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DOES BETTER ACCESS TO FINANCE LEAD TO HIGHER INNOVATION?

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ABSTRACT

This study mainly focuses on the impact of various financing channels on corporate innovations. For this purpose, three kinds of external financing sources and two kinds of internal financing sources are considered. The study covers 18 Turkish companies traded in Istanbul Stock Exchange with the highest R&D expenditures of the year 2019. The dataset covers a panel data of 18 Turkish companies for the period from 2010 to 2019. The *analysis are performed using dynamic panel data analysis. The estimation results show that loans have a negative and statistically significant effect on R&D expenditures. Moreover, according to the findings, there is no statistically significant effect of internal financing on R&D expenditures. The results of the study provide valuable information on how companies finance innovation processes.*

Keywords: *Innovation, R&D, Financing Sources.*

Jel Codes: *D53, C23, O3.*

1. INTRODUCTION

Sustainable growth can be defined as a whole set of operations to increase the production capacity and improve the living conditions. Although sustainability is on the one hand lives on economy and its various components, it is not solely dependent on the economic outcomes. Since sustainability refers to the ability of maintaining todays conditions without causing a disadvantage for the future generations, it can be closely related to the innovation.

Innovation is considered as a set of operations which are performed to increase efficiency, to receive better quality and to introduce new production methods. For a company an innovation process may emerge as introducing a new product or service, a new form of organization, a new marketing method, and pursuing constant technological development.

In literature the studies focusing on the relationship between economic growth and innovation trace back to 1800s (for early studies see. Smith, 1776; Schumpeter, 1927; 1934; Solow, 1957). However, in the last few decades the rapid developments in technology and the transformations in

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economies have emphasized the importance of innovation for both companies and economies. In other words, the development of technology and changes in living conditions increase the competition in the market and of course, companies which cannot accommodate themselves to these new circumstances will not be able to survive in this competitive environment. For this reason, today innovation has become a necessity for companies to gain a strategic advantage over their competitors (Bulut and Arbak, 2012). Hence, the basic sources of innovation can be listed as follows: competitors, suppliers, company employees, universities, technology transfer units, commercial and academic publications, commercial and professional relations, exhibitions, conferences, legal regulations and standards, communication networks and research and development organizations (Dodgson et al., 2008).

In general, innovation activities are associated with the companies' R&D expenditures. In this respect, financing of these expenditures is considered as a basic input for innovation (Bergemann and Hege, 2005). Therefore, having a strong capital structure is a great advantage for companies to invest more in R&D and innovation processes. In other words, large enterprises with strong equity can allocate more resources to R&D activities and focus on innovation activities (Örücü, 2011). However, having a strong capital is not particularly the only way to support innovative enterprises. Companies can finance innovation activities by using bank loans, collaborations, incentives, grants, etc. as well as equity.

Considering the fact that an innovation is a long term process with uncertain outcomes, the external financing is not always easy (Hall and Lerner, 2010) and the cost of external financing is much higher than the cost of internal financing (Xu and Su, 2016).

The focus of this study is to analyse the impact of various financing channels on corporate innovations. In this study 18 Turkish companies traded in Istanbul Stock Exchange with the highest R&D expenditures of the year 2019 are examined. For this purpose, three kinds of external financing sources and two kinds of internal financing sources are considered.

In the literature, there are different studies on how companies' R&D expenditures and their tendency to innovate are affected by financial resources (see. Minetti and Zhu, 2011; Zhang et al., 2016; Liu et al., 2019; Wang et al. 2020, and so on.). The studies concerning the innovation in the context of Turkish financial industry are centered around the relationship between innovation and economic growth (Genç and Tandoğan, 2020; Dereli and Salgar, 2019, Uçak, et al., 2018; Ülger and Uçar, 2018; Köse and Şentürk, 2017; Duman, 2017; etc.). However, the studies focusing on financial channels of innovation is very limited. To the best of our knowledge, in this regard the only study is done by Demirci (2018). Demirci (2018) examines 18 R&D-intensive companies listed on Istanbul Stock Exchange and in the analysis he uses a dynamic panel data model. In his paper, he only considers one internal financing source, i.e. the total net cash flows and one external financing source, i.e. the total debt financing source. He also use some control variables which are age, sales and size of the companies.

Therefore, the contributions of this study are threefold. Firstly, this study is important to better understand the role of finance in terms of investment in innovation. Secondly, our study contributes the literature by evaluating the effects of different sources of both external and internal financing. Thirdly, this study contributes to the innovation literature by adressing the impacts of the internal (the ratio of total assets and the ratio of operational profit/loss to total assets) and external (the ratio of short term debts to total assets, the ratio of short term trade liabilities to total assets and the ratio of long term debts to total assets) fundings on R&D expenditure.

