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DEPARTMENT OF ECONOMICS

Innovation & Financial Development from a Global Perspective

Empirical Evidence from Manufacturing Firms in Developing Countries

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Abstract

Financial development, *i.e.* access to finance, is needed for innovation and to resolve the current under-allocation of innovation investments in small firms in countries with lower financial development. Using firm level data from over 12,500 manufacturing firms and country characteristics from developing countries, we study the link between R&D, as a proxy for innovation, and financial development in terms of probability, expenditure, and productivity of R&D investments. We find that both firm size and financial development has a strong positive correlation with the probability of a firm engaging in R&D. We also find, using a R&D index, that small firms are more productive then larger firms in terms of R&D. It is also shown that levels of innovation between small and large firms decreases when financial development increases.

[Keywords: Innovation, R&D, Financial Development, Manufacturing firms]

[1]We would like to show our gratitude towards Johan Stennek, supervisor and Professor at the Department of Economics at School of Business, Economics and Law for his advice, comments, and patience. All errors are on the account of the authors.

INTRODUCTION

When previously measuring the relationship between innovation and financial development, *i.e.* access to financial means, the focus has been on developed countries. Our undertaking is to examine the relationship between Research and Development (R&D), our proxy for innovation, and different forms of financial market development, but with a focus on the developing world. More specifically, we want to investigate what determines the probability, productivity, and the amount of R&D expenditure and how it is affected by how developed countries' financial markets are.

Our approach allows us to capture innovation not only from R&D expenditure, but also from the everyday improvements introduced in the firm. Our measurement of financial development contains four widely accepted variables used by previous researchers, making our research consistent to previous ones.

To further explore the relationship between innovation and financial development; correlation between R&D investments in firms and financial resources provided are used as proxies for innovation and financial development, respectively.

The positive relationship between financial development and economic growth (WEF, 2012) has received great attention in economic literature during the last two decades[2]. With attention to developing countries, our aim is to examine how financial development affects innovation; a topic which is not only relevant to the developed world (OECD, 2012).

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[2] See Levin (2005) for a comprehensive overview of different studies on the topic

We aim to provide new insights on financial development and innovation using wider firm-data from the manufacturing sector with a focus on developing countries.

Earlier literature (Cohen & Klepper, 1996) has shown that smaller firms are less likely it to engage in R&D and that larger firms engaged in R&D spend proportionally more than smaller firms engaged in R&D. Research which estimates R&D productivity, however, shows that innovations produced per dollar of R&D is higher in smaller firms (Bound *et al.*, 1984). Acs and Audretsch's (1991) study indicates that small firms contribute with double the amount of innovations per employee compared to large firms. In line with that research, Plehn-Dujowich (2006) concludes that smaller firms achieve three times more patent citations per dollar of R&D than larger firms. This relationship of firm size with increasing R&D investment and decreasing R&D productivity puts forward greater return of R&D investment in smaller and more productive firms.

We apply three variables as measurements of R&D in this study: (1) an indicator if a firm is engaged in R&D or not; (2) a ration of the total amount of R&D expenditure to total sales; and (3), we sum up if each firm has invented a new product, process, and a significant upgrading of the product in order to create an unconventional R&D productivity index ranging from 0 to 3. The latter is different from the most commonly used measurement of innovation productivity, the number of patents taken out by a firm. Our advantage here is that we capture firms which invest in R&D but not always successfully receive a patent, allowing us to reflect practical experiences.

Previous empirical work has utilized standard quantitative indicators for measuring financial development. These indicators, unfortunately, only serve as a rough estimate and do not capture all aspects of financial development (World Bank, 2013). We attempt to overcome this caveat by including different indicators estimating the development of both financial institutions and financial markets.

