INNOVATION, CREDIT CONSTRAINTS AND NATIONAL BANKING SYSTEMS: A COMPARISON OF DEVELOPING NATIONS

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Innovation, Credit Constraints and National Banking Systems: A Comparison of Developing Nations

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Abstract

In that paper, we seek to extend exiting micro-level studies on the financing decisions of enterprises in developing countries by explicitly connecting these decisions to firms' innovation outcomes and to the wider institutional framework formed by the national banking system. Indeed, the national banking system is recognized as being central to the ability of developing-country firms to acquire the resources and develop the capabilities needed for innovation. We investigate the links between innovation and financial system characteristics for a sample of 36 developing nations spread across 5 regions of the world: Sub-Saharan Africa, the Middle East and North Africa, East Asia and Pacific, South Asia and Central Asia. Our results show that credit constraints have a significant negative impact on innovation and that the characteristics of the national banking system indirectly affect innovation through their impact on the likelihood that firms face these financing constraints.

Keywords: Financing Constraints, Innovation, Banking System, Developing Nations

JEL Classification: O3, O16, G2

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1. Introduction

The importance of innovation and technical change for economic development has been investigated in a large literature, both theoretical and empirical. One key finding of this research is that it is important to distinguish between innovations in the sense of cutting edge developments at the technological frontier and the incremental processes associated with the adoption and diffusion of existing technologies. Kim (1997), in his now classic study on the role of technological catch-up in Korea's rapid economic growth from the 1960s, refers to "innovation through imitation", and Lee (2005) in his analysis of the opportunities and barriers to technological catch-up also emphasizes the importance of imitation in the early so-called OEM (own equipment manufacturing) stage of the process. In a similar vein, Fagerberg *et al*. (2010) in a recent review of the empirical research on innovation and development observe that cutting edge technological development tends to be located in the "developed" world while innovation in the sense of imitation and diffusion tends to characterize the "developing" world. The largely imitative nature of innovation activity in developing nations, however, doesn't make it any less significant economically.

A closely related finding based on the results of innovation surveys is that innovation, in the sense of imitation and diffusion, far from being exceptional is a quite frequent and even common phenomenon in developing countries (Crespi and Peirano, 2007; Fagerberg *et al*. 2010; Goedhuys, 2007; Srholec, 2011). It may be the necessary condition for firms to sustain a competitive position in their local or national markets. Moreover, the opportunities for innovating in the sense of introducing products or technologies that are new to the firm but not necessarily new on world markets may well be greater in nations that are behind technologically, simply because the amount of mature technology available on international markets for enterprises in these nations to 'absorb' is greater. This issue is addressed in the literature on technological gaps and convergence between low income and high income nations (Fagerberg, 1987, Verspagen, 1991).

An important conclusion coming out of these related strands of research is that there is nothing "automatic" about the process whereby firms in less developed countries acquire the technological and organizational capabilities necessary to assimilate and possibly modify technologies and products first developed elsewhere (Fagerberg 1994, pp. 155-162 for an overview). While these capabilities are internal to the enterprise, their development depends in part on the characteristics of the national and local institutions and support structures the enterprise is embedded in. This reflects the fact that firms rely on their relations with different external organizations and institutions for the development of their core competences. Firms depend on relations with education institutions and training providers for

securing supplies of labor with the required basic and domain-specific skills, and on relations with universities and public and private research institutions for the development of their research and innovation capabilities. To varying degrees they depend on their relations with banks and other financial institutions for access to credit in order to develop, produce and commercialize new products and technologies. The importance of the nationally-specific institutional setting is investigated in a large literature on national and regional innovation systems in both developed and developing nations (Lundvall, 1992; Freeman, 1995; Arocena and Sutz, 2000; Dahlman and Nelson, 1995; Niosi *et al.* 1993).

In this chapter we focus on one dimension of the national institutional setting that is recognized as being central to the ability of developing-country firms to acquire the resources and develop the capabilities needed for innovation: the national financial system. We investigate the links between innovation and financial system characteristics for a sample of 36 developing nations spread across 5 regions of the world: Sub-Saharan Africa, the Middle East and North Africa, East Asia and Pacific, South Asia and Central Asia. We seek to extend exiting micro-level studies on the financing decisions of enterprises in developing countries by explicitly connecting these decisions to firms' innovation outcomes and to the wider institutional framework formed by the national banking system. Our results show that credit constraints have a significant negative impact on innovation and that the characteristics of the national banking system indirectly affect innovation through their impact on the likelihood that firms face these financing constraints.

The chapter is structured in the following way. Section 2 presents a brief overview of research examining the links between financial system development, credit constraints and innovation performance. Section 3 contrasts the national banking systems for the 36 developing nations investigated in this chapter and it develops a probit model predicting the likelihood of credit constraints as a function of both firm-level characteristics and country-level variables measuring the national banking systems. The sources of firm-level and country-level data are described. Section 4 extends the analysis by developing a recursive bivariate probit model in order to examine the indirect effects of national banking system characteristics on firms' innovation outcomes. Section 5 concludes with a discussion of the policy implications.

2. Financial systems, credit constraints and innovation

Macroeconomic research has identified a positive relation between economic development and the development of the financial system. Contemporary cross country econometric research starts with papers by King and Levine (1993) building on earlier work by Goldsmith (1969). Rajan and Zingales (1998) in an influential paper using industry and firm data find that financial development has a substantial impact of industrial growth in part though the availability of credit for new firm formation. These papers provide evidence for a "first-order" positive relationship between financial development and economic growth (Levine, 2005 for an overview).

At a more micro level, a number of studies focusing on both developed and developing nations have shown that firms face more or less important financing obstacles or constraints linked to the level of development of their national financial systems. Beck *et al*., (2006) explore the relationship between the characteristics of the financial system and the financing obstacles firms face for a sample of 80 countries using micro data from the World Bank's Enterprise Surveys (WBES). They show that firms in countries with higher levels of financial intermediary and stock market development, legal system efficiency and higher GDP per capita report, on average, lower financing obstacles. Presbitero and Rabellotti (2013) focus on the Latin America region and show that the financing constraints of firms depend in part of the degree of bank penetration (as measured by the number of bank branches) and bank competition. This literature also shows that the size of firms is an important determinant of access of external finance. There is substantial evidence that small and medium enterprises (SMEs) are financially more constrained than large firms and have less access to formal sources of external finance (Beck and Demirgüç-Kunt, 2006; Shiffer and Weder, 2001).

There are a number of micro-level studies examining the relation between the obstacles firms face in gaining access to credit and their R&D expenditures and innovation performance. Fazzari *et al*. (1988) in a path-setting study focused on the relation between investment and R&D expenditures and cash flows. They argued that higher investment-cash flow sensitivities provide a useful measure of financing or credit constraints. This gave rise to a literature focusing on advanced industrialized nations and giving particular attention to the financing decisions of small firms in high-tech or R&D intensive industries (Hall and Lerner, 2010 for a survey). Mulkay *et al*. (2001), for example, compared a panel of US and French firms and showed that investment-cash flow sensitivities are higher in the US, and Bond *et al*. (1999) compared firms in the UK and Germany, finding that UK firms were more sensitive to financing constraints. The broad conclusions of this literature, however, were that the investments

of firms that had exhausted all of their relatively low cost internal funds would be more sensitive to fluctuations in their cash-flow than firms with higher liquidity.

A more recent literature addresses these issues using direct measures of both firms' financing constraints and their innovation performance. Savignac (2006), for example, uses data from the French Financing of Technological Innovation (FIT) survey carried out in 2000 and focusing on the financial resources used for funding innovative projects. The survey provides direct measures of innovation based on the Oslo Manual definitions and direct measures of financial constraint based on questions asking respondent firms whether a lack of financing sources or too high interest rates have been obstacles preventing them from undertaking innovation projects. The analysis of Gorodnichenko and Schnitzer's (2013) similarly uses direct measures of innovation and credit constraints derived from the World Bank's Business Environment and Enterprise Performance Surveys (BEEPS), which cover Eastern Europe and Commonwealth Independent States (CIS). This approach based on direct measures not only avoids potential problems with using investment-cash flow sensitivities as a proxy for financing constraints,[1] but also overcomes the well-known weaknesses associated with using R&D expenditures as proxy for innovation. Not only is R&D only one amongst several important inputs to innovation, but as research based on the Community Innovation Surveys or surveys adopting the Oslo Manual definitions of innovation have shown, many firms innovate without having undertaken any formal R&D (Arundel *et al*. 2008; Leitner and Stehrer, 2013; Rammer *et al.* 2009).

In summary, one body of literature has shown that the level of development of the national financial system has an important impact on the ability of firms to gain access to credit and another has made the case for the importance of credit constraints for firms' investments in innovation activities. A main objective in this paper is to link these different insights and findings in a model investigating for a sample of developing countries the channels through which the banking system impacts indirectly on enterprise innovation performance through its effect on firms' financing constraints.

