Journal of Business and Social Science Review
Issue: Vol. 3; No.8; August 2022 (pp. 62- 72)
ISSN 2690-0866(Print) 2690-0874 (Online)
Website: www.jbssrnet.com
E-mail: editor@jbssrnet.com
Doi: 10.48150/jbssr.v3no8.2022.a5

Impact of the Amendment of the Statute for Industrial Innovation On Corporate R&D Expenditures

Huang, Chi-Ting
Associate Professor, Department of Accounting Information
National Taipei University of Business
No.321, Sec.1, Jinan Rd., Zhongzheng District. Taipei City, Taiwan, R.O.C.
E-mail: tina@ntub.edu.tw

Wang, Jui-Chih
Professor, Department of Accounting Information
National Taipei University of Business
No.321, Sec.1, Jinan Rd., Zhongzheng District. Taipei City, Taiwan, R.O.C.
E-mail: jcwang@ntub.edu.tw

Abstract

The Taiwan government seeks to encourage corporate R&D activities by offering tax incentives. In 2015, Article 10 of the *Statute for Industrial Innovation* was amended, in order to extend the tax deductible years to three years at 10%, meaning the restrictions were relaxed, and more flexibility was created to stimulate corporate R&D undertakings. This study samples the companies listed on the Taiwan Stock Exchange and the Taipei Stock Exchange from 2010-2018,in order to explore the effect of the 2015 amendment on corporate R&D expenditures. The amendment changes the tax deductibility from 15% in a single year to 10% for up to three years, which has enhanced the incentives for corporate spending on R&D in exchange for better tax credits. As a result, corporate R&D expenditures expanded. In fact, the R&D spending by companies in the IT and electronic components industry increased more than that in other industries. This suggests that the amendment of the Statute for Industrial Innovation has effectively channeled capital into products with higher value added.

Keywords: Amendment of the Statute for Industrial Innovation, Investment Tax Credits, IT & Electronics Industry, R&D Expenditures.

1. Introduction

In the early days, the National Government in Taiwan implemented a planned economy and provided tax incentives to stimulate economic growth, and while tax incentives contributed to economic growth, the public suffered a lower tax revenue and base erosion.

Moreover, tax incentives are often concentrated on specific industries or areas, which has created tax unfairness and resource misallocations across industries. The establishment of the Statute for Industrial Innovationaims to encourage industry innovations, better industrial environments, and boost industry competitiveness. The statute was published on May 12, 2010 and retroactive from January 1, 2010 as the *Statute for Upgrading Industry*.

Hall and Jorgenson (1967) and Wang and Tsai (1998)indicated that the tax credits for R&D spending achieve the best results, as compared with other tax incentives. The OECD research (1995) on developing countries suggested that tax incentives in Taiwan, Korea, and Singapore play an important role in economic growth. In contrast with the tax incentives specified in the Statute for Upgrading Industry, the Statute for Industrial Innovation canceled the tax credits offered only to tech industries.

Meanwhile, it lowered the tax deduction rate for R&D spending from 30% to 15% and the ceiling of deductible income during the year from 50% to 30%, thus, only the business income tax of the year was deductible. In contrast, the Statute for Upgrading Industry allowed the deductions for up to the fifth year. The empirical research by Chen and Li (2017)showed reductions in R&D spending after the massive cut of tax incentives under the Statute for Industrial Innovation.

Therefore, this paper examines the influence of the 2015 amendment of the Statute for Industrial Innovation on corporate R&D expenditures and tax burdens. The empirical results indicate that the amendment relaxed the tax deduction from 15% for one year to 10% up to three years. As a result, companies increased their R&D expenses in exchange for higher tax credits. In the meantime, after the promulgation of the Statute for Industrial Innovation, the R&D expenditures in the IT and electronic components industry were higher than those in other industries, which indicates the effective channeling of capital towards higher value-added products. Finally, companies were encouraged to invest in R&D for higher tax credits each year, which boosted the effective tax rate and increased the tax burden.

This paper consists of five sections. Section 1 is the introduction of the research background, motives, and objectives. Section 2 explains the literature review and hypotheses development. Section 3 illustrates the research design, empirical model structuring, and sample selection process. Section 4 summarizes the empirical findings and analysis. Section 5 presents the conclusions and suggestions.

2. Literature Review and Hypotheses Development

To ensure the diversity and balance of industry developments, the Statute for Industrial Innovation no longer limits tax incentives to specific industries. Rather, tax credits are offered for R&D spending only, in agriculture, service industries, and manufacturing industries.

To boost company competitiveness to an even playing field and reduce tax burdens on SMEs and traditional industries, the business income tax rate was reduced from 25% to 17%. The Statute for Industrial Innovation aims to encourage industry innovations, better industrial environments, and enhance industry competitiveness. Innovation and development are the pillars of a knowledge economy, and driver industry transformation. The tax credits for R&D expenses foster the circulation and utilization of intangible assets and increase the development of professional talents, which encourages innovation activities and enhances the added value and international competitiveness of industries.