For the development of financial institutions, we apply the ratio of domestic credit, meaning all credit to various sectors except of the central government (World Bank, 2013), to the gross domestic product (GDP). The ratio is a measurement to estimate the development of financial institutions which was collected from the International Financial Statistics (IFS) by the International Money Fund. As an alternative estimate for the development of financial intuitions, we also include an estimate on the number of deposit account holders at commercial banks[3]. This was chosen due to the assumption that banks in financially developed countries competes for fiercely and try to differentiate themselves from each other, resulting in more bank accounts nationwide. We also include an estimate of the difference between the interest rate charged by banks on loans to costumers and the interest paid by banks on saving accounts. Once again, banks are assumed to compete more fiercely in financially developed countries which lead to an increased interest rate in order to attract capital. Both these last two estimates are derived from the World Bank's World Development Indicators.

[3] and other resident banks functioning as commercial banks that are resident nonfinancial corporations (public and private) and households

As an alternative estimate of a country's financial market development (stock market development), we include an estimate on the stock market liquidity; the ratio of stocks traded to stock market capitalizations, also derived from the World Bank's World Development Indicators.

An obstacle that may arise is imperfections on the financial markets. According to The World Bank Enterprise Survey (2007), managers of small firms experienced lack of access to financial means and placed it as one of the most common obstacles when running their businesses. This is seen as a severe holdback for small firms due to banks' skepticism towards their trustworthiness and their collateral. Hence, banks reject more loan applications from small firms than those submitted by larger firms.

With the estimates mentioned above, we test our three hypotheses with the following three regression models: (1) a probit model estimating the probability of R&D; (2) an OLS model on R&D expenditure; and (3) an OLS model on the productivity of R&D.

We expect to find a positive relationship between innovation and financial development, particularly in more financially developed countries where the focus is rather on introducing new and slightly better options compared to previous one, while in less developed countries, much knowledge is being transferred from already successful manufacturers. Our task is here to determine whether these are causalities, or just correlations. This opens up the possibility of one or more unknown variables being responsible for the expected correlation, such as education.

The paper is structured in the following way: first, we describe the data set in our Descriptive Statistics section. Second, we briefly stipulate our hypotheses followed by our Empirical Strategy section. Finally, we describe the results from the regressions and provide conclusions in our two final sections.

DESCRIPTIVE STATISTICS

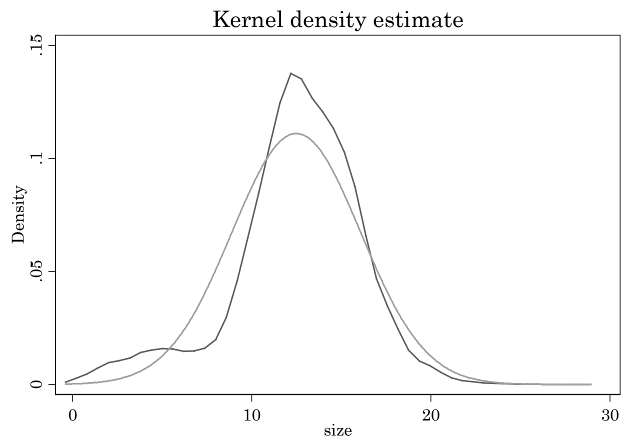
The firm-level data is collected from World Bank Enterprise Surveys. From the original cross-section data set, which contains more than 43,000 manufacturing firms from 105 countries collected between the years of 2002 and 2006, we sorted out approximately 12,500 firms from more 54 countries which provides the necessary information and corrected for some outliers (for a complete list of all countries included in the data, see table A3).

We chose to select manufacturing firms exclusively, hence, secluding service industry due to their lower likelihood applying for patents, which makes the data more comparable to previous studies.

Our data consist of firms from the following regions and the correspond percentages: 35.71 percent located in East Asia and the Pacific, 29.51 percent located in Latin America and Caribbean, 20.04 percent located in Europe and Central Asia, 7.61 percent located in African countries, and 7.13 percent located in Middle East and North Africa.

We categorize the firms into 14 industry groups according to the ISIC (International Standard Industrial Classification) format, which is created by the United Nations Statistics Division to enable international comparison of economic data. A short overlook at Table A2 entails that the most represented industry in the data set is metals and machinery (17.95 %), followed by garments (15.01 %), and foods (13.43 %).

