Innovation and Access to Finance: International Evidence from Developing Markets

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Abstract

We use various measures of access to finance and financial constraints to examine its effect on firm's likelihood of undertaking innovation activities by employing unique, rich data from World Bank's Enterprise Surveys for over 26,700 firms for 21 countries across all regions. We find robust evidence of the role of financial constraints as an impediment for firm innovation outputs including core (product or process innovations) as well soft forms (organizational-managerial and marketing innovations). After controlling for endogeneity concerns, our empirical evidence is robust to alternative measures of innovation activities, measures of financial constraints, innovation output complemenatrities, and for various sub-samples. These findings suggest that bank financing can play a crucial role in stimulating and promoting a variety of innovation activities in the developing countries. Further, in a first, we find that financial constraints' impact decreases in the innovation output novelty. In other words, impact of financial constraints is stronger for the less novel products than for the more novel, radical innovations, highlighting the need to take into account the innovation novelty in assessing finance-innovation nexus.

Keywords: innovation, productivity, financial constraints, firm performance,
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1. Introduction

The role of financial development on long-term economic growth have widely been recognized in the literature (Levine, 2005; Comin and Nanda, 2014; Guiso et al., 2004; King and Levin, 1993; Blackburn and Hung, 1998; Acemoglu, Aghion, and Zilibotti, 2006). Clearly, these studies show that financial development and, hence, better access to finance facilitates capital accumulation and growth. In a related literature, economists have identified innovation and technological progress as the main drivers of growth and productivity (Landes, 1969; Rosenberg, 1982; Solow, 1957; Griliches, 1979; Wakelin, 2001; Tsai and Wang, 2004; OrtegaArgilés et al., 2008). But the nature of innovation in developing markets is quite different from the technology-driven product and process innovations of industrial countries (see e.g., Sharma and Jha, 2016). These unique innovation activities are focused around imitation of developed market production processes (Iyer et al., 2006), technology cobbling (Sharma and Iyer, 2002), and a blend of imitation and innovation (Segerstorm, 1991; Shenkor, 2010). As argued by Acemoglu et al. (2006) and Dutz (2007) that developing economies gain more from the absorption and diffusion of current knowledge that implies the application of existing technologies, practices and processes in new settings and product domains, than attempting to push outward the global technological frontier of knowledge[1].

[1] Enterprise surveys on innovation in developing markets take this "inclusive innovation" into account. Organization for Economic Co-Operation and Development (OECD), in its Oslo Manual (OECD, 2005) define innovation for its Innovation Microdata Project, launched in 2006, as "the implementation of new or significantly improved products (goods and services), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations". Similar constructs were used by Ayyagari et al., (2011), Mahindra et al., (2015).

Considering the overwhelming evidence of technological advancement for economic growth and development, it is imperative to examine how access to finance is related to the innovation-growth nexus since external capital is critical for firm activities. Innovation projects have several peculiar characteristics compared to other investment projects. These features could create difficulties in gaining access to external finance under the classical view of information asymmetry and agency costs. First, investments in innovation activities are highly risky since returns from such investments are long-term and uncertain (Madrid-Guijarro, Lema and Auken, 2015; Carreira and Silva, 2010). This uncertainty is particularly higher during the initial stages of innovation projects. Firms are also reluctant to disclose full information about innovation projects to protect their proprietory rights (Anton and Yao, 2002), hence, further exacerbating the information asymmetries. Second, innovation investments develop specific intangible asset and knowledge base, created by investment in human capital through worker training in new technologies and processes, and knowledge creation through design and marketing investments (Hall, 2010). All this idiosyncratic intangible capital is firm-specific, embedded in human capital, and has a limited marketability and collateral value[2] (Mina et al., 2013). Third, lenders may lack the required skill set to evaluate R&D projects, which may typically be characterized by specific technical or scientific knowledge. This may further exacerbate the moral hazard problem given that lenders lack complete information, and understanding, of the signals about the nature of innovation investment value propositions (Mina et al., 2013). All these features can substantially escalate the cost of external capital (Carpenter and Petersen, 2002; De-Meza, 2002), which may subject innovation investments to the credit constraints. Consistent with this, several studies document the sensitivity of R&D investments to the firm's cash flows (Czarnitzki, 2006; Hewitt-Dundas, 2006; Bond et al., 2010; Brown and Petersen, 2011).

In this paper, we examine how access to finance facilitate firm's rate of innovation activities. Previous studies, such as Ayyagari et al. (2011) and Mahendra et al. (2015), examine firm's general access to bank finance and innovation in developing markets[3]. We take this analysis a step forward, use various direct measures of financial constraints, and examine whether credit frictions impede innovation activities in the developing economies by employing a unique and large data set from 21 countries across various regions of the world.

While there is a growing body of literature that has identified conditions that promote firm innovation and growth in industrial countries, (see e.g., Hall et al., 2009; Hall, 2011), but little is known on how firms in the developing markets, of which most are small and medium-sized, undertake innovation activities and adapt to their peculiar environmental conditions. Further, most of the studies pertain to large firms in the industrial countries. It is not clear whether such knowledge is applicable to developing economies where firms face rather different operating

[2] For instance, salaries and other payments to scientists and researchers, which form a significant portion of the R&D spending, and help to develop human capital, has little collateralization value.

[3] While Silva & Carreira (2012) use ordinal measure of financial constraints. Xiang et al. (2018) employ dummy variables to indicate if firm relies on external debt and equity. They also use ordinal variable to capture different interest rates for debt financing, as a proxy for credit constraint.

environment, and the nature of innovation is likely to be quite different since these firms are far from technological frontier.

We use several measures of innovation at the firm level that includes, besides core innovations namely new products, services, processes or new technologies, but other activities such as new logistical and distribution processes, and new organizational structures and practices. As argued by Ayyagri et al. (2015) and several other studies, that firms in the developing markets have several avenues to innovate. This view largely stems from the Kremer's (1993) O-ring theory of development that these activities by the firm are complementary to each other, help promote knowledge transfers, and increase firm's abilities to adapt to their peculiar environmental conditions. Hence, this "new-to-firm innovation" measure is more relevant to the nature of firms in the developing economies than the more radical innovations of new global technologies in advanced economies.

Empirical results of our study show that firm's general access to finance has a positive impact on various forms of innovation activities. In particular, bank financing is positively related to the introduction of new product lines and process innovations as well as to other "soft" forms such as organizational and marketing innovations. Further, large firms with access to bank financing are more likely to undertake innovation activities relative to the smaller, younger firms. Accounting for the endogeneity concerns regarding the simultaneity bias of the firm's decisions of undertaking innovative activities and the likelihood of facing financial constraints, and further applying a battery of robustness checks, we find unambiguous and robust evidence of the negative effects of financial constraints on firm's likelihood of undertaking all forms of innovative activities—whether radical innovations or soft innovations.

Our paper contributes to the literature on innovation and access to finance in several ways. First, previous studies (see e.g., Ayagri et al., 2011; Savignac, 2008; Brancati, 2015) have used single, self-reported, and generic form of financial constraints. We supplement that measure with the actual financing frictions experienced by firms while applying for external finance (bank loan, for instance). This measure is more inclusive of the actual credit frictions faced by firms. Second, we use a battery of robustness checks that provide convincing evidence of the hampering effects of financial constraints for various forms of innovation activities at the firm level. Our firt robustness check relates to the use of alternative measures of finanicial constraints. Empirical results remain robust to these measures. In a first, our second robustness check is related to the innovation output novelty. Previous studies, employing data from enterprise surveys, utilize generic definitions of innovation outpusts by using dummy variables to capture if firms have introduced new or significantly improved products (or services) and/or processes, without allowing for the extent of innovation output novelty or newness. Drawing on previous studies, we use a more refined and inclusive measure of innovation novelty in our estimations. Results show that financial constraints is negatively correlated to the degree of innovation novelty, suggesting that the impact of financial constraints is more pronounced for the less radical innovations than for the more novel innovations. This further highlights the need to account for the innovation output novelty while examining finance-innovation nexus.

Third, this is the first paper that, as far as we know, while examining the financial constraints-innovation effects, also accounts for the possible complementarities between product, process, and

organizational innovations. Our fourth category of robustness checks relates to the sub-sample analyses. First, we exclude those firms that have not reported access to finance as an obstacle and, concurrently, have not undertaken product and/or process innovations. Thus we separate potential innovators from non-innovators. Second, we exclude non-innovators irrespective of whether or not they experienced financial constraints. Third, we restimate econometric models for sub-sample of foreign-owned firms after accounting for selection bias by employing generalized (type II) tobit and Heckman selection models. All these battery of robustness checks confirm our earlier conclusions of hampering effects of financial constraints on firm's likelihood of undertaking innovation activities.

Overall, our results provide new insights on innovation activities at the firm level. The literature on firm innovation, pertaining mostly to the large publically traded firms in industrial countires, have limited implications for developing countries where innovation activities are a blend of imitation and innovation through the adoption and diffusion of new technologies, new means of production processes, products, and organizational arrangements. Our study takes a global perspective and adds to a small but growing multi-country literature on innovation and various channels that promote innovation-growth nexus.

The remainder of the paper proceeds as follows. Section II discusses data, methodology and analysis while the last section concludes the paper.

2. Methodology

2.1 Enterprise survey data

To analyze the link between financial constraints and the firm's likelihood to undertake innovation activities, our analysis is based on the firm-level data taken from the World Bank Enterprise Surveys. These surveys are conducted in many countries as part of a comprehensive program overseen by the World Bank to collect data on a variety of aspects of business environment and the conditions affecting firm performance and growth. This rich data is collected through intensive interviews with firm owners and manages by employing a standardized master questionnaire and a unifrm sampling methodology. It contains several sub-questionnaires that elicit data on firm's history, ownership structure, legal status, human resources management, top management characteristics such as educational background, industry experience; detailed information on firm's actual and perceived financial constraints; the type and nature of innovation activities undertaken by the firm; and the institutional constraints that can have impact on firm's investment decisions, financial performance and growth. This unique database provides standardized, consistent, and comparable information on business firms across countries. The unit has been conducting surveys since 2006 using a new global standardized methodology that allows cross-country analysis. The new datasets were generated owing to the methodological changes and evaluation of survey instruments. Hence, we use data from the surveys conducted from 2010 to 2016 for 21 countries from across all major regions namely Sub-Saharan Africa (28.60% of sample), East Asia and Pacific (23.81%), Eastern Europe and Central Asia (28.60%), Middles East and North Africa (4.80%), and South Asia (14.28%). The full sample consists of 26,747 firms. Almost half of the countries each contribute more than 1000 firms to the sample while the rest

each contributing between 700 to 900 firms. The variation in the size of sample across countries relates to the total number of firms in that country.

We use more recent, updated and newest versions of the datasets. Many new questions and variables, which have evolved over time in response to the experiences with the surveys, have been added to the new data sets. Enterprise survey data are comparable across countries since similar sampling strategy and sampling instruments are being employed by the World Bank Enterprise Surveys. These surveys also include follow up Innovation Module for a select group of countries. This module elicits detailed information about various aspects of product, process, management-organization, and marketing innovations, besides several other innovation-related activities such as innovation funding sources, in-house and external R&D activities, use of ICT.