2.1 Theory and Practice: Impact of Tax Incentives on Corporate Investments

Companies invest in order to maximize profits; to this end, all measures are for cost-cutting and product innovation. Governments provide tax incentives to entice corporate investments and boost economic development. Domar and Musgrave (1944)believed that taxes lower the expected return on investment; in other words, taxes impede investments. However, they argued that the tax system is a means for the government to share the business risks of companies. If start-ups become successful, the government will receive more tax revenues; if they fail, the government can share some risks through tax rebates. According to Gentry and Hubbard (2000), tax systems in real life often cannot provide enough compensation for loss borne by entrepreneurs. Moreover, most entrepreneurs are subject to progressive tax rates, and they believe that, even if they are risk neutral, progressive tax rates will hinder their new venture activities; therefore, lower progressive tax rates should be offered to entrepreneurs.

However, Cullen and Gordon (2005) posited that the incentives provided by the government to entrepreneurs are obviously not enough and that entrepreneurship has externalities, meaning that because entrepreneurship can be easily copied or imitated, many entrepreneurs do not receive the return they deserve. Therefore, they suggest the government should provide economic or tax incentives to encourage the entrepreneurial activities that have externalities and knowledge spillovers.

According to the statistics from the European Commission(2017), the most commonly seen tax incentives are tax credits, followed by tax breaks for investment returns (dividends or capital gains). The OECDresearch (1995)on developing countries suggested that the tax incentives in Taiwan, Korea, and Singapore play an important role in driving economic growth. Wang and Tsai (1998)found that tax credits for R&D spending yield the best results among all the tax incentive measures. Hall and Van-Reenen (2000) conducted an empirical study with U.S. data and concluded that tax credits can effectively encourage corporate R&D activities. However, as start-ups will not have adequate earnings currently or over the next few years, tax credits for R&D expenditures may not have convenient timing for the immediate future; in other words, very few new businesses can benefit from this tax policy. Klassen, Pittman, and Reed (2004)examined the structural difference between R&D tax credits in the U.S. and Canada, and their empirical research showed that the loss of $1 tax revenue boosts corporate R&D expenditures by $2.0 in the U.S and approximately $1.3 in Canada. The structural benefit is more significant in the U.S. because the tax credit is only offered to incremental increases of R&D spending.

Cullen and Gordon (2005) posited that if entrepreneurs are risk averse, the government can offer tax incentives to either entrepreneurs or start-ups; in other words, the government shares the entrepreneurial risks via tax measures, in order to encourage innovations. Chen and Gupta(2017)examined whether the 2002 amendment of the Statute for Upgrading Industryto increase R&D tax credits from 25% to 30% has stimulated corporate R&D spending. The results indicate positive influence of higher R&D tax credits on the R&D budgets of tech companies with taxable incomes, but not for the R&D activities of non-tech companies. Gupta, Hwang, and Schmid(2011) explored the impact of the calculation change in the tax credit for incremental R&D expenditures from a moving average to a fixed base according to the Omnibus Budget Reconciliation Act of 1989 in the U.S., and the results suggested a significant and positive effect on corporate R&D spending by companies in the U.S.

Some studies have examined the effect of the Statute for Industrial Innovation on corporate R&D budgets. Huang, Wang, Tsai and Hung (2017) posited that companies continue to innovate and develop in order to achieve competitive advantage in the business environment, despite the reduction in R&D tax credits following the promulgation of the Statute for Industrial Innovation. However, the stimulus effect on R&D expenditures by small firms significantly declined. It is worth noting that the Statute for Industrial Innovation reports a more pronounced and positive impact on the R&D spending from traditional industries than from high-tech sectors, which suggests that subsidies or support from the government to assist the upgrade of products and technologies are beneficial to the R&D and innovation in traditional industries.

Chen and Li (2017)examined the influence of the Statute for Industrial Innovation, aseffective in 2010,which significantly lowered the R&D tax credits of companies listed in Taiwan, and their empirical results showed a marked reduction in the R&D expenses ratio for high-tech companies, growth companies, and companies with limited financial resources. The change in the R&D expense ratio was less noticeable after the implementation of the Statute for Industrial Innovation. In fact, there was a significant and positive correlation between R&D tax credits and taxable incomes during the same year.

2.2 Impact of Tax Incentive Policies on Effective Tax Rates

Wilkie(1988)observed the influence of tax incentives and corporate income changes on effective tax rates, and indicated that the change of effective tax rates is a function of tax incentives and pretax earnings. The higher the pretax earnings, the greater the effective tax rate; on the other hand, the more tax incentives available, the lower the effective tax rate. Fischer and Russell(1991)built on the research structure of Wilkie(1988) and revisited the relation between tax incentives and effective tax rates. While their study supported the conclusion of Wilkie(1988), they found the conclusion was less definite if effective tax rates were measured with operating cash flows.

