Collateral Spread And Financial Development

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Abstract

We show that institutions that promote financial development ease borrowing constraints by lowering the collateral spread, and shifting the composition of acceptable collateral towards firm-specific assets. Using a novel cross-country loan-level data set, we estimate collateral spread as the difference in rates of collateralization between high and low risk borrowers in a given economy. The average collateral spread is large but declines rapidly with financial development. A one standard deviation improvement in financial development due to stronger institutions leads to a reduction in collateral spread by one-half. We also find that the composition of collateralizable assets shifts towards non-specific assets (e.g. land) with increased risk. However, this shift is considerably smaller in more developed financial markets, thus enabling risky borrowers to use a larger variety of assets as collateral.

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We explore how the level of financial development in a country effects the collateral cost of capital. A large body of work establishes a close connection between institutions, financial development and economic growth. There is widespread agreement that strengthening the informational and contractual environment eases the process through which firms access capital[1]. However, much less is known about the channels through which financial development lowers the cost of external financing.

An improvement in the institutional environment can lower the effective cost of capital through a variety of channels such as the interest rate, contracting choices, and the amount of collateral sought. While recent work by Qian and Strahan (2007) and Lerner and Schoar (2005) shows that financial development lowers the interest and contracting costs of financing respectively, not much is known about the impact of financial development on the collateral cost of capital.

The lack of empirical work on collateral cost and financial development is unfortunate given the importance given to collateral in theory. The demand for "collateralizable assets" is *the* fundamental cost of financing in many models of financial constraints (e.g. Bernanke and Gertler (1989), Kiyotaki and Moore (1997), and Banerjee and Newman (1998)). Most theoretical models postulate that the availability of collateral is a binding constraint on financing, and that this constraint binds harder in more underdeveloped financial markets.

However, despite this theoretical emphasis, not much is known about the effect of financial development on the collateral cost of capital. One of the reasons for a lack of empirical work is data availability. Information on the value and type of collateral offered by a borrower is difficult to obtain in practice. It is even more difficult to get this kind of information in a cross-section of countries.

This paper uses a novel cross-country data set containing business loans given out by a multinational bank in fifteen countries. The countries differ widely in their level of institutional and financial development, ranging from India, Turkey and Chile to Korea, Malaysia and Hong Kong. We have information on the value as well as the asset-type of collateral pledged as security for each loan. We also know the ex-ante assessment of risk by the bank for a loan, along with ex-post loan performance two years later.

We use our data to test the basic idea that the collateral cost of financing is large in emerging markets, but declines substantively with improvements in the financial institutional environment. We measure the cost of collateral in two different ways. The first is the dollar cost of collateral in terms

[1] The literature began with La Porta, Lopez-de-Silanes, Shleifer and Vishny (1997) and (1998) (henceforth LLSV). La Porta, Lopez-de-Silanes and Shleifer (2008) provide an excellent review.

of the value of collateral demanded for every dollar lent out. Our second measure of collateral cost is the *specificity* of the asset pledged as collateral. For example, a firm that is forced to pledge non-firm-specific assets (e.g. land) is more constrained relative to a firm that can also pledge firm-specific assets (e.g. inventory) as collateral. The current US credit crisis has highlighted the severe problems in financing that arise when lenders no longer feel comfortable to accept a particular class of assets as collateral. In the US case, the unacceptable collateral being mortgage backed securities.

Having loan level measures for the cost of collateral is useful but an important econometric issue must be resolved before collateral costs can be compared across countries in a meaningful sense. The concern is that differences across countries in the *level* of collateral cost may be driven by spurious country-specific factors. For example, a country may have high rates of collateralization because the macro environment is riskier for independent reasons. More generally the level of risk and choice of collateral across countries may depend on country specific factors beyond the level of financial development.

We therefore propose a *within country* estimate of the collateral cost of capital that completely absorbs factors influencing the level of collateral choice and loan risk in an economy. Using country fixed effects, we estimate "collateral spread", as the difference in rates of collateralization between high and low risk loans within the same economy[2]. The expected risk of a loan is estimated through predicted default probability that uses ex-ante bank risk assessment to predict ex-post loan default. Our use of objective default probabilities as measure of loan risk makes collateral spread comparable across countries.

A simple example helps illustrate our empirical methodology in more detail. Consider two economies E and F (for English and French origin respectively), where E has better financial institutions. Each economy has two type of borrowers, high default risk and low default risk. Both borrower types have access to a positive net present value (NPV) project. However, since the high risk borrower has a higher probability of failure he has a higher incentive to "shift risk" and pick a negative NPV (but large upside) project instead.

This is the classic moral hazard problem in lending. It is well known that lenders in both E and F will demand greater commitments, such as collateral, from the high risk borrower in order to prevent him from undertaking the negative NPV project. We would thus expect a positive collateral spread

[2] We define the asset-specificity cost of collateral in an analogous way, i.e. the difference in asset-specificity between high and low risk loans within an economy.

in equilibrium. However, the spread will be *smaller* in E due to stronger financial institutions. For instance, E can rely on its financial institutions and use alternative instruments such as covenants to restrict borrowers from risk-shifting. Similarly, creditors in E enjoy a higher probability of successful seizure of collateral, and can therefore afford to demand a lower collateral spread from high risk borrowers while maintaining the same expected value of seized collateral in the event of bankruptcy. Moreover, by focusing on the collateral spread, we have differenced out level differences between E and F that may be driven by spurious country-specific factors.