We measure size by the value of total sales (in logged values) from previous year in thousands of USD, *i.e.* sales data collected in year 2005 is total

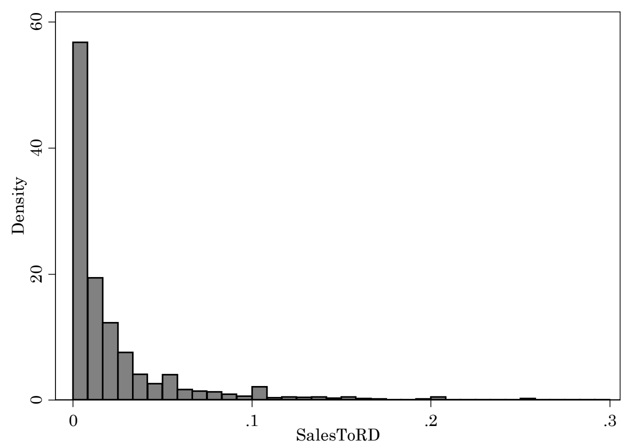


measured sales from 2004. The mean value for *Size*, in logged form is 12.5 with a standard deviation of 3.58. In the graph above, we see the distribution of variable Size compare to the bell-shaped curve of cumulative standard normal distribution, which entails a similar distribution pattern.

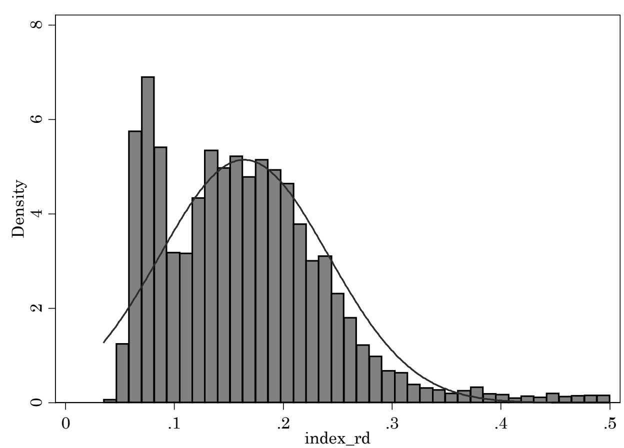
To estimate the rate of R&D, we apply last year's R&D expenditure divided by last year's sales in thousands of US dollars as a proxy for innovation expenditure[4]. The vast majority of all firms do not engage in R&D at all, the 30.50 percent of those which do, allocate no more than 1 percent of sales on

[4] The data on R&D expenditure and size was originally gathered in local currency was later as converted using an average yearly USD rate (previous year.

R&D. As mentioned above, the median R&D to sales rate is located at the 1 percent mark, while the average R&D expenditure reaches up to 2.7 percent of sales.



The deviation from the median and average is caused by a few outliers that reach as high as 27 percent. Initially, some firms demonstrated unrealistic figures far above the 50 percent margin. These few extreme outliers, 2 percent of the sample, were sorted out in order to have a more harmonized data-set.



When plotting our R&D index, a proxy for how productive a firm is with their R&D expenditure, we notice a skewed distribution with a tail on the right side of the mean value of 1.52. The plot clearly shows that the distribution is similar to the bell-shaped curve of the cumulative standard normal distribution, with the exception to the peaks on the left side, demonstrating a set of firms with lower productivity and greater than average firm size.

TABLE I: MEASURMENTS OF FINANCIAL DEVELOPMENT

Variable	#Obs	Mean	Std.Dev.
Spread	12897	6.84	6.01
Turnover	12588	46.98	46.01
Credit	15098	62.96	45.21
Deposit	2648	581.23	408.90

As seen in the table above, our measurement of financial development is multiple: *Credit*, *Spread*, *Deposit*, and *Turnover*. Where *Credit, Spread*, and *Deposit* are proxies for financial development within banking and Turnover is a proxy for financial activity on the stock market.