In order to do this, we make use of recently available harmonized enterprise-level data from the World Bank Enterprise Survey (WBES) in combination with aggregate measures of national banking systems available from the World Bank's Global Financial Development database. Firm-level surveys providing information on the financing decisions of enterprises have been conducted by different units within the World Bank since the 1990's. Starting in 2005-2006 data collection has been centralised in

[1] See notably Kaplan and Zingales (1997) who present evidence showing a non-monotonic relation between investment-cash flow sensitivities and the extent of financing constraints.

the Enterprise Analysis Unit using a harmonised methodology[2] and beginning with the 2010 survey wave questions on innovation outcomes conforming to the Oslo Manual definitions have been included in the separate manufacturing and services questionnaires in selected nations.[3] In this paper we analyze the subset of developing nations surveyed by the World Bank during the period 2010-2014 for which innovation indicators are available for both manufacturing and service sector enterprises and for which aggregate indicators characterizing the national banking system are obtainable from the World Bank's Global Financial Development database.[4] Table A.1 in the Annex lists the 36 countries analyzed and shows both their GDP and their GNI per capita in 2012 US dollars. Gross national income per capita for the sample of nations in 2012 ranges from a low of 320 US dollars in Malawi to a high of 9780 US dollars in Kazakhstan. The majority of nations that are classified as low income by the World Bank (less than 1025 US dollars in 2012) are located in Sub-Sahara Africa and in South Asia.

3. National banking systems in comparative perspective

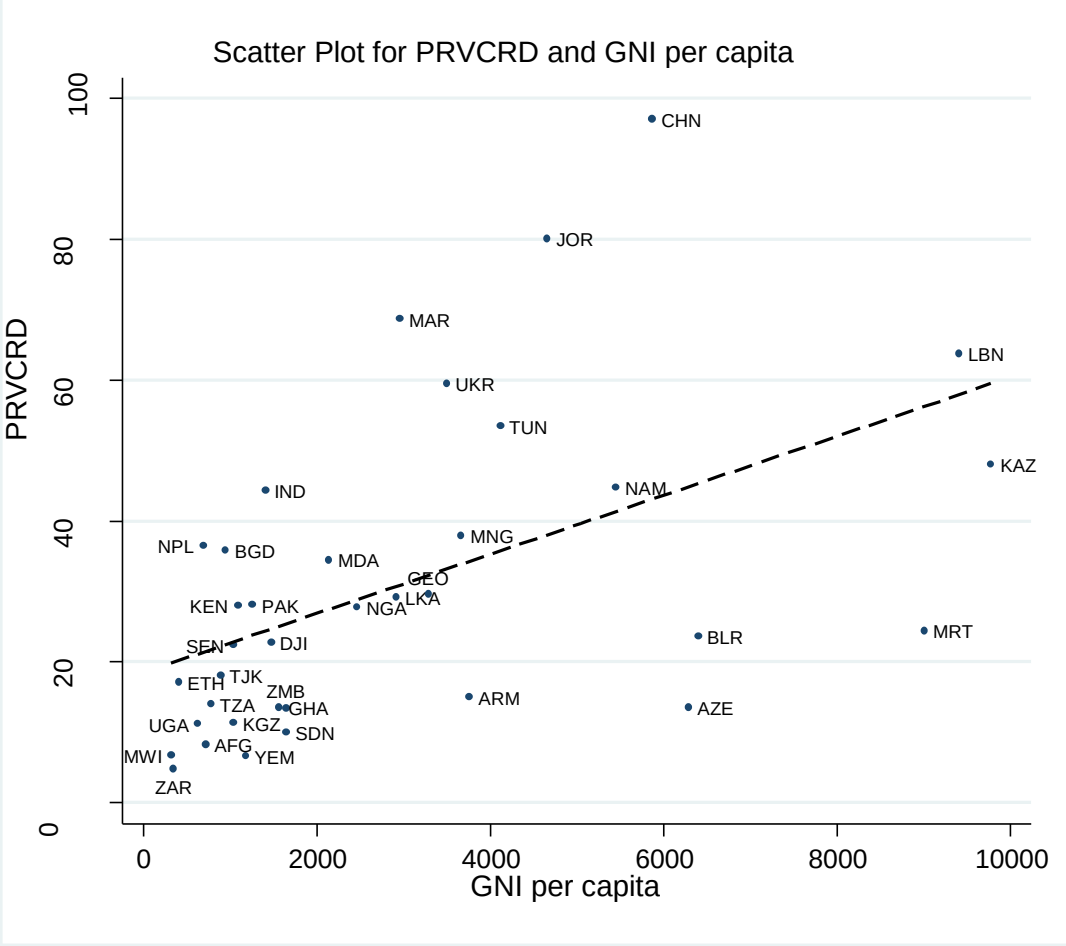
As securities markets play a minor or insignificant role in the provision of external finance in the majority of the countries analyzed in this paper, we focus on the characteristics of the national banking system. This applies to a considerable extent even to fast-growing Asian countries like China and India that experienced large increases in equity market capitalization during the 2000s. According to Didier and Schmukler (2014), the use of equity financing remains quite limited across East Asian nations and tends to be concentrated in a few firms. For example, the national shares raised by the top five issuers in China and India in the 2000s were 45% and 55% respectively, and trading is similarly concentrated with the top five capturing about 40% of the trading. Only a few firms in China and India use equity and bond markets on a recurrent basis and even fewer capture the bulk of capital market financing.

In comparing national systems we focus on measures of banking system depth, breadth, market concentration and the cost of financial mediation as reflected in net interest margins. A standard measure of the level of development or the 'depth' of the banking system is private bank credit as a percentage of GDP (*PRVCRD*). A number of cross national studies have identified a positive relation between this measure and the share of private sector firms having access to a line of credit from a

[2] See Annex 1 for a description of the sample frame and survey methodology.
[3] Earlier waves of the WBES conducted between 2003 and 2006 also included questions on innovation in selected countries. However, the survey methodology were not uniform in terms of the sample frames, stratification and the use of post stratification weights.
[4] We have excluded the Latin American the Caribbean nations surveyed in the 2010 wave of the WBES as innovation data were only collected for the manufacturing sector.

financial institution (Beck, *et al*., 2006; Fisman and Love, 2003). The un-weighted population average for *PRVCRD* in 2008 is 30.7 percent of GDP with values ranging from a low of 4.8 percent of GDP in the Democratic Republic of Congo to a high of 97 percent in China.[5] Figure 1 identifies a positive relationship between private bank credit as a percent of GDP and the level of economic development as measured by GNI per capita. As previous comparative work has observed, the banking systems of Sub Saharan African nations stand out in comparison to those of other regions of the world for their lack of depth (Beck *et al*., 2011). The only Sub-Saharan African nation included in the analysis with a value of private bank credit as a percentage of GDP over the population average is Namibia.

Figure 1



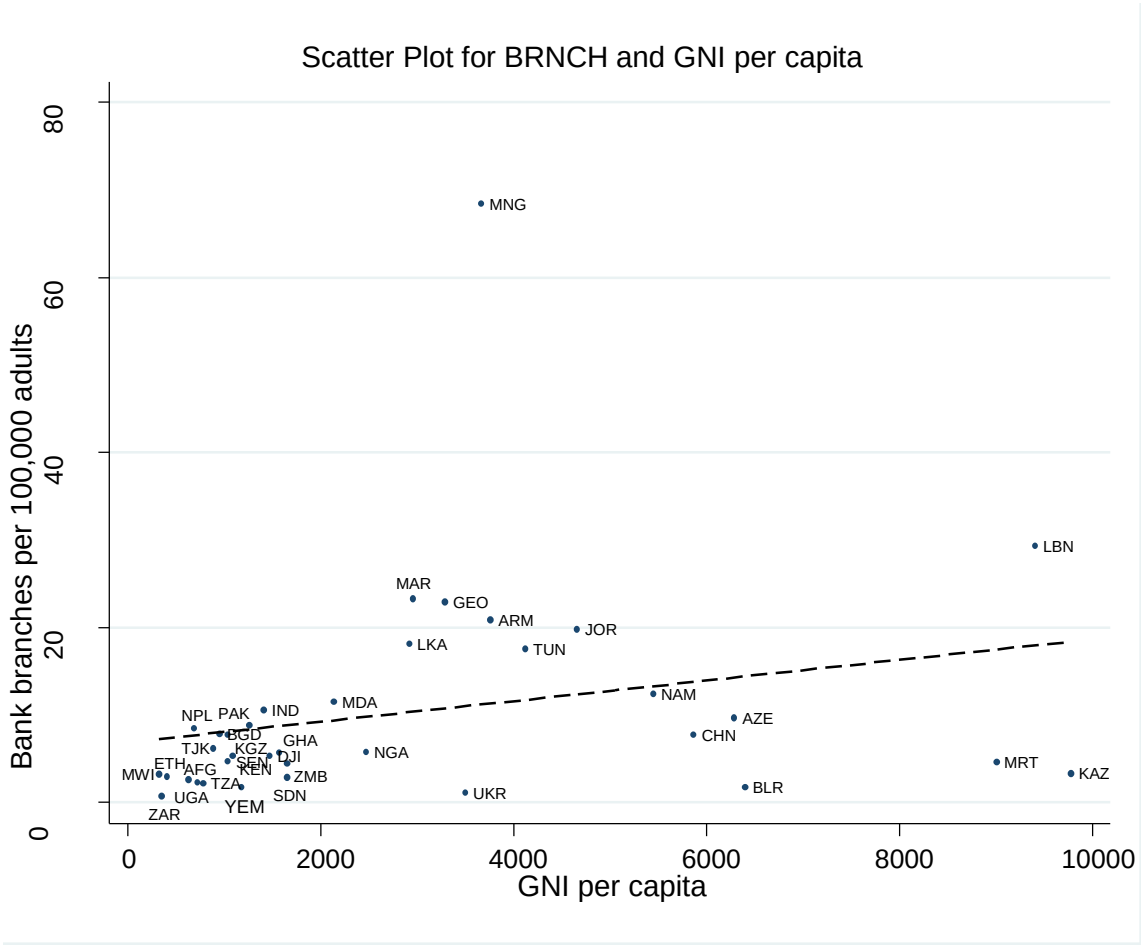
Source: World Bank Global Financial Development Database

