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Firm size and R&D tax incentives

Tadahisa Koga *

National Institute of Science and Technology Policy, 1-3-2 Kasumi-gaseki, Chiyoda-ku, Tokyo 100-0013, Japan

Abstract

This paper examines the effectiveness of R&D tax credits using data on 904 Japanese manufacturing firms over 10 years (1989–1998). I find evidence that tax price elasticity is about −0.68 when estimating it for all firms. This is smaller than those of previous studies, such as Hall (1993. R&D tax policy during the 1980s: Success or failure? In: Potarba, J. (Eds.), Tax Policy and The Economy, vol.7. The MIT Press, Boston, MA) and Bloom et al. (1999. Do R&D tax credits work?: Evidence from an international panel of countries 1979–94. IFS Working Paper No. W99/8). However, considering the firm's size, the tax price elasticity is −1.03 in large firms. This means that R&D tax credit is effective in increasing R&D investment, especially in such firms.

JEL classification: CB1

Keywords: R&D tax credit; Firm size; Japan

1. Introduction

In Japan, large firms share the greater part of industrial R&D. Table 1 shows the amounts of industrial R&D conducted in different classes. For example, in 1998, firms whose capitals were over 10 billion yen spent 7811 billion yen in R&D investments. This amounts to 72.3% of total industrial R&D investments. Table 1 also shows that the shares of these firms are very stable over time. From these facts, it seems that large firms play main roles in conducting industrial R&D.

The tax law equally treats R&D investments of firms whose capitals are over 100 million yen. Indeed, R&D tax credits are given to all the firms that satisfy necessary conditions referred later. However the facts shown in Table 1 imply that the response of R&D investment to fiscal incentives might differ according to firm size. Thus this paper examines whether R&D tax credits work more favorably for large firms than for medium firms.

In Western countries, there are many empirical studies that have examined the effectiveness of tax incentives for R&D investment. The previous studies, which were

Table 1
Industrial R&D and firm size (billion yen)

Firm size	1991	1992	1993	1994	1995	1996	1997	1998
10 million –100 million	391	373.1	311.2	349.6	371.2	406.3	384.4	489.6
100 million–1 billion	558	576	579.5	597.6	613	602.8	747.2	831.7
1 billion–10 billion	1392	1402	1364	1342	1393	1467	1537	1536
Over 10 billion	7373	7189	6773	6658	6955	7374	7952	7811
Total	9743	9561	9054	8980	9396	9881	10658	10800

Source: *Report on the Survey of Research and Development* (1989–1999).

* Tel .: +81-3-3581-2396; fax: +81-3-3500-5240.
E-mail address: tdkoga@nistep.go.jp (T. Koga).

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conducted mainly in the early 1980s, concluded that R&D tax credit did not promote company financed R&D efficiently[1] On the contrary, recent studies have shown that R&D is considerably sensitive to its after-tax price. For example, Hall (1993) and Hines (1993, 1994) consider the response of R&D to its price using data of US firms, and find that tax price elasticity is around unity. Mamuneas and Nadiri (1996) and Bloom et al. (1997, 1999) reach almost the same results based on industry level or country level data. These studies suggest that tax incentives are effective in increasing corporate financed R&D. These previous studies, however, do not consider the relationship between the effectiveness of R&D tax credit and firm size.

The results of this paper are summarized as follows. Tax price elasticity of R&D is −0.68 when estimating it for all firms. This is much smaller than the estimated results of western studies. However, considering firm size, the tax price elasticity of large firms becomes −1.03, which is almost the same as those of previous studies. This means that R&D tax credits are effective in increasing R&D investment, especially in large firms.

The contents of this paper are as follows. Next section briefly refers to R&D tax credit in Japan. Section 3 discusses the econometric model that is the basis of the empirical analysis. In Section 4 I divide the samples into two groups based on firm size, and estimate the tax price elasticity in each group. Finally, Section 5 makes some conclusions.

2. R&D tax credit in Japan

R&D tax credit was introduced to promote industrial R&D in 1967. The special feature of this credit is in the fact that R&D tax credit is calculated by incremental base method. Under the incremental base, firms whose R&D expenses in any given year exceed 'the comparative R&D expenses' can receive the R&D tax credits. The amount of the tax credits is calculated as 20% of the difference between the R&D expenses in a particular year and the comparative R&D expenses[2]. The comparative R&D expenses are defined as the maximum R&D in previous years. The upper limit of this credit is 10% of the company's corporation taxes.

The R&D tax credit was changed in April 1999. In the new law, an incremental tax credit is available for a firm whose R&D expenses in a given year exceed both "the base R&D expenditure" and "the comparative R&D expenditure". The credit is calculated as 15% of the difference between the R&D expenses in the year under consideration and the comparative R&D expenses. A firm can deduct this amount from its corporation taxes. The base R&D expenditure is defined as the maximum R&D expenditure in the past 2 years. The comparative R&D expenditure is defined as the average of the three maximum R&D expenses; that is, the average of the maximum R&D expense, the second largest R&D expense and the third largest R&D expense, in the past 5 years. The upper limit of this credit is 12% of the company's corporation taxes. If a company has some of the special R&D, this upper limit is 14% of its corporation taxes.

This paper only discusses the effectiveness of the old tax law. One of the reasons is that there are no academic studies to analyze the performances of the old law empirically. The other reason is that I could not have enough data with which to evaluate the new law[3].

3. Methodology and data

An empirical analysis is based on the following simple R&D equation. Eq. (1) could be derived from the first order condition for profit maximization, assuming a CES production function and evaluating that condition in the steady state[4].

$$r_{it} = \beta y_{it-1} - \gamma \rho_{it-1} + f_i + t_t + u_{it} \qquad (1)$$

In Eq. (1), index i represents firms and index t represents years. The dependent variable r_{it} is the natural logarithm of the corporate R&D investment. On the other hand, the explanatory variables include y_{it-1} (the natural logarithm of sales), ρ_{it-1} (the natural logarithm of user costs of R&D), and t_t (year dummies). The user cost of R&D in each firm in each period is calculated by using the formula of Bloom et al. (1999) and Hall and Reenen (2000). User costs are thought to be as a determinant on the supply side, and sales as a determinant on the demand side. Year dummies get rid of annual macro economic shocks. R&D investment might be also determined by a variety of firm-specific characteristics other than sales and user costs. I considered these characteristics to be time independent and captured these by the fixed effect f_i.

The dependent variables $y_{it-1}$and $\rho_{it-1}$are first lags of sales and user costs, respectively. This is because I

[1] For example, Mansfield and Switzer (1985).

[2] The effective credit rate might be smaller than nominal rate because of its incremental base method.

[3] The tax law allows small and medium sized enterprises (SME) to deduct 10% of their R&D expenses from their corporation taxes. This credit is calculated, not by an incremental method, but by an expenditure based method (as 10% of the R&D expenses in this year). The upper limit for this credit is 15% of their corporation taxes. An SME is defined as a firm whose permanent employees are <1000 people or one whose capital is <100 million yen. An SME can choose either this credit or the incremental tax credit..

[4] See Bloom et al. (1999).