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Do tax credits stimulate R&D spending? The effect of the R&D tax credit in its first decade ☆

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ABSTRACT

This paper examines the impact of the U.S. federal R&D tax credit between 1981–1991 using confidential IRS data from corporate tax returns. The empirical analysis makes two key advances on previous work. First, it implements a new instrumental variables (IV) strategy based on tax changes that directly addresses the simultaneity of R&D spending and marginal credit rates. Second, the analysis makes use of new restricted-access IRS corporate return data describing R&D expenditures. Estimates imply that a10% reduction in the user cost of R&D leads the average firm to increase its research intensity—the ratio of R&D spending to sales—by 19.8% in the short-run. Long-run estimates imply that the average firm faces adjustment costs and increases spending over time, though small and young firms show evidence of reversing initial increases. Analysis of the components of qualified research shows that wages and supplies account for the bulk of the increase in research spending. Elasticities of qualified and total research intensities from a smaller sample suggest firms respond to user cost changes largely by increasing their qualified spending, meaning that the type of R&D the federal credit deems qualified research is an important margin on which the credit affects firm behavior.

1. Introduction

How much the U.S. spends on R&D—relative to past levels and relative to other nations—attracts considerable interest from industry leaders, policymakers and researchers. Business has long performed the lion's share of U.S. R&D and has been the primary funder since the late 1970s. Nonetheless, the federal government plays a significant role in promoting private R&D. Federal support is motivated by both potential spillovers from privately conducted R&D and a notion that R&D affords U.S. firms a competitive advantage in global markets. In an attempt to stanch a decade-long decline in the GDP-share of private R&D, Congress adopted a tax credit for R&D expenditures in 1981. Today, the Research and Experimentation Credit (R&D Credit) awards firms that increase their research spending a tax credit of up to 20% of their expenditures, amounting to more than $8 billion in research credits annually (OTP, 2011). This paper uses new data and an instrumental variables strategy to assess how effectively the R&D tax credit, along with expensing provisions, increases corporate research spending.

Effective R&D tax credit rates have varied over time due to legislative changes and—thanks to the incremental nature of the credit—changes in R&D spending due to cyclical and firm-specific factors. In its earliest incarnation, the credit's design undermined its statutory rate of 25%. Between 1981 and 1984 effective credit rates averaged less than one-tenth of the statutory rate (Altshuler, 1988). Early studies of the credit's effectiveness suggested that the subsidy did little to increase corporate research spending (Eisner et al., 1984) and (Mansfield, 1986), while later studies, most notably Hall (1993b) and Hines (1993) found much higher elasticities—well exceeding unity in both the short- and long-run. Hall and Van Reenen (2000) provide an excellent review of prior work on the U.S. federal credit

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and other national credits. These studies of the credit's effectiveness employ publicly available data.[1]

More recent work examining the impact of state tax credits and international experiences has found more modest elasticities—particularly in the short-run. In the preferred dynamic specification of their cross-country analysis, Bloom et al. (2002) estimate a −0.14 short-run elasticity and a long-run elasticity of −1.09.[2] Wilson (2009) uses variation in state tax preferences for R&D to estimate the impact of a state's R&D policy on both R&D conducted within that state and on R&D conducted in neighboring states.[3] His analysis of state aggregate data yields elasticity estimates of −0.17 in the short-run and −0.68 in the long-run. In both of these studies some countries and states have incremental R&D credit regimes, where high spending firms receive higher credit rates. The authors assume that all R&D subject to incremental R&D tax credits receives the highest statutory rate, abstracting from the simultaneity between R&D spending and R&D user costs because they use aggregate data.

This paper examines the impact of federal tax advantages for R&D between the inception of the R&D tax credit in 1981 and 1991, the last year prior to the credit's first lapse in 1992.[4] The identification strategy hinges on tax policy changes that were common in the credit's early years but absent more recently. As the last change in the major provisions of the credit occurred in 1991, the sample ends in 1991. The empirical analysis presented here makes two main contributions. First, it implements a new instrumental variables (IV) strategy that directly addresses the simultaneity of R&D spending and marginal credit rates. Second, it makes use of new restricted-access IRS Statistics of Income (SOI) corporate return data describing R&D expenditures. During its first decade the R&D credit underwent several substantial revisions that allow for an instrumental variables strategy based on tax changes. As explained in more detail in section two, the structure of the R&D tax credit makes a firm's marginal tax subsidy difficult to infer from annual R&D spending as reported in its public financial filings. Using IRS tax data is crucial to accurately measure a firm's marginal research credit rate. I compare tax subsidy measures constructed from previously used public financial filing data to tax subsidy measures constructed using IRS SOI data. The measures differ and the differences vary from year to year, suggesting that the public data could lead to biased elasticity estimates. The IRS SOI data also describe private firms, including small firms not found among the public firms studied in prior research that relied on data compiled from financial filings. The combination of accurately measured marginal R&D tax credit rates and a new IV strategy allows for the unbiased estimation of the impact of the R&D tax credit on R&D expenditures.