Shevlin and Porter (1992) explored the impact of the Tax Reform Act of 1986 in the U.S. on corporate effective tax rates, and divided the before and after reasons for the change in effective tax rates into income effects, tax rate effects, and tax code effects. The research findings suggested that, despite a reduction in nominal tax rates, the cancelation of tax incentives by the Tax Reform Act of 1986 expanded the tax base and increased the effective tax rates. Manzon and Smith (1994) looked at the change of corporate effective tax rates after the promulgation of the Economic Recovery Tax Act of 1981 and the Tax Reform Act of 1986, and their research results indicated significant differences in effective tax rates from one industry to another before the Economic Recovery Tax Act of 1981.

This acts only lowered the effective tax rates by offering tax incentives, and did not change the variance in effective tax rates between industries; however, the implementation of the Tax Reform Act of 1986 significantly bumped up the effective tax rates and narrowed the gap between industries.

Chen (2003)reviewed the business income tax data from the Fiscal Information Agency, Ministry of Finance,conducted an empirical study on the correlation between tax incentives and firm characteristics, and constructed a regression model to examine the influence of tax incentives on effective tax rates, and the results indicated that the tax credits and the five-year tax break in Taiwan significantly reduced the effective tax rates of companies. Compared to small-and-medium enterprises, large firms enjoy greater tax benefits; moreover, the geographic and sectoral distribution of tax credits is not even.

Huang, Wang and Tsai (2016) performed empirical analysis on the influence of the tax reforms in 2010 (i.e. the reduction of business income tax rates and the promulgation of the Statute for Industrial Innovation) on the fairness of tax burdens, as measured with effective tax rates. Their empirical findings suggested that, despite the cancelation or massive reduction of tax incentives by the Statute for Industrial Innovation, the significant reduction of business income taxes dramatically lowered the tax burden of corporations.

Intangible assets resulted from R&D activities could be a meaningful component of assets. The objective of R&D programs is to enhance operating efficiency, boost competitiveness, and achieve greater profits. According to Taiwan's Statement of Financial Accounting Standards No.38, R&D spending should be recognized as expenses incurred; therefore, R&D expenditures reduce net incomes during the year. When filing income taxes, companies may recognize R&D spendingas expenses, which means R&D expenses serve as a tax shield and attract tax credits under the Statute for Upgrading Industry (Chen, 2002); in other words, the higher the R&D outlays, the greater the tax shields and tax credits, and hence, the lower the effective tax rates (Gupta and Newberry; 1997). Chen (2003)contended that tax incentives and the five-year tax break will indeed encourage corporate investments in areas preferred by the government. As a result, the effective tax rates for companies are significantly lower.

However, the Statute for Industrial Innovation effective in 2010changed the tax credit to 15% of R&D expenses and up to 30% of the taxable income during the same year. In the past, and under the Statute for Upgrading Industry, the tax credit was 30% of R&D expenses and 50% of the taxable income during the year, as based on the incremental increase from the R&D expenditures in the previous two years, and any tax credit not used during the year could be used for the next four years. In contrast, the Statute for Industrial Innovation only allows for up to 30% deduction of taxable income during the year. The significantly lower cap on the percentage of R&D expenses and the much shorter timeframe for the use of tax credits mean a dramatically reduced tax shield for high R&D spending.

Competitive pressures prompt companies to constantly invest in innovations to enhance their competitive edge; however, R&D expenditures come with uncertainty and risks, which is the reason for offering tax credits to encourage continued R&D activities. The amendment of Article 10 of the Statute for Industrial Innovation in 2015increasesthe timeframe for the use of tax credits from the current year to the following three years, and the deduction rate is reduced from 15% to 10%. This extra flexibility in tax credits is intended to facilitate a reduction of tax burdens, in order encourage R&D programs and continued investment in R&D activities. Thus, this paper develops the following hypothesis:

H1: After the amendment of the Statute for Industrial Innovation, corporate R&D expenses increase.

Tax incentives are often offered to high-tech companies with high R&D expenses. The technological evolutions and production innovations at pace shorten product lifecycles, thus, while market growth is strong, it is difficult to determine the appropriate investments. Chen and Li(2017) indicated that under the Statute for Upgrading Industry, 50% of any incremental R&D expenditures during the year above the average during the previous two years could attract tax credits, which provided incentives to dramatically boost R&D spending. Before the promulgation of the Statute for Industrial Innovation, companies were encouraged to spend more on R&D for higher tax credits; however, the Statute for Industrial Innovation only allows tax deductions equivalent to 15% of R&D expenses during the year, which removes the incentives of high R&D ratios for high tax credits.

Therefore, this paper expects the reduction of tax benefits for investments will boost effective tax rates under the Statute for Industrial Innovation, and thus, develops the following hypothesis:

H2: After the amendment of the Statute for Industrial Innovation, R&D expenses are high for the IT and electronic components industry.

