sections for subpart A of part IV of subchapter A of chapter 1 is amended by inserting after the item relating to section 44E the following new item:

"Sec. 44F. Credit for increasing research activities."

(d) EFFECTIVE DATE.—

(1) IN GENERAL.—The amendments made by this section shall apply to amounts paid or incurred after June 30, 1981, and before January 1, 1986.

(2) TRANSITIONAL RULE.—

(A) IN GENERAL.—If, with respect to the first taxable year to which the amendments made by this section apply and

which ends in 1981 or 1982, the taxpayer may only take into account qualified research expenses paid or incurred during a portion of such taxable year, the amount of the qualified research expenses taken into account for the base period of such taxable year shall be the amount which bears the same ratio to the total qualified research expenses for such base period as the number of months in such portion of such taxable year bears to the total number of months in such taxable year. A similar rule shall apply in the case of a taxpayer's first taxable year ending after December 31, 1985.

(B) DEFINITIONS.—For purposes of the preceding sentence, the terms "qualified research expenses" and "base period" have the meanings given to such terms by section 44F of the Internal Revenue Code of 1954 (as added by this section).

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