

## Effect of External Financing on Technology Innovation Activity (An evidence from non-financial firms listed at Pakistan Stock Exchange)

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### Abstract

*the purpose of the study is to examine the effect of external financing on technology innovation activity of the firms. The sample of the study consist of 15 non-financial sample firm listed at PSE for the period of 6 year from 2014 to 2019. The dependent variable of the study is TIA(Technology innovation activity) while the independent variables are bank loan and equity offering by the firms. There is also two control variables are used in this study which are size and growth rate. The results of the study show that there is positive and significant relationship between bank loan and technology innovation activity, Furthermore there is a significant relationship between size, growth rate and technological innovation activity. The study shows that there isn't any significant relationship between equity offering and technology innovation activity. The robustness test is used to analyze the effect of independent variable on dependent variable. Throughout the relationship between independent variable and dependent variable the results shows that there is positive significant relationship between bank loan, size and growth rate with technological innovation activity of the firms.*

**Key Words:** *Technological innovation activity, Bank loan, Equity offering, Size and Growth*

## 1.0 Introduction

Innovation considered as an essential factors for firms and economic growth in the country (Schumpeter 1942). Innovation activity of companies a driving force of the economy. According to Bechekh et al (2006) technological innovation including innovation in product and process are differentiated with the organizational or administrative innovation.

Technological product and process (TPP) comprises of implemented of technological new product and process which have significant improvement in product and process technologically. It is a series of innovative activities including technological organizational, financial and commerce. The TPP innovating firms are those where implemented technological new or significantly improved products or process during the period. (Oslo Manual 1997) With technology innovation activity firm improve their production process and quality of the product against the price, it may provide firm with an increase in sales and profit (Lieponen 2000). Furthermore innovative activity creates to adopt technology buildup in the firm which allows them to achieve a growth opportunity it is commonly known that TIA contribute a significant increase a firm value. External financing of a bank loan require official information from firms manager relating to investment plan, financial status where that of a securities (Bond or stock) issues does not is. Banks may evaluate the information in order to avoid from moral hazard and agency problem.

A second major source in R&D is that of equity finance as principal source of fund for any business. Several studies concluded that TIA firms use relatively little debt (Hall, 2002) one reason for TIA has limited because of limited collateral value and risky firms pledge to obtain debt financing (Berger and Udell 1990). Innovation is an important factor for firm and economy growth of any country. It has primary concern with innovation from last decades as described by Schumpeter (1942) and Solow (1957). In order to get understanding of internal and external financing and their relationship with technology activities, corporate finance have tried many studies in financing sources to support the technology innovation activity of firms which are categorized into two sources of financing internal & external financing. Several literature discussed that internal financing have positive impact on technology innovation activity of firm (Branch 1974, Switzer 1984, Brown 2000, Hall 2002). Under

external financing banks make their decision for firm's project with loan criteria, which are usually established on past experience and knowledge.

## 2.0 Literature Review

Several literature discussed that internal financing have positive impact on technology innovation activity of firm (Branch 1974, Switzer 1984, Brown 2000, Hall 2002). Under external financing banks make their decision for firm's project with loan criteria, which are usually established on past experience and knowledge.

However banks experience and knowledge in firm's new and risky project create limitation which discourages manager of whose are willing to make investment in innovative projects and deters them from the projects themselves (Scherer 1984; Rajan and Zingales, 2003) Dewatripont and Mastin (1995) also discussed that banks avoid flowing their money into uncertainty and risky TIA. Baumol (2001) argued that CEOs who finance capital needed for TIA through direct financing have larger managerial discretion.

Sanjai & Welch (1994) explored the determinant of corporate R&D for US, Canadian, British, European and Japanese 6549 firms for the period over 1985-1990. They discussed that debt ratio of last year found significantly negatively correlated with current R&D expenditure of US firms and positively for Japanese firms. They further explained that there is significant positive relationship between last year payment of Japanese firms and current expenditure and having significant negative relationship medium size and small size US firms.