The organization of the paper is as follows. We give a literature review by considering different financial channels of innovation in Section 2. In Section 3, we describe the data and empirical analysis. In Section 4, we discuss the empirical findings and conclude the paper..

2. LITERATURE REVIEW AND FINANCIAL CHANNELS OF INNOVATION

In the literature, two main sources of financial channels, i.e. the internal and the external channels, have primarily been of interest. The external financing channels have two sources: public and private, whereas the internal financing channels are the equity or operational income. Therefore, in this part of the study we present the literature and sources of financing in four sections.

2.1. Government subsidies and Innovation

Government subsidies are main financial tools used by the companies to finance the innovation acitivities. In general, these subsidies are as follows: Direct R&D subsidies, R&D tax exemptions and business-public cooperation supports (Garcia-Quevedo, 2010; Hall and Reenen, 2000; David et al., 2000).

There exist several studies which investigate the effect of these subsidies on innovation. One particular result of these studies imply that the impact of these subsidies on the innovations of institutions is a controversial issue. For example, some studies are reported that government innovation subsidies have an externality effect on corporate R&D investment and lower the industry's level of R&D investment (Hall and Reenen, 2000; Montmartin and Herrera, 2015). On the other hand, some other studies present that the government subsidies encourage the further innovations (Czarnitzki and Licht, 2006; Wang et al. 2020).

There are also studies which conclude that the government innovation subsidies do not have significant effects on innovation inputs and outputs of the enterprises (Audretsch et al., 2002; Wallsten, 2000; de Blasio et al., 2015). Despite numerous pessimistic studies, few studies from emerging economies have shown that the government subsidies' effects on innovation are positive (Lach, 2002; Czarnitzki and Licht, 2006).

2.2. Tax Preferences and Innovation

Tax preferences can occur in form of reducing the tax rate, tax amount and tax refund. In this context, it is considered as a financing tool which reduces the innovation costs. In other words, tax preferences can encourage companies to innovate more in terms of reducing the tax burden and thus reducing R&D costs (Wang, 2011).

Liu et al. (2019), Rao (2016), Carboni (2011) conclude that tax preferences have significant incentive effects on corporate innovation. Tax preferences by internalizing externality lower the cost, increase the benefits of innovation and therefore solve the problem of the positive externality of corporate innovation.

2.3. Bank Loans and Innovation

Although the importance of banks varies from country to country, banks are the largest financial intermediaries. Loans are of course one of the basic tools of banking. Some studies highlight the importance of loans on innovation (Minetti and Zhu, 2011; Giannetti, 2012; Bugamelli et al., 2012; Succurro, 2014). However, while innovation process needs a long-term capital investment, bank loans are generally short-term financial instruments. Therefore, the bank loans and the innovation conditions do not always match. Moreover, banks provide financial support preferably to investments with low risk, whereas innovation includes high risks (Lu et al., 2013).

Studies on the relationships between bank loans and innovation have provided fairly consistent results that bank loans do not have significant impacts on corporate innovation. For example, bank loans do not contribute significantly to corporate technological innovations (Ling et al., 2020; Liu, 2019).

2.4. Equity and Innovation

Equity financing refers to the sale of shares (eg. shares in a business) to raise funds for commercial purposes. As it is not easy to get support from bank loans or other funds, internal finance is an important source of finance that can be used in R&D investments. Especially for newly established businesses this is the case. In addition, compared to other financing instruments, the equity financing is a more stable financing channel. There are studies which find that equity financing is the most important source of innovation (Brown et al.2012; Zhang et al., 2016; Succora and Costanzo, 2016).

For example, Guariglia and Liu (2014) examined the extent to which funding constraints affect innovation activities. The findings of the study show that the innovation activities of Chinese firms are limited by the availability of internal financing.

3. DATA AND ANALYSIS

In the analysis, we consider 20 publicly traded companies with the highest R&D expenditures in 2019. These companies are listed in Table 1.

The data is restricted to a balanced panel by removing NETAS and TURKCELL which have missing or incomplete values. Therefore, our dataset covers a panel data of 18 Turkish companies for the time span starting from 2010 until 2019. The data is collected from 'stockeys.com' database.