Figure 2 shows the correlation between GNI per capita and the number of bank branches per 100,000 adults (*BRNCH*), a standard measure of banking system breadth or outreach. The figure identifies a

[5] 2008 is the most recent year for which values of *PRVCRD* for all 36 nations are available on the World Bank's Global Financial Development database.

weak positive correlation. Banking system outreach may be especially important for SMEs that tend to rely more than larger firms on relationship banking depending on geographical proximity and face-to-face contacts (Berger and Udell, 1998). The nations of Sub-Saharan Africa are also notable for their lack of banking system outreach, with Namibia at 12.4 branches being the only country with a value over the population average of 10.3 branches per 100,000 adults. Especially low values are reported in a number of Central Asian nations including the Ukraine, Belarus and Kazakhstan. Mongolia stands out as an outlier with over 60 bank branches per 100,000 adults.

Figure 2

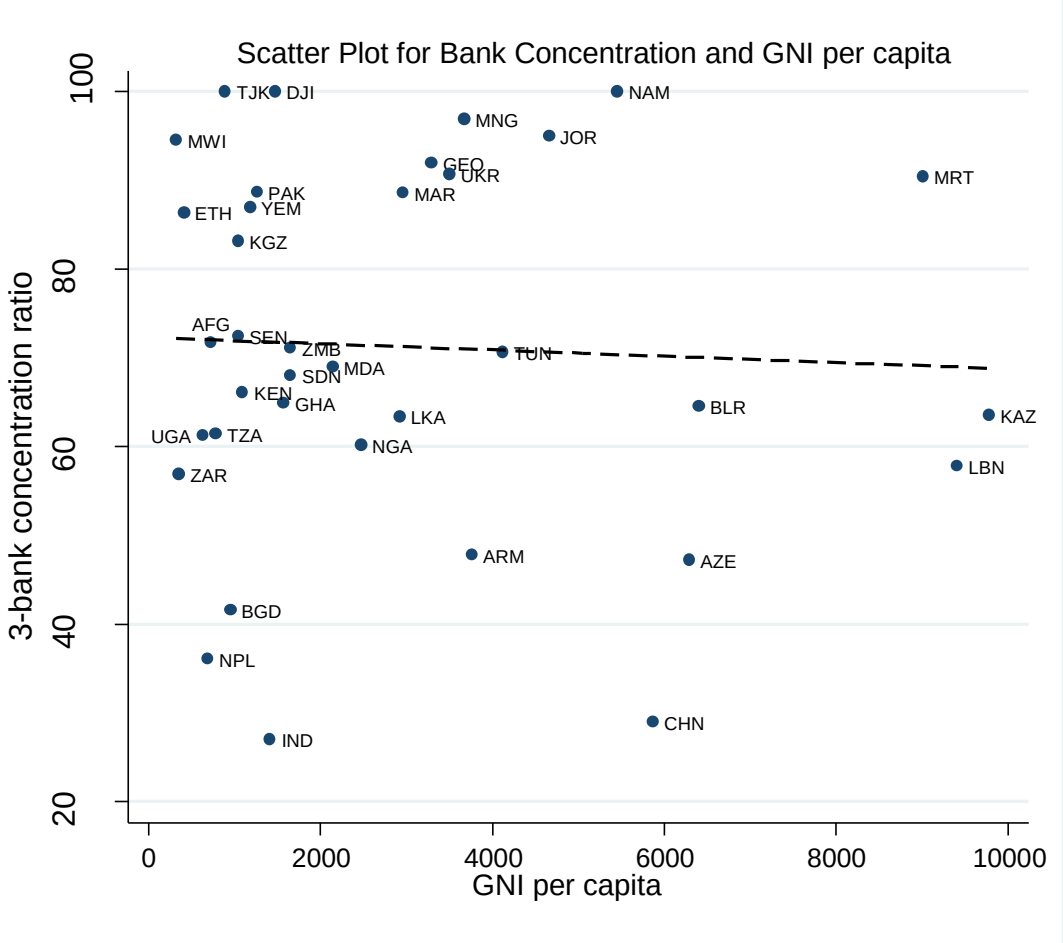


Source: World Bank Global Financial Development Database

Figure 3 presents the correlation between GNI per capita and the 3-bank concentration ratio (*CONCTR*). Concentration ratios range from a low of 27 percent in India to a high of 100 percent in Namibia, Djibouti and Tajikistan. The impact of concentration on access to credit and firm growth has been debated in the literature, especially as regards its impact on SMEs. Comparing states across the US, Black and Strahan (2002) find that higher levels of concentration result in lower rates of new firm formation. However, Petersen and Rjan (1995) using data from the US National Survey of Small Business Firms find that credit constrained firms are more likely to gain access to credit in concentrated credit markets because the lenders are more easily able to internalize the benefits of assisting them. From the cross-national perspective, Beck *et al*. (2004) in a seminal study using World Bank data for 74 developed and developing countries found that concentration had a negative impact on access to credit and that the negative impact is stronger for SMEs. This result is qualified, however, by the finding that the negative impact is dampened or rendered insignificant by higher levels of institutional

development, in the sense of more respect for rule of law and lower levels of corruption, and by the importance of foreign banks as a share of all banks.

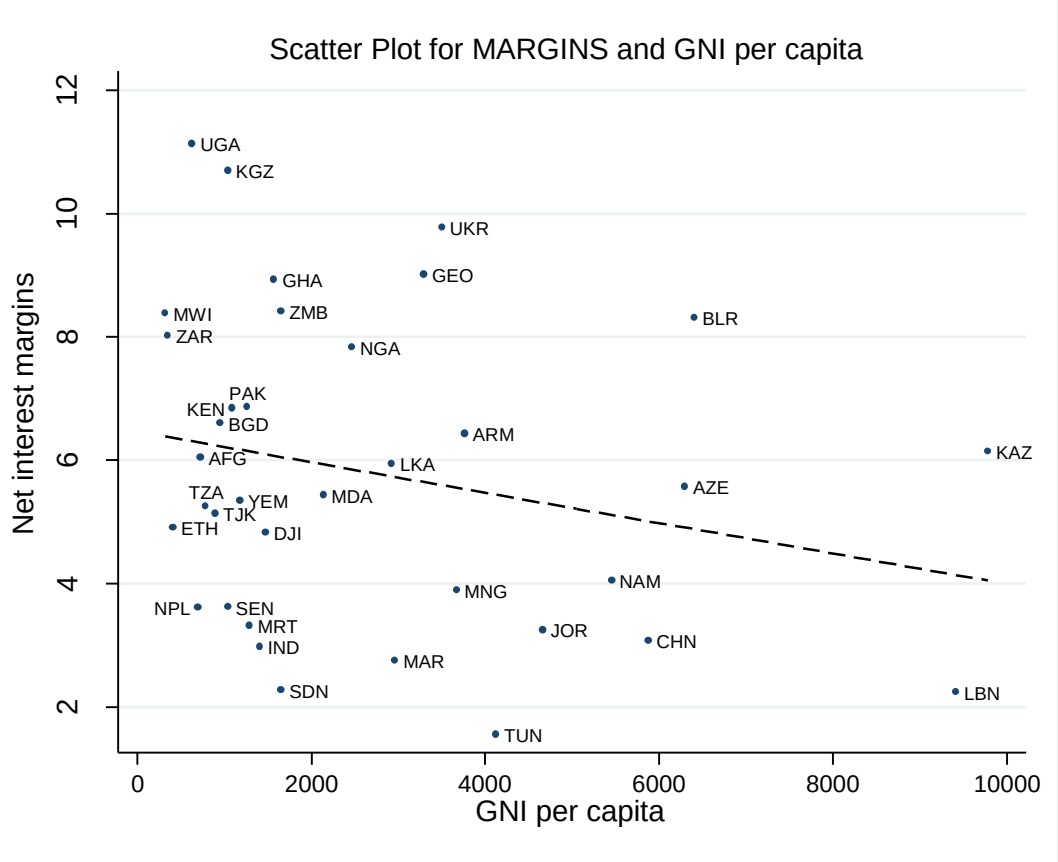
Figure 3



Source: World Bank Global Financial Development Database

Interest rate spreads and net interest margins are often used as proxies for financial intermediation efficiency. Costly finance, as reflected in high net interest margins, may result in credit rationing with some borrowers unable to borrow all they want or even impeded from having any access to bank finance. Beck *et al*. (2011, Ch. 2), focusing on finance in Sub-Saharan Africa, argue that the generally high interest rate spreads and margins in this region may be the counterpart of the small size and inefficiency of the national financial systems. Figure 4 below shows a negative relation for the 36 nations between the size of net interest margins and the level of economic development as measured by GNI per capita. Values range from a high of 11.1 percent in Uganda to a low of 1.6 percent in Tunisia.