Jinsu & Kim (2011) examined the effect of TIA on firm value as mediation effect of leverage. They studied the sample of Korean firms listed at Korean stock market for the period of eight year from 2001 to 2008. By using the observation of 4080 from sampled firm, they found that firms investment in TIA lead to increase in firm value but also causes decrease in value via reduction in leverage. The study further distinguishes the negative mediation effect of leverage on firm value and a leverage level.

Herrare.AM.Minetti (2007) studied the effect of informed finance on technological change in Italian manufacturing firm by using the sample of 4680 firms for the period of 1998-2000. They found that the firm's information used by bank promotes innovation and finds that bank-firm relationships increase the availability of funds and reduce financing costs.

Anna & Guite (2007) studied the determinant of Information technology innovation by using the sample consist of 17000 Italian Small and Medium size manufacturing firm. They found that geographical location, firm size, functional composition of workforce R&D activity, subcontracting, export and collaborate between firm are highly significant determinant of IT adoption in Italian firms.

Muller and Zimmermann (2009) conducted study on 6000 German SME's to determine the impact of equity finance on R&D activity of those firms. Their study found that equity external financing has positive influence on R&D activity of innovative firm prevailing in Germany. They further explain that equity ratio determined by young companies have larger influence in innovation. Their study suggests some outcome that low level of R&D activity does not require higher level of equity finance.

Brown et al. (2009) explored the relationship between financing innovation and growth during the 1990's R&D booms in US firms. They examined the panel data of 1347 publically traded, high tech firm for the period 1990 to 2004. By using GMM procedure they found that there is clear difference between mature and young firms for the effect of external equity finance in US firms R&D activities. They further concluded that young firms are economically and statistically significant than the mature firm in external financing. So the literature supports the view that finance, financial development, financial market is a key indicator for economic growth.

Atanassov et al (2007) studied the finance and innovation under the case study of publically traded firms by using the large panel of US companies for the period 1974-2000. Their study found that financing by the bank

to firm don't contribute increase in TIA. Their results support that external financing via bank loan have negative association on TIA of the US firms. They also concluded that firms that rely more on arm's length financing receive a larger number of patents and these patents are more significant in terms of influencing subsequent patents.

Benfratello et al (2008) investigated the effect of local banking development on firms innovative activities by using the data of larger number of Italian firm over the period of 1990's. Their finding explore that banking development affects the probability of innovation process, particularly for firms with high technology sectors and small firms and also these firms are more dependent upon external finance. They also concluded that number of banks branches in that region produce a positive influence on introducing an innovation of firms in those regions. They use micro data because of their relationship based on credit.

Brown & Petersen (2011) studied the publically traded US manufacturing firms using cash reserves to smooth their R&D expenditures, they found that there aren't any significance effects of debt issues on R&D investments of firms but instead cash holding by firms are crucial factor for increasing the R&D efforts by the firms. Their findings further concluded that suggest that R&D smoothing with cash reserves is now important for understanding cash management for a substantial fraction of publicly traded firms.

Min-Shik Shin and Soo-Eun Kim (2014) studied the effect of cash holding on R&D smoothing by using the sample data of 11,396 young and mature one Korean firms listed at Korean Exchange for the period of 1999 to 2009. By using fixed effect model their study explore that young firms use more cash holdings to smooth R&D investment as compared to the mature ones. This means that young firms can use the cash holdings to smooth R&D investment in the existence of the financial constraints. The findings further stated that firms use more cash holding to fund asset-counted R&D investment as compared to the cost-counted R&D investment, because the intangible assets created by asset-counted R&D investment may as innovative driver that can have greater effect on firm's value.

Robert et al (2002) investigated the capital market imperfection, high tech investment and new equity financing by using 2400 publicly traded US high tech companies over the period of 1981 -2008. During their study they found that small high tech firms obtain little debt financing because of asymmetric information and lack of collateral. They further explain that new equity offering has several advantages but costly as compared to internal finance which provide a major increase in firm size.