Credit, the ratio of domestic credit, as seen in the table, is the financial development measurement which accounts for the largest amount of observations. There is, however, a great difference between countries, *e.g.* Brazil has the lowest credit value of 4, while Malawi possesses the greatest credit value of 190. This kind of structural difference explains the standard deviation of 45.21.

We also include an estimate on the number of deposit account holders for each thousand adults at commercial banks as a proxy for financial development. *Deposit*, with its 2648 observations, is the lowest amount of observations we have for our financial development measurement. It ranges from 10 in South

Africa to around 200 in Vietnam. As *Deposit* is somewhat flawed with missing observations, we include it only for control measurements.

Spread, with a total of 12,897 observations, estimates the difference between the interest rate charged by banks on loans to costumers, and the interest rate paid by banks on saving accounts. *Spread*, does not, follow the common pattern with the other measurements of financial development. A lower spread would indicate a more competitive financial market as the marginal return on interest rate would be lower when more competitors are on the market. As the mean value (6.84) and the standard deviation demonstrates (6.01) that there are differences in spread and the financial market situation that the firms are facing.

Turnover is defined as "a ratio of the total value of shares traded during the period divided by the average market capitalization for the period" (World Bank, 2013) and is the only measurement which is aimed to capture stock market development. Similar to other measurements, Turnover demonstrated a high standard deviation (46.01) compare to mean value (46.98).

TABLE II: COUNTRY CHARACTERISTICS

	Credit	*Deposit*	*Spread*	*Turnover*	*GNI*
Credit	1				
Deposit	0.4895	1			
Spread	-0.4323	-0.5031	1		
Turnover	0.6488	0.4533	-0.2432	1	
GNI	0.1902	0.2526	-0.0801	0.0301	1

Table II demonstrates a correlation matrix between the country characteristics. *Credit* has a positive, but not very strong correlation with *Deposit*, *Turnover* and *GNI* (Gross National Income). Both *Deposit* and *Turnover* are expected to be positive, while *Spread* is expected to be negative. We, however, expected *GNI* to have a stronger correlation with *Credit*.

HYPOTHESIS

Below, we provide a brief and concrete overview of our initial hypothesis on our three research questions.

H1: Probability of Innovation Expenditure: We suggest, in line with current literature on the subject, that the probability of innovation expenditure is positively correlated with both firm size and financial development as a consequence of greater access to finance on a more developed financial market and skepticism towards grating smaller firms loans.

H2: Innovation Expenditure: We propose that firm size and financial development is positively correlated with increased expenditure on innovation as larger firms have greater access to funding.

H3: Productivity of Innovation Expenditure: We suggest that financial development is positively correlated with productivity of innovation and that productivity is decreasing as firm size increases.

EMPIRICAL STRATEGY

The empirical strategy aims to examine three topics: (1) the probability of R&D expenditure; (2) the expenditure on R&D, and (3) the productivity of innovation expenditure.

Probability of R&D Expenditure

In order to estimate the probability of R&D expenditure, we set firms that have answered that they have a greater than zero expenditure (R&D > 0) of R&D as a firm which is engaged in innovation. In contrary, firms which have stated a negative value or a value equal to zero (R&D ≤ 0) have been labeled as firms not engaged in R&D. By creating these two groups, we utilize a probit model to estimate the equation as a probability of innovation:

$$\Pr\left(P_{ijc} = 1\right) = \Pr\left(\begin{matrix} \gamma_{jc} + \mu_1 Size_{ijc} + \ \mu_2 FinDev_c + \mu_3 Size_{ijc} \times FinDev_c + \\ \mu_4 Size_{ijc} \times GNI_c + \epsilon_{ijc} \end{matrix}\right) \quad (1)$$

Where the dependent variable, P_{ijc}, is set as a dummy variable that equals 1 if a firm *i,* operating in industry *j,* located in country *c*, is engaged in R&D, otherwise 0. γ_{jc} is a dummy variable depending on the industry j in country c. $\mu_1 Size_{ijc}$ is the size of the firm, and $FinDev_c$ is the financial development calculated in country c from the data set. *GNI* is the Gross national income of country *c*. In order to estimate the coefficients in the probit model, we assume that the margin of error, ϵ_{ijc}, is normally distributed. The two variables, $Size_{ijc} \times FinDev_c$ and $Size_{ijc} \times GNI_c$ are two interaction terms[5] created