Taking the above methodology to data, we find that the average collateral spread is quite large. A one percent increase in the probability of default increases the rate of collateralization by 2.1 percentage points. While our within country estimation technique takes care of spurious country specific concerns, we also show that our estimate of collateral spread is unlikely to be driven by unobserved firm attributes that might affect the supply by firm (rather than demand by bank) of collateralization. For example, in a sub-sample of firms we show that variables proxying for the supply of collateral at firm level such as size-adjusted inventory, accounts receivable, cash, securities, and net fixed assets are *negatively* correlated with firm risk. Thus not accounting for these supply side firm variables should only lead to an underestimate of the true collateral spread.

The cost of collateral in terms of collateral spread declines sharply with the level of financial development. A one standard deviation improvement in financial development reduces collateral spread by almost one-half. Using legal origins, creditor rights and information sharing institutions as instruments for financial development, we show that the decline in collateral spreads is due to fundamental institutional differences across countries.

We also find a significant collateral cost of capital in terms of the specificity of asset pledged as collateral. There is a strong tendency for the composition of collateral assets to shift to non-firm-specific assets when loan risk increases. However, the shift in composition towards non-firm-specific assets is *smaller* in more financially developed economies. Thus not only does financial development reduce the demand for the dollar amount of collateral, but it also enables firms to pledge a broader class of firm-specific assets as collateral. The latter result suggests that better legal and creditor rights protection enables banks to seize and liquidate specialized forms of assets more efficiently.

Overall our results suggest that riskier firms in financially developed economies are able to access credit while pledging a lower amount of collateral, and having greater flexibility in the type of assets

they can offer as collateral. The drop in both of these margins suggests a possible channel through which better financial and legal institutions expand credit to riskier firms. Since firms that lie on the frontier of the aggregate production possibilities set are likely to be riskier, our finding also provide a channel through which financial development spurs growth.

The work of Stiglitz and Weiss (1981), showed why interest rates alone are not a sufficient pricing mechanism to clear markets. The moral hazard and adverse selection problems inherent in financial contracting imply that lenders look for commitments, collateral being the most dominant one, to protect themselves against borrowers' agency risk (Boot, Thakor and Udell 1991; Smith and Warner 1979; Stulz and Johnson 1985). Our results suggest that one of the key channels through which financial development operates is by lowering the demand for collateral.

While we are the first to analyze the link between collateral and financial development, a number of papers investigate the relationship between collateral and firm risk in the US. This work repeatedly finds that the incidence of collateral increases with firm risk (Orgler (1970), Hester(1979), Berger and Udell (1990, 1995), John, Lynch and Puri (2003), Carey, Post, and Sharpe (1998), and James (1988)).

Our paper is closest in spirit to recent work by Qian and Strahan (2007). Using Dealscan data, they compare loan characteristics across 43 countries and find that protection of creditor rights is associated with greater concentration of loan ownership, greater participation by foreign banks, longer term lending, and lower interest rates. Thus their paper also investigates how differences in legal regimes impact financial contracting. The main difference between our work and theirs is that we focus on the impact of legal regimes on collateral spreads while they focus on maturity, ownership and interest rates. Furthermore, their data comprises large publicly held borrowers, while ours are small and medium firms that are likely to be more affected by institutional weaknesses.

I Data

Our data come from the small and medium firm lending division of a large multinational bank that operates in 15 emerging economies. The data contain every loan given out by the bank and follows a loan over a two year period (on average) from 2002 to 2004, with information updated every six months. While the original data set has 12,591 firms, we are left with 8,414 firms after applying some screening rules.

First, we drop 766 firms that are already in default at the beginning of our sample period. These

firms are not actively borrowing during our sample period, and as such we do not know their ex-ante risk assessment, nor the initial level of collateralization demanded by the bank. Second another 2,005 firms are dropped as they are missing the ex-ante firm risk variable, and without this variable we cannot calculate collateral spreads. Finally, 1,406 firms do not draw any loan from the bank during our sample period and are hence dropped because there is no collateral information on these firms.[3]

The range of countries in our final sample of 8,414 firms is diverse in terms of geographical location, financial development and per capita income (Table I). The number of loans is not uniform across countries, varying from 1,427 in Korea to 96 in Pakistan. This potentially raises the concern that our results might be driven by one or two countries with large number of observations. However, we shall carefully test for this in the analysis section. There are a total of 87 (finely defined) industries in our sample as shown in appendix table 1.

For every loan we observe the borrower's identity, total approved loan, loan outstanding, whether the loan is currently in default, the size category of firm as determined by firm sales, internal firm risk assessment determined by the bank, liquidation value of collateral used to secure the loan, type of collateral, and borrower's industry, and country. We keep the first observation for each loan in our sample to represent the initial loan characteristics at the time of origination. We then add for each loan its end of sample period default status. This variable is 1 if a firm goes into default by the end of the sample period (i.e. within two years), and 0 otherwise. We thus end up with a cross sectional sample of 8,414 loans.

Table II provides summary statistics for all variables in our data set. Since our empirical methodology uses country and country interacted with industry fixed effects, we report country and country-industry demeaned standard deviations as well. While some variables are self-explanatory, others require further elaboration. A key variable in our analysis is ex-ante risk grade for a borrower. The grade varies from A (best) to D (worse) and represents the "riskiness" of a borrower at the time of loan origination as determined by the bank's loan officer.