Figure 4



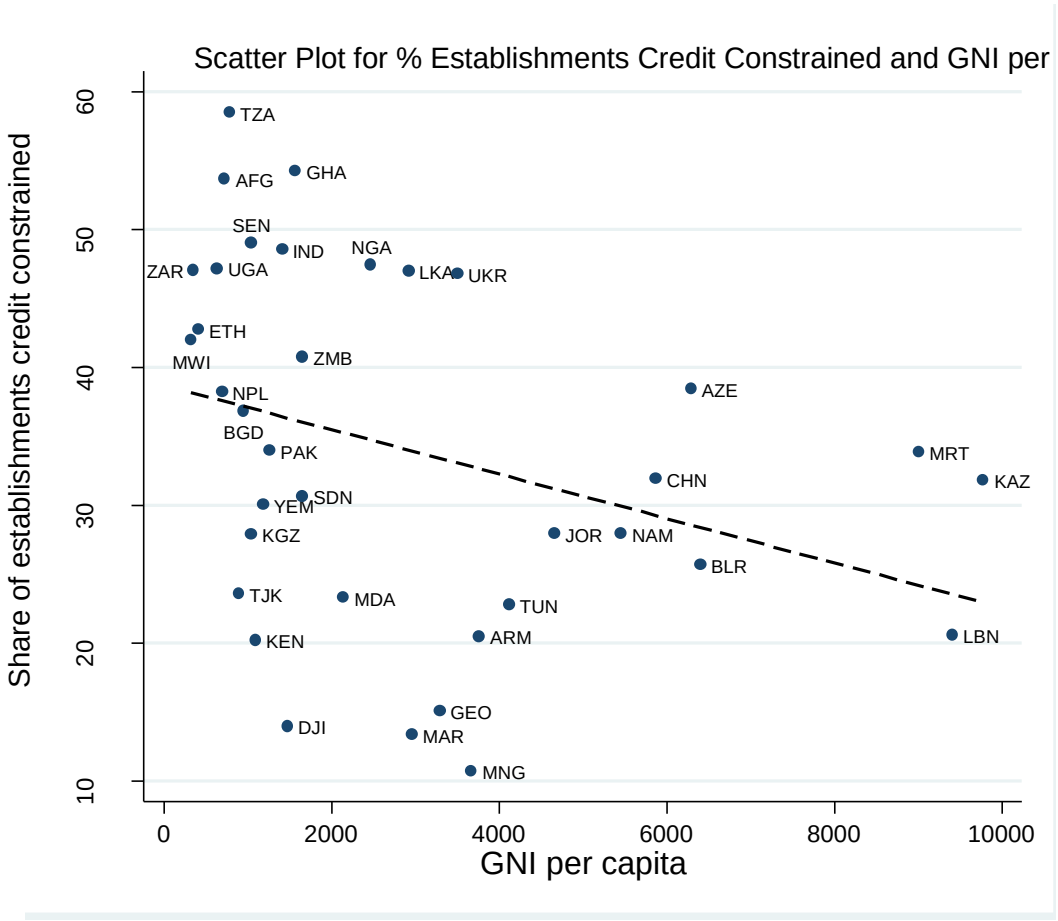
Source: World Bank Global Financial Development Database

3.1. The relation between national banking systems and credit constraints

In order to measure whether or not firms are credit constrained, we use the approach developed by Kuntchev *et al*. (2012) which draws on the rich information collected in the WBES on the financing decisions of establishments during the year prior to survey. Credit constrained establishments (*FC*) are defined as establishments that either applied for a loan or a line of credit and had their application rejected, or did not apply for a loan or a line of credit for reasons other than having enough capital for their needs. The possible reasons include the following terms and conditions implying that these firms, at least to some extent, were rationed out of the market: interest rates were not favourable, collateral requirements were too high, the size of the loan and maturity were insufficient, did not think the application would be approved, or the application procedures were too complex. In short, credit

constrained firms are defined as firms that would like additional credit to meet their investment needs but have been unable to gain access to it.[6]

Figure 5



Sources: World Bank Global Financial Development Database, World Bank Enterprise Survey and authors' calculations

The national share of firms that are credit constrained varies from a high of about 58 percent in Tanzania and Ghana to a low of about 11 percent in Mongolia. Figure 5 above points to a negative relationship between the share of establishments in each nation that are credit constrained and GNI per capita. Nations in the Sub-Saharan African region stands out for the high shares of their establishments that are credit constrained, with Namibia and Kenya being the only nations with a share below the sample average of 34 percent.

[6] Our category of credit constrained firms combines the categories of 'fully' and 'partially' credit constrained firms in the terminology of Kuntchev *et. al*. (2012, p. 10). They define partially credit constrained firms as firms that while meeting the conditions in the definition above did make some use of external finance during the previous fiscal year and/or had an outstanding loan at the time of the survey.

In order to explore the impact of the characteristics of national banking systems on the probability that a firm is credit constrained, we use a probit model which takes the following form:

$$W^* = \boldsymbol{x}'_1\beta_1 + \varepsilon_1 \quad \text{W = 1 if } W^* > 0, \text{ 0 otherwise where } \varepsilon_1 \sim N(0, 1) \qquad (1)$$

where W* is an latent variable that can be interpreted as the unobservable severity of financing constraints.

Equation 2 presents the baseline probit model without country-level covariates. At the enterprise level we control for a set of firm characteristics that are likely to impact on the probability of being credit constrained. *LogEmp* refers to size of the firm as measured by the natural logarithm of the number of full-time employees, *Foreign* measures whether or not the firm's ownership is over 20 percent foreign. We expect that larger establishments with a greater sales volume will be less likely to be credit constrained and that firms with foreign ownership will have better access to sources of external credit. *Young* is a binary equal to 1 if the firm was established within the last 3 years. It is assumed that other things equal, younger firms without established reputations will be more likely to be credit constrained. *Export* is a variable equal to 1 if the firm exports any of its output, either directly or indirectly. It is assumed that exporters will have better access to credit and will be less constrained than non-exporters. The regressions control for whether the sector of activity is either manufacturing, mining and utilities, or service. (*Sector*). The data is weighted and as with Beck *et al.* (2006a) and Presbitero and Rabellotti (2013) we use cluster controlled standard errors in order to correct for within-country error correlation. Table A.2 in the Annex gives the definitions and descriptive statistics for the enterprise-level variables.

$$Prob\ (FC = 1) = f\ (LogEmp,\ Foreign,\ Young,\ Export,\ Sector) \qquad (2)$$

Table 2 presents the results for the probit regressions. The column 1 shows the results for a model without country-level variables and the column 2 results include the four aggregate indicators for banking system depth, breadth, concentration and net interest margins.[7] In column 3 we add an interaction term (*PRVCRD * BRNCH*) in order to assess whether the level of banking system depth moderates the impact of banking system breadth. Our expectation is that if an increase in the number of bank branches is accompanied by a simultaneous increase in the total amount of private bank credit available for lending the negative effect on the financing constraints of firms will be enhanced.

[7] See Table A2 in the Annex for descriptive statistics for the 4 aggregate indicators.

Table 2: Probit model estimating credit constraints

VARIABLES	(1) *FC*	(2) *FC*	(3) *FC*
Foreign	-0.135**	-0.116***	-0.115***
	(0.0538)	(0.0322)	(0.0314)
LogEmp	-0.164***	-0.163***	-0.164***
	(0.0536)	(0.0536)	(0.0536)
Young	-0.119	-0.190***	-0.189***
	(0.0799)	(0.0699)	(0.0697)
Sector	0.144***	0.337***	0.334***
	(0.0456)	(0.0279)	(0.0283)
Export	-0.276***	-0.258***	-0.258***
	(0.00519)	(0.0190)	(0.0193)
CONCTR		-0.00445***	-0.00184
		(0.00124)	(0.00154)
BRNCH		-0.0237***	0.00367
		(0.00675)	(0.0144)
PRVCRD		-0.00600***	-0.00125
		(0.000593)	(0.00224)
MARGIN		-0.00159	-0.0253
		(0.0225)	(0.0188)
*BRNCH*PRVCRD*			-0.000628**
			(0.000280)
Constant	0.171	0.850***	0.648***
	(0.147)	(0.206)	(0.220)
Pseudo R^2	0.0309	0.0347	0.0348
Prob>Chi2	0.0000	0.0000	0.0000
Observations	25,485	25,485	25,485

Robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1***, **, * denote significance at the 0.01, 0.05, 0.10 levels respectively. The data are weighted and the regressions control for clustering of errors within countries.