Table 1. Rankings of the Companies' R&D Expenditures in 2019

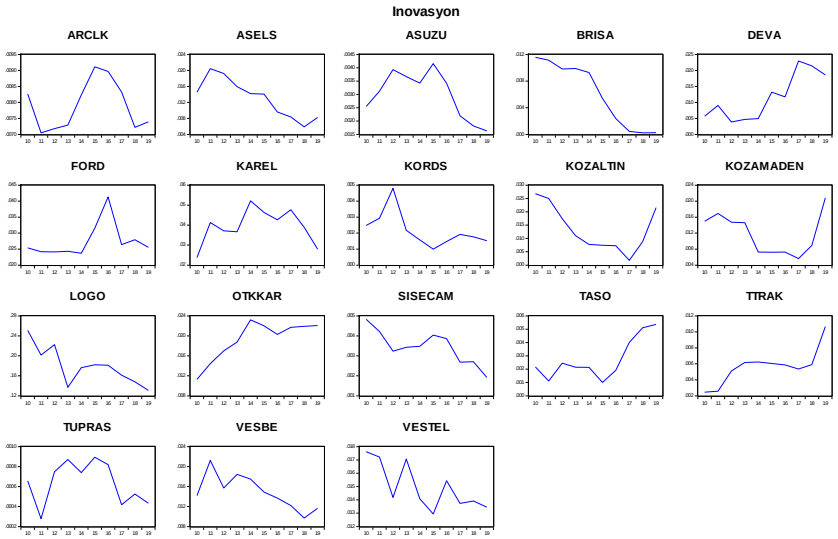
Ranking	Company Name	Stock Code
1	Arçelik A.Ş.	ARCLK
2	Aselsan Elektronik Sanayi ve Ticaret A.Ş.	ASELS
3	Anadolu Isuzu Otomotiv San. ve Tic. A.Ş.	ASUZU
4	Brisa Bridgestone Sabancı Lastik Sanayi ve Tic. A.Ş.	BRISA
5	Deva Holding A.Ş.	DEVA
6	Ford Otomotiv Sanayi A.Ş.	FORD
7	Karel Elektronik San. ve Tic. A.Ş.	KAREL
8	Kordsa Teknik Tekstil A.Ş.	KORDS
9	Koza Altın İşletmeleri A.Ş.	KOZALTIN
10	Koza Anadolu Metal Madencilik İşletmeleri A.Ş.	KOZAMADEN
11	Logo Yazılım San. ve Tic A.Ş.	LOGO
12	Otokar Otomotiv ve Savunma Sanayi A.Ş.	OTKKAR
13	Türkiye Şişe ve Cam Fabrikaları A.Ş.	ŞİŞECAM
14	Tofaş Türk Otomobil Fabrikası A.Ş.	TASO
15	Türk Traktör ve Ziraat Makineleri A.Ş.	TTRAK
16	Türkiye Petrol Rafinerileri A.Ş. (Tüpraş)	TUPRAS
17	Vestel Beyaz Eşya Sanayi ve Ticaret A.Ş.	VESBE
18	Vestel Elektronik Sanayi ve Tic. A.Ş.	VESTEL

Source: http://www.turkishtimedergi.com/arge250/

To quantify the innovation, we consider the R&D expenditures as an indicator of it. In the empirical analysis, we investigate the impacts of two different types of financial channels, the external and the internal one. The former is analysed by means of the ration of short term debts as external financial channels we use the ratio of short term debts to total assets (STD), the ratio of short term trade liabilities to total assets (STL) and the ratio of long term debts to total assets (LTD). Concerning the internal channels, the ratio of total equity/the total assets (Equ) and the ratio of operational profit/loss to total assets (ROA) are chosen to measure their effect.

The Figure 1 demonstrates the changes in innovation rates for companies between 2010 and 2019. The ratio of R&D expenditures to total assets is extremely high for LOGO. This ratio varies from 13% to 25.10% for LOGO while it is below 5% for other companies. Specifically, for LOGO the ratio shows a sharp decline of about 12% during the three-year period from 2010 to 2013. Then, the ratio increases to18% and stays at this level for two years but after 2016 it again drops and reaches its lowest level. Among others the TUPRAS has a small but a stable innovation rate in this period.

Figure 1. Innovation rate of the companies between 2010 and 2019



The descriptive statistics of the variables with respect to companies are reported in Table 2. Accordingly, the mean value of R&D expenditures over total assets is maximal for LOGO and minimal for TUPRAS. Moreover, the highest variability in innovation rate also belongs to LOGO and lowest variability in innovation rate belongs to TUPRAS. LOGO's innovation rate has been the most highest among these 18 companies indeed, but also exhibits some jumps. On the other hand, the TUPRAS's innovation rate stays more stable over years.