[5]Manually created interaction terms are simply a new variable created by multiplying one variable with the other.

manually by the authors. The interaction term allows us to measure if the effect from one independent variable on the dependent variable is different at different values of another independent variable. Concretely, in our sample it is useful to add interaction terms to our model because we would like to test if the relationship between innovation and financial development is different for small and large firms.

Innovation Expenditure

To estimate expenditure on R&D, we sort the data by firms which are engaged in R&D $(P_{ijc} = 1)$ and run an OLS regression on the following equation:

$$E_{ijc} = \gamma_{jc} + \mu_1 Size_{ijc} + \mu_2 FinDev_c + \mu_3 Size_{ijc} \times FinDev_c + \mu_4 Size_{ijc} \times$$
$$\mu_4 Size^2{}_{ijc} \times GNI_c + \epsilon_{ijc} \qquad (2)$$

Whereas E_{jc} is the amount of expenditure on R&D in the previous year divided by sales from previous years by firm i in industry j, located in country c. All other variables are equal to equation (1) with the exception of $Size^2$, which is intended to examine a non-linear relationship between size and productivity.

Productivity of Innovation Expenditure

To estimate productivity, we utilize an innovation index, I, ranging from 0 to 3, where firms earn 1 point for each positive answer to the following three questions: Has your company attained any of the following initiatives in the last three years: (Q_1) Developed a major new product line?; (Q_2) Upgraded an existing product line?; (Q_3) Introduced at least one new technology that has substantially changed the way that a main product is produced? Consequently, answering negative to all of the three questions, $Q_{1,2,3}$, results in an index value of 0, whereas answering positive to one of the three questions, results in an index value of 1, answering positive to two of three questions result in an index value of 2, and finally answering positive to three out of three questions result in an index value of 3.

We thereafter divide the above-mentioned innovation index with R&D, E_{ijc}, to estimate the productivity of innovation R_{ijc}. Finally, we utilize an OLS regression to estimate the following equation:

$$R_{ijc} = \gamma_{jc} + \mu_1 E_{jc}\, \mu_2 Size_{ijc} + \mu_3 FinDev_c + \mu_4 Size_{ijc} \times FinDev_c + \mu_5 Size_{ijc} \times \mu_5 {Size^2}_{ijc} \times GNI_c + \epsilon_{ijc} \quad (3)$$

Whereas R_{ijc} is the amount of expenditure on R&D in the previous year by firm i, in industry j, located in country c, $\mu_1 E_{jc}$ is the amount of expenditure on R&D in the previous year divided by sales from previous years, and $Size_i$ is the size of firm which has a positive R&D expenditure. All other variables are equal to equation (2).

When running all the regressions we apply robust standard errors. For further elaboration, please see Appendix B.

RESULTS

Below we present our findings from our three regressions: (1) Probability of R&D Expenditure; (2) Innovation Expenditure; and (3) Productivity of Innovation Expenditure.

Probability of R&D Expenditure

Table III: PROBIT - PROBABILITY OF R&D EXPENDITURE

Variable	Credit		Deposit
	(1)	*(2)*	*(3)*
Size(log)	0.219*** (0.075)	0.221** (0.0722)	0.392** (0.194)
FinDev	0.301** (0.091)	0.382** (0.152)	-0.079** (0.035)
*Size*FinDev*	0.0120 (0.010)	0.012** (0.040)	-0.001 (0.000)
*Size*GNI*		0.000* (0.000)	0.073*** (0.012)
Observations	15098	15098	2648
R^2	0.050	0.059	0.050
Prob > chi2	0.000	0.000	0.000