James & Bruce (2014) report the R&D smoothing with the panel data publicly traded US manufacturing firms over the period 1970-2006. Their finding shows that there is linkage between corporate liquidity and real investment decision. They further discuss that during 1998-2002 boom period young firms' uses cash holding to reduce the volatility in R&D by 75% and also firms most likely to face financing friction rely extensively on cash holding to smooth R&D. It's give insight the value of liquidity and financing of intangible investment which suggests that R&D smoothing with cash reserves now important in cash management by publicly traded firms during substantial fractions.

Charles & Petersen (1994) studied a panel of 179 small firms in high tech industries to get understanding of R&D and internal finance. Their study found that there is significant relationship between R&D investment and internal finance. Furthermore their finding shows that due to capital market imperfection, the flow of internal finance is principal determinant to small high tech firm to acquire technology through R&D.

Further contribution regarding market value and innovation as described by Derrek & Roger (2001) by using sample of 60 large Australian firms for the period 1994-1996. They examined the market value, R&D and

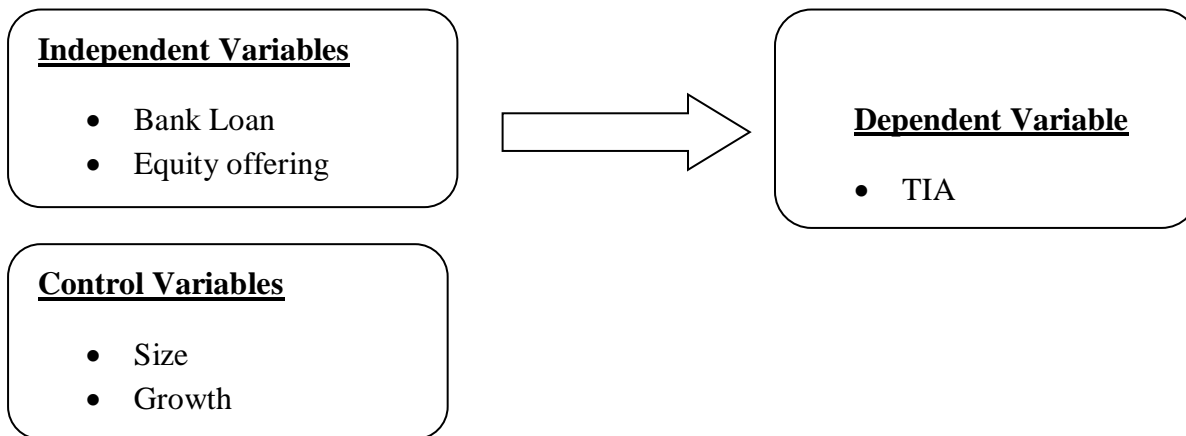
intellectual property their finding shows that R&D and patent activity have positively significant association with market value. Haselmann et al (2009) explored the real effect of bank governance and corporate innovation of 9000 German manufacturing companies. They found that ownership of financial intermediaries has impact on firm innovation activity. Firms having public bank as main lender of financing are less likely in developing innovation as compared to firm having lending relationship with private banks. Furthermore their finding suggests that private bank is superior in selective successful innovation projects as compared to public banks. Extensively government involvement in credit allocation by public banks causes cost of lower corporate innovation and economic growth.

### 3. Theoretical Framework

By identifying the literature gap inside the recent review of literature we comes to know that innovative activity are also used by the firm at startup stage under financial arrangement. This paper develops a framework to assess the effect of external financing on the technology innovation activity (TIA) of manufacturing firm in Pakistan. To measure the innovation, TIA used as proxy for Research & Development of the firms.