Table 1 provides a summary of the percentage of firms undertaking various forms of innovation activities. As shown by the table that there is a great variation in the type of innovation activities accross countries. In case of core innovation index, the table shows that Kenya, India, and Romania has the highest percentage of innovative firms in the sample while Georgia, Thailand, and Indonesia have the lowest proportions of such firms. Comparing firms across different sizes, we observe that larger firms are more innovative than medium or small firms are in terms of product and process innovations, as well as for the core and composite innovation indices .

Panel B of Table 1 provides a summary of the information about the type and nature of innovations. Some interesting observations emerge from the table. Overall, 44.39% of firms in the sample introduced at least one form of core innovation, while the frequency of product and process innovations is almost same for our sample. We also observe this equal distribution if we look at the incidence of introducing one form of innovation when the firm has also introduced another during the same time. This is not surprising given that product innovation may require a significant change in or an upgradation of an existing production techniques. Second, a large percentage of firms are not involved in formal R&D activities: less than a quarter (22.315%) of firms having R&D spending. Third, as shown by the last few rows of the table, the likelihood of introducing both forms of innovation is higher when firms undertake R&D activities than the corresponding unconditional probabilities for either form of innovation. This suggests a positive correlation between R&D spending and innovation. Panel C of Table 1 presents the share of firms with different forms of innovation across industries. The table shows substantial heterogeneity of innovation incidence across industries. As expected, there is a higher percent of innovation diffusion in high-tech sectors and this is coherent across types of innovations.

2.2 Access to finance and firm innovation

First, we examine whether firm's general access to finance affects the extent to which it undertakes innovation activities. To begin with, we use two general measures of access to finance. *LOAN_CREDIT_LINE* is an indicator variable that takes a value of one if a firm has an overdraft and/or line of credit facility, zero otherwise[4]. In the Enterprise Survey, managers are asked to report, over the last fiscal year, the proportion of investments financed from each of the six various sources including internal funds, new equity, borrowings from banks, non-bank financial institutions, credit from suppliers, and other (e.g., moneylenders, friends, relatives, etc.). Hence,

[4] We also use two separate dummies for overdraft and line of credit facilities. Results remain unchanged.

our second measure, $BANK\_FIN$, is the proportion of investment financed from banks and non-bank financial institutions[5].

To examine our research objectives, we proceed with the following baseline regression that takes the following form:

$$INNOV_{i,m,j} = \alpha + \beta_1 LOAN\_CREDIT\_LINE + \beta_3 BANK\_FIN_{i,m,j} + \beta_4 X1_{i,m,j} + IND_m + CNT_j \; --- (I)$$

Where *INNOV* is one of the several measures of innovations while subscript *i*, *m*, and *j* represents firm, industry and country, respectively. These various forms of innovation outcomes are: i) Product innovation is constructed by adding 1 if a) a firm has introduced, in the last three years, new or significantly improved products or services, and b) whether this product is new to the firm's main market or industry. ii) Process innovation is an indicator variable coded as one if a firm has introduced new methods of manufacturing products or offering services, 0 else. iii) Core innovation is the sum of product and process innovations. Hence, its value ranges from 0 to 3.

The standard measure of innovation output in the economics literature is the patents counts (Schmookler, 1966; Mansfield, 1986; Dutta and Weiss, 1997; Moser and Voena 2012)[6]. However, patent counts and citations as a measure of innovation has recently received criticism because patent data may fail to capture innovation that occurs outside the realm of patents measures. For instance, in industries where firms rely on alternative mechanisms, such as secrecy and lead time (Levin et al., 1987; Kohen et al., 2001) to protect their intellectual property (Mose, 2013). Further, not all innovation activities result in new patent filings. Hence, our measure of core innovation is a relatively thorough and direct measure of innovation at the firm level than the number of patents filed. However, the core innovation index, like the patents, also suffers from the limitation that it is a count measure rather than a direct measure of the economic value of the new products or processes.

The uniqueness and richness of the data allow us to exploit all forms of innovations at the firm level. Less radical forms, such as organization and managerial innovations, may be critical to firm's survival and growth, especially for SMEs in developing countries. These soft forms of innovations embed phenomenon of a learning curve that can affect firm performance and growth. Hence, we also consider these soft innovations in our analysis. Organizational innovation (marketing innovation) is an indicator variable taking on a value of 1 for introduction of new organizational structures or management practices (marketing methods), 0 else. Lastly, Composite Innovation is an aggregate measure constructed by summing up all innovation measures. Thus, values for the index ranges from 0 to 5 for each firm. Hence, the degree to which a firm has undertaken more innovative activities increases in the value of the index.

[5] Only 1.378 percent of the firms in the sample had some portion of the investment being financed from informal external sources such as money lenders, friends and relatives (Enterprise survey variable: #k5hdj) while only 2.258 percent of the firms had financed some portion of their investments through Credit From Suppliers/Advances From Customers (enterprise survey variable: k5i). These constitute very small portions of the sample and, hence, we focus our analysis on bank financing which is the most dominant source of external financing in developing countries, as is also evident from our sample firms.

[6] This large body of literature on patent counts and patent citations as a measure of innovation output and innovation quality largely owes to the methodological ease of patent-based measures and is fueled by the availiablity of the historical US patent data through various datasets (Hall et al., 2001; Moser, P., 2013)

In equation (1) $X1_{i,m,j}$ is a vector of firm-level covariates that can affect innovation rates at the firm level. Among these standard determinants, lets first consider firm age, $AGE_{i,j}$, measured as the natural logarithm of the number of years since the first year when the firm was formally registered. Age represents firm's accumulation of knowledge and experience over time and seems to be linked to the firm's ability to have better knowledge management systems needed to undertake innovation activities. We use three dummies for firm size, measured as the number of full-time employees. $SMALL\_FIRM_{i,m,k}$, $MEDUYN\_FIRM_{i,m,k}$, and $LARGE\_FIRM_{i,m,k}$ are dummy variables that take value of one if firm has employees from 5-19, 20–99, and above 100, respectively, and 0 otherwise[7]. Large firms can devote more resources to innovation activities by exploiting their economies of scale and better access to resources. In contrast to the predictions of theoretical models, empirical results are far from conclusive evidence that rate of innovation increases with firm size. Some studies find a positive relation for size with R&D intensity (Lunn & Martin, 1986) while others document that small firms are more innovative in some industries in competitive markets (Mansfield, 1968; Acs and Audretsch, 1988; Acs et al., 1991).

Previous literature in economics (see e.g., Ghosal and Loungani, 1996) have used industry capitalization rates as a proxy for investment opportunity while Ayyagari et al. (2011) argues that firm capacity utilization rate and industry fixed effects can be a useful approximate alternative to industry capitalization rates at the firm level. Gorodnichenko et al. (2010) argue that firms may need to innovate if they are at the capacity. $CAPEX\_DUMMY_{i,m,k}$ is a dummy variable equal to one if a value for capital expenditures is positive, zero otherwise. This variable is included to capture firm's investment opportunities and makes it more likely that firm may introduce new innovations. On average, 30 percent of the firms in our sample had made new capital expenditures in the last fiscal year.

Besides these standard determinants, firm's innovation orientation may also be shaped by other strategic and environmental considerations. $GROUP\_DUMMY_{i,m,k}$, is an indicator variable coded one if a firm is a part of a larger firm and zero if it is standalone firm. Being part of a larger setup provides potential access to additional resources such as financial and technical support besides the benefits of economies of scale. On average, 18 percent of the sample firms are part of a large setup.

Economic literature has emphasized the role of competition in the firm's incentives to undertake innovation activities (Aghion et al., 2001; Blundell et al., 1999; Tang, 2006). Theoretical and empirical models, though, find contrasting results. Competition may drive down margins that may encourage firms to introduce new products and technologies. Alternatively, innovation may decline with competition as firms derive suboptimal returns from innovation activities (Aghion et al., 2005). We include a measure of competition—*COMPET*—is an indicator variable coded 1 if market for firm's product is national and 0 if it is a local market. About 57 percent of the firms indicate that their products are for the national market. Another proxy for competition in our analysis is *EXPORT_SHARE*, measured as direct exports as a proportion of total sales. We also account for firm's intrinsic ability to innovate by including a dummy variable, *FORMAL_TRAINING*, coded as 1 if there is a formal training program in place for employees, 0 else. On average, 34.50 percent of the firms in the sample have had training programs. Next control

[7] Firms with employees less than 5 are not included in the Enterprise Survey Analysis. We also use the number of full-time employees as a measure of size in some estimations

variable, *QUALITY_CERTFICATION*, is a binary variable equal to 1 if a firm has an internationally recognized quality certification, 0 else. This variable is included to account for firm's internal efficiency. About 31.64 percent of all firms in the sample have quality certifications. We also include the proportion of skilled workers out of total workers (*SKILLED_WORKERS*) in some estimations for core innovations since skilled workers are crucial for the adoption and diffusion of new innovation investments and technologies (Autor et al., 2003; Card et al., 2002; Bosetti et al., 2015). Industry and country fixed effects are included in the model to control for the possible differences in innovation rates across industries and countries. Since the dependent variables (composite and core innovation indices) are ordinal variables, we use ordered logit model with robust standard errors clustered at the country level to account for the possibility of firms in the same country having correlated unobservables in the error term.

2.3 Empirical Analysis: Access to finance and firm innovation

Empirical results for equation (1) are reported in Table 2. This table shows that firm's access to finance has a positive impact on the extent of firm innovation activities, namely, the core and composite innovation indices as well as the introduction of new product lines and process innovations. Access to a line of credit and/or overdraft facility also positively affect firm's likelihood to undertake more innovation activities. Size interaction regressions (unreported here), show that large firms with access to bank financing are more likely to innovate more than small firms do for all forms of innovations[8]. In another unreported interaction regressions, foregin-owned firms innovate more with bank financing as compared to domestic firms.

As shown in Table 2 that firm-specific covariates are closely linked to innovation activities. Larger firms, and those that are part of a large group, are more likely to introduce product and/or process innovations as compared to smaller and independent firms. Further, legal status of the firm (organized as a corporation), firms with higher investment opportunities, firms with exports, having quality certifications, formal training for employees, and having licensed foreign technology positively impact the likelihood of undertaking various forms of innovation activities. Finally, innovation rates in all industries are not equal, with manufacturing industries being more innovative than other industries.

2.4 Empirical Analysis: Financial constraints and firm innovation

One strand of literature, beginning with the seminal paper of Fazari et al. (1998), have employed empirical data to identify financially constrained and unconstrained firms based on firm-specific accounting data and other characteristics such as size and firm-age (Devereux and Schiantarelli, 1990; Gilchrist and Himmelberg, 1995), and then comparing emerging cash-flow sensitivities as a proxy of financial constraints. This approach remained dominant for empirical analysis until it received severe criticism from Kaplan and Zingale (1997, 2000) who cast serious doubt on the ability of investment-cash flow sensitivity to be a reliable proxy of financial constraints. In contrast to the use of balance sheet information, another body of literature relies on firm's self-reported assessment (perception) of the access to finance as a major constraint for business operations.

[8] Restricting the sample to only small firms, we still find that bank financing is positively and significantly related to firm innovation.