*Note: The three columns represents,(1) credit to GDP ratio with, and (2) without size*GNI(log) ,(3) number of deposit accounts per 1000 adults as the financial development variable. Robust standard errors in parenthesis. GNI and industry dummy variables (Metal and Machinery as reference group) are included unless specified as a control variable. *,**, and *** corresponds to a significance level of 90, 95 and 99 percent.*

Table 1 presents the results from the probit estimation on the probability of R&D expenditure on the sample. We initially observe a positive and significant coefficient for *Size,* suggesting that as size increase, the probability of a firm's engagement in R&D follows. As seen in the first column, financial development, credit, is also positive and significant, in line with our first hypothesis: financial development has a positive effect on the probability of innovation. Intuitively, one could assume that financial development is closely correlated with other country characteristics which could facilitate innovation, such as education, property rights, etc. These other country characteristics, which may be relevant to innovations, become apparent when we include *GNI* and its interaction with *Size*. The previous significant coefficient of *Credit* is now insignificant, while *GNI* and its interaction with size become significant and positive.

In column 3, we apply an alternative specification for financial development, deposit[6] number of deposit accounts per 1000 adults. We once again strengthen our hypothesis of the positive relationship between size and innovation with the positive and significant coefficient of size. The interaction term between size and deposit shows a negative value in column 3 which also controls for GNI. Hence, we interpret this as when the number of deposit accounts increases in an economy, the probability of smaller firms to engage in R&D also increases.

Innovation Expenditure

Table 2 presents the results from the OLS estimation on R&D expenditure. The three columns represent Credit, domestic credit to GDP ratio, Deposit, the number of deposit account per 1000 adults, Spread, an estimate of the difference between the interest rate charged by banks on loans to costumers and the interest paid by banks on saving accounts, as the financial development variables. In the column *Credit*, which applies credit as the proxy for financial development, we observe that *Size* has a positive and significant

[6] We tested spread and turnover as other proxies for financial development. The size and spread interaction, showing a negative, but significant coefficient, while turnover and its interaction were insignificant. Logically, a greater spread is a sign of lower financial development, hence the negative sign.

coefficient to innovation, while the interaction term as a negative and significant coefficient.

TABLE IV: OLS ESTIMATION ON R&D EXPENDITURE

Variable	Credit	Deposit	Spread
Size	0.002**	0.007***	0.004**
	(0.001)	(0.001)	(0.222)
Size^2	-0.002**	-0.003***	-0.002
	(0.001)	(0.000)	(0.002)
FinDev	0.001***	0.000***	0.000
	(0.001)	(0.000)	(0.000)
*Size*FinDev*	-0.00***	-0.000***	0.003
	(0.000)	0.000	(0.002)
Obs	3858	445	3716
R^2	0.076	0.079	0.064
Prob > F	0.000	0.000	0.000

*Note: The three columns represents, (1) credit to GDP ratio with, (2) number of deposit accounts per 1000 adults (3) Spread, an estimate of the difference between the interest rate charged by banks on loans to costumers and the interest paid by banks on saving accounts as the financial development variable. Robust standard errors in parenthesis. GNI and industry dummy variables (Metal and Machinery as reference group) are included unless specified as a control variable. *,**, and *** corresponds to a significance level of, 90, 95 and 99 percent*

The negative value for the interaction coefficient implies that the lower the size, the higher the effect of financial development on R&D is. Similarly, the higher the financial development is, the lower the effect of size on R&D is. For Size^2, we notice a negative significant coefficient for both Credit and Deposit. This relationship entails a concave function for size and R&D expenditure, a decreasing expenditure once a firm has reached a certain size. When observing the remaining proxies for financial development, the interaction term between size and spread together with size itself demonstrates a positive and significant value. In contradiction to *Credit*, an increase in *Spread* is a sign of decreased financial development. *Deposit* follows the same pattern as *Credit*; negative interaction term and positive and significant *Size* coefficient, which is endorsing an uneven effect of financial development on innovation activities in smaller firms. When running the regression on *Turnover,* we did not reach any sufficient significance on any of the main variables, therefore excluded in the table.