#### 3.1 Research model

The methodology consist of the regression model of Bhagat and Welch (1995), whereas aggregate leverage as proxy for external financing, the study divided into different category including bank loan and stock issues and analyzes the impact of these two external financing on TIA.



The study use panel data techniques which allow controlling the variables effectively. The panel data regression model estimated in this study is

$$TIA_{it} = \alpha_0 + \beta_1 bank_{it} + \beta_2 eo_{it} + \beta_5 size_{it} + \beta_6 yd + \delta_i + \epsilon_{it}$$

#### Whereas

- $rd_{it}$ : TIA of firm  $i$  at the year  $t$
- $bank_{it}$ : change in remaining bank loans of firm  $i$  at the end of the year  $t$
- $eo_{it}$ : equity offerings of firm  $i$  at the year  $t$
- $size_{it}$ : the number of employees of firm  $i$  at the year  $t$
- $yd$ : year dummies over the full sample periods (9 years)
- $\delta_i$ : time invariant and unobserved panel effects (fixed or random effect)
- $\epsilon_{it}$ : time variant error terms

### 3.2 Measurement of variables:

#### 3.2.1 Dependent Variable

In this panel regression model, the dependent variable is TIA used as proxy for R&D

#### 3.2.2 Independent Variable

There is too dependent variable used in this study including bank loan & equity offering ,these two variables are considered as external financing for the firms.

#### 3.2.3 Control Variables

In order to control firm characteristics that influence on TIA, we use two control variables; future growth opportunities (qit), and firm size (sizeit).

### 3.3 Hypothesis of study:

By using above mentioned variables the relationship between these variables will be checked out by hypothesis.

H1: Bank loan have negative effect on TIA

H2:- Stock issues under external financing have positive impact on TIA

H3:-Bank loan have positive effect on TIA

H4: Equity offering have negative effect on TIA

## 4.0 Methodology

A cross sectional data is being used to analysis the effect of external financing on the technology innovation activity of firm in Pakistan.

### 4.1 Data Collection

The sample study consists of 15 firms using R&D listed at Pakistan Stock Exchange for 6 years data from 2014 to 2019 of KSE. The data has been collected from annual reports of the companies.

The study included those firms whose are performing their research and development activities and the firm whose are not performing research and development expenses are not included in their studies.

## 5.0 Results and Discussion:

### 5.1 Descriptive statistics

Table 1.

Variables	Mean	Std Dev.	Maximum	Minimum
tia	6.772078	0.960046	8.878650	4.812910
bl	8.629210	0.980216	10.58201	5.808890
eq	9.024604	0.758854	10.63356	6.954240
size	10.12390	0.807252	11.74335	7.817260
gr	10.16257	0.650220	11.40996	8.395360

Table 1 represents the descriptive statistic of the observations of 15 sample companies listed at PSE. Its highlights the variable computed from the financial statement of the sample companies for 6 years. The tia in the table measure the expenses incurred by firm in research & development as proxy for tia. As the dependent variable tia have means value of 6.772 and std deviation value is 0.960046 while maximum value and minimum values are 8.87860 and 4.812910 respectively. The variable bl and eq represent the external financing of the firm and also as independent variable, in the above table the bl means value is 8.63 and maximum and minimum value is 10.582 and 5.808890 respectively. In the above table size and gr are used as control

variables. Furthermore the means value of eq is 9.024 and the minimum and maximum values are 10.633 and 6.95 respectively .The value in the table 1 shows that there is an effect of external financing on technology innovation activity of the firms.