Several of these studies employ this direct measure of financial constraint elicited from manager's responses in the enterprise survey data sets to examine firm-level determinants of financial constraints. For instance, Beck et al. (2006, 2008) use World Business Environment Survey (WBES) for financing obstacles while Coluzzi et al. (2009) employ the same data set for five Euro Area countries for determining factors of financing obstacles. Ferrando and Mulier (2013) compare firm's self-assessed (perceived) financial constraints with more objective measures of actual financial constraints employing a sample of 11,886 firms. Authors match each firm, based on financial characteristics, with "the nearest neighbor balance sheet' in AMADEUS dataset containing data on over 2.3 million firms. Results, based on bivariate probit model, document some support for the perceived financial constraints to be correlated with measures of actual financial constraints. In another related study, Ferrando and Griesshaber (2011) show that firm age and ownership structure, considered as important determinants of financial constraints, closely related to firm's perceived financing obstacles for cross-country firm analysis.

We employ a measure of financial constraints based on firm's actual financing constraints, as suggested by Artola and Genre (2011), Popov and Udell (2012) and Banerjee (2014). This measure is constructed by combining firm's responses to several questions asked in the finance section of the enterprise surveys. To identify financially constrained and unconstrained firms, first, we classify firms into two groups: those that need credit and those that do not need credit. In the first group, we then identify firms that applied for a loan and those that did not apply for a loan. Next, among those that applied, we identify firms whose loan application was rejected. Hence, a firm is considered as credit constrained if it meets the following conditions:

I. Applied for a loan and the loan application was rejected (*Enterprise survey question # k16: "In last fiscal year, did this firm apply for new loans/lines of credit? Yes/No"), and (# K20a: outcome of the recent application for loans/lines of credit: Rejected/Accepted)*
II. Did not apply for a loan (*# k16: Yes/No*)
III. Reason for not applying for a loan was other than "having sufficient funds" (*# k17: Main reason for not applying for new loans/lines of credit)*. Enterprise survey identifies various reasons, such as higher interest rates, the complexity of application procedure, lack of required collateral, or firm's own perception of not getting the loan, as reasons which deterred these firms from not applying for a loan.

On the other hand, a non-credit constrained firm is one that satisfies the following conditions:

I. Did not apply for a loan (#K16: No)
II. Reason for not applying for a loan was "having sufficient funds" (#k17: Sufficient funds)

Hence, based on the above qualifications, *FINANCIALLY_CONSTRAINED* is a dummy variable coded as 1 if a firm is credit constrained, 0 if it is non-credit constrained. Descriptive statistics show that 55.30 percent of the firms in our sample needed a loan. Of those that needed a loan, 67.60 percent were credit constrained. Almost one-third (31%) had a loan/line of credit facility at the time of the survey.

As a robustness check, we also use a qualitative, self-reported measure based on firm's perception of the access to finance as their most pressing constraint to its growth.

FIN_MAJOR_CONSTRAINT is a dummy variable that equals one if a firm has reported access to finance as either a "major obstacle" or "very severe obstacle" and zero if firm's response is either "minor obstacle" or a "no obstacle" for business operations and growth[9].

Table 3 provides descriptive statistics for the proportion of innovative and financially constrained firms across different sectors. The table shows that we observe substantial variation across sectors in terms of innovative and financially constrained firms. Chemicals, plastic and Rubber (81.25%), Motor Vehicles (68.84%) and IT and IT services (68.55%) have the most innovative firms whereas Non- metallic mineral products (34.91%) and retail (32.34%) are characterized by the least innovative firms. Unlike the distribution of innovative firms across sectors, financially constrained firms shows fairly even distribution across sectors. On average, 47.36% of firms are credit constrained, the highest proportion of financially constrained firms are in the furniture (57.97%), wholesale (56.88%) and IT and IT services (56.56%) whereas the lowest proportion amounts to chemicals, plastic and rubber (24.14%).

Table 4 reports univariate tests for the general access to bank credit and innovation activities. Firms are placed into three groups: firms with a bank loan or credit line, firms without bank loan but no demand for credit, and finally, firms without bank loan but with an unmet demand for credit. This last category consists of credit-constrained firms since either their application for bank credit was rejected or they did not apply for a loan since they feared that either their application will be rejected or other factors deterred them to apply for the loan.

A cursory look at the likelihood of various innovating activities, we observed a striking difference between the firms with loan or credit line and those that are credit constrained. Of the firms facing credit frictions, 12.99%, 12.62% ,and 8.33% have undertaken product innovation, process innovation and R&D activities, respectively, over the last three years. On the other hand, firms that had a bank loan or credit line had a significantly higher likelihood of engaging in various innovation activities, and these percentages stand at 17.97%, 18.38%, and 13.55%, respectively, for product innovation, process innovation and R&D activity. Expressed differently, firms with access to bank credit are around 40 percent more likely to undertake innovation activities than those firms facing credit constraints. These preliminary results warrant further econometric specifications to look at these causal relationships, and these are presented in the subsequent sections.

Employing logit and probit models for various measures of innovation, empirical results (not reported in the paper) shows that financial constraints have a significantly positive impact on the likelihood of firm undertaking product and/or process innovations. This may suggest that financial constraints seem to act as a stimulus for innovation activities at the firm level. These findings are counterintuitive and somewhat difficult to defend since they are at odds with the commonly held view that financial resource constraints have an inhibiting influence on innovation (Laforet and Tann, 2006; van Burg et al., 2012), and that financial constraints may be endogenous.

[9]Further, we exclude responses where firms have reported this as a moderate obstacle since such firms may or may not be financially constrained. In the Enterprise surveys, managers are provided various options to rank finance as an obstacle to firm's operations. These options include "no obstacle', minor obstacle, moderate obstacle, major obstacle and very severe obstacle.

Consequently, a simultaneous estimation is needed to control for the unobserved heterogeneity influencing innovation and firm's financial condition. The following section deals with this potential problem.

2.5 Endogeneity, financial constraints, and innovation

Endogeneity of financial constraints variable may lead to biased coefficient estimates. This endogeneity may arise on two counts. First, firm's decision to undertake innovation activities and the likelihood of facing financial constraints are likely to be both affected by common factors of unobserved heterogeneity. Innovation projects are characterized by the uncertainty associated with their expected output or eventual success. Another important feature is the firm's unwillingness to disclose projects' full details for fear of losing the strategic and competitive advantage, which may further exacerbate information asymmetries (Hall & Lerner, 2010). These firm-specific risk factors can exacerbate financial constraints. Second, another source of endogeneity arises from the possibility that firm's decision to undertake innovation activities, and how these new investments are financed, may probably be simultaneously determined.

Hence, we take firm's decisions of undertaking innovative activities and the prospect of experiencing financial constraints as simultaneous questions: potential financial constraints affecting firm's likelihood of undertaking innovation activities and the innovative conduct inducing credit constraints. The following equations can take into account these relationships.

$$K_{1i}^{*} = X_{1i}\beta_1 + \lambda_1 K_{2i}^{*} + \vartheta_j + \epsilon_{1i} \qquad (2)$$

$$K_{2i}^{*} = X_{2i}\beta_1 + \lambda_2 K_{1i}^{*} + \vartheta_j + \epsilon_{2i} \qquad (3)$$

Where K_{1i}^{*} and K_{2i}^{*} represent respective expected innovation output and the degree of financial constraints. In equation (2) X_{1i} is a vector of firm-specific covariates that can affect the probability that a firm undertake innovation activities[10]. In equation (3) X_{2i} represents the firm-level determinants of whether a firm is financially constrained, while ϵ_{1i} and ϵ_{2i} are i.i.d. errors with bivariate normal distribution with variance equal to 1 and $\rho = corr(\varepsilon_1, \varepsilon_2)$. ϑ_j is a vector of industry fixed effects. This controls for the unobservable industry variations for firm's access to finance and for the possibility of the intra-industry knowledge and technology spell-overs.

Maddala (1986) and Hajivassiliou (2005) argue that such a model is inconsistent and requires some restrictions on the coefficients for the model to be consistent. Hence, either λ_1 or λ_2 is to be set equal to zero in order for the model to be logically consistent. Following Savignac (2008), Ploetscher and Rottmann (2002), we set λ_2 equal to zero in the model as follows:

$$K_{1i}^{*} = X_{1i}\beta_1 + \lambda_1 K_{2i}^{*} + \epsilon_1 ------- (4)$$

$$K_{2i}^{*} = X_{2i}\beta_1 + \epsilon_2 ---------(5)$$

The correlation coefficient, ρ, between the error terms of equation (4) and (5) accounts for the potential presence of unobservable factors that can affect simultaneously the decisions to

[10] The detailed explanations for these covariates are provided in equation (1)

undertake innovation activities and the likelihood of facing financial constraints. If $\rho = 0$, K_{2i}^{*} is not correlated with ϵ_1. Consequently, the two equations can be estimated separately as univariate probit models. However, if $\rho \neq 0$, we need a joint estimation to obtain consistent estimates. Hence, we estimate equation (4) and (5) simultaneously by Bivariate Ordered Probit Model.

Results are reported in Table 5. As shown by the table that we now get a statistically significant negative impact of financial constraints on the firm's likelihood to undertake innovation activities. These estimates indicate that a credit-constrained firm faces about 47% (50%) lower probability of carrying out product innovation (column 2) or process innovation (column 4), respectively, as compared to non-credit constrained firms, ceteris paribus. Interestingly, the effect of credit constraints is also substantial for organizational and marketing innovations. This is rather surprising results given the relatively lower levels of funds needed to undertake such less radical soft innovations. Brancati (2015) argues that one plausible explanation lies in the possibly lower expected returns from such soft innovativeness. Given that a firm is facing credit constraints, but has a number of profitable innovative projects for implementation, it will substitute costly external finance (bank credit, for instance) with internally generated funds for the most profitable innovation projects, and would postpone second-ordered, albeit profitable projects. In this case, the firm will undertake organizational innovations only if sufficient external funds are available. This may induce the sensitivity of organizational or marketing innovations to costly external financing, and hence, to financial constraints.

Besides, we also briefly reflect on the coefficients of other covariates. The coefficient estimates for determinants of firm-level innovation are also in line with theoretical predictions. The statistically significant results indicate that innovative firms are larger, older and are part of a larger group, have exports, have recently invested in capital expenditures, serve national market as opposed to the local market, have a quality certification, use technology that is licensed from foreign-owned firm, and provide formal training for employees.

Bivariate probit model estimates also show a strong positive correlation between the error terms of the two equations for all types of innovation indices. Hence, accounting for the endogeneity of financial constraints yields statistically significant negative impact of financial constraints on firm's likelihood to be innovative.

Marginal effects, evaluated at the sample means, are summarized in Table 6. Marginal effects report shortfall in innovation activity that can be attributed to financial constraints. The table shows that core innovation activity is likely to increase by 10.99% in the absence of financial constraints—a significant increase in innovation rates. Overall, findings from the marginal effects tend to confirm the main findings of our analysis that financial constraints hamper rate of innovation at the firm level.