3. Research Design

3.1Empirical model

This paper examines the impact of the 2015 amendment of the *Statute for Industrial Innovation*on corporate R&D expenditures. The following regression model is constructed to validate H1 and H2.

$$RD_{i,t}=\alpha_0+\alpha_1 DY15_{i,t}+\alpha_2 ELEC_{i,t}+\alpha_3 DY15_{i,t}\times ELEC_{i,t}+\alpha_4 Tobin'Q_{i,t}+\alpha_5 CFShort_{i,t} +\alpha_6 LagRD_{i,t}+\alpha_7 Pre\_ETR_{i,t}+\alpha_8 DEBT_{i,t}+\alpha_9 SIZE_{i,t}+\alpha_{10} ROA_{i,t}+\sigma_{i,t} \quad (1)$$

Where$RD_{i,t}$ denotes the R&D expense ratio, i.e. R&D expenses divided by net sales; $DY15_{i,t}$is the period after the amendment of the Statute for Industrial Innovation(2015-2018);$ELEC_{i,t}$is a dummy variable, 1 if for the IT and electronic components industry and 0 if not; $Tobin'Q_{i,t}$ denotes the growth opportunity, measured with [(market price per share × number of ordinary shares outstanding)+book value of preferred shares + long-term debts + short-term debts] divided by total assets; $CFShort_{i,t}$ denotes financial resource constraints, measured with (cash dividends paid out + cash flows from investing activities – cash flows from operating activities – R&D expenses) divided by total assets. Deferred R&D expense ratio (*LagRD*) is the R&D expense ratio deferred for one period; $Pre\_ETR_{i,t}$ denotes the effective tax rate before R&D expenses, measured with [income tax expenses during the period+(R&D expenses ×*tax rates*)] divided by [net income of continuing operations +R&D expenses]; $DEBT_{i,t}$ is the debt ratio, measured with total liabilities divided by total assets; $SIZE_{i,t}$denotes firm size, measured with the logarithm of total assets; $ROA_{i,t}$ is return on assets, measured with net income of continuing operations divided by total assets.

3.2Variable Measurements

3.2.1 Explained variable: R&D expense ratio (*RD*)

Literature on the influence of R&D expenses on effective tax rates sometimes refers to R&D intensity as the proxy variable (Gupta and Newberry, 1997; Huang et al., 2016; Chen and Li, 2017). This paper explores whether the increase in R&D expenses lowers the effective tax rates after the implementation of the Statute for Industrial Innovation. This paper uses the R&D expense ratio (R&D expenses as a percentage of net sales) and expects a positive correlation between the product of the R&D expense ratio, the promulgation of the Statute for Industrial Innovation($DY10\times RD$), and the influence of effective tax rates.

3.2.2 Explanatory variable

Time period after the Statute for Industrial Innovation(*DY15*)

Most literature on the impact of tax policies refer to implementation years as the dummy variable; for example, Shevlin and Porter (1992)examined the influence of the Tax Reform Act of 1986 on corporate effective tax rates, and referred to year 1986 as the dummy variable. Their study aimed to explore whether the act boosted the effective tax rates. Huang et al. (2017) and Chen and Li (2017) also referred to the implementation year of the Statute for Industrial Innovationin their research on the statute’s impact on R&D expenditures.

The Taiwan government amended Article 10 of the Statute for Industrial Innovation in 2015, in order to extend the tax deduction to up to three years at a lower rate of 10%. The relaxation in tax credit applicability and the additional flexibility are intended to encourage continued R&D activities by reducing tax burdens; therefore, this paper expects a positive correlation between the amendment (*DY15*) and influence on R&D spending.

This paper refers to the time period after the amendment year (*DY15*) as the dummy variable and expects a positive direction of R&D expenditures, as resulted from the tax credits following the amendment of the Statute for Industrial Innovation.

IT & electronic components industry (*ELEC*)

Governments typically grant tax incentives to high-tech industries with high R&D burdens. The technological evolutions and production innovations at pace shorten product lifecycles, thus, while market growth is strong, it is challenging to determine the appropriate investments.Yang, Huang, and Hou (2012)indicated that R&D tax incentives in Taiwan have more significant effects in boosting R&D expenses for the electronics industry, thus, the tax credits under the Statute for Industrial Innovation are likely to encourage post-tax R&D spending for high-tech sectors. As the amendment of the Statute for Industrial Innovation extends the deductible years up to three years at a lower rate of 10%, this paper expects pronounced effects on the tech industry, which encourages higher R&D budgets for the IT and electronic components industry. Therefore, there should be a positive correlation between the product of these two factors (*DY15×ELEC*)and the spending on R&D.

3.2.3 Control variables

Literature lists growth opportunities, financial constraints, debt ratios, firm sizes, profitability, and the electronics industry as the factors that influence R&D expenditures (Chen and Li, 2017). When there are opportunities for innovations and investments, R&D expenses will be high; in other words, the companies with high growth opportunities (*Tobin'Q*) are incentivized to spend on R&D (Swenson 1992; Chen and Li, 2017).According to the Statute for Industrial Innovation, the R&D tax deduction from 30% to 15% has adverse effect on cash flows associated with tax expenses for companies that previously enjoyed the benefits under the Statute for Upgrading Industry, which is a negative for R&D outlays, as the companies with heavier financial constraints (*CFShort*) have less capital available for R&D activities (Brown and Krull, 2008). In such an instance, the reduction of R&D tax credits according to the Statute for Industrial Innovation bumps up the cash-based income tax expenses,which squeeze out the potential funding for R&D programs. Therefore, it has adverse influence on the R&D expenses for companies with greater financial constraints.