The mean values of financing channel variables show that KOZALTIN is the company among which uses the least external financing and the most internal financing in their activities. In addition, in mean value TUPRAS, VESTEL and BRISA have the highest STD, STL and LTD intensities, respectively. On the other hand, in mean values OTKKAR and ASUZU have the lowest Equ rate and ROA, respectively.

Table 2. Descriptive Statistics of Variables

	Innovation		External Financing Channels						Internal Financing Channels			
			STD		STL		LTD		Equ		ROA	
	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.
ARCLK	0.0079	0.0008	0.0999	0.0396	0.1511	0.0201	0.2101	0.0313	0.3570	0.0525	0.0733	0.0047
ASELS	0.0131	0.0049	0.0428	0.0169	0.1055	0.0294	0.0232	0.0184	0.4445	0.0549	0.0799	0.0159
ASUZU	0.0030	0.0009	0.1742	0.0497	0.2360	0.0390	0.0883	0.0786	0.4217	0.0848	0.0312	0.0236
BRISA	0.0060	0.0048	0.1689	0.1304	0.1447	0.0232	0.2609	0.1714	0.3272	0.1326	0.0987	0.0264
DEVA	0.0116	0.0072	0.1631	0.0601	0.0537	0.0236	0.1457	0.0660	0.4910	0.0316	0.0795	0.0614
FORD	0.0275	0.0054	0.0899	0.0419	0.2629	0.0396	0.1572	0.0334	0.3730	0.0739	0.1320	0.0344
KAREL	0.0395	0.0087	0.0931	0.1044	0.1040	0.0131	0.0904	0.0558	0.4545	0.0919	0.0792	0.0561
KORDS	0.0022	0.0011	0.1650	0.0431	0.0892	0.0182	0.0771	0.0426	0.5661	0.0802	0.0669	0.0236
KOZALTIN	0.0135	0.0086	0.0044	0.0082	0.0166	0.0098	0.0042	0.0103	0.8896	0.0431	0.2914	0.1453
KOZAMADEN	0.0118	0.0052	0.0059	0.0066	0.0205	0.0091	0.0071	0.0083	0.8832	0.0299	0.1885	0.0777
LOGO	0.1792	0.0379	0.0254	0.0525	0.0460	0.0189	0.0853	0.0675	0.5872	0.1137	0.1465	0.0630
OTKKAR	0.0193	0.0039	0.0650	0.0676	0.0961	0.0509	0.2002	0.0696	0.1989	0.0484	0.0798	0.0259
ŞİŞECAM	0.0034	0.0009	0.0575	0.0188	0.0529	0.0061	0.1983	0.0466	0.5948	0.0404	0.0595	0.0208
TASO	0.0027	0.0015	0.2284	0.2103	0.1685	0.1185	0.2260	0.0311	0.2975	0.0340	0.0895	0.0247
TTRAK	0.0056	0.0023	0.0408	0.0500	0.2220	0.0384	0.2379	0.1166	0.3749	0.1175	0.1865	0.0568
TUPRAS	0.0006	0.0002	0.2657	0.2692	0.1403	0.1023	0.2402	0.1042	0.2749	0.0284	0.0937	0.0532
VESBE	0.0149	0.0034	0.0884	0.0683	0.3672	0.0478	0.0553	0.0452	0.4048	0.0519	0.0963	0.0618
VESTEL	0.0150	0.0017	0.1112	0.0909	0.4395	0.0820	0.1014	0.0683	0.2108	0.0424	0.0540	0.0348

Note: STD: the ratio of short term debts to total assets, STL: the ratio of short term trade liabilities to total assets, LTD: the ratio of long term debts to total assets (LTD), Equ:the ratio of total equity/the total assets, ROA:the ratio of operational profit/loss to total assets (ROA

For further investigation, the correlation between innovation rates and financing channel variables are calculated and shown in Table 3. The correlations between innovation rates and external financing variables are negative and significant. However, the correlations between innovation rates and internal financing variables are positive and only significant for Equ variable. On the other hand, in case when a significant and negative correlation exists between internal and external financing channels, there does not exist any significant correlation among the external financing channels. Moreover, Equ and ROA are also correlated.

Table 3. Correlations Between Variables

	Innovation	**STD**	**STL**	**LTD**	**Equ**
Innovation	1.000				
STD	-0.216**	1.000			
STL	-0.183*	-0.055	1.000		
LTD	-0.184*	0.011	0.092	1.000	
Equ	0.173*	-0.294***	-0.556***	-0.601***	1.000
ROA	0.138	-0.278***	-0.193**	-0.216**	0.425***

Note: '*', '**' and '***' show $\alpha = 0.05, 0.01$ and 0.001 levels of significance, respectively.

