

**STUDYING THE IMPACT OF INCOME TAX ON THE RELATIONSHIP BETWEEN R&D INVESTMENT AND FINANCIAL CONSTRAINTS IN COMPANIES LISTED ON TEHRAN STOCK EXCHANGE**

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**Abstract.** The purpose of the study is to examine the impact of income tax on the relationship between R&D investment and financial constraints in companies enlisted on Tehran stock exchange. Companies enlisted on Tehran stock exchange during 2011-2015 are regarded as locative and time dimension. 118 companies are selected by eliminated systematic method as sample. In this study, R&D investment was considered as independent variable and financial constraints was intended as dependent variable and income tax was taken into consideration as moderating variable. This is a kind of descriptive-correlative study. Regarding data nature, this is a kind of quantitative study and regarding aim, this is a kind of applied study. Jarque-Bra test is done for normality testing. Regression significance and coefficient significance tests were considered in order to investigate significance in regression pattern. Heterogeneity, F-limer and Husman tests were considered as regression pre-test as well. The results showed that R&D investment affected on financial constraints in companies enlisted in Tehran stock exchange. Also, income tax affected the relationship between R&D investment and financial constraints in companies enlisted in Tehran stock exchange.

**Keywords:** Income Tax; R&D Investment; Financial Constrains

## 1. INTRODUCTION

Firms' income tax rate plays an important role in identifying financial and tax policies of firms, legislators, and analysts. Firms' income tax enforces a considerable cost to the firm and its shareholders. Since firms have a dual dependence onto the shareholders, firm's social responsibility is known as one of the main strategy parts in reducing the controversy among the shareholders and has a fundamental effect on shareholders' value (Becchete & et al, 2012). Growth theories have noticed the role of investment in research and development in economic growth a lot (Ayton & Hawit, 1992). Meanwhile, investing on research and development is along with information problems of the lack of surety value regarding lack of confidence in R & D activities (Hall, 2007). Therefore, some controversies may arise regarding the access to external financing for R & D. This is observed specifically in developing countries due to not developed capital markets and ambiguous financial reporting. Thus, financial constraints may halt economic growth specifically in newly established economies (Sasidaran & et al, 2014). Faults and inefficiencies in capital market affect firm's investment decisions (Arbil & et al, 2012). These faults and inefficiencies lead to difficulties in financing in investment in physical assets and intangible assets, specifically regarding financial constraints. In fact the effect of financial constraints can be analyzed in investment on R & D (Hall & Lerner, 2013). Investing on R & D is considered as one of the key stimulators in long-term economic growth and those firms that notice investment on R & D appropriate a great proportion of capital market to themselves (Lee, 2011). If a firm is not able to do external financing during economic stagnation period it will encounter collapse regarding the non periodical aspect of investment on R & D (Ahyoun & et al, 2012). In a bad economic shock period, the firms should give the priority to short-term investment; also short-term investment is required to achieve benefits resulted from innovations. Firms with high financing and many credit constraints show a periodical behavior in investment on R & D. Regarding liquidity shocks, if firms are not able to preserve a similar level of investment on future, there would not be a probability of taking the responsibility of investment on R & D. This stems from the foundational nature of investment on R & D which entails high costs of redoing (Berit & et al, 2013). Dyreng and et al (2016) used new methods and found that firms that do tax avoidance encounter a positive and meaningful relationship between financial constraints and income changes. Howell (2016) showed in his research that

increasing tax costs leads to reduce investment on R & D activities and firms' financial constraints. The results of studies by Kim and Estembaf (1996) and Stuck and Watson (2003) showed a difference between interest rates related to deposits received from the investors and facilities delivered and it is technically called interest range. The research has shown that the intensity of financial constraints is varied and different during different time periods. Jertler and Hubard (2001), Kashyap (1996), and Jertler and Gilkrist (2006) all showed that credit constraints emerge more than anything else during stagnation or during the time when monetary policies are very severe. Therefore, income tax affects the relationship between investment on R & D and financial constraints and has an adjusting role on this relationship. It is absolutely known that income tax and financial constraints of financing and investments on R & D are among important issues and they have not been investigated vastly in our country. It seems that firms should invest more on developing their activities and on achievement of target markets using R & D and notice that it can not be achieved unless financial constraints are reduced and the organizations and related institutions should help the firms to have access to required financial resources for those firms. Therefore, it seems that studying how to identify the effect of income tax has a specific importance regarding the relationship between investment on R & D and financial constraints of firms enlisted in Tehran Stock Exchange and it can affect the investors, shareholders, managers, and other beneficiary groups. In this study we are going to respond the following question: Does income tax affect the relationship between investments on R & D and financial constraints of firms enlisted in Tehran Stock Exchange?