The column 1 results show that there is a negative and statistically significant impact of the variables *LogEmp*, *Foreign* and *Export* on the probability of the firm being credit constrained. Larger firms, firms with foreign ownership and firms that export are less likely to be credit constrained than their counterparts These results are consistent with those in the literature discussed above. The results also show that the firms belonging to the manufacturing sector have a higher probability of being financially constrained than those belonging to the services sector. The variable *Young* has a negative but not statistically significant impact.

The column 2 results show that the aggregate banking system indicators measuring breadth, depth and concentration have a negative and statistically significant impact on the probability of a firm being credit constrained with the effect being relatively strong in the case of *BRNCH*. The coefficient on *MARGIN* is negative but not statistically significant. Contrary to expectations, the results show that

higher levels of banking concentration reduce the probability of a firm being credit constrained after controlling for the other characteristics of the national banking system.

The column 3 results show that the interaction term between the system depth and breadth is negative and statistically significant, supporting the hypothesis that the negative impact of increasing the number of bank branches on financing constraints will be larger as private bank credit as a percent of GDP increases. This implies that policies designed to reduce financing constraints by increasing banking system outreach will have a greater impact when combined with measures to increase the amount of private bank credit in the economy.

4. The relation between innovation, credit constraints and national banking systems

In this section we focus on how the characteristics of national banking system indirectly affect enterprise innovation performance through their impact on the probability that the enterprise is credit constrained. In keeping with the basic Oslo Manual definition, innovation is measured as the introduction onto the market during the three years prior to the survey of a product or service that is new-to-the firm (*NewFrm*). This measure captures processes of imitation and technology diffusion that tend to characterize innovation in developing countries as it includes the introduction of product and services that although new to the firm are already available elsewhere, either on the national or international market. Column 4 in Table A.1 in the Annex shows the share of firms in each country that have introduced a new product or service. Values range from a high of about 68 percent in Kenya to a very low value of about 2 percent in Azerbaijan.

As a number of authors has observed, the cross sectional nature of the data used in estimating the probability of innovation creates a potential problem of endogeneity resulting in biased estimates of the impact of financial constraints on innovation performance (Savignac, 2006; Gorodnichenko and Schnitzer., 2013). The simplest way to understand this is to observe that for reasons of asymmetric information associated with the intangible nature of the human and knowledge assets used in the early stages of an innovation project involving search and possibly prototype development, firms wishing to innovate generally rely on internal financing. To the extent that their internal funds are exhausted during the early stages of innovation activities, firms wishing to innovate will be forced to turn to relatively costly external financing in the form of bank loans or equity financing for the latter stages, including the production and marketing of the new products or services. For these reasons, firms trying to innovate are more likely to face credit constraints in the form of having their applications to banks

for a loan or a line of credit rejected or of being rationed out of the market by terms and conditions than firms that did not even try to innovate, since these non-innovators will be less likely to have exhausted their internal funds (Gorodnichenko and Snitzer, 2013). This endogeneity means that the coefficients in a regression model estimating the impact of financial constraints on innovation outcomes will tend to be biased upwards and they may even show a positive relation between financial constraints and innovation whereas the direction of the impact is actually negative.

One approach to addressing the endogeneity problem is through the use of instrumental variables. However finding variables that meet the criteria for good instruments often poses a problem since many of the variables that have a direct effect on the endogenous variable will also have an effect on the dependent variable. To circumvent the difficulty in identifying valid instruments, we adopt the approach used by Savignac (2006) and use a bivariate probit model with correlated disturbances and an endogenous binary variable. This is a recursive simultaneous equation model where the binary dependent variable in the first equation appears as an endogenous variable on the right-hand side of the second structural equation (Greene, 2012 for a presentation). As Wilde (2000) has shown, under the standard assumption that the correlated disturbance terms between the two equations are bivariate normally distributed, the endogenous nature of one of the variables on the right-hand side of the structural equation can be ignored in formulating the log-likelihood. The only restriction on the parameters that needs to be imposed in order for complete identification is that the two equations in the simultaneous model contain a varying exogenous regressor.[8]

4.1 The baseline bivariate probit model

The bivariate probit model with an endogenous binary variable takes the following form:

$$W^* = \boldsymbol{x}'_1\beta_1 + \varepsilon_1 \qquad W = 1 \text{ if } W^* > 0, \text{ 0 otherwise,} \qquad (3)$$

$$y^* = \boldsymbol{x}'_2\beta_2 + \gamma W + \varepsilon_2 \qquad y = 1 \text{ if } y^* > 0, \text{ 0 otherwise,}$$

$$\varepsilon_1, \varepsilon_2 \sim N(0,1) \text{ et } Cov(\varepsilon_1, \varepsilon_2) = \rho$$

where W* and y* are unobserved latent variables. The latent variable y* can be interpreted as the expected returns from innovating and W* is the unobservable severity of financing constraints. The

[8] As Savignac (p. 17) observes, there is some confusion on this point due to the claim by Maddala, (1983, p. 222) that further exclusion restrictions on the exogenous variables comparable to the linear case are required for identification in the bivariate probit model. Wilde (2000) shows that this is only true in the special case treated by Maddala of the simple intercept model where the exogenous variable in each equation is a constant. Wilde provides an example where a varying dichotomous variable enters the right hand side of both equations.

assumption is that the error terms of the two equations are bivariate normally distributed and correlated with the covariance equal to ρ.

Equation (4) presents the baseline bivariate probit model estimated to determine the impact of credit constraints on the probability of innovating. The first equation modelling the probability of being credit constrained takes the same basic form as equation (1) in the ordinary probit model developed in Section 3 above.

$$Prob\ (FC = 1) = f\ (LogEmp,\ Foreign,\ Young,\ Export,\ Sector) \qquad (4)$$
$$Prob\ (NewFrm = 1) = f\ (FC,\ R\&D,\ Train,\ Export,\ LogEmp,\ LogEmp^2,\ Sector)$$

In the second structural equation explaining innovation outcomes, the enterprise level covariates include *FC*, the endogenous binary variable measuring credit constraints, *RD*, a binary variable equal to 1 if the establishment undertakes R&D expenditures, *Train*, a binary variable equal to 1 if the establishment offers formal training to its permanent employees and the control variables appearing in the first equation. The variable *Export* in the second equation is designed to capture horizontal linkages and it reflects the hypothesis that exporters will be more innovative through their contacts with more knowledgeable foreign customers or due to the increased pressure of international competition. We also assume that larger establishments are more likely to innovate as they have more resources than smaller establishments. Returns to scale are hypothesized to be decreasing due to problems of managerial inefficiency and organizational inertia in larger establishments and this is captured by including the square of the natural logarithm of employment (*LogEmp2*). As for the first equation we control for sector of activity. The data are weighted as in the ordinary probit regressions in Section 3 above and we use cluster controlled standard errors throughout to correct for within-country error correlation. Table A.2 in the Annex presents descriptive statistics for the enterprise-level covariates.

4.2 Results for the baseline bivariate probit model

Table 3 presents the results for both the univariate probit model estimating the probability of innovating (column 1) and for the baseline bivariate probit model taking into account the endogeneity of firm-level credit constraints (Column 2). The value for *rho* in the bivariate model is 0.799 and highly statistically significant showing that the disturbances of two univariate probit models are highly correlated. This result supports the hypothesis that credit constraints are endogenous to the decision to innovate and that firms that engage in innovation development projects are more likely to face financial

constraints than firms that don't even try to innovate.[9] The importance of the bias introduced by the endogeneity can be appreciated by comparing the results for the univariate probit model shown in column 1 with those for the bivariate probit model in column 2. In the univariate model the coefficient on the financial constraint variable (*FC*) is weakly negative and non-statistically significant while in the structural equation predicting innovation outcomes in the bivariate probit model the negative coefficient on *FC* is both considerably larger in absolute size and highly statistically significant.

Table 3: Baseline Bivariate Probit Model

	(1) Univariate Probit	(2) Bivariate probit model
Innovation equation	Dependent variable : NewFrm	
FC	-0.128	-1.373***
	(0.0894)	(0.153)
R&D	1.253***	0.980***
	(0.0154)	(0.0181)
Train	0.0405*	0.0132
	(0.0238)	(0.0121)
LogEmp	0.210***	0.0599***
	(0.0490)	(0.0119)
LogEmp²	-0.0221***	-0.0135***
	(0.00734)	(0.00395)
Export	0.515***	0.274***
	(0.0645)	(0.0348)
Sector	-0.312***	-0.159***
	(0.0570)	(0.0432)
Constant	-1.034***	-0.0571
	(0.0764)	(0.113)
Credit constraint equation	Dependent variable : FC	
LogEmp		-0.167***
		(0.0542)
Foreign		-0.244***
		(0.0466)
Young		-0.00925
		(0.0201)
Export		-0.279***
		(0.00870)
Sector		0.146***
		(0.0484)
Constant		0.186
		(0.145)
Rho		0.799
(Wald test of rho=0) Prob>Chi2		0.000
Observations	25,485	25,485

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1***, **, * denote significance at the 0.01, 0.05, 0.10 levels respectively. The data are weighted and the regressions correct for clustering of errors within countries.