We also examine differential effects of financial constraints by firm size on various measures of innovation, by including interaction terms of financial constraints with size in the bivariate model. Results are reported in Table 7. Coefficients for the interaction terms of Financial constraints with size dummies (*SMALL_FC and MEDIUM_FC*) are negative and statistically significant at 1 percent level for all forms of innovation measures. This indicates that impact of financial constraints is more pronounced for smaller firms relative to large firms.

2.6 Robustness checks

We apply several robustness checks to examine if our main results are sensitive to various alternative measures of financial constraints, sample selection, types of firms, and ownership structure. First, we use alternative measures of financial constraints. Our first measure, *FINANCE_OBSTACLE*, is based on firm's self-reported perception of the finance as a major constraint. Specifically, we construct this measure from firm's response to a survey question "*#K30*" where managers are asked to rank access to finance as an obstacle for business operations. The reported responses range on a scale from 0 (no obstacle) to 4 (very severe obstacle). Results of the bivariate probit model for the innovation equations are reported in the first five columns of Table 8. The measure of financial constraint still has a negative and statistically significant coefficient for all forms of innovation measurement, confirming our earlier results of hampering effect of financial constraints on the likelihood of undertaking innovation activities at the firm level. Additionally, empirical results, not reported in the paper, remain qualitatively same when we recode this ordinal measure as a dummy variable by coding it as one if firm reports access to finance as a "major" or "very severe obstacle", 0 else.

Financial constraints have several dimensions. So far, we have considered one major aspect namely whether a firm faces difficulty accessing external credit. Another important aspect is the cost of external financing which may be a significant constraint for firms. Hence, our second alternative measure, *COST_FINANCING*, is an indicator variable equal to 1 if a firm reported "unfavorable interest rate" as a reason for not applying for a loan[11]. Results are reported in the last 5 columns of Table 8. Again, the financial constraint effect is negative, statistically significant, and is consistent with what we find for other credit constraint measures.

Our third robustness check relates to the inclusion of the degree of novelty, or innovativeness, of product and process innovations. Prior studies employing data from innovation surveys have used an indicator variable if a firm has introduced a new or significantly improved product or service. This definition measures innovation in a rather broad sense, thus, largely ignoring the degree of newness of the output. Innovation outputs differ in their novelty. Radical innovations tend to be more influential. Firms introducing highly innovative products or services (radical innovations) can gain a significant competitive advantage over those that introduce imitative or only-new-to-firm routine types of innovations (Ali, 1994; Danneelsa and Kleinschmidt, 2001; Tellis et al., 2009). Such highly profitable innovative projects can also attract external finance and can possibly alleviate firm's credit constraints for innovation investments[12]. To examine this possibility we re-estimate financial constraint-innovation model for a measure of product innovation novelty.

Patent characteristics, and more specifically, data on patent citations can provide valuable insights on the dynamics of radical innovations (Nordhaus, 1967; Albert et al., 1991; Reitzig, 2003). However, radical and incremental innovations have not clearly been defined in literature (Dahlin Behrens, 2005), and there is a lack of consensus on the clear difference between the two forms of

[11] In the enterprise survey, managers are asked to report reason for not applying for a loan despite indicating, in earlier survey questions, the need for external finance. Firms identify different reasons. Of those firms that did not apply for a loan for reasons other than "having sufficient funds", 30.44% (2,474 firms out of 8,127) of them reported "unfavorable interest rate" as a reason for not applying for a loan.

[12] On the other hand, radical innovations can also be associated with high risks, require more firm resources, and different development approach (Colarelli-O'Connor, 1998; Lynn, 1998).

innovations. The anecdotal evidence that low percentage of patents actually turns out to be radical innovations (Henderson, 1993) further exacerbates this lack of consensus. Given that most of the measures of innovation novelty and radicalness are based on the patent contents and patent citations, how can we measure innovation novelty using data from enterprise surveys? Employing survey data, Nietoa and Santamarı´a (2007) defines innovation novelty by looking at the functions of the new products and measures innovation newness by employing two indicator variables for whether new product has had new functions (high novelty) or whether it involved minor modifications such as design, presentation or change in any component (low novelty). We build on this definition and include two more dimensions of the innovaiton output's newness. The richness of the data in the innovation follow-up module provides various dimensions to estimate a proxy for product or process innovation novelty[13]. Specifically, we take the following four dimensions:

i) PROD_NEWNESS1 (0/1): indicator variable coded as one if the new product or service has "completely new functions", 0 else[14].
ii) PROD_NEWNESS_NATIONAL (0/1): dummy coded as 1 if the new product or service is new to the firm's national market as opposed to the local or international market
iii) PROD_NEWNESS_INTERNATIONAL (0/1): dummy variable equal to 1 if the new product or service is new to the international market, and coded as 0 if it is new to the local and/or national market.
iv) NEWNESS_ORIGINAL (0/1): dummy variable coded as one if the firm originated this innovative product or service based on original ideas, otherwise coded as zero if it was an adaptation or imitation of an already existing product or service offered by another firm.

Our composite measure, PRODUCT_NOVELTY, is the sum of these four dimensions thus taking the value from 0 (no novelty) to 4 (highly novel). Hence, the novelty of innovation output increases in the value of the index.

Results for the bivariate probit model is reported in Table 9. We find a negative impact of financial constraints on the degree of novelty of the product. This implies that impact of credit frictions is more for the less novel innovative products than for the more innovative products. This may suggest that the negative impact of financial constraints the previous studies have reported for innovation activities, may partially be driven by the fact that these studies have not accounted for the innovation novelty while examining the financial constraint-innovation relationships. Less radical/novel innovations, which are based on mere repetition or imitation of the existing products or services, may not attract enough external capital since they may not be that promising in terms of future expected returns. More novel product innovations are expected to provide a significant competitive advantage and to have higher potential returns making them better candidates for financing, and increasing their likelihood of getting external capital.

[13] However, this separate innovation module follow-up data is available for nine countries in our sample, with a total of 8279 firms. Thus, we limit our analysis to these eight countries' sample when we incorporate innovation novelty aspect in the finance-innovation models.

[14] In a sub-section of the innovation module, managers are asked to compare the new innovative product or service with the firm's existing products or services in terms of its specific features such as having "completely new functions; cheaper to produce or offer; have better quality; use different inputs; or is it based on new technology or industrial design not used by this firm"

An alternative explanation for a weak evidence for the causal relationship between financial constraints and product novelty could be that, given a firm is faced with few highly profitable investment opportunities (e.g., highly novel innovative product), it will go for the most profitable investment opportunity by financing with the internally generated funds. The firm will then finance the least profitable investments with the external capital. This may lead to a negative causal relationship between financial constraints and the likelihood of introducing product or process innovations since lenders may be less willing to finance the risky but less profitable innovation projects[15].

We also apply other robustness checks to estimate effects of financial constraints using a series of sub-samples. First, as in Savignac (2006), we exclude those firms that report access to finance as "no obstacle" and has also not introduced any new product or service. Thus, it can be assumed that such firms do not wish to innovate and, at the same time, are not credit constrained. Hence, in this subsample, we restrict our analysis only to potentially innovative firms. As shown in Table 10 that 24.48% of firms reported finance as "no obstacle" and has not undertaken product innovation. Hence, we exclude these firms from our analysis. For this sub-sample, we still obtain a negative and statistically highly significant effect of financial constraints for various measures of innovation, as reported in the first five columns for *FINANCIALLY_CONSTRAINED* and last five columns for *COST_FINANCING*, in Table 11.

Second, we exclude those firms for which product and/or process innovation is zero (13,197 firms dropped from the sample) and run regressions for those firms that had a product and/or process innovation irrespective of whether such firms face financial constraints. In other words, we run our models on data that has at least one form of core innovation. This leaves us with 10,535 firms to work with. Results are reported in Table 12. Coefficients for the *FINANCIALLY_CONSTRAINED* is negative and significant for all forms of innovation measurements.

Third, we exclude domestic firms and re-estimate econometric models for foreign-owned firms only. Literature has identified foreign ownership to be instrumental in the extent of technology transfer, knowledge spillovers through business networks and cross-border merger and acquisitions (Aitken and Harrison, 1999; Chen, 2011; Wang and Wang, 2014; Maksimovic and Phillips, 2001). These studies highlight the importance of foreign-ownership in relaxing the credit constraints for domestic firms through various channels such as enhanced productivity and employment growth, export participation, knowledge and technology spillovers and improved financial conditions. Hence, foreign-owned firms are less likely to experience financial constraints compared to local firms. Enterprise survey classifies firms as foreign-owned if foreign ownership is at least 10%. We use this measure (*FOREIGN_FIRM*) and drop domestically owned firms from the sample. The empirical results (not reported here) remain qualitatively the same and we still get statistically significant negative effect of financial constraints on the likelihood of product or process innovations. However, since we perform our analysis on the sub-sample of the foreign firms from the dataset, this may induce selection bias. As in Klomp and Leeuwen (2001), Lööf

[15] As a further robustness to measure novel (radical) innovations, we follow Laursenand Salter (2006), Keuppa and Gassmannb (2013) to define radical innovation as "fraction of sales out of total sales attributable to the innovative product or service that is new to the market", as opposed to whether the product/service is only new to the firm.

and Heshmati (2000), we attempt to correct for this possible selectivity biases by applying generalized (type II) tobit and the Heckman two-stage procedure. Results are reported in Table 13. Financial constraints are still negatively correlated to the extent of firm's product innovation, even after accounting for the selectivity bias for foreign ownership structure.

Finally, introduction of new innovative products may be accompanied by an adoption of new methods of production processes, technologies and new forms of organizational-managerial arrangements. This may leave these various forms of innovations as complementary (Miravete and Pernias, 2006). This conjecture is consistent with the findings that it is optimal for firms to implement new technologies, new manufacturing processes and new organizational practices jointly. We take into account these possible complementarities between innovation outputs by using a multivariate probit model. Testing for complementarities in the innovation-performance has been an econometrically challenging task (Athey and Stern, 1998). We adapt the methodology of Polder et al. (2013) and Hall et al. (2011) by substituting for the financial constraints estimations. In the first stage estimation, probit model is used to get the predicted values for financial constraints that feed into the multivariate probit model. This second stage model consists of three equations for product, process and organization-managerial innovations, jointly estimated using multivariate probit model. It allows the joint estimations of the probabilities of the innovation choices. Corboni and Russu (2017) argues that ignoring the possibility of the correlated error terms of the innovation choices in the individual probit models may lead to inefficient estimations.

Results, reported in Table 14, are still negative and sifnificant for financial constraints measure. Furthermore, correlation coefficients of the error terms (rho) are positive and highly statistically significant. This supports our earlier conjecture of the interdependence and complementarity between the three innovation choices. Remarkably, rho for the combination of process and organization innovation (rho_{32}= 0.634) is the highest of the three, suggesting a strong complementarity between the two innovation choices[16]. As a robustness check, wald test, reported in the table, rejects the null hypothesis that the slope coefficient of the three models are same, suggesting the complementarirty and interdependence between the innovation choices.

3. Conclusion

The extant literature identifies innovation and technological progress as the main drivers of economic growth and material progress. Innovation by developing market firms is far from the technological frontier and these firms innovate through the adoption of new production processes, products and organizational arrangements already in place in developed markets. These firm-specific innovation activities are a blend of imitation and innovation. Given these unique and inclusive innovation perspectives, it is imperative to examine the channels that promote the innovation-growth nexus. One of the important aspects relates to the firm's access to finance and financial constraints.