## 2. THEORETICAL FOUNDATIONS AND RESEARCH HYPOTHESES

Considering the fact that capital cost is one of the most important issues it should be noticed in capital supply. Also we should make sure that the income gained from investment is appropriated to capital owners. It should be noted that capital cost is not merely related to bank interest and firm's capital is supplied through different resources and bank is one of them. The rest is due to the shareholders' capital whose cost is several times more than loan costs (Samoel, 2011). To categorize firms regarding financing constraints first we should define financial constraints. The most complete and clearest definition is that when firms encounter financial constraints there would be cracks between internal and external

consumptions of the appropriated cash. Therefore by using this definition all firms can be considered to have financial constraints but the level of financial constraints are different. Using external cash provides an appropriate framework to isolate firms based on the amount of their financial constraints (Farzari & et al, 2001). When there is a big difference between internal and external investment cash consumptions in a firm it has more financial constraints. On the whole, firms without financial constraints or with lower financial constraints are those that have relatively high liquidation capability and high net assets. Therefore, financial constraints refer to those constraints that halt supplying all cashes required for optimal investments for the firms (Kaplan & et al, 2000). In most activities of a firm it is expected to have rapid return or rapid improvement in performances aiming at fostering investment return, but these items do not consider any of the R & D models mentioned above. Generally, the engineers form the personnel in first R & D model, while in second R & D model often industrial scientists are busy. R & D activities are carried out by private firms or governmental institutions or firms (Janson & et al, 2008).

Drake and et al (2017) showed in their researches that tax risk can affect the severity of the relationship between tax avoidance and shareholders' value. Gary and et al (2016) showed in their research on the relationship between income tax changes and firms' investment that there has been a meaningful relationship between income tax changes and firms' investment. Howell (2016) investigated about the effect of income tax on the relationship between investments and financial constraints in firms. The research results showed that increasing tax costs leads to reduce investment and financial constraints in firms. Therefore, income tax affects the relationship between investments and financial constraints. Zeynep (2014) carried out a study on the relationship between financial constraints and investments on R & D. The goal of this research was to investigate about the role of financial constraints on decision making regarding investments on R & D by the firms during economic crises. In a research using the data in manufacturing firms with high technologies in the United States, it was shown that firms that lack security rates encounter obligatory financial constraints affecting investment on R & D. Sasidaran and et al (2014) investigated about the effect of financial constraints on investment on R & D in firms enlisted in Indian Stock Exchange during the time period between 1991 and 2011. Financial constraints may halt economic growth specifically in newly established economies. Results of the research showed that there has been a meaningful relationship between internal

financing and R & D costs. There has not been any meaningful relationship observed between external costs and R & D costs. Also in new economies such as in India the interferences of the government (tax and subsidy) leads to reduce constraints regarding investments on R & D. Carlo and et al (2013) studied the relationship between investments on R & D and financial constraints. The focus of these studies was investigations on a big sample of manufacturing companies in some European countries such as France, Germany, Italy, and Spain. Based on the study, the results showed that financial constraints were among key R & D activities in firms. And investment on R & D was meaningfully efficient. Edwards and et al (2013) investigated about the relationship between financial constraints and tax avoidance activities. Results showed that firms suffering from financial constraints have had less liquidity for tax rates and thus there has been a meaningful relationship between financial constraints and tax programming. Kortweg (2007) studied the costs resulted from financial constraints in different industries. To do so, 244 firms were chosen from among 22 industries within the time period between 1994 and 2004. Financial constraint cost is identified regarding market value and systematic risk resulted from debts or firm capital. In bankruptcy time the cost of financial constraint increases up to 31 percent. Based on the analyses it was concluded that there has been a meaningful relationship between income taxes and financial constraints and firms choose their leverage ratios based on balance between tax benefits and financial distress cost. Bond and et al (2003) investigated about the relationship between investments on R & D and financial constraints in firms enlisted in Stock Exchanges in Britain and Germany. The goal of this research was to test the importance of cash flows in investment on R & D using integrated data of the two countries within the time period between 1985 and 1994. Based on the analyses, it was found that financial constraints were more meaningful in Britain and have had a meaningful effect on R & D activities, but in Germany some different results were achieved. The researches mentioned above could respond some of the questions posed but some of them were left unanswered and they were posed in the form of research hypotheses below. In other words, regarding the previously carried out researches, the hypotheses and research model in current study were as follows:

**First hypothesis:** investments on R & D can affect financial constraints in firms enlisted in Tehran Stock Exchange.

**Second hypothesis:** income tax can affect the relationship between investments on R & D and financial constraints in firms enlisted in Tehran

Stock Exchange. Income tax Investments on R & D financial constraints Firm life leverage firm size  
Figure 1: The conceptual research model (Adjusted form of the model posed by Howell, 2016)

### 3. RESEARCH METHODOLOGY

The present research is called applied regarding categorization based on the goals and id a descriptive research considering the method. Also

it is correlation type, from among descriptive researches. Also, considering the lack of the possibility of controlling all unrelated variables and using historical data to test the hypotheses, the present study can be categorized as quasi-experimental and post incidental due to the data collection method used. The statistical population of this research is all firms enlisted in Tehran Stock Exchange during the time period between 2011 and 2015. Firms included in the sample using systematic deletion method should have had the following characteristics:

Table 1: The limitations utilized to select the firms

No.	Limitation	Number
1	Total number of firms before applying the limitations	520
2	They were not enlisted in stock exchange before 2011	82
3	The end of their fiscal year has not been 21 <sup>st</sup> of March	60
4	Those firms that have changed their fiscal year during the study period	81
5	The firms are not from among bank, insurance companies, investment firms and others	42
6	The data of the variables under investigations were not ready for all study years	82
7	Firms that could not exchange their stocks during the intended time period	55
<b>Total remaining companies</b>		<b>118</b>

To collect data, first the theoretical foundations regarding the identification of research literature were extracted using library studiers and documentation. To access the required data to process research hypotheses we have used the magazines and ledgers of Tehran Stock Exchange and annual reports and financial statements of firms enlisted in Tehran Stock Exchange. In this research the databases were: data extracted from Tehran Stock Exchange, dissertations, foreign and local papers, and specifically valid internet resources. Also the research data were collected from [www.codal.ir](http://www.codal.ir) and gathered using Excel software. Hypotheses test method was multiple regressions using Eviews9 software.

The model and research variables

The research models in this research were extracted from the study done by Howell (2016) as follows. Also we will deal with research variables below:

$$(1) \text{Constraint } s_{it} = \alpha_0 + \beta_1 R \& D_{it} + \beta_2 Size_{it} + \beta_3 Lev_{it} + \beta_4 Age_{it} + \varepsilon_{it}$$

$$(2) \text{Constraint } s_{it} = \alpha_0 + \beta_1 Tax_{it} + \beta_2 R \& D_{it} + \beta_3 (Tax_{it} \times R \& D_{it}) + \beta_4 Lev_{it} + \beta_5 Age_{it} + \varepsilon_{it}$$

Constraint  $s_{it}$  : financial constraints

In this research and following the study by Kaplan and et al (1996) we identified the KZ index for each of the selected firms. In this way we used KZ index formula for each firm represented with a number. Then the median for the firms was calculated and firms residing higher than the average with KZ index have had financial constraints and firms lower than average KZ index were categorized among firms without constraints.

$$KZ = a_0 LEV_{it} + a_1 \frac{DIV_{it}}{A_{it-1}} + a_2 \frac{CF_{it}}{A_{it-1}} + a_3 \frac{C_{it}}{A_{it-1}}$$