[9] See Knapp and Seaks (1998) for a demonstration that a likelihood ratio (LR) test of the hypothesis that rho = 0 is equivalent to a Hausman test for endogeneity.

Both the univariate probit and the bivariate probit models show that there is a positive and statistically significant impact of R&D expenditures on the probability of innovating. The variable measuring the provision of formal training for the firm's full-time employees is positive in the univariate model though of borderline statistical significance. It is no longer statistically significant in the bivariate probit model. The results also show that being an exporter has a statistically significant impact on the probability of innovating and that firms in the manufacturing, mining or utilities sectors have a lower probability of innovating compared to service sector enterprises. The results for the impact of *LogEmp* on innovation activity do not differ between the univariate and bivariate probit models, showing that larger firms have a higher probability of innovating. There is evidence to support the presence of decreasing returns to scale in the effect of establishment size on innovation with the squared employment term being negative and significant in both models.

Table 4 below presents the results for the bivariate model models including the national banking system indicators in the equation predicting the probability of being credit constrained. The column 2 results are for the model including an interaction term between banking system breadth and depth. In the innovation equation we control for the level of economic development by including the natural logarithm of GNI per capita (*LnGNICAP*).

In the column 1 results show that the coefficients on the measures of banking system depth (*PRVCRD*) and breadth (*BRNCH*) are negative and statistically significant as in the univariate probit model presented in Section 3 above. In the innovation equation the coefficient on *LnGNICAP* measuring the level of economic development is negative and statistically significant. To the extent that the size of technological gap is larger in less economically developed nations, this result supports the hypothesis that firms in nations that are more distant from the technological frontier will have a higher probability of innovating due to the greater amount of mature technology available on national and international markets for diffusion and adoption. The statistically significant negative coefficient on the interaction term between banking system depth and breadth in column 2 points to complementarities with the negative impact of banking system breadth on the probability of being credit constrained being greater when the level of private bank credit as a percentage of GDP is greater.

Table 4: Bivariate Probit Model with Country-level Covariates

	(1) Bivariate probit model	(2) Bivariate probit model
Innovation equation	Dependent variable: NewFrm	
FC	-1.277***	-1.284***
	(0.302)	(0.285)
R&D	1.040***	1.037***
	(0.0955)	(0.0884)
Train	0.0769	0.0760
	(0.0535)	(0.0523)
LogEmp	0.0707***	0.0699***
	(0.0201)	(0.0180)
LogEmp²	-0.0144***	-0.0143***
	(0.00368)	(0.00377)
Export	0.337***	0.335***
	(0.0455)	(0.0410)
Sector2	0.143**	0.144**
	(0.0612)	(0.0592)
LnGNICAP	-0.285***	-0.284***
	(0.0259)	(0.0252)
Constant	1.918***	1.915***
	(0.179)	(0.166)
Credit constraint equation	Dependent variable: *FC*	
Foreign	-0.236***	-0.234***
	(0.0320)	(0.0320)
LogEmp	-0.167***	-0.167***
	(0.0549)	(0.0548)
Young	-0.0484	-0.0451
	(0.0461)	(0.0441)
Export	-0.264***	-0.263***
	(0.0270)	(0.0274)
Sector2	0.345***	0.341***
	(0.0389)	(0.0383)
CONCTR	-0.00239	0.000887
	(0.00169)	(0.00199)
PRVCRD	-0.00533***	0.000749
	(0.000888)	(0.00252)
BRNCH	-0.0144*	0.0204
	(0.00805)	(0.0139)
MARGIN	-0.0115	-0.0410
	(0.0299)	(0.0255)
*PRVCRD*BRNCH*		-0.000801***
		(0.000301)
Constant	0.693***	0.434**
	(0.168)	(0.182)
Rho	0.7269	0.7317
(Wald test of rho=0) Prob>Chi2	0.0061	0.0032
Observations	25,485	25,485

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1***, **, * denote significance at the 0.01, 0.05, 0.10 levels respectively. The data are weighted and the regressions correct for clustering of errors within countries.

4.3 The indirect impact of the national banking system on innovation

In order to estimate the indirect effects of the level of development of the national banking system on innovation performance though its impact on firm-level financing constraints, we calculate the marginal effects of the enterprise and country-level covariates in the bivariate probit model on the probability of innovating conditional on the firm being credit constrained. Table 5 reports both the indirect and direct average marginal effects for the covariates in the column 2 model in Table 4. The table distinguishes between those variables having a direct effect, those having an indirect effect, and those having both direct and indirect effects on the probability of innovating. The marginal effects reported for the four macro financial systems variables are indirect and reflect the way they affect innovation through their impact on the endogenous dependent variable FC measuring whether or not the firm is credit constrained. For the binary variables the marginal effects measure discrete changes and show how the probability of innovating changes as a binary variable changes from 0 to 1.

Table 5: Conditional Direct and Indirect Marginal Effects on the Probability of Innovating

Variables	Marginal effects	p-value
Direct effects		
FC	-0.3761	0.000
R&D	0.3037	0.000
Train	0.0223	0.209
LnGNICAP	-0.0832	0.000
Indirect effects		
Foreign	0.0362	0.000
Young	0.0070	0.254
CONCTR	-0.0001	0.660
PRVCRD	0.0009	0.000
BRNCH	0.0075	0.001
MARGIN	0.0063	0.121
Direct and indirect effects		
LogEmp	0.0463	0.000
Export	0.1389	0.000
Sector	-0.0107	0.366

The data are weighted and the regression corrects for clustering of errors within countries.

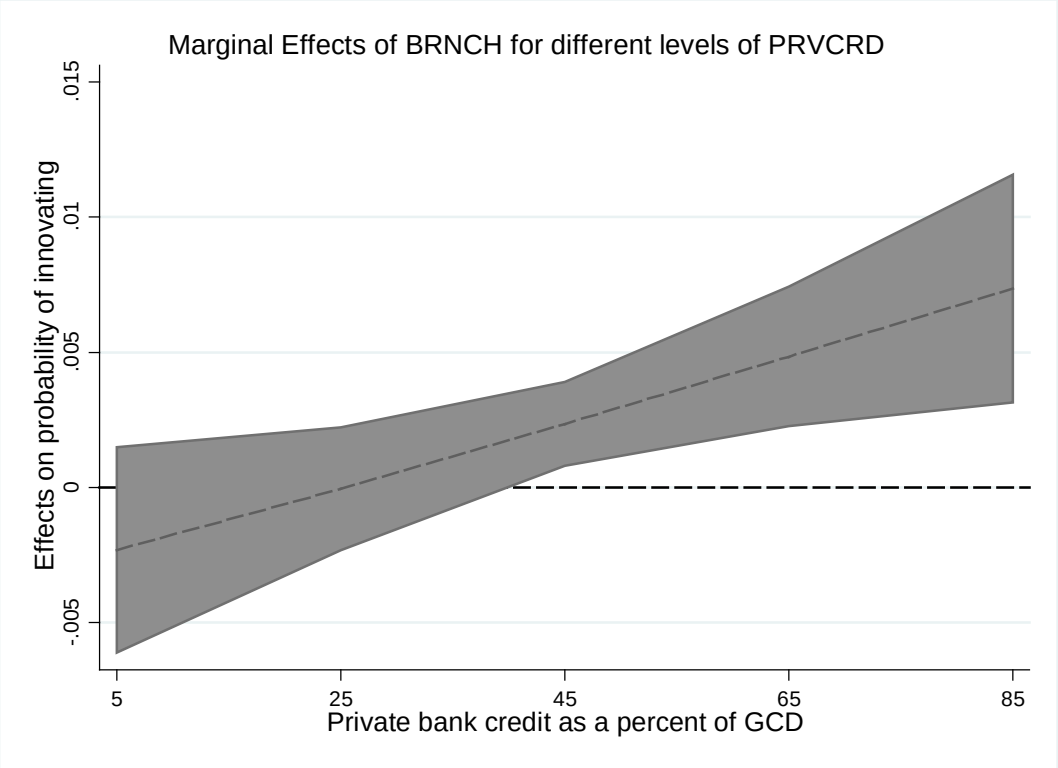
The results show on average that being credit constrained reduces the probability of innovating by about 38 percent. Undertaking R&D expenditures increases the probability of innovating by about 30 percent and exporting increases the probability of innovating by about 14 percent. Foreign ownership

through its negative impact on the probability of being credit constrained indirectly increases the probability of innovating by about 4 percent. The effect of undertaking training and the effect of the firm being established within the previous 3 years are not statistically significant.

With respect to the aggregate banking system variables, the results show that on average the indirect effects of *BRNCH* and *PRVCRD* on the probability of innovating are positive and statistically significant. The estimated indirect effect of *PRVCRD* is quite small and it implies that a 10 percent increase in the value of bank credit as a share of GDP would lead to an approximate 1 percent increase in the probability of innovating. In the case of *BRNCH* the marginal effect is considerably larger with an increase in the number of bank branches per 100,000 adults by 10 increasing the probability of innovating by about 7.6 percent. For countries like Yemen, Uganda and the Democratic Republic of Congo this could account for an approximate 20 percent shortfall in the probability of innovating when compared with countries with relatively well developed banking systems like Tunisia, Morocco and Jordan.