SMEs in developing countries are widely considered significant contributor to economic growth, development and value addition to the economy, yet our understanding of the firm innovation and

[16] This result in hardly surprising given the theoretical prediction that process innovation is the one that is most likely to induce organization-managerial changes in the firm (see e.g., Carboni and Russu, 2017; Ballot, Fakhfakh, Galia & Salter, 2015; Battisti and Stoneman, 2010; Perez et al., 2018).

innovative processes is mainly limited to the large-scale firms in the industrial economies. We attempt to fill this research gap by studying unique, rich data of over 26,700 firms from 21 developing economies across different regions of the world. Besides product and process innovations, we also account for the other aspects of innovation such as new organizational arrangements, new ways of logistical and distribution processes, and new marketing innovation activities. All these activities reinforce and help firms in developing markets to adapt to their peculiar environmental conditions and ensure survival and growth.

Overall, this study provides insights into firm innovation for small and medium enterprises and the channels that promote this innovation. The empirical analysis shows that firms remain plagued by limited access to credit, especially bank credit. In such a scenario, it is imperative to ask whether better access to bank lending can promote innovation activities in private firms in developing countries.

Empirical results indicate that expanding access to finance for SMEs is related to the likelihood of firm to be more innovative in a variety of ways. Bank financing can stimulate both radical innovations as well as more “soft innovations” such as adoption of new logistical and distribution activities, organizational and marketing innovations. The paper also identifies the role of financial constraints as an impediment for firm innovation activities.

Results of our study highlight the crucial importance of bank credit for promoting innovation activities by facilitating firms to introduce new or significantly improved and upgraded products/services and processes through innovation and adoption of new technologies at the firm level. This suggests that private firms could benefit more from policy interventions aimed at developing financial systems and banking regulations that encourage expansion and availability of credit that can allow private firms in developing countries to catch up to the technological frontier through imitative and adaptive innovations.

Table 1, Panel A: Firm Innovation Activities

This table provides percentage of firms undertaking various forms of innovation activities. Product and process innovations are dummy variables taking on value of 1 if firm has introduced, in the last three yrears, new or significantly imporved products (or services) or new production and manufacturing processes, 0 else. RND is a dummy variable equal to 1 if firm has incurred R&D expenditures, 0 else. Mean values for core innovation and composite innovation indices are reported in the table.

	Product Innovation	Process Innov	Core Innovation Index	Organizational Innovation	Marketing Innovation	Composite Innovation Index	RND	N
Bangladesh	0.340	39.83	0.503	0.3540	0.3326	0.613	0.1540	1,442
Georgia	0.100	0.098	0.133	0.0670	0.0870	0.121	0.050	360
Hungry	0.233	0.202	0.271	0.1323	0.1935	0.3548	0.0779	310
India	0.4486	0.4796	0.6946	0.4429	0.4695	0.6915	0.3508	9,281
Indonesia	0.1212	0.1276	0.1727	0.0690	0.1382	0.2258	0.0540	1,320
Jordan	0.2356	0.2061	0.2794	0.0973	0.1989	0.3473	0.1320	573
Kazakhstan	0.1937	0.1350	0.2437	0.1553	0.1486	0.3183	0.0252	600
Kenya	0.6735	0.5956	0.7529	0.5556	0.6297	0.8540	0.3092	781
Malaysia	0.1000	0.2667	0.2820	0.2350	0.3381	0.4550	0.2022	1,000
Pakistan	0.2895	0.2563	0.3472	0.1817	0.2018	0.4202	0.1657	1,247
Philipines	0.3506	0.3677	0.4891	0.3090	0.2960	0.5753	0.2204	1,335
Romania	0.4056	0.3667	0.5370	0.3941	0.4630	0.6926	0.1243	540
Senegal	0.4725	0.3967	0.5324	0.3512	0.3829	0.6573	0.0723	601
Thialand	0.1040	0.1305	0.1460	0.1065	0.2429	0.2770	0.0421	1,000
Turkey	0.1257	0.1205	0.1751	0.1452	0.1572	0.2626	0.1590	1,344
Ukrain	0.1996	0.1255	0.2405	0.0959	0.1298	0.3114	0.0628	1,002
Veitnam	0.3052	0.2325	0.4197	0.1752	0.2955	0.5060	0.2230	996
Ghana	0.5146							
Tanzania	0.5166							
Uganda	0.6430							
Zambia	0.5306							
Size-Wise Distribution								
Small Firms (5—19)	0.2613	0.2539	0.3422	0.2143	0.2705	0.4310	0.1282	8,972
Medium Sized firms (20—99)	0.3459	0.3647	0.4259	0.3233	0.3538	0.5212	0.2338	9,099
Large-Sized Frims (100+)	0.4261	0.4666	0.5300	0.4219	0.4454	0.6716	0.3576	5,661
Mean values: size wise								
Small Firms (5—19)	0.4252118	0.2538539	0.6766607	0.214318	0.2705195	1.15671		
Medium Sized firms (20—99)	0.5777558	0.3646916	0.9403231	0.323337	0.3537543	1.613034		
Large-Sized Frims (100+)	0.7254902	0.4666188	1.184773	0.421909	0.4453601	2.040982		

Table 1: Panel B: Percent of innovative firms by type of innovation	
Process Innovation	34.69%
Product Innovation	33.62%
Atleast one form of innovation (Process or Product)	44.39%
Process and Product Innovation	34.39%
Product Innovation given Process Innovation	69.88%
Process Innovation given Product Innovation	67.77%
R&D>0	22.31%
Product Innovation given R&D>0	44.36%
Process Innovation given R&D>0	47.15%
Organizational Innovation	30.57%
Marketing Innovaiton	34.40%
Total observations	23,732

Table 1: Panel C: industry-wise percentage of innovation and financial constraints

	PRODUCT INNOVATION	PROCESS INNOV	ORGANIZATIONAL INNOV	MARKETING INNOV	FINANCIAL CONSTRAINT
Non-Metallic Mineral	24.43%	27.61%	22.81%	26.96%	53.38%
Construction	39.42%	51.45%	46.28%	47.52%	55.19%
Food	31.66%	31.48%	26.44%	31.35%	40.43%
Textile & Products	28.79%	29.94%	24.07%	27.93%	41.56%
Furniture	28.41%	39.77%	27.27%	22.73%	57.97%
Chemicals	37.80%	36.80%	36.80%	38.17%	38.05%
Rubber & Plastics Pro	35.63%	38.99%	32.60%	36.58%	48.16%
Leather Products	34.51%	42.48%	33.63%	28.32%	54.17%
Basic Metals & Metal	37.09%	39.73%	35.66%	37.56%	54.62%
Fabricated Metal Prod	35.15%	39.54%	39.36%	37.63%	42.36%
Manufacturing	41.05%	40.37%	34.55%	35.90%	43.63%
Electronics & Communication	44.05%	42.56%	40.29%	41.70%	50.21%
Motor Vehicles & Tranp	37.70%	39.34%	25.86%	22.03%	47.92%
Other Manufacturing	35.00%	34.84%	30.11%	33.09%	45.07%
Motor Vehicles	52.55%	57.30%	52.55%	47.45%	52.32%
Transport, Storage, &	39.39%	54.22%	38.36%	47.06%	51.55%
Retail and Wholesale	27.62%	26.10%	24.07%	32.78%	36.38%
Hotels & Restaurants	54.55%	60.51%	53.69%	63.17%	45.85%
Services of Motor Veh	44.63%	54.37%	54.37%	69.01%	54.58%
Tourism	25.73%	25.10%	22.92%	28.23%	33.47%
HIGH_TECH	37.62%	39.35%	35.84%	37.06%	39.35%
TOTAL	33.62%	34.69%	30.57%	34.40%	43.26%

Note: HIGH_TECH are technology-intensive industries and refers to chemicals, electronics & communications, engineering, rubber & plastics, IT & IT services.

Table 2: Access to finance and firm innovation

This table provides results for an estimated model for access to finance and innovation. Description of variables is as follows: Product and process innovations are dummy variables coded as 1 if a firm has introduced, in the last three years, new or significantly improved products (or services) or new production and manufacturing processes, 0 else. EXPORT_SHARE is an indicator variable taking a value of 1 if firm's direct exports are ≥50% of the total sales. AGE is the natural logritham of number of full time employees. $CORPORATE\_DUMMY_{i,m,k}$ is an indicator variable equal to 1 if a firm is legally registered as a corporation and 0 if it is registered as a sole proprietorship, partnership or any other legal form. LOAN_CREDIT_LINE is an indicator variable that takes a value of 1 if a firm has an overdraft and/or line of credit facility and 0 otherwise. $BANK\_FIN$ is the proportion of investment financed from banks and non-bank financial institutions. Logit regressions were used for product and process innovations while ordered logit regressions were used for core innovation and composite innovation indices. Robust standard errors (clustered at the country level) are in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

	Core Innovation		Product Innovation		Process Innovation		Composite Innovation		Organizational Innovation		Marketing Innovationi	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	Bank Financing	Loan/Credit Line facility	Bank Financing	Loan/Credit Line Facility	Bank Financing	Loan/Credit Line Facility	Bank Financing	Loan/Credit Line Facility	Bank Financing	Loan/Credit Line Facility	Bank Financing	Loan/Credit Line Facility
EXPORT_SHARE	0.404*	0.802***	0.137	0.758***	0.504***	0.771***	0.518***	0.935***	0.245	0.476**	0.654**	0.651***
	(0.242)	(0.151)	(0.361)	(0.206)	(0.164)	(0.0975)	(0.150)	(0.174)	(0.314)	(0.187)	(0.277)	(0.131)
CORPORATE_DUMMY	0.203	-0.0539	0.176*	-0.0810	0.0586	-0.0163			-0.525***			
	(0.146)	(0.169)	(0.1000)	(0.145)	(0.237)	(0.238)			(0.163)			
FIRM_SIZE	0.0803*	0.109***	0.0974***	0.122***	-0.00983	0.0977**	0.0648		0.0661	0.115**	0.0609	0.0983**
	(0.0447)	(0.0239)	(0.0377)	(0.0169)	(0.0727)	(0.0395)	(0.0704)		(0.129)	(0.0563)	(0.0684)	(0.0401)
CAPEX_DUMMY	0.708***	0.564***	0.352***	0.622***	1.170***	0.409***	0.412**	0.496***		0.131	-0.222	0.276
	(0.0533)	(0.102)	(0.0376)	(0.0696)	(0.235)	(0.149)	(0.191)	(0.158)		(0.212)	(0.475)	(0.184)
AGE	0.220***	0.139***	0.188***	0.142***	0.221***	0.113***	0.178***	0.100**	0.0659	-0.0553	0.0671	-0.0258
	(0.0445)	(0.0245)	(0.0475)	(0.0342)	(0.0439)	(0.0228)	(0.0476)	(0.0476)	(0.0642)	(0.0578)	(0.0773)	(0.0372)
GROUP_DUMMY	0.164**	0.260***	0.0311	0.174***	0.342**	0.313***	0.398***	0.485***	0.672**	0.651***	0.551***	0.556***
	(0.0765)	(0.0511)	(0.127)	(0.0577)	(0.164)	(0.111)	(0.123)	(0.0763)	(0.288)	(0.155)	(0.158)	(0.118)
QUALITY_CERTIFICATION	0.406***	0.299***	0.557***	0.430***			0.279***	0.330***	0.248*	0.186**	0.0614	0.0409
	(0.0937)	(0.0473)	(0.157)	(0.0361)			(0.0816)	(0.0612)	(0.131)	(0.0785)	(0.128)	(0.0698)
COMPETITION	0.308**	0.188*	0.127	0.160*	0.539**	0.312**	0.514**	0.377***	0.657**	0.412***	0.707**	0.518***
	(0.139)	(0.0963)	(0.0779)	(0.0818)	(0.257)	(0.140)	(0.240)	(0.107)	(0.299)	(0.144)	(0.307)	(0.121)
BANK_FIN	0.176***		0.1869**		0.317***		0.316***		0.239***		0.452***	
	(0.0639)		(0.1008)		(0.0717)		(0.0663)		(0.0814)		(0.0788)	
LOAN_CREDIT_LINE		0.270***		0.190***		0.441***		0.493***		0.558***		0.561***
		(0.0668)		(0.0634)		(0.0900)		(0.0729)		(0.116)		(0.0950)
FORMAL_TRAINING					0.631***	0.693***						
					(0.0701)	(0.0384)						
LICENSED_FOREIGN_TECH							0.429***	0.654***	-0.0817	0.345*	-0.0115	0.371*
							(0.130)	(0.0981)	(0.343)	(0.210)	(0.370)	(0.198)
Observations	4,282	14,880	4,282	15,077	4,327	15,220	4,227	14,975	4,213	14,881	4,210	14,881
Industry Dummies	YES	YES	YES	YES	YES	YES		YES		YES		YES
Country Dummies	YES	YES	YES	YES	YES	YES		YES		YES		YES

