# Innovation, R&D Activities, and Tax Policies

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***Abstract*—Innovation and technology have been central themes for the growth and development of firms in all economies. This paper examines innovation, R&D activities, and tax policy in the Chinese automotive sector. The automotive sector crucial to the country's economy and it is known to invest heavily in innovation and technology. This study examines external factors that affect automotive firms' innovation and R&D activities: government policies, including tax policies and government subsidies and corporate ownership structures, including ownership concentration and state ownership are two examples. By using the China Stock Market Financial Statement Database and the SINA ownership structure database, this study finds that Chinese automotive firms' expenditures in R&D activities are positively associated with state ownership, government subsidies, tax reduction, and firm size, but are negatively associated with income tax burden, ownership concentration, and investments in other assets such as inventory. The same results are also found for intangible asset such as goodwill. Overall, this study finds that government policy and ownership structure play an important role in firms' innovation and R&D activities.**

***Index Terms*—R&D activities, goodwill, ownership, tax rate, tax reduction, automotive sector**

## I. Introduction

Innovation, technology and R&D activities are central themes for growth and development in both industrial and developing economies. A question of why some firms spend a large portion in R&D while other firms do not has been an important agenda for policy makers and academic researchers as well. This paper examines innovation, technology and R&D activities in the automotive industry in China. The automotive industry is crucial to the country's economy, and it usually invests heavily in innovation and technology.

China is one of the world's largest investors in research and development. According to OECD observer, Chinese spending on R&D has increased by 19% per year since 1995 to reach US$30 billion in 2005, which put China sixth in world ranking. If adjusted currencies for purchasing power parity between different countries, China would rank third in the world behind the U.S. and Japan. Despite such increase in R&D investments, R&D spending in China is still low as a share of GDP per capita and far lower than the OECD average. In addition, as observed by researchers, R&D expenditures are inefficiently used in China as there is little output of internationally valuable patents. According to Oxford analysis, United States Patent Office (USPTO) patents have increased twenty-fold over the last 15 years from a very low base, but China still only ranked 12th in USPTO patents received in 2008. Foreign firms rather than domestic firms lead this innovation activity. From 2003 to 2007, multinational corporations generated 1,125 USPTO utility patents where the lead inventor on the patent was located in China. In contrast, Chinese domestic firms and institutes only created 244 such lead inventor patents.

The automotive industry has grown fast in China in the 21st century. Since 2008, it has been the largest in the world based on the number of automobiles being produced. Table I shows the top five auto production countries. In 2005, China was ranked in the 4th place. In 2010 and 2011, it was ranked in the 1st place, and its production of automobiles exceeded that of the U.S. and Japan combined.

TABLE I. Auto Production by the Top 5 Countries

| Rank | Country | 2012 | 2011 | 2010 | 2005 |
|---|---|---|---|---|---|
| 1 | China | 19,271,808 | 18,418,876 | 18,264,667 | 5,708,421 (4) |
| 2 | U.S | 10,328,884 | 8,653,560 | 7,761,443 (3) | 11,946,653 (1) |
| 3 | Japan | 9,942,711 | 8,398,654 | 9,625,940 (2) | 10,799,659 (2) |
| 4 | Germany | 5,649,269 | 6,311,318 | 5,905,985 | 5,757,710 (3) |
| 5 | South Korea | 4,557,738 | 4,657,094 | 4,271,941 | 3,699,350 |
| | World | 84,141,209 | 80,092,840 | 77,629,127 | 66,482,439 |

Source: OICA statistics – www.OICA.net

TABLE II. Top 10 Domestic Auto Firms Based on 2013 Sales

| Rank | Firm | 2013 sales (# of autos) |
|---|---|---|
| 1 | Shanghai GM | 1,575,167 |
| 2 | Shanghai VW | 1,525,008 |
| 3 | First Motor VW | 1,512,206 |
| 4 | Shanghai GM Wu Ling | 1,425,563 |
| 5 | Beijing Hyundai | 1,030,808 |
| 6 | Dong Feng Nissan | 926,229 |
| 7 | Chang'an Auto | 822,209 |
| 8 | Chang'an Ford | 682,686 |
| 9 | Great Wall Motor | 627,436 |
| 10 | First Motor Toyota | 554,661 |

Source: www.auto.sohu.com

After China joined the WTO in 2001, domestic firms established joint ventures with multinational auto firms such as GM, Volkswagen, Ford, Toyota, Hyundai, etc.

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Today in China, about 55% of the automobiles are produced through these joint ventures. Table II shows the top 10 auto makers based on 2013 auto sales. Of the top ten firms, eight are joint-ventures and only two are local firms (Dong Feng and Chang'an).