$LEV_{it}$  = Book value of debt / Book value of assets

$DIV_{it}/A_{it-1}$  = The amount of dividends per year / Total asset value at the beginning of the year

$CF_{it}/A_{it-1}$  = Cash flow in year t / Total asset value at the beginning of the year

$C_{it}/A_{it-1}$  = Cash in year t / Total asset value at the beginning of the year

$Tax_{it}$  : income tax; logarithm of the difference between earnings after subtracting tax and earnings before subtracting firms' tax

$R \& D_{it}$  : investments on R & D: the ratio of R & D costs to total sales of the firm

$Size_{it}$  : firm size: natural logarithm of total assets of the firm

$Lev_{it}$  : leverage: the ratio of total debts to total assets

$Age_{it}$  : firm age: the number of the years a firm has been enlisted in Tehran Stock Exchange

$\epsilon_{it}$  : error level

#### 4. RESEARCH FINDINGS

The descriptive research variables' statistics

The major central tendency index is average that shows balance point and focal point of the distribution and is considered as a good index to show centrality of the data. The average financial constraint is equal to 0.536. The average income tax and investments on R & D were equal to 9.042 and 0.15, respectively. The average of control variables of firm size, leverage, and firm age were equal to 12.494, 0.691, and 12, respectively. Standard deviation is among the most important dispersion parameters. In this research the highest standard error was related to firm age and the least amount was related to investments on R & D. Also regarding table 2, since the meaningfulness level of the variables has been higher than 0.05, they had a normal distribution.

Table 2: Research variables' descriptive statistics

Variable	Constraint $S_{it}$	$Tax_{it}$	$R \& D_{it}$	$Size_{it}$	$Lev_{it}$	$Age_{it}$	Observation
Median	0.561	9.024	0.145	12.703	0.624	12.16	590
Mean	0.536	9.042	0.151	12.494	0.691	12	
Maximum	3.159	10.091	0.325	14.966	0.955	17	
Minimum	-1.006	7.040	0.055	10.954	0.120	5	
Standard error	0.050	0.476	0.032	1.246	0.242	3.399	
Skewness	0.585	-0.119	1.167	0.392	-0.640	-0.302	
Pulling	1.954	2.712	3.957	2.237	2.441	2.033	
Jarque-Berra test (meaningfulness level)	2.568 (0.276)	0.145 (0.929)	6.637 (0.136)	1.246 (0.536)	2.032 (0.361)	1.353 (0.508)	

Testing research hypotheses

Studying first hypothesis

In this part we will deal with results of testing the first research model represented in table 3 using the dependent variable of financial constraints.

Table 3: Testing first hypothesis model

Variable	Estimation coefficients	Estimation error	t statistic	Meaningfulness level
Fixed	0.603	0.132	4.568	0.2036
Investments on R & D	-0.461	0.082	-5.621	0.0158
Firm size	-0.603	0.198	-4.025	0.0214
Leverage	-0.714	0.502	-1.422	0.0923
Firm age	0.312	0.071	4.394	0.0244
Durbin-Watson	Identification coefficient	Adjusted identification coefficient	F statistics	Meaningfulness level
1.8	0.67	0.65	47.031	0.000 **

Regarding table 3, Durbin-Watson statistic is equal to 1.8 and it shows that there is not error correlation because it is between 1.5 and 2.5. The adjusted identification coefficient of this test is equal to 0.65 and it shows that the independent and control variables can predict 65 percent of the changes in the dependent variable (financial constraint). Due to the meaningfulness of F statistics in an error level of 1% we can say that the research model has been meaningful and appropriate statistically.

The estimated coefficient of the variable of investments on R & D and financial constraints is equal to -0.461 and it shows that there has been a negative and reversed relationship between investments on R & D and financial constraints. It means that through investments on R & D we can reduce financial constraints. The effect of the control variable of firm age on financial constraint

is positive. The control variable of leverage is not effective because it is bigger than the probability level of %5. The effect of firm size on financial constraints is negative. Finally, due to the meaningfulness level of t statistic, the research independent variable has been smaller than 5% error level and with an assurance level of 95%, the existence of a negative relationship was approved between investments on R & D and financial constraints in firms enlisted in Tehran Stock Exchange.