Productivity of Innovation Expenditure

TABLE V: OLS ESTIMATION ON R&D PRODUCTIVITY

Variable	**Credit**	**Deposit**	**Spread**
Size	-0.037***	-0.008	-0.031***
	(0.01)	0.010	0.011
Size^2	0.005***	0.002	0.004**
	(0.001)	(0.002)	(0.002)
R&D Exp	-0.157***	-.3541***	-.314***
	(0.05)	(.048)	(.0481)
FinDev	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.004)
*Size*FinDev*	0.000***	0.000***	-0.001
	(0.000)	(0.000)	(0.000)
Obs	3858	445	3716
R^2	0.212	0.342	0.201
Prob > F	0.000	0.000	0.000

*Note: The three columns represents, (1) credit to GDP ratio with, (2) number of deposit accounts per 1000 adults (3) Spread, an estimate of the difference between the interest rate charged by banks on loans to costumers and the interest paid by banks on saving accounts as the financial development variable. Robust standard errors in parenthesis. GNI and industry dummy variables (Metal and Machinery as reference group) are included unless specified as a control variable. *,**, and *** corresponds to a significance level of, 90, 95 and 99 percent.*

Table 3 presents the results from the OLS estimation on our innovation index to R&D expenditure. The three columns represent, *Credit*, credit to GDP ratio, *Deposit*, number of deposit accounts per 1000 adults, and *Spread*, interest rate difference between lending and depositing in banks, as the financial development variables.

As seen in the second column to the left, *Credit*, we observe a negative and significant coefficient for size. Similar negative value can be found for *Size* in column *Deposit* and *Spread* as well, even if the coefficient for *Deposit* is insignificant. These finding suggests that innovation productivity tends to decrease as firm size increases. Size^2 with its positive and significant value demonstrates a convex function between size and productivity, which entails a lessening productivity decrease with increasing size.

R&D Exp's, the R&D to Sales ratio, significant and large impact on productivity in all our models, clearly shows how increased R&D expenditure negatively affects productivity.[7] This result points out again that the firms with lower R&D (generally smaller firms) are more productive with their R&D investments.

The interaction terms between *Size*, *Credit*, and *Deposit* are all negative, while *Spread* demonstrates a positive coefficient. Given these results, we argue that the difference between small and large firms in innovation productivity is smaller in countries with greater financial development. Consequently, we conclude that there is a reverse relationship between productivity and spending in regard to small and large firms in our sample.

CONCLUSION

Financial development is needed for innovation and to facilitate access to finance for R&D investments that small firms are demanding. Using firm level

[7] A unit increase in *R&D Exp* is a somewhat unrealistic increase as the variable is measured as a ratio.

data from manufacturing firms and country characteristics from developing countries, we find that financial development influences probability, quantity of, and productivity of R&D expenditures.

In line with our three hypotheses, we draw the following conclusions from our results. Firstly, the probability of R&D expenditure is positively related with firm size and financial development. We noticed that the probability of smaller firms to engage in R&D increases when they are situated in a country with a well-developed financial market. Hence, our findings clearly indicate financial development as a key component in stimulating innovation in small firms.

Secondly, firm size and financial development is positively correlated with increased expenditure on R&D. Our findings show that smaller firms is affected the most by market imperfection and benefits the most from financial development, while larger firms are more robust to market imperfections that could hamper their access finance for their R&D activities.

Thirdly, innovation productivity decreases as firm size increases and the gap between small and large firms in innovation productivity is at its largest in less developed financial markets.

These tangible findings proves that current market imperfections on less developed financial markets is affecting the small firms the most, and that increased efforts to provide access to finance for small firms yields the greatest return on the probability, quantity and productivity, of innovation investments.