The risk grade is based upon two separates sets of information. The first includes objective measures of firm performance based on firm and industry fundamentals such as profitability, sales growth and past credit history. The second set includes subjective measures of firm performance such

[3] The bank has approved a credit line for these firms, but since the firms choose not to withdraw against the approved amount, they do not have to put up any collateral. We did keep firms with very small loans in sample. These are few firms and excluding them does not change any of our results significantly.

as assessment of the "quality and reliance" of information, management interviews, and site visits[4]. The firm risk grade is an *ex-ante* assessment of the firm, before any decision is made about how much to lend to the firm and on what terms. Thus risk grade does not include information on ultimate loan contractual terms such as collateral, interest rates, and loan maturity. This is important because otherwise firms with high level of collateral may be given a safe grade due to collateral, and not because the firm's cash-flows are less risky.

Table II shows that all four types of grades are fairly well represented in the data and there is significant variation in grades not only across countries but also within country and country-industry categories.

The bank also constructs a variable using firm sales that categorizes firms into four sales size indicators (0 to 3) capturing the size of a firm. Firms in our sample are skewed towards smaller sized firms, which is consistent with the focus of the lending program. Other variables recorded in our data include total approved loan, outstanding loan amount taken out by a borrower, and default outcome. The mean outstanding loan amount is \$351,000, and 5.41% of the firms enter into default by the end of our sample period.

An important dimension of our data is its information on collateralization of loans. For each loan, the bank records the *liquidation value* of collateral pledged for a loan. It reflects bank's assessment of the market value of the collateral in the event of bankruptcy, assuming the lender receives full ownership of collateral. We divide the liquidation value of collateral (in the beginning of sample period) with the approved loan amount to construct the rate of collateralization for a loan. The average collateralization rate is 54% with a standard deviation of 45%.

In addition to the value of collateral, our data also records the *type* of asset pledged as collateral. These asset types can belong to one of seven categories: (i) firm inventory, machinery and equipment, (ii) accounts receivable including receivables, contract orders and post-dated checks, (iii) cash or liquid securities held by the firm such as bonds and shares, (iv) guarantees including any type of promissory note, third-party or other bank guarantees, (v) letters of credit including stand-by, import and export letters of credit, (vi) real estate including land and building, and (vii) other firm specific collateral that does not qualify in the preceding categories.[5]

[4] For example before coming up with the final ex-ante risk grade for a firm, a loan officer responds to questions such as: "How reliable is the information provided by the management?", "Does the firm have good governance mechanisms?", "Does the firm have professional management?", etc.

[5] We discussed with loan officers the reason to categorize this collateral as firm-specifc. What we do know is that it

Table II shows the composition of collateral by summarizing the percentage of collateral value that belongs to each of the seven collateral categories. Firm specific assets, and firm machinery/inventory are the most common types of collateral, followed closely by real estate and liquid assets (cash and securities). The type of collateral varies significantly in its "specificity" to the firm's operation and performance. For example, while firm machinery and inventory are highly specific to the state of a firm, real estate and liquid assets are not.

We want to emphasize that country bank managers are free to lend to whoever they want and have complete discretion in terms of the value and type of collateral they want to demand from each borrower. The central objective given to each country manager is to maximize return on lending assets while minimizing defaults. Thus none of our findings on the relationship between collateralization rate and firm risk are "hard wired" by bank rules.

One downside of the cross-country data described above is that it does not have information on firm financials or loan interest rates. However we were able to gather firm financial and loan interest rate data from the same lending program for Argentina for 587 firms from 1995 to 2001[6]. While our primary cross-country data set came from the central computer archives of the bank, this second data base was hand collected from credit files in Argentina. The hand collected data includes information on ex-ante firm risk grades, annual balance sheet, income statement, and interest rates. However, the credit files we were given access to did not contain information on collateralization. We therefore use this second data set not for computing collateral spreads, but for estimating how other firm attributes such as interest rate, profitability, and supply of collateralizable assets vary with firm risk. Appendix table 2 reports summary statistics for key variables in this data set. The summary statistics are reported after taking the time series average of each firm, thus leaving us with 587 observations (one for each firm).

does not qualify to merit classification in any of the other categories and it is firm-specific to the operational business of the firm under consideration. (See Appendix for more detail on the definition of asset types)

[6] The number of firms in the pre-2000 sample from Argentina is much larger that the number of firms in our primary sample (587 vs. 120) because the Argentine crisis of 2000-2001 forced many firms out of business.

II Empirical Methodology

A. Conceptual Framework

We present a simple model to illustrate the link between financial development and collateral spread. While our model is built upon the particular assumption of ex-post risk shifting moral hazard, the intuition delivered by the model is more general and applies to other forms of financial frictions as well.

Consider an environment where banks compete to lend to firms. Both banks and firms are risk neutral. Each firm has access to a "genuine" project that requires one unit of capital, and produces $R > 1$ with probability p and nothing otherwise. p is distributed uniformly over the interval $[0.9, 1]$, with $0.9 * R > 1$. We normalize the cost of capital to 1, which implies that all firms in the economy have a positive Net Present Value (NPV) project. In a first best world, all firms should get their projects financed at a gross interest rate equal to $r = \frac{1}{p}$, where $(1-p)$ is a firm's expected default rate.