Although auto firms invest heavily in R&D, there is a lack of research on the Chinese auto firms' R&D investment. A large body of literature exists focusing on innovative activities in the automotive sectors in the U.S., Japan, Germany, and other industrial countries. For example, Falk (2009) empirically investigates the determinants of business-sector R&D intensity using a panel of OECD countries and finds that tax incentives for R&D have a significant and positive impact on business R&D spending. Griffiths and Webster (2004) trace the innovation pathways of new creations from R&D activity and find that R&D activity is a highly path dependent process that relies heavily on firm specific effects such as managerial style, use of incentive schemes for employees, debt ratio etc.

Current studies also focus on foreign firms' innovation and R&D in China. For example, in September, 2011, General Motor (GM) opened an advanced technical centre in Shanghai. In December 2013, Microsoft launched its first automobile industry innovation center in Changchun.

Techakanjanakit and Huang (2012) argued that China's automobile industry is facing fierce market competition. Innovation and core technology are crucial to building international competition ability. This will need support from all parties including the government, the consumers, and the industry itself.

A few studies have shown that managers tend to underinvest in R&D, but institutional investor ownership influences firms to invest in R&D [1]-[4].

One recent study examines the impacts of environmental uncertainty including market, technological, and competitive uncertainty and firm's investments in R&D. Using a survey study of Chinese firms, it finds that market uncertainty, along with technological and operations capability have positive influences, while competitive intensity and marketing capability have negative effects on R&D investments.

To face the challenges of multinational automotive companies after China's entry into WTO, the National Development and Reform Commission released the New Automotive Industry Policy. The new policy included, among other things, encouraging self-reliant product development and local brand development, with a view to building up a few famous brands and globally competitive automotive enterprises and encouraging independent research and development and production on a large scale for key components and parts.

This study examines what is associated with automotive firms' innovation and R&D activities. Using the China Stock Market Financial Statement Database and the SINA ownership structure database, I find that Chinese automotive firms' expenditures in R&D activities are positively associated with state ownership, government subsidy, tax reduction, and firm size, but are negatively associated with income tax burden, ownership concentration, and investments in other assets such as inventory. The same results are also found for the intangible assets including both R&D and goodwill. Overall, this study finds that government policy and ownership structure play an important role in firms' innovation and R&D activities.

The remainder of this paper is organized as follows. Section two reviews literature and develops hypotheses. Section 3 designs models for empirical testing and presents the results. Finally, a conclusion and summary is presented in section 4.

## II. Literature and Hypotheses

### A. Government Policies Including Tax Policies and Government Subsidies and R&D Activities

The nominal corporate tax rate in China was 33% before 2008 and reduced to 25% in 2008 as a result of 2007 Tax Reform. It is argued that government policies play crucial roles in allocating resource, promoting R&D activities and technological innovation [5]-[7]. Government can support firms' innovation and R&D by providing preference treatments and financial supports, such as tax reductions and government subsidies; hence I test the following hypotheses:

H1*:* Tax reduction from the 2007 Tax Reform will improve R&D activities and investments.

H2*:* Government subsidies will improve R&D activities and investments.

H3*:* High tax rates reduce R&D activities and investments.

### B. State Ownership and R&D Spending

A large body of literature examines the impact of ownership structure on firm performance, stock market reaction, earnings management, and tax aggressiveness [8]-[16], among others.

I first examine whether the nature of the shareholders (i.e., state vs. non-state ownership) influences firms' investments in R&D investment.

Despite continuing changes in the corporate ownership structures resulting from the government's reform in the financial systems and legal or regulatory mechanisms, many of China's listed firms are still closely linked to the government; for these firms, the largest shareholder is a central/local government or a large state-owned enterprise.

The association between state ownership and R&D investment decision has not been sufficiently explored. In principle, it is argued that state ownership has an incentive to closely monitor management, and in so doing reduce agency costs, hence has positive effects on R&D spending [17], [18]. My next hypothesis states:

H4: Firms with large state ownerships will invest more in innovation and R&D practices.

### C. Ownership Concentration and R&D Spending

I next examine the effect of ownership concentration on R&D investment. As in many East Asian countries, China's listed firms are characterized by highly

 

concentrated ownership structures. In principle, ownership concentration could have two opposing effects on management decisions on R&D spending, depending on whether the incentive alignment effect or the managerial entrenchment effect dominates [13].

From the incentive alignment perspective, it is argued that where there is a lack of controlling shareholders, the dispersed investors have little incentive to monitor managers' behavior. Conversely, as ownership becomes more concentrated, holding a large stake in a firm encourages the owner to ensure that the managers behave in ways that will benefit shareholders.