Table 3: Proportion of financially constrained and Innovative firms across sectors

	Number of firms	%	% of innovative firms in the sector	% of Financially Constrained firms in the sector
Basic Metals & Metal Products	674	2.84	50.15%	54.62%
Chemicals & Chemical Products	1,243	5.24	46.90%	38.46%
Chemicals, Plastics & Rubber	48	0.2	81.25%	24.14%
Construction	242	1.02	57.85%	55.19%
Electronics	122	0.51	52.46%	9.09%
Electronics & Communinications Equipment	787	3.32	55.15%	55.85%
Fabricated Metal Products	975	4.11	47.90%	42.36%
Food	2,418	10.19	41.44%	40.43%
Furniture	88	0.37	43.18%	57.97%
Garments	1,330	5.6	34.74%	37.76%
Hotels & Restaurants	353	1.49	68.84%	45.85%
IT & IT Services	247	1.04	66.40%	56.56%
Leather Products	113	0.48	55.75%	54.17%
Machinery & Equipment	847	3.57	56.79%	45.58%
Manufacturing	586	2.47	40.61%	32.17%
Motor Vehicles	550	2.32	68.55%	52.32%
Motor Vehicles and Transport Equipment	62	0.26	46.77%	47.92%
Non-Metallic Mineral Products	1,272	5.36	34.91%	53.38%
Other Manufacturing	3,618	15.25	46.05%	45.07%
Other Services	2,514	10.59	32.34%	32.26%
Retail	2,381	10.03	33.68%	34.62%
Rubber & Plastics Products	1,153	4.86	47.61%	48.16%
Services of Motor Vehicals	355	1.5	63.38%	54.58%
Textiles	1,009	4.25	39.74%	46.75%
Textiles & Garments	50	0.21	80.00%	39.39%
Tourism	126	0.53	63.49%	54.55%
Transport, Storage, & communications	391	1.65	61.64%	51.55%
Wholesale	178	0.75	62.92%	56.88%

Table 4: Univariate Tests: general access to bank credit and innovation activities. Two-sample t-test for a difference in means with unequal variances. The test compares all firms with loan or credit line (first row) with credit constrained firms (last row)

	Product Innovation	Process Innovation	RND %
Firms with Loan or Credit line	**17.97%*** **	**18.38%*** **	**13.55%*** **
Private commercial banks	5.55%	5.70%	
State-owned banks	5.34%	6.47%	
Non- Bank Financial Institutions	0.29%	0.31%	
Firms without loan or credit line			
No demand for credit	12.99%	12.62%	8.33%
Credit Constrained	**12.72%**	**13.26%**	**8.02%**

Table 6: Marginal effects of Financial constraints on various measures of innovation

Variable	Marginal Effects	Mean	Normalized Marginal Effects
Core Innovatrion	0.1099	0.9661	0.1136
Product Innovation	0.0942	0.5968	0.1578
Process Innovation	0.1588	0.3776	0.4206
Composite innovation	0.0949	1.6563	0.0573
Organizational Innovation	0.0856	0.3210	0.2667
Marketing innovation	0.0973	0.3616	0.2691

Table 5:Financial Constraints and Firm Innovation: Controlling for Endogeneity

This table report results for the Bivariate Ordered Probit Model.

VARIABLES	(1) Finnaical Constrain	(2) Core Innovation	(3) Finnaical Constrain	(4) Product Innovationi	(5) Finnaical Constrain	(6) Process Innovation	(7) Finnaical Constrain	(8) Composite Innovation	(9) Finnaical Constrain	(10) Organizational Innovation	(11) Finnaical Constrain	(12) Marketing Innovation
FINANCIALLY_CONSTRAINED		-0.598***		-0.571***		-0.965***		-0.488***		-0.545***		-0.572***
		(0.122)		(0.140)		(0.0862)		(0.112)		(0.159)		(0.167)
EXPORT_SHARE		0.492***		0.431***		0.206***		0.161***		0.228***		0.185***
		(0.0878)		(0.0932)		(0.0391)		(0.0348)		(0.0433)		(0.0422)
CORPORATE_DUMMY	-0.315***	-0.178***	-0.264***		-0.247***	-0.142***	-0.207***		-0.228***		-0.218***	
	(0.0397)	(0.0370)	(0.0399)		(0.0288)	(0.0289)	(0.0294)		(0.0291)		(0.0300)	
COMPETITION		0.0754***		0.0454*								
		(0.0231)		(0.0240)								
CAPEX_DUMMY		0.335***		0.379***		0.312***		0.353***		0.204***		0.254***
		(0.0246)		(0.0259)		(0.0209)		(0.0176)		(0.0212)		(0.0214)
FIRM_SIZE	-0.0871***	0.0547***	-0.0844***		-0.0872***		-0.0971***		-0.0941***		-0.0963***	
	(0.0109)	(0.0119)	(0.0106)		(0.00775)		(0.00760)		(0.00763)		(0.00763)	
AGE	-0.0322	0.0611***	-0.0235	0.0710***	-0.0167	0.0226*	-0.0337**	0.00302	-0.0335**	-0.0424***	-0.0335**	-0.0449***
	(0.0200)	(0.0164)	(0.0191)	(0.0168)	(0.0149)	(0.0132)	(0.0147)	(0.0113)	(0.0147)	(0.0138)	(0.0147)	(0.0135)
GROUP_DUMMY	0.109***	0.165***	0.106***	0.104***	0.0436*	0.195***	0.0394	0.218***	0.0393	0.320***	0.0386	0.297***
	(0.0365)	(0.0317)	(0.0347)	(0.0326)	(0.0263)	(0.0254)	(0.0261)	(0.0214)	(0.0262)	(0.0265)	(0.0262)	(0.0262)
FORMAL_TRAINING		0.310***		0.246***		0.371***		0.410***		0.381***		0.433***
		(0.0254)		(0.0257)		(0.0224)		(0.0186)		(0.0233)		(0.0243)
QUALITY_CERTIFICATION		0.200***		0.228***		0.112***		0.212***		0.152***		0.107***
		(0.0266)		(0.0274)		(0.0208)		(0.0189)		(0.0232)		(0.0226)
MAIN_BUS_CITY	-0.324***		-0.309***		-0.264***		-0.283***		-0.268***		-0.263***	
	(0.0303)		(0.0295)		(0.0229)		(0.0243)		(0.0246)		(0.0240)	
LEASED_FIXED_ASSET	0.0720***		0.0558**		0.0677***							
	(0.0251)		(0.0241)		(0.0177)							
AUDITED_ACCOUNTS	-0.106***		-0.0523*		-0.146***							
	(0.0291)		(0.0286)		(0.0201)							
CAPITAL_CITY_DUMMY	0.353***		0.365***		0.274***		0.305***		0.305***		0.295***	
	(0.0391)		(0.0380)		(0.0288)		(0.0287)		(0.0293)		(0.0300)	
Rho		0.435***		0.429***		0.802***		0.383***		0.417***		0.438***
Observations	11,533	11,533	12,773	12,773	21,524	21,524	21,953	21,953	21,853	21,853	21,866	21,866
Industry Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table 7: Differential Effect of Fianncial Constraints on Firm Siz