Financial frictions however may prevent firms from getting the first best choice of financing. We model these frictions in a moral hazard setting where firms may "shift risk" onto banks once a loan is given out. Firms may do so by choosing a "risky" project instead of the *genuine* project that banks were willing to finance initially. The *risky* project produces $R^{'}$ with probability $p^{'}$, such that $R^{'} > R$, but $R^{'}p^{'} < 1$. Thus the risky project gives firms a higher return in case of a successful outcome, but has a negative expected return. For illustrative purposes, we pick $R = 1.2$, $R^{'} = 2$ and $p^{'} = 0.4$[7].

The access to a risky project creates a moral hazard problem since firms have an incentive to pursue the risky negative NPV project once a loan has been extended. To see this, suppose a firm receives financing at the first best interest rate of $r = \frac{1}{p}$. Then its payoff from investing in the genuine project is $(R-r)*p = (1.2p-1)$, while payoff from investing in the risky project is $(R^{'}-r)*p^{'} = (0.8-\frac{0.4}{p})$. Since $(1.2p-1) < (0.8-\frac{0.4}{p})$ for all firms[8], no firm has an incentive to invest in the genuine project. Knowing this, no bank will lend any money to firms, and the first best equilibrium is broken down.

The fundamental problem in our moral hazard framework is one of commitment. If a firm could commit not to engage in the risky venture, banks would be willing to offer them credit. A credible commitment device should impose greater costs on a firm if it were to choose the risky project.

Since the risky project has a greater likelihood of default, an obvious - and often used - commitment

[7] Our exact choice of numbers is not important. We assign value to these variables only to avoid tracking unnecessary notation. The basic "risk shifting" result is well known in the literature.

[8] Solving the inequality, one gets $p > 0.27$, which is true for all firms in our set up.

device is collateral. Suppose a borrower pledges $Y < 1$ as collateral such that it stands to lose this amount to the bank in case of default. Then the borrower can credibly commit to pursuing the genuine project if the following investment compatibility condition holds:

$$(R - r) * p - Y * (1 - p) \geq (R^{'} - r) * p^{'} - Y * (1 - p^{'}) \tag{1}$$

where in a competitive banking environment, interest r is given by:

$$rp + (1 - p) * Y = 1 \tag{2}$$

Plugging (2) in (1), and recognizing that (1) must bind in equilibrium to provide the lowest cost to firms, we get collateralization rate (Y) and interest rate (r) as increasing functions of firm expected default risk X. Let X=(1-p) be the expected default risk(see appendix for details). An increase in expected default rate increases the temptation for firms to opt for the risky project which forces banks to impose a higher cost for failure through increased collateralization. This gives us the basic result that there is a positive collateral spread in equilibrium, i.e. $\frac{\partial Y}{\partial X} > 0$.

How should collateral spread vary with financial development? LLSV (1997 and 1998) show that financial development is associated with strong legal and financial institutions. Therefore one way to introduce financial development is to allow for variation in creditor protection in case of default. Suppose a bank can successfully liquidate collateral with probability F in case of borrower default. F changes the incentive compatibility condition (1) by replacing Y with its expected value (YF). Since the expected realized value of collateral increases with creditor protection, it follows that collateral spread would decline as financial development (F) goes up, i.e. $\frac{\partial^2 Y}{\partial X \partial F} < 0$ (see appendix for formal proof).

An alternative way to model financial development is through the cost that borrowers face in case of default. A strong legal system will impose greater cost on a borrower for default, which we can introduce as a cost of $c(F)$ on the right hand side of the incentive compatibility equation (1). F measures the ease with which contracts can be enforced, and the ease with which creditors can detect and punish deviations from the agreed upon contract. We assume $c^{'} > 0$ to reflect that stronger institutions increase the expected cost of deviation for a borrower. It follows then that lenders can afford to reduce collateral spread in stronger legal regimes, i.e. $\frac{\partial^2 Y}{\partial X \partial F} < 0$ (see appendix for formal

proof).

B. Regression Specification

Let Y_{ic} denote collateralization rate for loan i in country c, and let X_{ic} be a measure of expected default risk. Then the estimate for collateral spread, is given by $\beta_1 = \frac{\partial Y_{ic}}{\partial X_{ic}}$, which can be estimated through the regression:

$$Y_{ic} = \alpha + \beta_1 * X_{ic} + (\varepsilon_c + \varepsilon_{ic}) \tag{3}$$

$\widehat{\beta}_1$ in (3) is an unbiased estimate of β_1 if the error term in parenthesis is un-correlated with X_{ic}. The concern however is that country specific factors, denoted by the country specific component of the error term ε_c, may be spuriously correlated with expected firm risk X_{ic}. For example, the average level of collateralization in a country may depend on macro factors (such as the industry mix of investments), and these factors may in turn be correlated with the average loan risk as well. In such circumstances, $\widehat{\beta}_1$ will be biased. Similarly, the measurement of ex-ante loan risk may not be comparable across countries. For example, a risk grade of "A" in one country may not be comparable with a grade of "A" in another.

We address such concerns of country-specific spurious factors by including country fixed effects (α_c)in equation (3):

$$Y_{ic} = \alpha_c + \beta_1 * X_{ic} + \varepsilon_{ic} \tag{4}$$

We also use country interacted with industry fixed effects as more extreme controls in robustness checks. Doing so forces comparison within the same industry in a given country, and takes care of concerns that expected risk and collateralization rates may differ across industries for spurious reasons.

The variable X_{ic} in (4) reflects expected loan default risk at the time of collateral determination. In general this is a very difficult variable to observe. However, our data presents a novel opportunity to compute an estimate of expected default risk using realized ex-post loan outcomes, and ex-ante bank assessment of loan risk. We can predict loan default using ex-ante firm characteristics observable to the bank including internal risk assessment grade, industry and firm size.