Investments in R&D projects involve temporal trade-offs: R&D expenditures are incurred over the near term with payoffs likely only over the long term. Organizational stakeholders, however, may differ in their temporal preferences, and this can have important implications for R&D investments. Managers are likely to invest in the projects with faster payoffs that enable them to enhance their reputations speedily and thereby hasten career improvement. However, owners favor long-term investments [3]. Under the incentive alignment argument, controlling shareholders have strong incentives to monitor managers to ensure that they invest in R&D for the benefit of the shareholders.

The managerial entrenchment hypothesis on the effect of ownership concentration is developed by a more recent stream of agency theory research. This literature focuses on the conflict of interest not between owners and managers but between controlling shareholders and minority shareholders. Controlling shareholders have opportunities to divert firms' resources at the expenses of minority shareholders so long as the rights of minority shareholders are not well protected [18], [19]. La Porta et al. (1998) argue that the expropriation of minority shareholder wealth by controlling shareholders is a worldwide phenomenon and can take various forms such as self-dealing transactions, excessive executive compensation, withholding unfavorable information or selectively disclosing information, etc. Such self-serving behavior may have negative effect on firms' expenditures on R&D.

Hence, it is an empirical question whether firms with ownership concentration exhibit similar or different R&D spending practices. My next hypothesis states:

H5: Firms with different levels of ownership concentration exhibit different R&D practices, ceteris paribus.

## III. Research Design

### A. Regression Models for Hypothesis Testing

To determine the impact of government policy and ownership structure on firms' R&D investments, I design the following regression model:

$$R\&D_{it} = \alpha_0 + \alpha_1 Y2008 + \alpha_2 ETR_{it} + \alpha_3 SUB_{it} + \alpha_4 OWN_{it} + \alpha_5 STA_{it} + \sum_k \lambda_k CONTROL_{it} + \varepsilon_{it}$$

where

R&D: R&D investment, measures as R&D expenditure, divided by total assets

Y2008: indicator variable, equal to 1 for years 2008 – 2012, and 0 other wise

ETR: effective tax rate, measured as tax payable, divided by total assets

SUB: government subsidy, measure as tax refund, divided by total assets

OWN: ownership concentration, indicator variable, equal to 1if the largest shareholders owns at least 50% of shares, and 0 otherwise

STA: state ownership, indicator variable, equal to 1 if the largest shareholder is the government and 0 otherwise

CONTROL: a set of control variables.

Following previous relevant studies on R&D investment decision [20], [21], I choose six control variables that are known to influence R&D spending; firm size (*SIZE*), measured as log of total assets; leverage (*LEV*), measured as the sum of short and long term debts over total assets; capital intensity (*FIX*), the ratio of fixed assets to total assets; and inventory intensity (*INV*), the ratio of inventory to total assets; return on assets (*ROA*), measured as profit over total assets; and cash flow (*CASH*), measured as cash flow from operation over total assets.

### B. Data Collection and Testing Results

Financial data is collected from the China Stock Market Financial Statement Database (CSMAR). I collect by hand corporate ownership information from the SINA finance database. The SINA finance database covers accounting and economics data of listed Chinese firms including financial statements and footnotes, financial analysis, ownership structure, top ten shareholders, etc. The firms selected for this study meet the conditions that they are in the automotive industry.

I choose the data sample for the regression model for the years 2003-2012. There are 636 observations for 87 auto firms.

Table III reports the results from the regression model. It shows that state ownership (*STA*) is positively related to R&D [22], which provides significant evidence to suggest that firms owned by the state invest more in R&D. This result is consistent with the argument that state ownership provides an incentive for government shareholders to closely monitor management to pursue long-term goals, and in so doing reduce agency costs. Hence state ownership has positive effects on R&D spending [17], [18]. It may also suggest that a good reputation of investing more in R&D activities benefits managements to the extent that managers with such good reputation are more likely to have a promotion and a promising political career. Indeed, some state-owned auto firms have established their R&D centers.

However, this result is consistent with the concern that state - owned firms account for large share of R&D spending while there is a shortage of R&D in private firms.

Table III also show that the coefficient of *SIZE* is positive and significant, which provides support for the

economy of scale for R&D investment. In addition, the coefficient in *SUB* is positive and significant, which suggests that government subsidies support those firms to spend more on R&D.

The coefficient in *OWN* is negative and significant, which suggests that ownership concentration motivates firms to spend less on R&D. It is consistent with the managerial entrenchment theory. The coefficient in *ETR* is negative and significant, which suggests that heavy tax burdens reduce firms' investments in R&D. In addition, the coefficient in *INV* is negative and significant, which suggests that inventory intensive firms spend less on R&D. It implies that *INV* is a substitute for R&D.