Studying the second hypothesis

In this part the results of testing the second research hypothesis regarding financial constraints has been represented in table 4.

Table 4: Testing second research model

Variable	Estimation coefficients	Estimation error	t statistic	Meaningfulness level
Fixed	0.603	0.132	4.568	0.0226
Investment on R & D	-0.461	0.082	-5.621	0.0158
Income tax	0.625	0.112	5.581	0.0162
Income tax * investments on R & D	0.203	0.056	3.625	0.0336

Firm size	-0.203	0.098	-3.025	0.0314
Leverage	-0.714	0.602	-1.422	0.0823
Firm age	0.371	0.071	4.602	0.0251
Durbin-Watson	Identification coefficient	Adjusted identification coefficient	F statistics	Meaningfulness level
1.9	0.57	0.55	51.303	0.000 **

Regarding table 4, Durbin-Watson statistic is equal to 1.9 and it shows that there is not error correlation because it is between 1.5 and 2.5. The adjusted identification coefficient of this test is equal to 0.55 and it shows that the independent and control variables can predict 55 percent of the changes in the dependent variable (financial constraint). Due to the meaningfulness of F statistics in an error level of 1% we can say that the research model has been meaningful and appropriate statistically.

The estimated coefficient of the variable of investments on R & D and financial constraints is equal to -0.461 and it shows that there has been a negative and reversed relationship between investments on R & D and financial constraints. It means that through investments on R & D we can reduce financial constraints. The estimated coefficient of the income tax variable on financial constraints is equal to 0.625 and it shows that there has been a positive and direct relationship between income tax and financial constraints. This means that by increasing income tax, financial constraint increases. The estimated coefficient of income tax \* investments on R & D is equal to 0.203 and it shows that income tax affects the relationship between investments on R & D and financial constraints positively. The effect of the control variable of firm age on financial constraint is positive. The control variable of leverage is not effective because it is bigger than the probability level of %5. The effect of firm size on financial constraints is negative. Finally, due to the meaningfulness level of t statistic, the research independent variable has been smaller than 5% error level and with an assurance level of 95%, the existence of a positive relationship was approved between investments on R & D and financial constraints in firms enlisted in Tehran Stock Exchange.

## 5. DISCUSSION AND CONCLUSION

Results of testing research hypotheses showed that investments on R & D could affect financial

constraints in firms enlisted in Tehran Stock Exchange. Also the effect of income tax has been approved on the relationship between investments on R & D and financial constraints in firms enlisted in Tehran Stock Exchange. Sasidaran and et al (2014) showed that there has been a meaningful relationship between internal financing and R & D costs. There has not been any meaningful relationship observed between external costs and R & D costs. Also in new economies such as in India the interferences of the government (tax and subsidy), it leads to reduce constraints regarding investments on R & D. Carlo and et al (2013) represented that financial constraints were among key R & D activities in firms. And investment on R & D was meaningfully efficient. Bond and et al (2003) stated that financial constraints were more meaningful in Britain and have had a meaningful effect on R & D activities, but in Germany some different results were achieved. Howell (2016) showed that increasing tax costs leads to reduce investment and financial constraints in firms. Therefore, income tax affects the relationship between investments and financial constraints. Results of a research by Edwards and et al (2013) showed that firms suffering from financial constraints have had less liquidity for tax rates and thus there has been a meaningful relationship between financial constraints and tax programming. Zeynap (2014) confirmed that firms that lack security rates encounter obligatory financial constraints affecting investment on R & D. The suggestions based on the results of research hypotheses tests could be presented as follows: through applying appropriate planning and policies using different methods the cash required for the firms can be supplied internally and externally and they should appropriate a part of these financial resources to R & D in order to increase the variety of the firm's products in future, recognize the needs of the customers and alleviate them. Also they should consider the importance of investments on R & D and permanently follow the required strategies to increase firm activities and to meet the needs of their customers. Also the investors and

shareholders can get a positive perspective behaviorally towards future and through this they can have more tendencies to purchase firm stocks and to reduce firm's financial constraints.

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