VARIABLES	(1) Financial Constraint	(2) Core Innovation	(3) Financial Constraint	(4) Product Innovation	(5) Financial Constraint	(6) Process Innovation	(7) Financial Constraint	(8) Organizational Innovation	(9) Financial Constraint	(10) Marketing Innovation	(11) Financial Constraint	(12) Composite Innovation
FINANCIALLY_CONSTRAINED		-0.714***		-0.611***		-1.091***		-0.714***		-0.778***		-0.612***
		(0.123)		(0.152)		(0.0874)		(0.160)		(0.163)		(0.113)
EXPORT_SHARE		0.497***		0.487***		0.201***		0.221***		0.176***		0.156***
		(0.0868)		(0.0963)		(0.0388)		(0.0429)		(0.0417)		(0.0346)
CORPORATE_DUMMY	-0.317***	-0.184***	-0.277***	-0.0566	-0.247***	-0.144***	-0.225***	0.132**	-0.213***	0.0487	-0.204***	0.0652
	(0.0395)	(0.0367)	(0.0413)	(0.0816)	(0.0288)	(0.0288)	(0.0291)	(0.0618)	(0.0299)	(0.0611)	(0.0293)	(0.0505)
COMPETITION		0.0757***		0.0317								
		(0.0229)		(0.0252)								
CAPEX_DUMMY		0.335***		0.365***		0.308***		0.201***		0.249***		0.351***
		(0.0244)		(0.0268)		(0.0207)		(0.0212)		(0.0214)		(0.0176)
FIRM_SIZE	-0.0866***	0.0599***	-0.0942***		-0.0880***		-0.0946***		-0.0971***		-0.0978***	
	(0.0109)	(0.0130)	(0.0110)		(0.00775)		(0.00762)		(0.00763)		(0.00761)	
AGE	-0.0321	0.0606***	-0.0320	0.0671***	-0.0166	0.0216	-0.0333**	-0.0430***	-0.0332**	-0.0460***	-0.0335**	0.00232
	(0.0199)	(0.0163)	(0.0199)	(0.0177)	(0.0149)	(0.0132)	(0.0147)	(0.0137)	(0.0147)	(0.0134)	(0.0147)	(0.0113)
GROUP_DUMMY	0.110***	0.189***	0.114***	0.126***	0.0431	0.193***	0.0386	0.317***	0.0376	0.295***	0.0390	0.217***
	(0.0363)	(0.0315)	(0.0363)	(0.0341)	(0.0263)	(0.0253)	(0.0262)	(0.0266)	(0.0262)	(0.0263)	(0.0261)	(0.0214)
FORMAL_TRAINING		0.324***		0.260***		0.366***		0.375***		0.425***		0.407***
		(0.0253)		(0.0273)		(0.0223)		(0.0237)		(0.0248)		(0.0186)
QUALITY_CERTIFICATION		0.197***		0.242***		0.110***		0.149***		0.105***		0.210***
		(0.0264)		(0.0293)		(0.0206)		(0.0231)		(0.0224)		(0.0188)
SMALL_FC		0.0703		0.0657		0.0571		0.0502		0.108**		0.0549
		(0.0544)		(0.0647)		(0.0443)		(0.0498)		(0.0481)		(0.0404)
MEDIUM_FC		0.169***		0.127**		0.186***		0.200***		0.207***		0.176***
		(0.0475)		(0.0624)		(0.0440)		(0.0491)		(0.0480)		(0.0402)
MAIN_BUS_CITY	-0.328***		-0.328***		-0.264***		-0.271***		-0.265***		-0.285***	
	(0.0301)		(0.0310)		(0.0228)		(0.0242)		(0.0237)		(0.0241)	
LEASED_FIXED_ASSET	0.0677***		0.0633**		0.0666***							
	(0.0249)		(0.0253)		(0.0176)							
AUDITED_ACCOUNTS	-0.107***		-0.0871***		-0.146***							
	(0.0289)		(0.0299)		(0.0199)							
CAPITAL_CITY_DUMMY	0.355***		0.358***		0.271***		0.302***		0.290***		0.304***	
	(0.0387)		(0.0393)		(0.0287)		(0.0293)		(0.0301)		(0.0286)	
MEDIUM_FIRM_DUMMY				0.0731*		0.00381		0.106***		0.0256		0.0700***
				(0.0386)		(0.0265)		(0.0317)		(0.0298)		(0.0244)
LARGE_FIRM_DUMMY				0.145***		0.0669*		0.177***		0.0819**		0.143***
Industry Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	11,625	11,625	11,625	11,625	21,524	21,524	21,853	21,853	21,866	21,866	21,953	21,953

Table 8: Robustness tests: Alternative measures of Financial constraints and innovation

	FINANCE_OBSTACLE					COST_FINANCING				
VARIABLES	(2) Core Innovation	(2) Product Innovation	(3) Process Innovation	(4) Organizational Innovation	(5) Marketing Innovation	(6) Core Innovation	(7) Product Innovation	(8) Process Innovation	(9) Organizational Innovation	(10) Marketing Innovation
FINANCE_OBSTACLE	-0.390***	-0.560***	-0.230***	-0.560***	-0.519***					
	(0.0417)	(0.0287)	(0.0620)	(0.0236)	(0.0275)					
COST_FINANCING						-0.695***	-1.020***	-1.258***	-1.310***	-1.273***
						(0.148)	(0.123)	(0.0975)	(0.0637)	(0.0765)
EXPORT_SHARE	0.418***	0.358***	0.216***	0.142***	0.113***	0.532***	0.534***	0.215***	0.191***	0.207***
	(0.0677)	(0.0680)	(0.0397)	(0.0284)	(0.0293)	(0.0930)	(0.105)	(0.0450)	(0.0432)	(0.0433)
CORPORATE_DUMMY	-0.0783***	-0.187***	-0.0579**	0.0841**	0.0562	-0.121***	-0.0592	-0.0648**	0.170***	0.153**
	(0.0260)	(0.0716)	(0.0264)	(0.0395)	(0.0421)	(0.0348)	(0.0900)	(0.0297)	(0.0634)	(0.0646)
COMPETITION	0.100***	0.0300*				0.101***	0.0300			
	(0.0181)	(0.0174)				(0.0229)	(0.0255)			
CAPEX_DUMMY	0.303***	0.259***	0.346***	0.130***	0.179***	0.318***	0.319***	0.310***	0.148***	0.206***
	(0.0214)	(0.0226)	(0.0217)	(0.0148)	(0.0166)	(0.0241)	(0.0279)	(0.0216)	(0.0200)	(0.0203)
FIRM_SIZE	0.0293***					0.0639***				
	(0.00987)					(0.0106)				
AGE	0.0427***	0.0248	0.0252*	-0.0543***	-0.0536***	0.0760***	0.0758***	0.0316**	-0.0394***	-0.0397***
	(0.0144)	(0.0160)	(0.0135)	(0.0113)	(0.0114)	(0.0158)	(0.0184)	(0.0143)	(0.0141)	(0.0140)
GROUP_DUMMY	0.159***	0.148***	0.204***	0.246***	0.252***	0.152***	0.138***	0.233***	0.343***	0.319***
	(0.0264)	(0.0295)	(0.0243)	(0.0235)	(0.0232)	(0.0316)	(0.0366)	(0.0273)	(0.0271)	(0.0270)
FORMAL_TRAINING	0.295***	0.186***	0.405***	0.247***	0.307***	0.360***	0.256***	0.415***	0.328***	0.404***
	(0.0213)	(0.0209)	(0.0224)	(0.0185)	(0.0203)	(0.0247)	(0.0277)	(0.0247)	(0.0221)	(0.0232)
QUALITY_CERTIFICATION	0.159***	0.165***	0.133***	0.0878***	0.0743***	0.201***	0.242***	0.127***	0.138***	0.0906***
	(0.0208)	(0.0218)	(0.0215)	(0.0155)	(0.0158)	(0.0260)	(0.0298)	(0.0228)	(0.0219)	(0.0220)
MEDIUM_FIRM_DUMMY		0.0248	0.105***	0.0805***	0.0201		0.112***	0.107***	0.162***	0.0811***
		(0.0213)	(0.0231)	(0.0178)	(0.0168)		(0.0288)	(0.0225)	(0.0221)	(0.0214)
LARGE_FIRM_DUMMY		-0.0224	0.136***	0.0508*	-0.0164		0.135***	0.121***	0.154***	0.0439
		(0.0321)	(0.0344)	(0.0262)	(0.0251)		(0.0412)	(0.0321)	(0.0313)	(0.0308)
Industry Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	16,272	12,666	23,650	24,025	24,034	12,866	10,101	18,587	18,768	18,785

Table 9: Robustness Check: Product novelty and effect of financial constraints on product innovation

VARIABLES	(1) FINANCIALLY_CONSTRAINED	(2) PRODUCT_NOVELTY3
FINANCIALLY_CONSTRAINED		-1.383***
		(0.0788)
EXPORT_SHARE		0.508***
		(0.195)
DEMAND_PULL		0.329***
		(0.0421)
SKILLED_WORKERS		-0.166**
		(0.0804)
CORPORATE_DUMMY		0.285*
		(0.171)
FIRM_SIZE	-0.0502*	0.0404*
	(0.0264)	(0.0232)
AGE		-0.0516
		(0.0348)
GROUP_DUMMY	0.0171	0.134**
	(0.0787)	(0.0658)
FORMAL_TRAINING		-0.0742*
		(0.0423)
QUALITY_CERTIFICATION		0.0711
		(0.0457)
COMPETITION		-0.0449
		(0.0433)
	(0.369)	(0.384)
MAIN_BUS_CITY	-0.286***	
	(0.0642)	
LEASED_FIXED_ASSET	0.0977**	
	(0.0493)	
AUDITED_ACCOUNTS	0.268***	
	(0.0584)	
CORPORATE_DUMMY2	-0.0875	
	(0.0811)	
LOGAGE	-0.131***	
	(0.0454)	
CAPITAL_CITY_DUMMY	0.364***	
	(0.0806)	
Constant		
Industry Dummies	YES	YES
Country Dummies	YES	YES
Observations	1,969	1,969

Table 10: Cross tabulationS for FINANCE_OBSTACLE and Product Innovation

Panel A: FINANCE_OBSTACLE and Product Innovation

	FINANCE_OBSTACLE				
	No Obstacle	Minor Obstacle	Moderate Obstacle	Major Obstacle	Very Severe Obstacle
	0	1	2	3	4
Product Innovation					
No	6,541	3,694	3,480	2,063	914
Yes	2,790	2,582	2,040	1301	714
Total	**9,331**	**6,276**	**5,520**	**3,364**	**1,628**

Panel B: FINANCE_OBSTACLE and Process Innovation

	FINANCE_OBSTACLE				
	No Obstacle	Minor Obstacle	Moderate Obstacle	Major Obstacle	Very Severe Obstacle
	0	1	2	3	4
Process Innovation					
No	6,511	3,728	3,180	1,919	901
Yes	2,810	2,557	2,330	1,445	732
Total	**9,321**	**6,285**	**5,510**	**3,364**	**1,633**

Table 11: Sub-Sample of Potentially Innovative firms and financial constraints: Bivarite Probit Model