The positive coefficient on the interaction term between *BRNCH* and *PRVCRD* shown in Table 4 implies that the marginal effects on innovation of an increase in banking system breadth will be larger for higher levels of banking system depth. To explore this relation in more detail, Figure 6 below shows the average marginal effects with 95 percent confidence intervals of an increase in *BRNCH* conditional on the level of private bank credit as a percent of GDP. The results show that the average marginal effects on the probability of innovating of an increase in *BRNCH* increase in size as *PRVCRD* increases, and that they are positive for values of *PRVCRD* above 30 percent. The positive effect is only statistically significant for values of *PRVCRD* over 40 percent.

Figure 6



The first quartile of the sample of 36 nations investigated here have values of *PRVCRD* under 23 percent of GDP and half of the nations have values under 40 percent. The results presented in Figure 4 imply that for the majority of nations an increase in banking system outreach or breadth will have only a limited or no positive impact on enterprise innovation performance. The results point to a threshold value of *PRVCRD,* over 30 percent of GDP, which needs to be attained in order for innovation performance to possibly benefit from increases in banking system breadth. These results support the view that institutions matter and moreover provide insight into the factors that may slow or inhibit innovation and technological catch-up in low income nations with a very low level of financial institutional development.

4.3 The indirect effect of firm size on innovation performance

There is considerable evidence to show that smaller firms are more likely to be credit constrained than larger ones. At the same time, increases in the breadth or outreach of the banking system (in the sense of the number of branches and their geographic spread) will arguably improve the relative position of smaller firms that tend to rely more on relational banking than larger ones. To provide evidence relevant to this we present in Table 6 the results of regressions including firm size categories and we estimate their interactions with the measures of banking system breadth and depth. We use a three-

level categorical variable to measure size with small firms employing less than 20 employees, medium firms employing 20 to 99 employees and large firms employing over 99 employees. Large firms are the reference category in the regressions. We remove the continuous variable used in the previous regressions that measured firm size as the natural logarithm of the number of employees.

Table 6: Bivariate Probit Model with Interaction effects on Firm Size

	(1) Bivariate probit model	(2) Bivariate probit model
Innovation equation	Dependent variable: NewFrm	
FC	-1.008***	-0.776**
	(0.175)	(0.303)
R&D	1.145***	1.204***
	(0.0589)	(0.0396)
Train	0.0883*	0.106*
	(0.0475)	(0.0605)
Export	0.385***	0.444***
	(0.0570)	(0.0353)
Sector	0.108***	0.0856*
	(0.0303)	(0.0476)
LnGNICAP	-0.290***	-0.292***
	(0.0195)	(0.0166)
Constant	1.857***	1.745***
	(0.1332)	(0.1808)
Credit constraint equation	Dependent variable: *FC*	
Foreign	-0.182***	-0.145***
	(0.0565)	(0.0213)
Young	-0.0705**	-0.0515**
	(0.0337)	(0.0239)
Size (small)	0.468***	-0.0438
	(0.139)	(0.315)
Size (medium)	0.183***	0.256*
	(0.0359)	(0.145)
Export	-0.280***	-0.258***
	(0.0279)	(0.0489)
Sector	0.308***	0.260***
	(0.0301)	(0.0241)
CONCTR	-0.00327**	-0.00285*
	(0.00156)	(0.00159)
PRVCRD	-0.00606***	-0.0111***
	(0.000629)	(0.00203)
BRNCH	-0.0169**	0.0118
	(0.00770)	(0.0181)
MARGIN	-0.00725	0.00397
	(0.0279)	(0.0261)
*Size (small)*PRVCRD*		0.00995***
		(0.00256)
*Size (medium)*PRVCRD*		0.00208**

		(0.00102)
*Size (small)*BRNCH*		-0.0410*
		(0.0215)
*Size (medium)*BRNCH*		-0.0317***
		(0.00884)
Constant	-0.0330	0.159
	(0.164)	(0.284)
Rho	0.550	0.401
(Wald test of rho=0) Prob>Chi2	0.0004	0.0174
Observations	25,482	25,482

Robust standard errors in parentheses. ***, **, * denote significance at the 0.01, 0.05, 0.10 levels respectively.
The data are weighted and the regressions control for clustering of errors within countries. Here, we have a sample of 25482 observations because 3 firms were not classified in one of the 3 group in the data.

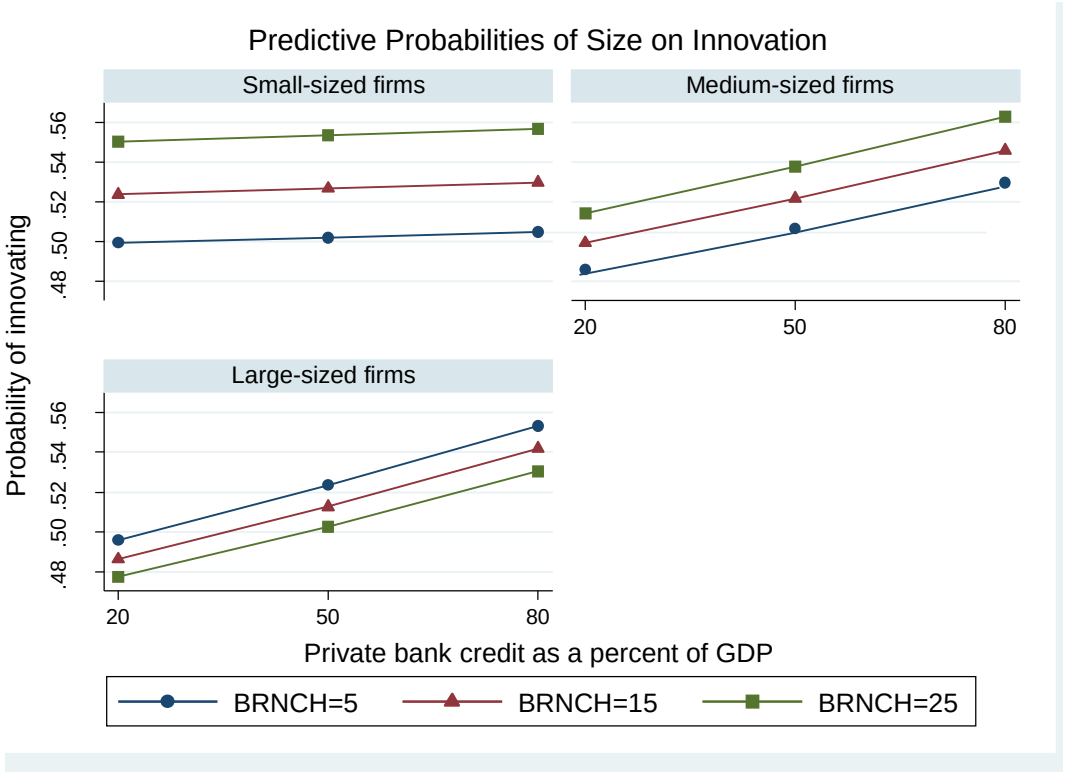
The results in the column 1 show that relative to large firms, small and medium sized firms are more likely to be credit constrained with the effect being greater in the case of small firms. Expressed in terms of marginal effects, the indirect negative effects on the probability of innovating for small and medium-sized firms respectively compared to large come to about 6 and 2 percent.

In column 2, the model includes interaction effects. There is a clear difference between how firm size interacts with the level of *BRNCH* and *PRVCRD*. In the case of *BRNCH* the coefficients on the interaction terms are negative and statistically significant implying that the probability of being credit constrained for small and medium-sized firms decreases relative to larger ones when the number of bank branches per 100,000 adults increases. The effect is stronger for the small firm category. In the case of *PRVCRD*, while the interaction effects are much weaker, they work in the opposite direction implying that the relative positon of larger firm improves as the amount of private bank credit in the economy increases. Again the size of the effect is larger for small firms than for medium-sized ones.

In Figure 7 we take a closer look at how the innovative performance of small and medium-sized firms is affected by banking system breadth and depth. The Figure shows the predictive margins or probabilities of innovating for each size category of firm for different levels of banking system depth and breadth. The results show that for all levels of private bank credit as a percent of GDP, the innovative performance of small firms and to a lesser extent medium-sized firms benefits from increases in the number of bank branches. This support the hypothesis that increases in banking system outreach are relatively advantageous for smaller establishments. The innovative performance of both medium and large-sized firms improves from increases in the amount private bank credit in the system regardless of the level of banking system breadth or outreach. For medium-sized firms this improvement means that their probability of innovating is slightly greater than that for smaller firms at very high levels of private bank credit as a share of GDP. In the case of large firms, at very high

levels of private bank credit their probability of innovating is equal to or outstrips that of small firms except in the case where the number of bank branches per 100,000 adults is well above the sample average.