Let Z_{ic} denote the vector of firm characteristics that a loan officer observes at the time of loan

origination, and let D_{ic} be an indicator variable for whether a loan goes into default by the end of our sample period. We can then estimate default probability at the time of loan origination using the equation:

$$D_{ic} = \beta_2 * Z_{ic} + \alpha_c + \varepsilon_{ic} \tag{5}$$

Equation (5) uses the full matrix of available information to predict default[9]. The loan officer may have private unobservable information as well. However, as long as the internal risk assessment grade (which is assigned by a loan officer himself) is an unbiased estimate of the full private information of the bank, $\widehat{D}_{ic}$ provides an unbiased estimate of expected loan default risk. The use of country fixed effects in (5) ensures that comparisons are made within a country, and average differences across countries in default risk due to macro factors, as well as differences in grading schemes across countries are factored out. We can therefore set $X_{ic} = \widehat{D}_{ic}$ in equation (4).

The use of in-sample predicted probabilities in (5) as default likelihoods in (4) gives as an objective and ex-ante measure for loan risk. Collateral spread is thus measured in terms of the same objective units (i.e. change in probability of default) across countries, making the estimate comparable cross-sectionally. We test whether financial development F_c reduces the collateral cost of capital, i.e. whether $\beta_3 = \frac{\partial^2 Y_{ic}}{\partial X_{ic} \partial F_c}$ is negative,by estimating:

With an unbiased estimate of collateral spread in hand, we can estimate β_3 through the equation:

$$Y_{ic} = \alpha_c + \beta_1 * X_{ic} + \beta_3 * (X_{ic} * F_c) + \varepsilon_{ic} \tag{6}$$

C. Identification Concerns

While fixed effects at country and country-industry levels address concerns of potentially omitted factors at country and country-industry levels, we discuss some additional identification concerns below. First there is an implicit assumption in the default prediction equation (5), that risk scales are similar across countries. For example, it imposes the restriction the going from grade "B" to "C" leads to the same change in default rate in Korea vs. Turkey. This need not be true, i.e. there may be

[9] (5) can also be estimated using a non-linear probability model that replaces the RHS of with a non-linear function $\Phi(.)$ of the arguments. However, this is not essential in our case because all variables on the RHS of (5) are indicator variables such as country-industry FE, firm size category fixed effects and risk grade fixed effects. Thus estimating (5) using linear probability model gives us the predicted default propensity for firms of a particular size category, in a specific industry-country, and receiving a particular internal grade.

heterogeneity in risk scales across countries. We shall explicitly test for this in the robustness section.

A second concern may be our implicit assumption that $\widehat{\beta}_1$ captures how the *demand* (by bank) for collateralization varies with expected default risk. One could argue instead that $\widehat{\beta}_1$ is spuriously affected by supply-side firm specific factors. For example, perhaps firms with greater (or cheaper) supply of collateralizable assets are more willing to put up collateral per dollar borrowed in exchange for lower interest rate charged by the bank, *and* such firms also tend to be riskier on average. Such a scenario would spuriously generate a positive collateral spread as higher risk firms provide higher rates of collateralization not because the bank demands so for covering agency risk, but because these firms find it cheaper to substitute collateral for lower interest rates.

While the aforementioned scenario is a theoretical possibility, we believe it is far more likely that the unobserved supply of collateral is negatively correlated with firm risk. Riskier firms are more likely to have a lower supply of collateralizable assets such as inventory and property. If this were the case then unlike the scenario above, our estimated collateral spread would be a conservative estimate of the true collateral spread. In the robustness section we provide direct evidence using our sub-sample with firm financial information from Argentina, that measures of the supply of collateralizable assets such as firm inventory, property, liquid securities etc. are negatively correlated with firm risk.

A third related concern is that the estimated collateral spread is artificially influenced by the latent loan demand of a firm which in turn is correlated with firm risk. For example, suppose less risky firms are more productive and demand larger loans on average. Could it be the case that all else equal (including firm risk), larger loans lead to lower rates of collateralization? Once again we show that it is in fact the opposite. Controlling for other firm attributes, banks demand higher rates of collateralization for larger loans. This is sensible since a loan officer worries about his total exposure to a single client and will get increasingly risk averse as exposure to a single client goes up.

Finally what about other unobserved features of the loan contract that might be used by the bank as a substitute for higher collateral in the face of increased firm risk? For example, at the margin, a bank may be willing to trade-off higher interest rates or tighter loan covenants for lower rate of collateralization. This is very much possible and in fact is exactly the trade-off that we are interested in estimating. For instance, in countries with better contract enforcement a bank may be able to substitute tighter covenants for collateral thus relaxing collateral constraints for the borrower. This is precisely the financial development channel that we want to estimate and hence such unobserved loan

characteristics should not be a concern.

III Collateral Spread and Financial Development

A. Estimating Collateral Spread

Table III estimates equation (4) using collateralization rate as the dependent variable. However, instead of using predicted default probability on the right hand side, we first use the bank's internal risk assessment for a loan applicant. The purpose is to show the "raw" correlation between collateralization and ex-ante subjective risk assessment. The assessment varies from "A" to "D", with "A" being the omitted category. Coefficients on other grade dummies therefore represent the average difference from grade "A" firms within a given country.