	FINANCIALLY_CONSTRAINED							COST_FINANCING					
	(1) Core Innovation	(2) Product Innovation	(3) Process Innovation	(4) Composite Innovation	(5) Organizational Innovation	(6) Marketing Innovation		(7) Core Innovation	(8) Product Innovation	(9) Process Innovation	(10) Composite Innovation	(11) Organizational Innovation	(12) Marketing Innovation
VARIABLES													
FINANCIALLY_CONSTRAINED	-0.947***	-0.984***	-1.250***	-0.862***	-0.932***	-1.011***							
	(0.117)	(0.117)	(0.0623)	(0.0945)	(0.136)	(0.134)							
COST_FINANCING								-0.407*	-0.775***	-1.194***	-0.888***	-1.217***	-1.108***
								(0.239)	(0.214)	(0.141)	(0.108)	(0.0971)	(0.131)
EXPORT_SHARE	0.492***	0.469***	0.200***	0.162***	0.223***	0.191***		0.616***	0.610***	0.248***	0.197***	0.220***	0.252***
	(0.0980)	(0.102)	(0.0415)	(0.0378)	(0.0469)	(0.0452)		(0.121)	(0.128)	(0.0528)	(0.0437)	(0.0512)	(0.0525)
CORPORATE_DUMMY	-0.113***	0.0107	-0.123***	0.122**	0.148**	0.0796		0.0141	0.0495	0.0127	0.198***	0.202***	0.227***
	(0.0422)	(0.0893)	(0.0323)	(0.0551)	(0.0682)	(0.0668)		(0.104)	(0.108)	(0.0352)	(0.0646)	(0.0761)	(0.0788)
COMPETITION	0.0577**	0.0218						0.0728**	0.0115				
	(0.0246)	(0.0251)						(0.0288)	(0.0296)				
CAPEX_DUMMY	0.276***	0.359***	0.218***	0.292***	0.154***	0.176***		0.241***	0.346***	0.240***	0.286***	0.125***	0.167***
	(0.0265)	(0.0279)	(0.0204)	(0.0189)	(0.0225)	(0.0225)		(0.0302)	(0.0319)	(0.0241)	(0.0204)	(0.0231)	(0.0237)
FIRM_SIZE	0.0503***							0.0754***					
	(0.0137)							(0.0139)					
AGE	0.0850***	0.0995***	0.0255*	0.00596	-0.0463***	-0.0594***		0.112***	0.111***	0.0397**	0.0156	-0.0374**	-0.0537***
	(0.0179)	(0.0181)	(0.0143)	(0.0124)	(0.0150)	(0.0146)		(0.0194)	(0.0205)	(0.0162)	(0.0134)	(0.0160)	(0.0160)
GROUP_DUMMY	0.0999***	0.0254	0.141***	0.152***	0.273***	0.229***		0.0893**	0.0347	0.211***	0.197***	0.345***	0.300***
	(0.0341)	(0.0345)	(0.0275)	(0.0235)	(0.0299)	(0.0296)		(0.0396)	(0.0417)	(0.0307)	(0.0257)	(0.0304)	(0.0305)
FORMAL_TRAINING	0.319***	0.238***	0.357***	0.420***	0.399***	0.437***		0.376***	0.265***	0.455***	0.459***	0.395***	0.476***
	(0.0275)	(0.0271)	(0.0232)	(0.0205)	(0.0269)	(0.0286)		(0.0308)	(0.0318)	(0.0292)	(0.0219)	(0.0265)	(0.0283)
QUALITY_CERTIFICATION	0.195***	0.226***	0.111***	0.222***	0.136***	0.114***		0.186***	0.279***	0.142***	0.240***	0.145***	0.115***
	(0.0289)	(0.0293)	(0.0218)	(0.0207)	(0.0250)	(0.0244)		(0.0335)	(0.0344)	(0.0266)	(0.0227)	(0.0258)	(0.0264)
SKILLED_WORKERS		-0.0352											
		(0.0440)											
MEDIUM_FIRM_DUMMY		0.0754**	0.0206	0.104***	0.155***	0.0270			0.163***	0.0979***	0.159***	0.185***	0.0858***
		(0.0299)	(0.0222)	(0.0215)	(0.0291)	(0.0261)			(0.0338)	(0.0261)	(0.0218)	(0.0263)	(0.0258)
LARGE_FIRM_DUMMY		0.0958**	-0.0111	0.0877***	0.110**	-0.0177			0.251***	0.120***	0.171***	0.176***	0.0663*
		(0.0451)	(0.0332)	(0.0321)	(0.0440)	(0.0410)			(0.0495)	(0.0376)	(0.0307)	(0.0370)	(0.0368)
Industry Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country Dummies	YES	YES	YES	YES	YES	YES		YES	YES	YES			
Observations	8,795	9,690	16,068	16,391	16,307	16,319		7,523	7,574	13,792	13,992	13,918	13,933

Table 12: Robustness Test: Financial Constraints and Sub-Sample of Core Innovative firms: Atleast one form of core innovation

VARIABLES	(1) Financially Constrained	(2) core	(3) Financially Constrained	(4) Product Innovation	(5) Financially Constrained	(6) Process Innovation	(7) Financially Constrained	(8) Composite Innovation	(9) Financially Constrained	(10) Organizational Innovation	(11) Financially Constrained	(12) Marketing Innovation
FINANCIALLY_CONSTRAINED		-1.234***		-1.118***		-1.087***		-0.635***		-0.994***		-1.063***
		(0.0824)		(0.123)		(0.111)		(0.160)		(0.165)		(0.146)
SKILLED_WORKERS		0.174***		0.117**								
		(0.0528)		(0.0570)								
CORPORATE_DUMMY	-0.0694	-0.0401	-0.154**	-0.0748	-0.249***	-0.126**	-0.195***	0.182**	-0.198***	0.197**	-0.189***	0.204**
	(0.134)	(0.117)	(0.0605)	(0.108)	(0.0484)	(0.0488)	(0.0453)	(0.0731)	(0.0437)	(0.0847)	(0.0434)	(0.0851)
COMPETITION		-0.0365		-0.114***								
		(0.0299)		(0.0335)								
CAPEX_DUMMY		0.127***		0.209***		-0.0471		-0.00171		-0.0925***		-0.0609**
		(0.0302)		(0.0343)		(0.0301)		(0.0248)		(0.0272)		(0.0269)
FIRM_SIZE	-0.109***	-0.0354**	-0.107***		-0.0998***		-0.0885***		-0.0847***		-0.0874***	
	(0.0170)	(0.0157)	(0.0169)		(0.0129)		(0.0125)		(0.0124)		(0.0122)	
AGE	-0.0307	0.0568**	-0.0277	0.0459*	-0.0254	0.0218	-0.0333	-0.0432**	-0.0371	-0.0927***	-0.0314	-0.107***
	(0.0311)	(0.0243)	(0.0315)	(0.0248)	(0.0251)	(0.0226)	(0.0240)	(0.0178)	(0.0239)	(0.0208)	(0.0240)	(0.0210)
GROUP_DUMMY	0.113**	0.0924**	0.131**	-0.00502	0.0532	0.201***	0.0299	0.250***	0.0252	0.342***	0.0310	0.332***
	(0.0511)	(0.0439)	(0.0519)	(0.0456)	(0.0401)	(0.0420)	(0.0387)	(0.0317)	(0.0388)	(0.0421)	(0.0384)	(0.0418)
FORMAL_TRAINING		0.242***		0.0625*		0.347***		0.345***		0.279***		0.365***
		(0.0313)		(0.0322)		(0.0345)		(0.0275)		(0.0345)		(0.0374)
QUALITY_CERTIFICATION		0.0262		0.118***		-0.138***		0.0357		-0.0200		-0.0588**
		(0.0316)		(0.0354)		(0.0336)		(0.0273)		(0.0296)		(0.0295)
MAIN_BUS_CITY	-0.262***		-0.259***		-0.147***		-0.239***		-0.234***		-0.212***	
	(0.0421)		(0.0454)		(0.0390)		(0.0429)		(0.0378)		(0.0368)	
LEASED_FIXED_ASSET	0.0260		-0.0156		0.0234							
	(0.0342)		(0.0369)		(0.0297)							
AUDITED_ACCOUNTS	0.0632		0.112**		-0.115***							
	(0.0419)		(0.0487)		(0.0358)							
CAPITAL_CITY_DUMMY	0.296***		0.243***		0.251***		0.248***		0.190***		0.187***	
	(0.0524)		(0.0574)		(0.0440)		(0.0455)		(0.0430)		(0.0424)	
EXPORT_SHARE				0.181		0.310***		0.153***		0.192***		0.156***
				(0.131)		(0.0686)		(0.0507)		(0.0580)		(0.0565)
MEDIUM_FIRM				-0.0146		-0.0468		0.0405		0.0835**		0.00585
				(0.0373)		(0.0352)		(0.0302)		(0.0353)		(0.0327)
LARGE_FIRM				-0.0532		-0.169***		-0.0325		0.00350		-0.129***
				(0.0535)		(0.0473)		(0.0407)		(0.0487)		(0.0442)
Country Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	4,554	4,554	4,543	4,543	7,273	7,273	7,788	7,788	7,766	7,766	7,769	7,769

Table 13: Robustness Check: Foreign ownership and financial constraints, controlling for selectivity bias

VARIABLES	(1) Product Innovation	(2) Process Innovation	(3) Core Innovation
FINANCIALLY_CONSTRAINED	-0.845***	-0.565***	-0.587***
	(0.149)	(0.184)	(0.136)
CORPORATE_DUMMY2	-0.281***	-0.211***	-0.216***
	(0.0474)	(0.0499)	(0.0430)
FOREIGN_OWNERSHIP^	1.290***	0.465	0.833***
	(0.343)	(0.339)	(0.292)
FINANCIALLY_CONSTRAINED_FOREIGN	-0.857***	-1.248***	-1.216***
	(0.325)	(0.330)	(0.288)
EXPORT_SHARE	0.125	0.356**	0.269**
	(0.139)	(0.149)	(0.125)
SKILLED_WORKERS	0.123**	0.200***	0.188***
	(0.0495)	(0.0531)	(0.0461)
CAPEX_DUMMY	0.342***	0.235***	0.337***
	(0.0328)	(0.0321)	(0.0281)
FIRM_SIZE	0.0319**	0.0631***	0.0628***
	(0.0161)	(0.0169)	(0.0140)
AGE	0.0536**	0.0628***	0.0623***
	(0.0219)	(0.0225)	(0.0196)
GROUP_DUMMY	0.168***	0.290***	0.200***
	(0.0402)	(0.0408)	(0.0358)
FORMAL_TRAINING	0.269***	0.426***	0.315***
	(0.0323)	(0.0353)	(0.0285)
QUALITY_CERTIFICATION	0.176***	0.0376	0.149***
	(0.0328)	(0.0337)	(0.0296)
COMPETITION	0.0813***	0.186***	0.0957***
	(0.0284)	(0.0304)	(0.0260)
Industry Dummies	YES	YES	YES
Country Dummies	YES	YES	YES
Observations	8,720	8,720	8,736

Table 14: Multivariate Probit Regression: Complementarity of innovation activities and Financial Constraints

VARIABLES	(1) Product Innovation	(2) Process Innovation	(3) Organizational Innovation
FINANCIAL_CONSTRAINT	-0.447**	-1.181***	-1.194***
	(0.201)	(0.223)	(0.204)
EXPORT_SHARE	0.449***	0.505***	0.384***
	(0.103)	(0.102)	(0.104)
CORPORATE_DUMMY	0.0295	-0.0774**	-0.0382
	(0.0804)	(0.0394)	(0.0786)
CAPEX_DUMMY	0.374***	0.283***	0.0975***
	(0.0275)	(0.0273)	(0.0281)
MEDIUM_FIRM_DUMMY	0.113***	0.0950***	0.169***
	(0.0315)	(0.0315)	(0.0323)
LARGE_FIRM_DUMMY	0.123***	0.0505	0.0481
	(0.0466)	(0.0467)	(0.0475)
AGE	0.0704***	0.0554***	-0.0610***
	(0.0184)	(0.0184)	(0.0186)
GROUP_DUMMY	0.152***	0.304***	0.486***
	(0.0363)	(0.0363)	(0.0362)
FORMAL_TRAINING	0.300***	0.435***	0.369***
	(0.0286)	(0.0285)	(0.0286)
QUALITY_CERTIFICATION	0.260***	0.116***	0.136***
	(0.0303)	(0.0303)	(0.0307)
COMPETITION	0.00786		
	(0.0242)		
Constant	-1.117***	-0.947***	-1.115***
	(0.235)	(0.203)	(0.217)
Industry Dummies	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes
rho_{21}	0.806***		
	(0.0191)		
rho_{31}	0.523***		
	(0.0179)		
rho_{32}	0.819***		
	(0.0196)		
Log likelihood	-17996.2		
Wald chi2(131)	3676.83***		
Likelihood ratio test of $rho_{21} = rho_{31} = rho_{32} = 0$; χ^2	4416.14***		
Number of random draws in the simulator	50		
Wald test on joint significance of industry dummies, χ^2 (51)	143.70***		
Wald test (slope coefficients) χ^2(32)	1486.68***	12,104	12,104

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