Finally, to avoid the problems of endogeneity associated with R&D tax credits, and hence, lower effective tax rates, this paper refers to Chen and Li, 2017) by measuring the R&D ratio of one lagged period (*LagRD*) and the effective tax rate before R&D expenses (*Pre_ETR*). Given the deferred effect of R&D spending, the higher the deferred R&D ratio (*LagRD*), the lower the R&D expenses during the current period; hence, this paper expects a negative correlation between the deferred R&D ratio and the current R&D ratio. The business income tax rate in Taiwan was lowered from 25% to 17% in 2010; therefore, the equation for the effective tax rate before R&D (*Pre_ETR*) was based on 25% in 2009 or earlier and 17% in 2010 or later. The higher the effective tax rate, the greater the benefits of R&D tax credits. This paper expects a positive correlation between the effective tax rate before R&D expenses and R&D ratio during the current period.

The larger the companies, the more attention and scrutiny from the government and the public, which means higher political costs, as compared to smaller firms, and the less likelihood of tax management via investment activities. This is the argument from the hypothesis of political costs (Zimmerman, 1983; Chen, 2002; Chen, 2003). On the other hand, some study results posit otherwise, meaning large corporations have more resources and budgets for R&D activities, as well as greater capability in tax planning to reduce tax burdens. This is the hypothesis of political power (Siegfried, 1974; Porcano, 1986). This paper includes firm sizes (*SIZE*) in the regression model, but does not assume the direction of influence on R&D expenses or effective tax rates.

In theory, companies with high profits report higher effective tax rates (Gupta and Newberry, 1997; Chen, 2002); however, some argue that companies enjoying hefty profits have more capital for tax planning to reduce tax burdens (Rego, 2003; Huang and Yang, 2011).

Profits are the funding source of continued R&D and innovations; that said, R&D and innovations are needed for future growth when profits are shrinking (Chen and Li, 2017). This paper includes return on assets (ROA) as a profitability metric in the examination of the influence on explained variables, but does not expect the direction of the regression coefficient.

Myers and Majluf(1984)indicated that external funding has higher costs for R&D activities due to information asymmetry. Moreover, interest expenses are tax deductible and serve as a tax shield (Chen, 2003). Finally, the higher the debt ratio, the greater the risks and bankruptcy costs, and the less favorable to risky R&D expenses. This paper includes debt ratios (*DEBT*) and leverage ratios (*LEV*) in the regression model and expects a negative impact on R&D ratios (*RD*).

3.3 Data Sourcing and Sample Selection Process

This paper examines the impact of the amendment of the Statute for Industrial Innovation on effective tax rates by sampling companies listed in Taiwan. The amendment was made in 2015,and the research period is from 2010 to 2018, meaning after the promulgation of the Statute for Industrial Innovation. The sample is divided into two sub-groups, before 2015 and after 2015. The data on the companies listed on the Taiwan Stock Exchange and the Taipei Exchange is sourced from financial reports available on the Market Observation Post System and the Taiwan Economic Journal(TEJ). Financial data is sourced from the TEJ Finance DB and market capitalization data from TEJ's share price database. A total of 16,577 data points from 2010 to 2018were selected, and after the elimination of missing values and outliers (higher than 95% or lower than 5%), the finalized sample pool consists of 12,804 data points.

4.Empirical Results and Analysis

4.1 Descriptive Statistics & Analysis

This paper explores the impact of the amendment of the Statute for Industrial Innovation on corporate R&D spending. Table 1 shows the descriptive statistics and analysis: the average mean of the R&D ratio (RD) is 5.195%, the median is 1.713%, maximum value is 1, and the minimum value is 0, which suggests significant variances in R&D spending levels. Approximately 43.6% of the sampled data points are for the period after the amendment of the Statute for Industrial Innovation(2015to 2017), and 13.7% are from the IT and electronic components industry.

Control Variables: The mean of growth opportunities (*Tobin'Q*) stands at 1.42x, the median is 1.18x, the maximum value is 5.72x, and the minimum value 0.54x. The mean of financial resource constraints (*CFshort*) is -5.19%, the median is -3.27%, the minimum value is -60.55%, and the maximum value is 31.32%. The mean of the deferred R&D ratio (*LagRD*) is 5.17% and the median is 1.71%. The mean of the effective tax rate before R&D expenses (*Pre_ETR*) is 10.94% and the median is 10.56%, which are both lower than the nominal tax rate of 17% during the sample period. The mean of the debt ratios (*DEBT*)is 35.61% and the median is 34.38%, which are both lower than 40%, and indicates a healthy balance sheet in general. The mean of firm sizes (SIZE) is 15.04 and the median is 14.90. Finally, the mean of return on assets (*ROA*) is 3.37 and the median is 4.52.