The focus of this study is to verify and to test the impacts of the two financial channels on innovation. For this purpose the dynamic panel regression model which is given in (1) is used.

$$Innovation_{it} = \alpha_1 Innovation_{it-1} + \beta_1 STD_{it} + \beta_2 STL_{it} + \beta_3 LTD_{it} + \beta_4 Equ_{it} + \beta_5 ROA_{it} + \gamma_t + u_i + \varepsilon_{it} \quad (1)$$

where $i \in \{1,2,\dots,18\}$ represents the companies, $t \in \{2010, 2011, \dots, 2019\}$ denotes the time and ε_{it} indicates the random errors. Moreover, γ_t and u_i represent the time and companies' individual effects, respectively.

In panel data estimation, the endogeneity is a problem which should be handled carefully. The traditional approach to solve this problem is using the instrumental variables method. However, Wooldridge (2010) states that random effects (RE) and fixed effect (FE) models rely on the assumption of those instruments being strictly exogeneous and conditional on the unobserved effects. Moreover, in RE model it is also assumed that intruments are uncorrelated with the unobserved effects. Therefore, we estimate the model by using Generalized Method of Moment (GMM) which is proposed by Arellano and Bond, 1991; Blundell and Bond, 1998). In the GMM method the estimations are consistent even if there exists unobserved heterogeneity, simultaneity and dynamic endogeneity in the explanatory variables (Wintoki et al., 2012). In particular, the GMM considers at the beginning that all the

explanatory variables could be endogenous and therefore it internally transforms the variables before estimation (Roodman, 2009).

In the dynamic panel data estimation we use the plm package of R software (Croissant and Millo, 2018; Croissant and Millo, 2008; Millo, 2017). The twosteps GMM method of Arellano and Bond, 1991 is applied. The results are shown in Table 4.

Table 4. Dynamic Panel Data Estimation Results

Variables	Coefficients (Std. Errors)
$Innovation_{t-1}$	0.3655*** (0.0258)
STD_t	-0.0316*** (0.0039)
STL_t	-0.0423*** (0.0068)
LTD_t	-0.0280*** (0.0085)
Equ_t	-0.0134 (0.0126)
ROA_t	0.0156 (0.0115)
Sargan test: chisq(35) = 4.5284 AR (2): normal = 0.9749 Wald test for coefficients: 668.7355*** Wald test for time dummies: 129.4857***	

Note: '*', '**' and '***' show $\alpha = 0.05, 0.01$ and 0.001 levels of significance, respectively.

According to the Dynamic Panel Data Model estimation results; one-period lagged value of innovation has positive and statistically significant effect on innovation. This means that the companies' previous period R&D expenditures may cause or may have an incentive to an increase in current R&D expenditures. Moreover, while all the loan variables, which are STD STL and LTD, have negative and statistically significant effects on innovation, the effects of internal financing variables are insignificant.

The diagnostic tests of the model are also shown in Table 4. Sargan test of over-identifying restrictions shows that the null hypothesis is not rejected. Therefore, the instrument variables are said to be valid. In addition we can say that there is no 2nd order autocorrelation. Besides, Wald test results show that the model is significant.

5. CONCLUSION

As stated in the literature, R&D investments of companies reflect their attitudes towards innovation. The amount of this R&D investment can be also analysed in terms of the development level of a country. For instance, in developing countries insufficient R&D investments can result in slower economic growth (Mercan and Çetin, 2018).

One particular challenge related to innovations is the difficulty of predicting the possible outcomes. In principle, an innovation reqiures a long term investment which might involve high risks. Therefore, finding a financial resource to support the innovation activities becomes a rather challenging task on its own. In this regard, government subsidies, tax rebate, loans, equity and earnings might be potential ways of financing the innovations.

This article considers loans as external financing sources and equity and corporate earnings as internal financing sources. In the study, we implement an empirical study on the impacts of internal and external financing channels for Turkish companies.

The findings of the study shows that the relation between the innovation and external financing channels differs from the relation between the innovation and the internal financing channels. The results can be listed as follows:

1. Loans have significantly negative impacts on R&D expenditures. This finding supports the literature (Ling et al., 2020) and states that borrowing has a reductive effect on innovation.

2. There is no statistically significant effect of internal financing on R&D expenditures.

As a final remark, the findings of the study may address that the financial channels used by Turkish companies to support their innovation activities are mostly external sources. However, this study does not cover the impacts of government supports such as government subsidies and tax rebates on innovation due to the limited available data. Therefore, this study is limited in this context.

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