**5.2 Correlation:**

**Table 2.0**

	TIA	BL	EQ	SIZE	GR
TIA	1.000000	0.006497	0.179099	0.380310	0.635531
BL	0.006497	1.000000	-0.153339	0.234966	0.163916
EQ	0.179099	-0.153339	1.000000	0.544771	0.503009
SIZE	0.380310	0.234966	0.544771	1.000000	0.816697
GR	0.635531	0.163916	0.503009	0.816697	1.000000

Table 2.0 shows the association between the variables. In above table there is negative insignificant relationship between equity and bank loan as the value of -0.15339. Furthermore there is positive significant relationship between bank loan and technology innovation activity (tia) as value is 0.006.This shows that firms use bank loan to finance their innovation activity. The table shows that there is a positive relationship between all independent variable with dependent variable. The control variables have also insignificant relationship between size and tia while growth rate have positive insignificant relationship with technological innovation activity. In the above table 2.0 the value shows that equity offering have insignificant relationship with size and growth rate.

**5.3 Regression:**

**Table 3.0**

**Dependent Variable**  
TIA

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-5.403839	1.227771	-4.401343	0.0000
BL	0.228929	0.073825	3.100972	0.0019
EQ	0.051464	0.111199	0.462808	0.6435
SIZE	-1.432949	0.152883	-9.372860	0.0000
GR	2.389673	0.177220	13.48418	0.0000
	Robust Statistics			
R-squared	0.457705	Adjusted R-squared	0.432185	
Rw-squared	0.692794	Adjust Rw-squared	0.692794	
Akaike info criterion	124.3956	Schwarz criterion	137.2573	
Deviance	27.88416	Scale	0.492932	
F- statistic	0.0456	Prob(Rn-squared stat.)	0.000000	

This table shows that how variables influence the depended variable they show that the variable is significantly related with the depended variable or in-significant related. There is a positive significant relationship between bank loan and technological innovation activity and this shows that firm use bank loan as external financing to support innovation activity of the firm, while there is also significant relationship between size and technological innovation activity. Furthermore the control variables size and growth rate have positive relationship with technology innovation activity while equity offering have insignificant positive relationship with TIA. The value of F-statistics shows the goodness of the model in case its value is less than 0.05 which shows that the model is good and probability is also 0.000. The R-square also show the goodness of the model by using the data. The value of R square in the table is 0.45 which means that 45% variation in dependent variable are being explain by independent variables in the model. While Adjusted R square also show the variation in dependent variable because of

independent variable. In the above table the constant value is -5.40 which show that 100% change in dependent variable is because of 54% decrease in constant or residual value, while  $b_1$  and  $e_q$  have value of 22% and 5% respectively. The size has negative value of -14% effecting dependent variable. The adjusted R square shows the specification of the model while the f-statistics shows the joint significance of the variables used in the model. The f-statistics value is 0.04 which means that the model is overall significant at 5% significances level.

#### 5.4 Results & Discussion:

The overall results shows that there is positive significant relationship between bank loan and technology innovation activity of the firm, which shows that firms in Pakistan using research and development in their innovation process goes for bank loan as external financing to finance their innovation activity. Furthermore the results also shows that there is positive significant relationship between size and growth rate with the firm innovation activity as the previous literature support the results while there is insignificant relationship between equity offering and technology innovation activity. Table 2.0 shows that there is negative co-relationship between equity offering and bank loan. The whole study shows that bank loan, size and growth rate have positive significant relationship with technological innovation activity.

#### 6.0 Conclusion:

After the empirical study we find that sample firm listed at Pakistan Stock Exchange goes for external financing of bank loan to finance their innovation activity. The results shows that there is positive significant relationship between bank loan and innovation activity of the firm which are supporting the pervious study of Anna & Guite (2007) and Atanassov et al (2007). In this study the H3 is accepted which shows that there is positive relationship between bank loan and TIA. Firm using external financing to support their innovation activity tend to use bank loan as external source of finance. So overall results shows that firm are there isn't any relationship between equity offering and innovation activity of firm, which represents that those sample firms in the study are not using equity offering as source of finance to support innovation activity while there is also other sources of finance including bond and internal financing. Many of the studied conducted in different developed countries are showing the same result as this study is supporting those literature included in the study. The implication of the study is that managers should consider bank loan as external finance in order to perform technology innovation activity in Pakistani non-financial companies.

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