4.2 Test Results on Correlation Coefficients

As shown in Table 2 regarding the test results on Pearson coefficients, R&D expense ratios (*RD*) are positively and significantly correlated with the amendment of the *Statute for Industrial Innovation*(*DY15*), growth opportunities (*Tobin'Q*), and the deferred R&D expense ratio (*LagRD*). The correlation coefficient with the one-period deferred R&D expense ratio (*LagRD*) is 0.854. Meanwhile, the R&D expense ratio (*RD*) is inversely and significantly correlated with the IT and electronic components industry (*ELEC*), financial resource constraints (*CFshort*), effective tax rates before R&D expenditures (*Pre_ETR*), debt ratios(*DEBT*), firm sizes (*SIZE*), and return on assets (*ROA*).

Finally, the correlation coefficients between the independent variables are mostly in the range of -0.334 to 0.621. Ho and Wong(2001) believed that multicollinearity is an issue only when correlation coefficients exceed 0.8. The coefficients in this paper are all smaller than 0.8,thus, the collinearity between independent variables should not be serious.

4.3 Regression Results & Analysis

The promulgation of the Statute for Industrial Innovation in 2010 only allowed 15% of the R&D expenses to be offset against taxable incomes during the year, while the amendment of Article 10 in 2015 lowered the tax credits from 15% to 10%, but extended the deductible years to up to three years. Companies can choose the optimal deduction rates and years at their discretion; therefore, the 2015 amendment exhibits the most significant influence on the R&D spending of the IT and electronic components industry.

According to the regression analysis summarized in Table 3,the regression coefficient between the 2015 amendment of Statute for Industrial Innovation(*DY15*) and R&D expense ratios is 0.460 and statistically significant (T value 4.04, P value <.0001). The R&D tax credits are changed from 15% during the current year to 10% for up to three years, and companies may choose the best deduction rates and years, which creates tax incentives in support of continuous R&D activities, and supports H1. Meanwhile, the amendment of the Statute for Industrial Innovation primarily affects the IT and electronic components industry with high R&D burden. As shown in Table 3, the industry reports a statistically significant coefficient of 0.633 after the amendment (t value 2.06, p value 0.039). The tax benefits for the IT and electronic components industry are greater than for other industries, as evidenced by a marked increase in R&D spending; therefore, H2 is also supported.

Table 3 presents the empirical results of the control variables. The companies with greater growth opportunities (*Tobin'Q*) and higher deferred R&D expense ratios (*LagRD*) will choose to continue R&D activities and use the tax credits for three years. This is evidenced by the higher and statistically significant R&D expense ratios (*RD*), which is in line with the expectations; for companies, the greater the financial resource constraints (*CFshort*), the lower the cash flows from operating activities, but the higher the R&D ratios. This runs contrary to the expectations. In the meantime, the higher the effective tax rate before R&D expenses (*Pre_ETR*), the greater the reduced R&D expenses during the current period. This is in contrast with the expectations. The higher the debt ratios (*DEBT*), the greater the bankruptcy risks, and the less likely the R&D activities. Finally, lower return on assets (*ROA*) also suppress R&D and innovations (Chen and Li, 2017).

5. Conclusion

While R&D activities boost industry competitiveness and economic development, R&D spending comes with its own risks and uncertainties. In fact, the economic benefits of R&D are often deferred to later periods, thus, governments provide tax incentives to support corporate R&D activities and encourage R&D expenditures to enhance industry development and national competitiveness.

This study samples the companies listed on the Taiwan Stock Exchange and the Taipei Stock Exchange from 2010-2018, in order to explore the effect of the 2015 amendment on corporate R&D expenditures. The amendment changes the tax deductibility from 15% in a single year to 10% for up to three years, which has enhanced the incentives for corporate spending on R&D in exchange for better tax credits. As a result, corporate R&D expenditures expanded. In fact, the R&D spending by companies in the IT and electronic components industry increased more than that in other industries. This suggests that the amendment of the Statute for Industrial Innovation has effectively channeled capital into products with higher value added. Going forward, Taiwan's government should ensure tax fairness and a balance between industry development and tax revenues. It is necessary to evaluate and assess whether the tax incentives under the Statute for Industrial Innovation can promote industry innovations and boost industry competitiveness.