Figure 7



5. Conclusions

There is considerable evidence at the country level that financial system development is positively correlated with economic development. At the same time micro-level studies drawing on firm-level data have identified a significant negative relation between financing constraints and firms' investments in their R&D and innovation activities. These combined results are suggestive of a channel through which financial development may influence innovation and technological change and hence promote economic development. A main objective in this paper is to contribute to the modelling of this channel by showing how the level of development of the national banking system indirectly influences enterprise innovation activity through its effects on firms' financing constraints. Our results show that low levels of financial system development may hinder or slow processes of innovation and technical change.

When estimating the impact on innovation of measures of country-level banking system depth and breadth, we obtain a number of important results. At the margin, the indirect effects of increases in the depth and breadth of national banking systems on the probability of innovating are important and we show that the impact of an increase in banking system breadth or outreach only becomes positive above a threshold level of private bank credit as a percentage of GDP. This result illuminates a possible obstacle to technological catch-up in lower income nations with relatively shallow financial systems and it may, as Levine (1997) has suggested, be a contributing factor to the creation of a "poverty trap".

Our results are relevant to understanding the position of small enterprises which account for the majority of businesses in developing nations and for about 56% of our sample. Consistent with other research we find that small firms are more likely to be credit constrained than medium and large-sized firms and we show that this disadvantages the innovation performance of small firms relative to larger firms. We also identify important differences in the effects of increases in banking system depth and breadth on innovation performance according to firm size. Large firms tends to benefit disproportionately from increases in banking system depth while small firms, and to a lesser extent medium-sized firms, reap relative innovation benefits from increases in banking system breadth. Our results show that the majority of enterprises will garner limited benefits from policies focusing narrowly on increasing the amount of available credit in the banking system without concomitant increases in the number of bank branches.

Our research could be usefully extended in a number of directions. The measure of innovation we use is the basic one proposed by the Oslo Manual defined as the introduction of a product or service that is new-to-the firm. While this measure allows us to capture processes of imitation and diffusion of technologies and products, it fails to characterize differences in the importance of the firm's in-house contribution to the innovation activity. While in some cases firms will be creatively adapting or modifying products or services developed by other organizations, in other cases they may be simply adopting and selling on new products or services developed by other organizations without any significant contribution. While the adoption of existing technologies and products without modifications requires in-house learning activity and may require investments in workforce training, we would expect financing constraints to be more binding in the case of the more substantial investments needed for the creative forms of adaption and modification. The WBES group is currently undertaking in selected nations follow-up surveys providing a rich characterization of the innovation process, including marketing and organizational innovations. As this survey work continues and

provides coverage for a large number of nations worldwide, it will become possible to extend the analysis we have undertaken here to take into account differences in the firm's in-house creative contribution to innovation.

Another useful extension would be to explore more explicitly the links between the level of development of the financial system, the existence of a technology gap and processes of catch-up. Our results are suggestive in this respect. On the one hand we find that the probability of innovating tends to be greater in nations at lower levels of economic development, as measured by GNI per capita, which is suggestive of positive catch-up through technology diffusion. At the same time we have shown that having a relatively shallow financial system decreases the probability of firms innovating. These results could be strengthened by determining whether there are threshold levels of economic development below which processes of catch-up tend to slow. By relating these thresholds to the level of institutional development, such an analysis could contribute to a better understanding the factors that hinder or even block economic development in the world's weakest nations.

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Annex

World Bank Enterprise Survey Methodology

The World Bank Enterprise Surveys (ES) are conducting by private contractors on the behalf of the World Bank (WB). According to the World Bank, an ES is a firm-level survey of a representative sample of an economy's private sector. The survey topics include firm characteristics, gender participation, access to finance, annual sales, costs of inputs/labor, workforce composition, bribery, licensing, infrastructure, trade, crime, competition, capacity utilization, land and permits, taxation, informality, business-government relations, innovation and technology, and performance measures. Over 90% of the questions objectively ascertain characteristics of a country's business environment. The remaining questions assess the survey respondents' opinions on what are the obstacles to firm growth and performance. The mode of data collection is face-to-face interviews.

The manufacturing and services sectors are the primary business sectors of interest and the firms targeted for interview are formal (registered) companies with 5 or more employees. Firm-level surveys have been conducted since the 1990's. Since 2005 the WB has used a standardized methodology of implementation, sampling and quality control in most countries which allows for better international comparisons. ES are composed of representative random samples of firms and all samples are constructed following a stratified random selection. The survey questionnaire is answered by business owners and top managers. Sometimes the survey respondent calls company accountants and human resource managers into the interview to answer questions in the sales and labor sections of the survey. Typically 1200-1800 interviews are conducted in larger economies, 360 interviews are conducted in medium-sized economies, and for smaller economies, 150 interviews take place. The strata for ES are firm size, business sector, and geographic region within a country. Firm size levels are: small (5-19 employees), medium (20-99 employees) and large (100 and more employees). Sector breakdown is usually: manufacturing, retail, and other services and geographic regions are selected based on which cities/regions collectively contain the majority of economic activity. For more details on the sample frame and survey methodology, see the following link: (http://www.enterprisesurveys.org/methodology).

Table A.1

Country Descriptive Statistics

Region	Country	GDP (billion $)	GNI per capita	NEWFRM	CONSTR
East Asia & Pacific	Mongolia (MNG)	12.293	3670	26.18	10.74
	China (CHN)	8461.623	5870	46.81	31.96
Central Asia	Tajikistan (TJK)	7.633	890	16.43	23.58
	Kyrgyz Republic (KGZ)	6.605	1040	38.43	27.89
	Moldova (MDA)	7.285	2140	29.81	23.3
	Georgia (GEO)	15.846	3290	10	15.1
	Ukraine (UKR)	175.781	3500	20.04	46.77
	Armenia (ARM)	10.619	3760	15.83	20.51
	Azerbaijan (AZE)	68.731	6290	2.05	38.46
	Belarus (BLR)	63.615	6400	31.01	25.67
	Kazakhstan (KAZ)	203.517	9780	19.33	31.81
South Asia	Nepal (NPL)	18.852	690	44.4	38.23
	Afghanistan (AFG)	20.537	720	45.07	53.69
	Bangladesh (BGD)	133.356	950	34.1	36.84
	Pakistan (PAK)	224.646	1260	29.79	33.97
	India (IND)	1831.781	1410	44.91	48.53
	Sri Lanka (LKA)	68.434	2920	31.03	47.02
Middle East & North Africa	Yemen. Rep. (YEM)	32.075	1180	40.79	30.03
	Djibouti (DJI)	1.354	1471	35.14	13.99
	Morocco (MAR)	98.266	2960	31.34	13.37
	Tunisia (TUN)	45.131	4120	27.2	22.83
	Jordan (JOR)	30.937	4660	23.89	27.98
	Lebanon (LBN)	43.205	9410	43.85	20.62
Sub-Saharan Africa	Malawi (MWI)	4.24	320	53.86	41.97
	Congo. Dem. Rep. (ZAR)	27.463	350	41.59	47.09

	Ethiopia (ETH)	43.311	410	42.55	42.73
	Uganda (UGA)	23.237	630	64.3	47.16
	Tanzania (TZA)	39.088	780	51.66	58.52
	Senegal (SEN)	14.046	1040	47.57	49.03
	Kenya (KEN)	50.41	1090	67.87	20.21
	Mauritania (MRT)	4.845	1290	55.33	33.85
	Ghana (GHA)	41.94	1570	51.25	54.24
	Zambia (ZMB)	24.939	1650	55.44	40.76
	Sudan (SDN)	62.689	1650	53.06	30.68
	Nigeria (NGA)	460.954	2470	49.85	47.43
	Namibia (NAM)	13.016	5450	63.87	27.95

Source: World Bank Development Indicators

Table A.2

Descriptive Statistics

Variable	Mean	St. dev.
NewFrm (= 1 if firm has introduced onto the market a product or service that is new-to-the firm, 0 otherwise)	0.411	0.492
Constr (= 1 if the firm is credit constrained, 0 otherwise)	0.398	0.489
R&D (= 1 if the firms has spent on R&D over the last year, 0 otherwise)	0.238	0.426
Train (= 1 if firm offers formal training to its permanent employees, 0 otherwise)	0.346	0.476
Export (= 1 if the firm has positive direct of indirect exports, 0 otherwise)	0.191	0.393
LogEmp (= natural logarithm of number of permanent employees)	3.259	1.364
$LogEmp^2$ (= square of LogEmp)	12.484	10.780
Foreign (=1 if over 20 percent foreign ownership, 0 otherwise)	0.056	0.229
Young (= 1 if the firm was established within the last 3 years	0.048	0.215
Sector (= 1 if manufacturing, mining or utilities, 0 = services)	0.606	0.489
Size (small) (= to 1 if < 20 employees)	0.460	0.498
Size (medium) (= to 1 if 20-99 employees)	0.357	0.479
Size (large) (= to 1 > = 100 employees)	0.183	0.386
BRNCH (= number of bank branches per 100,000 adults)	9.237	7.383
CONCTR (= 3-bank concentration ratio as expressed in %)	55.479	24.652
PRVCRD (= private bank credit as a percentage of GDP)	38.079	22.139
MARGIN (=bank net interest margin as expressed in %)	5.153	2.496

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