Column (1) shows a positive collateral spread on average as collateralization increases with firm risk. The largest increase in collateralization occurs for firms with the worst risk assessment (19% of firms). The rate of collateralization is 13.4 percentage points higher for grade D firms compared to grade A firms. This jump is all the more striking given that the mean collateralization rate is already 54 percent. Column (2) includes country-industry fixed effects (total of 782 fixed effects), thus forcing comparison across firms that belong to the same industry in the same country. While R-sq increases by 11 percentage points, the coefficients on risk grade dummies remains qualitatively unchanged.

Column (3) includes firm size controls as well, and results remain unchanged. Size controls include sales size indicators and approved loan-amount-decile fixed effects. The approved loan amount decile corresponds to the decile that a loan falls into in the approved amount distribution. Column (4) includes the loan amount control parametrically by adding log of approved loan (and dropping the decile fixed effects). The coefficient on log of approved loan amount is large and highly significant. Thus all else equal, bank demands greater collateralization for larger loans, possibly reflecting the increased moral hazard concerns with greater leverage. The relationship between collateralization and firm risk gets stronger with the inclusion of more controls in Table III, consistent with the notion underscored in section II C that unobserved firm characteristics are likely to lead to an underestimate of the true relationship between collateralization and firm risk.

Standard errors in Table III and rest of our tables are computed after allowing for correlation across observations in a given country. We assume that each loan in a country is equally-well correlated with

every other loan in the same country. The magnitude of this correlation can be arbitrary, and can vary for each country. In other words, we model the error components as $\upsilon_{ic} = \varepsilon_c + \varepsilon_{ic}$. where ε_c represents the common shock affecting all loans equally in a country. ε_{ic} is typical i.i.d. error term for firm i in country c. The Generalized Least Squares (GLS) approach to resolving such correlation within countries is to partial out country fixed effects, and then compute robust standard errors for coefficients. This is our default methodology throughout the paper. While the assumption of symmetric correlation across firms in a given country is quite natural and reasonable, we nonetheless also take the most extreme position possible by collapsing our data at the country level to test the robustness of our main results.

Table IV estimates equation (5) to compute predicted default probabilities for loans. Column (1) uses country fixed effects and shows that ex-post default increases with worse ex-ante assessment of risk. A move from grade "A" to "D" on average increases the propensity to default after two years by 6.9 percentage points. This is a large increase given that the mean default rate in sample is only 5.4 percent. Comparing the results of column (1) with the corresponding column in Table III also reveals an interesting fact: The increase in collateralization was largest when moving from grade "C" to "D", and the increase in default is also largest when moving from "C" to "D". This suggests that consistent with our theoretical framework, collateralization increases with expected default risk. Table V will make this connection more explicit.

Columns (2) through (4) show that as in Table III, our results are robust to the inclusion of country-industry fixed effects, sales size indicators, and approved loan amount controls. Consistent with the notion that greater leverage increases moral hazard concern, larger approved loans are more likely to enter default. As we saw in Table III, larger approved loans are also more likely to face stiffer collateralization requirements.

Table V uses the predicted default probabilities from Table IV to estimate collateral spreads with respect to expected default risk in equation (4). Columns (1) through (4) use the respective predicted default probabilities from columns (1) through (4) of Table IV. The estimated collateral spread is large and statistically significant. A one percentage point increase in the probability of default increases the rate of collateralization by 2.1 percentage points (columns (2) through (6)), and the result is always significant at the 1% level. The increase of 2.1 percentage points is equivalent to 3.9% of the mean collateralization rate. Column (5) shows that the collateral spread is not entirely driven by loans with

a grade "D", as excluding 19% of observation with grade D gives very similar estimates.

While collateral spread is robust to controls such as country, country-industry and size fixed effects, as well as sample exclusion of grade "D" firms, there may be a concern that the estimate is primarily driven by one or two countries. Table I showed that the distribution of loans across countries is highly skewed with countries such as the Czech republic having over 1,400 loans, while others such as Pakistan having only 96. The regressions in columns (1) through (5) weigh each loan equally, in effect giving a lot more importance to the Czech republic versus Pakistan.

We test if the estimated collateral spread is primarily driven by a couple of countries by giving each country equal weight in the regression regardless of the number of loans from that country. This is done by estimating collateral spread in equation (4) separately for each country[10], and then computing the simple average of country-specific elasticities. Column (6) shows that the equal–country-weighted collateral spread is almost identical to earlier estimates, and significant at the 1% level.

B. Effect of Financial Development on Collateral Spread

Tables III to V establish the presence of a positive collateral spread. Table VI estimates equation (6) to test how collateral spread varies with financial development. Column (1) shows that collateral spreads decline significantly with financial development. Financial development is measured using the ratio of private credit to GDP, which is the most commonly used measure of financial development for banking in the literature.

A natural concern with this finding is that it is driven by cross-country differences in income per capita which might be proxying for a host of factors other than financial development. However, column (2) shows that this is not the case. Collateral spreads are uncorrelated with income per capita. Although not show in the table, including the interaction of log gdp per capita in column (1) as a control does not change the coefficient on private credit to gdp interaction either.

Higher private credit to GDP might be an eventual outcome of better institutions, but if collateral spreads are fundamentally driven by differences in institutions directly then we should also see a direct relationship between collateral spread and measures of better institutions. A recent paper by Djankov, McLiesh and Shleifer, 2007 (henceforth DMS) introduces a couple of new measure of the quality of financial institutions in a country. The first is an index of "creditor rights" that measures how easy it

[10] i.e. replace β_1 with β_{1c} in equation (3)

is for creditors to secure assets in the event of bankruptcy, and the second is an index of "information sharing" institutions in the economy[11].