Table 1: Descriptive Statistics

Total samples:12,804					
Variables	**Mean**	**Median**	**Standard deviation**	**Minimum**	**Maximum**
Independent Variable					
RD	5.195	1.713	11.746	0	100
Dependent Variables					
DY15	0.436	0	0.496	0	1
ELEC	0.137	0	0.344	0	1
Tobin'Q	142.286	117.735	76.826	53.765	572.041
CFshort	-5.191	-3.274	11.552	-60.556	31.322

LagRD	5.170	1.706	11.707	0.000	100
Pre_ETR	10.943	10.555	12.308	0.000	100
DEBT	35.614	34.379	17.319	4.000	82.85
SIZE	15.041	14.895	1.339	10.420	20.104
ROA	3.470	4.524	11.631	-215.061	62.218

Note 1：$RD_{i,t}$is the R&D expense ratio; $DY15_{i,t}$ is the period after the amendment of the Statute for Industrial Innovation (2015-2018);$ELEC_{i,t}$ is a dummy variable, 1 if for the IT and electronic components industry and 0 if not; $Tobin'Q_{i,t}$ is the growth opportunity; $CFShort_{i,t}$ denotes financial resource constraints; *LagRD*is the R&D expense ratio deferred for one period; $Pre_ETR_{i,t}$is the effective tax rate before R&D expenses; $DEBT_{i,t}$ is the debt ratio; $SIZE_{i,t}$is the firm size; $ROA_{i,t}$ is return on assets.

Note 2：All the variables are winsorized by 5% and 95%。

Table 2: Correlations Statistics

Variables	*RD*	*DY15*	*ELEC*	*DY15×ELEC*	*Tobin'Q*	*CFshort*	*LagRD*	*Pre_ETR*	*DEBT*	*SIZE*	*ROA*
RD	1	0.051**	-0.088**	-0.050**	0.232**	-0.334**	0.854**	-0.120**	-0.247**	-0.225**	-0.228**
DY15		1	-0.012	0.281**	0.022*	0.015	0.038**	0.080**	0.013	0.014	0.002
ELEC			1	0.621**	-0.095**	0.058**	-0.068**	0.012	-0.038**	-0.039**	0.013
DY15×ELEC				1	-0.048**	0.045**	-0.052**	0.023*	-0.008	-0.012	0.005
Tobin'Q					1	-0.159**	0.229**	0.022*	-0.168**	-0.117**	0.239**
CFshort						1	-0.305**	0.082**	-0.023**	0.187**	0.234**
LagRD							1	-0.109**	-0.225**	-0.214**	-0.188**
Pre_ETR								1	-0.058**	0.061**	0.283**
DEBT									1	0.189**	-0.182**
SIZE										1	0.245**
ROA											1

Note 1: All variables are defined on the Table 1 Note1.

Note 2: ** and * separately stand for two-tailed statistical significance at the level of 1% and 5%.

Table 3: Regression Statistics

$$RD_{i,t}=\alpha_0+\alpha_1 DY15_{i,t}+\alpha_2 ELEC_{i,t}+\alpha_3 DY15_{i,t}\times ELEC_{i,t}+\alpha_4 Tobin'Q_{i,t}+\alpha_5 CFShort_{i,t}+\alpha_6 LagRD_{i,t}+\alpha_7 Pre\_ETR_{i,t}+\alpha_8 DEBT_{i,t}+\alpha_9 SIZE_{i,t}+\alpha_{10} ROA_{i,t}+\sigma_{i,t} \quad (1)$$

Variables	**Pred.Sign**	**Coefficient**	**t-value**	**p>|t|vaule**
Intercept	?	2.753	4.20***	<.0001
DY15	+	0.460	4.04***	<.0001
ELEC	-	-1.237	-6.15***	<.0001
DY15×ELEC	+	0.633	2.06	0.0393
Tobin'Q	+	0.007	9.09***	<.0001
CFshort	-	-0.068	-13.69***	<.0001
LagRD	+	0.786	155.53***	<.0001
Pre_ETR	+	-0.011	-2.51***	0.0121
DEBT	-	-0.056	-16.96***	<.0001

SIZE	+/-	-0.041	-0.96***	0.3374
ROA	+/-	-0.087	-16.19***	<.0001
Adj R-Sq.0.7470 F 值=3780.30 (p<.0001) N=12,803				

Note 1:All variables are defined on the Table 1 Note1.
Note 2: ** and * separately stand for two-tailed statistical significance at the level of 1% and 5%.

References

Adhikari, A., C. Derashid, and H. Zhang. 2006. Public policy, political connections, and effective tax rate: Longitudinal evidence from Malaysia. Journal of Accounting and Public Policy 25:574-595

Brown. J. L., and K. L. Krull. 2008. Stock options, R&D, and the R&D tax credit. The Accounting Review 83(3):705-734.

Chen, M. C. 2002. The Effect of Tax Incentives on Tax Burden of Profit-Seeking Enterprises.Management Review 22(1):127-151.(in Chinese)

Chen, M. C. 2003. The Determinants of Effective Tax Rates of Profit-Seeking Enterprises. International Journal of Accounting Studies 34:57-75. (in Chinese)

Chen, M. C., and S. Gupta. 2017. The incentive effects of R&D tax credits: An empirical examination in an emerging economy. Journal of Contemporary Accounting & Economics 13:52-68.

Chen, M. C., and Y. L. Huan. 2017. The Effects of Cutting R&D Tax Credit by the Act for Industrial Innovation on Corporate R&D Expenditures. Journal of Management 34(2):277-305. (in Chinese)

Cohen, J., P. Cohen., S. G. West., and L.S. Aiken. 2003. Applied multiple regression/correlation analysis for the behavioral Sciences (3rd ed.). Hillsdale, NJ: Lawrence Erlbaum.