Using new IRS SOI data and an IV strategy based on tax law changes to disentangle any potential simultaneity between R&D spending and its user cost, I estimate the user cost elasticity for R&D expenditures. Estimates imply that a 10% reduction in the user cost of R&D leads the average firm to increase its research intensity—the ratio of R&D spending to sales—by roughly 20% in the short-run. Long-run estimates imply that the average firm faces adjustment costs and increases spending over time, though small and young firms show evidence of reversing initial increases. IRS SOI data report the different components of R&D spending separately. Analysis of the components shows that wages and supplies account for the bulk of the increase in research spending. Elasticities of qualified and total (qualified and non-qualified) research intensities from a smaller sample suggest that firms respond to changes in the user cost largely by increasing their qualified spending, meaning that the type of R&D the federal credit deems qualified research is an important margin on which the credit affects firm behavior.

The paper proceeds as follows. Section 2 overviews the key provisions of the R&D tax credit and describes the restricted access IRS SOI data used in this study. The empirical model is laid out and estimation strategy is detailed in Section 3. Section 4 presents the results of the regression analysis. Section 5 assesses the policy implications and concludes.

2. Measuring R&D user costs and R&D expenditures

2.1. Federal tax subsidies and the user cost of R&D

In addition to direct federal support for R&D, such as research performed by federal agencies and grants for basic and applied research, the federal government provides indirect support of private research through the tax code. Federal tax law offers two incentives for private R&D: a deduction for qualified research spending under Section 174 of the Internal Revenue Code (IRC), and a non-refundable tax credit for qualified research spending above a base amount under IRC Section 41. These two tax advantages reduce the after-tax price of R&D investment; they are jointly referred to here as the "R&D tax credit" and their combined effect on the after-tax price of and impact on R&D spending is assessed.

The tax credit is incremental in nature; it aims to reward research expenditures in excess of what the firm would have spent in the absence of the credit. As such, the credit defines a firm's base level of R&D spending and awards a tax credit equal to a fraction of spending above that base level. Originally, the credit was equal to 25% of qualified research expenditures (QREs)—which are expenses incurred in research undertaken to discover knowledge that is technological in nature for a new or improved business purpose—above the firm-specific base amount. A firm's base was its average nominal qualified R&D spending in the previous 3 years or 50% of current spending, whichever was greater. Because a firm's base was a moving average of its past spending, increased qualified research spending in the current year raised the firm's base by one-third of the increase in each of the subsequent 3 years. This 'claw-back' muted the credit's incentive effects; some firms were even left with negative marginal credit rates.

The tax credit was extended and its provisions were amended by several legislative acts after its introduction in 1981; they are detailed in Table 1. The credit was revamped in 1989 to address the dynamic disincentives for current qualified R&D spending created by the claw-back provision. The legislative overhaul altered the base formula, replacing the moving average with a base unrelated to recent R&D spending. The new formula for the base was the greater of 50% of current QREs and the product of the firm's average gross

[1] Hall (1993b) employs data from financial filings and using cross-time within-firm variation in a log first-difference specification finds a short-run elasticity of −1.5 and a long-run elasticity of −2.7. Hall addresses the endogeneity of the user cost using lags of the user cost and other right-hand side variables as instruments. Hines (1993) explores the effect of changes in the allocation rules of R&D expensing on the R&D activity of multinational firms, exploiting variation in the fraction of U.S. R&D expenses firms can deduct against U.S. income to estimate the response of R&D spending to its after-tax price. His short-run estimates range from −1.2 to −1.6 and long-run estimates range from −1.3 to −2.0. Although the changes in the allocation rules are conceivably exogenous, This tack hinges on differences between firms with and without foreign tax credits—an experiment that is different from the changes in the main statutory provisions of the R&D tax credit examined here.

[2] Because the user cost of R&D is a function of the interest rate, which is positively correlated with R&D spending, Bloom et al worry that OLS estimates of the user cost elasticity would be biased upward. They instrument the R&D user costs with the tax component of the user cost to address this endogeneity issue as well as attenuation bias concerns.

[3] Using state aggregate data he finds that R&D spending is negatively impacted by tax preferences in other states, suggesting that firms shift R&D to proximate states with lower R&D user costs. The magnitude of this response nearly offsets the in-state response of R&D to changes in the in-state user cost.

[4] Limiting the sample to the years before the first (of many) lapses in the credit also limits the sample to years when firms' expectations regarding the credit were similarly stable; the first lapse in 1992 and subsequent lapses likely affected firm expectations of the after-tax user cost of R&D.