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APPENDIX A: TABLES

TABLE A1: SUMMARY STATISTICS

Variable	#Obs	Mean	Std.Dev.
Size (log)	15039	12.50	3.59
R&D Dummy	15098	0.31	0.46
R&D/Sales	4593	.027	.081
Index	15098	1.52	1.11
GNI	12655	2479	1713
ln_GNI	12655	7.57	0.75
Spread	12897	6.84	6.01
Turnover	12588	46.98	46.01
Credit	15098	62.96	46.01
Deposit	2648	581.23	408.90

TABLE A2: MEAN VALUES BY INDUSTRY

Industry	Obs.%	Size	R&D dummy	R&D/Sales	Index
Auto and auto components	5.01	14.18	0.38	0.069	1.57
Beverages	4.16	9.14	0.24	0.059	1.57
Chemicals and pharmaceutics	6.7	13.20	0.41	0.137	1.60
Electronics	6.6	14.40	0.48	0.097	1.66
Food	13.43	13.24	0.29	0.097	1.51
Garments	15.01	12.09	0.28	0.064	1.44
Leather	2.69	11.41	0.30	0.111	1.70
Metals and machinery	17.95	11.94	0.28	0.105	1.47
Non-metallic and plastic materials	8.13	12.18	0.22	0.132	1.33
Other manufacturing	2.09	12.04	0.34	0.095	1.68
Other transport equipment	0.33	13.96	0.40	0.269	1.75
Paper	2.29	11.62	0.18	0.051	1.58
Textiles	6.77	13.13	0.29	0.167	1.52
Wood and furniture	8.84	11.97	0.28	0.045	1.71

TABLE A3: SURVEY COVERAGE

Country	#Firms	Country	#Firms	Country	#Firms
Albania	43	Kazakhstan	221	Slovakia	22
Armenia	177	Kyrgyzstan	36	South Africa	456
Belarus	10	Latvia	14	Syria	151
BiH	28	Lebanon	85	Tajikistan	52
Brazil	1,542	Lesotho	4	Tanzania	29
Bulgaria	35	Lithuania	34	Thailand	1,256
Cambodia	11	Madagascar	237	Turkey	814
Chile	639	Malawi	144	Ukraine	84
China	1,552	Malaysia	350	Vietnam	237
CostaRica	270	Mali	63	Zambia	61
Croatia	57	Mauritius	148		
Czech	73	Moldova	100		
Ecuador	305	Mongolia	191		
Egypt	812	Montenegro	15		
El-Salvador	311	Nicaragua	426		
Georgia	27	Oman	27		
Guatemala	433	Philippines	559		
Guyana	132	Poland	366		
Honduras	398	Romania	226		
Hungary	219	Russia	75		
India	1,427	Serbia	65		

APPENDIX B: REGRESSION DIAGNOSTICS

In order to verify the regression outputs, we briefly describe the examination of the mains regressions below. To verify that we have met the assumption of the OLS regression we test for heteroscedasticity and omitted variable bias.

One of the assumptions of the OLS regression is the homogeneity of variance of the residuals, *i.e.* the error variance should be consistent. To test if the variances of the residuals are non-constant, we control for heteroscedasticity (Stock and Watson, 2003).

Two common tests for heteroscedasticity are the Breyscg.Plagan test and White's test. Both tests examines if variance of the residuals being homogeneous. After running both tests on our OLS regressions, we receive a p-value of 0.3210. Hence, we cannot reject the null hypothesis of variance being homogenous and can therefore assume that OLS estimators are efficient and that the OLS standard errors are unbiased and valid for constructing confidence intervals and t-statistics (Cameron and Trivedi, 2009).

To further test our error terms, we compare robust standard errors and clustered standard errors (countries). To apply the clustered error, we assume that firms within the same cluster (countries) are correlated in some way, while there is no correlation in standard errors among the different clusters.

When running the regression of the two OLS models, we received lower standard errors applying robust standard errors than the others. We therefore, apply robust standard errors.

Testing for omitted variable bias, examining if the model is missing crucial variables: *i.e.* determinants for the dependent variable and correlated with independent variables would lead to a correlation between the error term and an independent variables in the model and violate one of the assumptions of the OLS. When running a Ramsey test with a null hypothesis of no omitted variables in our models we receive the lowest p-value of 0.1207. Hence, we cannot reject the null hypothesis of no omitted values.