Cullen, J. B., and R. H. Gordon. 2005. Tax reform and entrepreneurial activity. NBER conference on tax policy and the economy in Washington, D.C. U.S.A.

Domar, E. D., and R. A. Musgrave. 1944. Proportional income taxation and risk taking. Quarterly Journal of Economics 58(3):388-422.

European Commission 2017. Effectiveness of tax incentives for venture capital and business angels to foster the investment of SMEs and start-ups. Final Report

Fischer, C. M., and J. D. Russell. 1991. Replication of empirical tax research. The Journal of the American Taxation Association 13(1):73-91.

Gentry, W. M., and R. G. Hubbard. 2000. Tax policy and entrepreneurial entry. American Economic Review 90:283-287.

Gupta, S., and K. Newberry. 1997. Determinants of the variability incorporate effective tax rates: Evidence from longitudinal data. Journal of Accounting and Public Policy 16(1): 1-34.

Gupta, S., Y. Hwang, and A. P. Schmidt. 2011. Structural change in the research and experimentation tax credit: Success or failure. National Tax Journal 64(2):285-322.

Hall, B., and J. Van-Reenen. 2000. How effective are fiscal incentives for R&D? A Review of the Evidence, Research Policy 29:49-69.

Hall, R. E., and D. W. Jorgenson. 1967. Tax policy and investment behavior. The American Economic Review, 57(3):391-414

Ho, S. S. M., and K. S. Wong. 2001. A Study of the relationship between corporate governance structures and the extent of voluntary disclosure. Journal of International Accounting, Auditing and Taxation 10(2):139-160.

Huang, M. C., Y. H. Wang, and Y. C. Tsai. The Effects of Tax Reform on Corporate Effective Tax Rates—Moderated by Industry and Firm-Specific Characteristics. Management Review 35(4):51-73. (in Chinese)

Huang, M. C., Y. H. Wang, Y. C. Tsai, and C. Y. Hung. 2017. The Effects of the Implementation of the Statute for Industrial Innovation on R & D Expenditure. Tunghai Management Review19(1):95-127. (in Chinese)

Huang, M. J., and Y. J. Lee. 2009. The Effects of Alternative Minimum Tax on Corporate Tax Burden: A Comparison between High-Tech and Traditional Industries. Journal of Contemporary Accounting 10(2):189-224. (in Chinese)

Klassen, K. J., Pittman, J. A., and M. P. Reed 2004. Across-national comparison of R&D expenditure decision: Tax incentives and financial constraints. Contemporary Accounting Research 21(3): 639-680.

Manzon, G., and W. R. Smith. 1994. The effect of the economic recovery tax act of 1981 and the tax reform act of 1986 on the distribution of effective tax rates. Journal of Accounting and Public Policy 13:349-362.

Myers S. C.. and N. S. Majluf. 1984. Corporate financing and investment decisions when firms have information that investors do not have. Journal of Financial Economics 13(2):187-221.

Porcano, T. 1986. Corporate tax rates: Porgressive, proportional, or regressive. The Journal of the American Taxation Association 7(2):17-31.

Rego, S. O. 2003. Tax avoidance activities of U.S. multinational corporations. Contemporary Accounting Research 20(4):237-265.

Reyes, B. M. 2004. R&D intensity and financing constraints. Journal of Business and Economic Studies 10(2):38-53.

Shevlin, T., and S. Porter. 1992. The corporate tax comeback in 1987: Some further evidence. The Journal of the American Taxation Association 14(1):58-79.

Siegfried, J. 1974. Effective average U.S. corporation income tax rates. National Tax Journal 27(2):245-259.

Swenson, C. W. 1992. Some tests of the incentive effects of the research and experimentation tax credit. Journal of public Economics 49(2):203-218.

Swenson, C. W. 1992. Some tests of the incentive effects of the research and experimentation tax credit. Journal of Public Economics 49(2):203-218.

Tsai, K. H., and J. C. Wang. 2004. The innovation policy and performance of innovation in Taiwan's technology intensive industries. Problems and Perspectives in Management 2(1):62-75.

Wang, J. C., and K. H. Tsai. 1998. The impact of research and development promotion schemes in the Taiwanese electronic component industry. R&D Management 28(2): 119-124.

Wilkie, P. 1988. Corporate average effective tax rates and inferences about relative tax preferences. The Journal of the American Taxation Association 10(1):78-88.

Wu, W., Y. Wang, W. Luo., and P. Gillis. 2012. State ownership, tax status and size effect of effective tax rate in China. Accounting and Business Research 42(2):97-114.

Yang, C. H., C. H. Huang, and T. C. Hou. 2012. Tax incentives and R&D activity: Firm-level evidence from Taiwan. Research Policy 41(9):1578-1588.

Zimmerman, J. 1983. Taxes and firm size. Journal of Accounting and Economics 5(2):119-149.