The creditor rights index is the sum of four variables that measure the relative power of secured creditors in the event of bankruptcy: (i) requirement of creditor consent when a debtor files for reorganization, (ii) ability of creditor to seize collateral once petition for reorganization is approved, (iii) whether secured creditors are paid first under liquidation, and (iv) whether an administrator, and not management, is responsible for running the business during the reorganization. A value of one is added to the index when a country's laws and regulations provide each of these powers to creditors. Thus a score of 0 suggests very poor creditor rights, while 4 suggests strong creditor rights. We use the creditor rights index for 2003 reported in the DMS data set. Given the very high level of persistence in creditor rights for a country over time, it does not change our results if we use the average creditor rights index over a different time period.

The information sharing index records a value of 1 if a country has either a public registry, or a private bureau for sharing credit information across financial institutions. Table I provides summary statistics for measures of financial development and institutions across countries and shows that there is significant variation in variables such as creditor rights and financial development across the fifteen countries in our sample.

Columns (3) and (4) of Table VI interact expected default with creditor rights and information sharing indices. The results show that collateral spreads are much smaller in economies with stronger creditor rights and better mechanisms for information sharing. Since all regressions include country fixed effects, there is no need to include the level of country specific variables.

If better institutions lower collateral spread by promoting financial development, then this can be empirically confirmed by using proxies for institutions as an instrument for financial development. Columns (5) does so by using creditor rights, information sharing, and legal origins as instruments for financial development[12]. The results confirm the idea that better institutions lower collateral spreads by improving financial development in a country.

Columns (6) and (7) use country level estimates of collateral spread as the dependent variable and regress it on private credit to GDP ratio to illustrate that our results in earlier columns are not

[11] Both creditor rights index and private credit to GDP index were downloaded from the DMS data source at www.andreishleifer.com. Private credit to GDP is averaged over 1999 to 2003 in the DMS data set.

[12] Using these instruments separately also gives similar results (available upon request).

subject to weighting concerns. Column (6) runs the OLS specification, while column (7) instruments for financial development using the three instruments in columns (5) through (7).

The magnitude of the drop in collateral spread due to financial development is large. If we take -2.0 as the average effect, then a one standard deviation increase in financial development (i.e. 0.47) lowers the collateral spread by -0.94. This reflects a drop of almost fifty percent from the average collateral spread of 2.1 estimated in Table V.

Figure Ia plots collateral spreads estimated for each country against private credit to GDP, and shows the negative relationship between the two along with the regression line. The size of each dot represents the number of loans in that country used to estimate the collateral spread. Figure Ib plots the line for the 6 countries with over 500 loans and again highlights the strong and negative relationship between collateral spread and financial development[13].

C. Composition of Collateral and Financial Development

Collateral spread estimates how the *value* of collateral per dollar lent varies with borrower risk. The value of collateral is a critical component of the cost of collateralization. However, another dimension of collateral cost is the type of assets that a bank accepts as collateral[14]. A key feature of our data is that it permits us to look at how the *composition* of collateral varies with firm risk. Collateral can be of many different types ranging from firm specific assets such as inventory, accounts receivables, and plant machinery to non-specific assets including liquid securities and real estate. Since the value of firm specific assets is more susceptible to concerns regarding a borrower's agency risk, the composition of collateral may shift towards non-specific assets as firm risk increases. Our data set provides a novel opportunity to test this for the first time to our knowledge.

We collapse the collateral types in our sample into two categories, "non-specific collateral", and "firm-specific collateral". Non-specific collateral includes land and liquid securities, while firm-specific collateral includes inventory, accounts receivable, plant and machinery, and other firm specific assets. We then decompose the variable "collateralization rate", into its non-specific and firm-specific components. Thus the original collateralization rate variable is a sum of these two components. The mean collateralization rate in our sample is 53.9%. A breakdown of the collateralization rate shows that

[13] 3 countries have a negative estimated collateral spread. However, these estimates are not statistically different from zero.

[14] To give an analogy, the "credit crunch" ensuing the mortgage crisis in the US is to a large extent driven by the refusal of counter-parties to accept mortgaged assets as collateral.

16.8 percentage points is due to non-specific collateral and the remaining 37.1 percentage points is due to firm-specific collateral.

While we know from Table V that overall collateralization rates go up with expected firm risk, columns (1) and (2) of Table VII test how the increase in collateralization is shared between non-specific and specific collateral types . There is a stark difference between the coefficients in column (1) and (2) as the increase in collateralization in the face of firm risk is primarily being driven by an increase in non-specific types of collateral. An F-test on the difference between coefficients of column (1) and (2) comes out highly significant. Thus the marginal increase in collateral in the face of an increase in expected firm risk is primarily driven by non-specific collateral. This occurs despite the fact that firm-specific collateral forms, on average, a larger share of collateral. Columns (1) and (2) indicate a sharp shift in the composition of collateral towards non-specific assets as firm risk increases.

Columns (3) and (4) test whether this shift in composition varies with financial development. We interact expected firm risk with financial development, and separately run regressions using non-specific and firm-specific forms of collateralization rates. The shift towards non-specific collateral as firm risk goes up is *lower* in financially developed economies. There is no such effect for firm-specific collateral in column (4). An F-test on the difference in coefficients on the interaction terms in columns (3) and (4) is also highly significant.