Other variables including the return on assets, fixed asset intensity, and debt-asset ratio are not significant.

When I measure the dependent variable as intangible assets including R&D expenditures and goodwill, the results are similar, as shown in Table III.

TABLE III. TESTING RESULTS FOR 2003- 2012

| Dependent variable | R&D expenditures | |
|---|---|---|
| | *Coefficients* | *t Stat* |
| YEAR | 0.001 | 3.462*** |
| SOE | 0.001 | 2.498** |
| OWN | -0.001 | -2.50** |
| INV | -0.006 | -2.783*** |
| FIX | 0.001 | 0.389 |
| SIZE | 0.002 | 5.243*** |
| LEV | 7.45E-05 | 0.601 |
| ROA | -3.1E-06 | -0.016 |
| CASH | -0.001 | -0.530 |
| ETR | -0.062 | -2.661** |
| REFUND | 0.046 | 2.707*** |
| R-squared | 0.12 | |
| Obs. | 636 | |
| Dependent variable | R&D expenditures and goodwill | |
| | *Coefficients* | *t Stat* |
| YEAR | 0.002 | 3.875*** |
| SOE | 0.000 | 0.617 |
| OWN | -0.001 | -2.701** |
| INV | -0.006 | -2.028** |
| FIX | -0.001 | -0.743 |
| SIZE | 0.004 | 8.500*** |
| LEV | 0.000 | 1.742* |
| ROA | 1.57E-05 | 0.066 |
| CASH | -0.003 | -1.109 |
| ETR | -0.046 | -1.614* |
| REFUND | 0.048 | 2.305** |
| R- squared | 0.17 | |
| Obs. | 636 | |

*** significant at 0.01 level; ** significant at 0.05 level; * significant at 0.1 level

Table IV reports the results from the regression model using the sample for the time periods 2007–2012, since data of intangible assets are not complete for time periods before 2007. Overall, it shows that the results are quite similar to those in Table III. That is, expenditures in R&D activities are positively associated with state ownership, government subsidy, tax reduction, and firm size, but are negatively associated with income tax burden, ownership concentration, and investments in other assets such as inventory. The same result is also found for the intangible assets including both R&D and goodwill.

TABLE IV. TESTING RESULTS FOR 2007- 2012

| Dependent variable | R&D expenditures | |
|---|---|---|
| | *Coefficients* | *t Stat* |
| **SOE** | 0.001 | 2.532** |
| **OWN** | -0.001 | -2.366** |
| **INV** | -0.015 | -3.791*** |
| FIX | 0.002 | 0.838 |
| SIZE | 0.002 | 5.009*** |
| LEV | 2.1E-05 | 0.119 |
| ROA | -5.1E-06 | -0.021 |
| CASH | -0.004 | -0.955 |
| ETR | -0.065 | -1.910** |
| REFUND | 0.060 | 2.588** |
| R-squared | 0.13 | |
| Obs. | 424 | |
| Dependent variable | R&D expenditures and goodwill | |
| | *Coefficients* | *t Stat* |
| SOE | 0.001 | 0.828 |
| OWN | -0.002 | -2.508** |
| INV | -0.013 | -2.835*** |
| FIX | -0.001 | -0.263 |
| SIZE | 0.004 | 7.891*** |
| LEV | 0.000 | 1.04 |
| ROA | 1.45E-05 | 0.051 |
| CASH | -0.005 | -1.128 |
| ETR | -0.047 | -1.149 |
| REFUND | 0.058 | 2.059** |
| R-Squared | 0.17 | |
| Obs. | 424 | |

*** significant at 0.01 level; ** significant at 0.05 level; * significant at 0.1 level

## IV. CONCLUSION

In this study, I find that, in China, the auto firms' expenditures in R&D are positively associated with state ownership, government subsidy, tax reduction and firm size, but negatively associated with tax burden, ownership concentration, and investments in other assets including inventories. Overall, this study finds that government policy and ownership structure play an important role in firms' innovation and R&D activities.

Nevertheless, profitability, fixed asset intensity, and leverage are not significantly associated with R&D spending. However, these findings should be treated with caution as they are not robust to changes in the timing of its measurement, changes in the estimation approach, and changes in the sample.

Current R&D activities are generally limited to minor models and building local brands rather than developing

significant products. This study is of interest to policy makers, corporate managements, and academics who wish to examine corporate R&D and innovation activities and, in particular, to examine what motivates firms to spend on R&D. For example, further studies could examine if government subsidies for R&D are used efficiently and what role tax policies could play in encouraging firms to invest more heavily in R&D.

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