It is worth reiterating the new findings from columns (3) and (4). We already know from Table VI that collateral spread declines with financial development (i.e. the coefficient on interaction of financial development with predicted default is negative). Therefore if the interaction terms in columns (3) and (4) were both negative, it would not be a big surprise. All that would have meant is that as collateral spread reduces in financially developed economies, both specific and non-specific types of collateral are equally likely to be reduced. However, the coefficients in columns (3) and (4) paint a different picture. While the coefficient on interaction in column (3) is negative and significant, the interaction term in column (4) is in fact weakly positive. Furthermore the difference in these two interaction terms is highly significant.

Thus not only does collateral spread decline in overall value in financially developed economies, but the composition of collateral also shifts towards non-specific assets. Financial development does not only reduce the reliance on collateral, but also enables banks to accept firm-specific forms of assets as collateral. This makes sense theoretically as well, since better creditor rights and bankruptcy regimes

will make it easier for banks to seize and liquidate specialized forms of assets.

Columns (5) and (6) repeat the analysis of columns (3) and (4), but instrument financial development using all of our three main instruments (legal origins, creditor rights, and information gathering institutions). The results are essentially unchanged. Finally, we would like to point out that all of the aforementioned results are completely robust to the addition (and subtraction) of our usual set of controls. We do not report these results for sake of brevity.

The results in columns (1) and (2) of Table VII are also robust to collapsing data at the country-level, and regressing country-specific coefficient on predicted default on a constant. However, we start losing power when we compare the coefficient across columns (i.e. in F-tests). Similarly, standard errors blow up when we estimate how the "specificity spread" varies with financial development in country level regressions.

D. Collateral Spread and Credit Expansion

The collateral cost of external financing is large in terms of the value of collateral required per unit of incremental risk, as well as in terms restrictions put on assets acceptable as collateral. However, improvements in financial institutions that promote creditor rights and contractual enforcement reduces the collateral cost of financing. This reduction in collateral cost is particularly useful for small and medium firms that are often the most constrained firms financially (see e.g. Beck, Demirguc-Kunt and Maksimovic 2005a). Moreover, recent evidence from China and Taiwan, as well as more systematic evidence in Beck, Demirguc-Kunt and Levine (2005b) suggests that helping small and medium enterprises is likely to have important effects on economic growth as well.

The fact that an increase in private credit to GDP is associated with lower collateral spreads suggests that a reduction in the reliance on collateral helps expand the supply of overall credit in an economy. Lower collateral requirements and greater flexibility in the types of assets that can be pledged, enables firms to borrow more with the same dollar of internal capital. More direct evidence from our sample is also consistent with the idea that a reduction in collateral spread leads to an expansion in credit available to firms.

Table VIII replicates our empirical methodology but uses log of approved credit as the left hand side variable. Columns (1) and (2) show that, as expected, firms with higher ex-ante probability to default are given less credit. However, this reduction in credit to riskier firms is *less pronounced*

in more financially developed countries, and the result holds when we IV for financial development (columns (3) and (4)). Columns (5) through (7) show that all of these effects hold when we collapse data to the country level as well.

The findings in Table VIII are consistent with the idea that as riskier firms have to put up relatively less additional collateral in financially developed economies, they are able to borrow more. We would also like to emphasize that we measure firm risk in an objective manner, i.e. propensity to default. Thus "high risk" vs. "low risk" has the same objective meaning across countries, particularly in light of our robustness tests that allow for heterogeneity in risk scales across countries (see below).

IV Robustness Checks

A. Heterogeneity in Risk Scales

The default prediction regression in equation (5) regressed ex-post default rates on ex-ante risk grades with country fixed effects. The fixed effects absorbed any average differences across countries in their default rate or risk grades. However, the equation implicitly assumed that the risk scales are similar across countries. For example, it imposed the same increase in default rates across all countries as risk grades move from "B" to "C". This need not be true in principle, though the use of uniform risk assessment practices across countries makes it more likely to be a valid assumption.

Even if the assumption of common risk scales across countries did not exactly hold, it is not clear why that should bias our coefficient of interest negatively. Nonetheless we explicitly test for heterogeneity in risk scale across countries, and re-estimate collateral spread after taking any heterogeneity into account. We find no evidence for heterogeneity in risk scales, and our collateral spread estimate essentially remained unchanged.

We allow for heterogeneity in risk scales by splitting countries according to GDP per capita and the level of financial development separately. We then re-estimate equation (5) while allowing countries above and below the median cutoffs to have different risk scales across countries. The results indicate no significant difference in risk scale. Moreover, when we use the predicted default probabilities from this more flexible regression to compute collateral spread, we get very similar estimates as before (1.94 and 1.90).[15]

[15] Results available from authors upon request.

B. Firm Specific Factors

Section II C outlined some firm-specific concerns of supply-side variables affecting our estimate of collateral spread. In particular, positive correlation between collateral supply and risk at the firm level could, in theory, generates a spurious positive collateral spread. However, using our sample of loans from Argentina that have more detailed firm financial data, we show that the supply of collateralizable assets is in fact negatively correlated with firm risk.

We use balance sheet information on firm assets to construct measures of "collateralizable assets" that are available for borrowing. Our first measure (Net Worth) is the total book net worth of the firm (*i.e.* total assets minus total non-equity liabilities). Our second measure (Net Collateral) is computed by adding the primary collateralizable assets of the firm and subtracting total collateralized liabilities issued by the firm. Primary collateralizable assets include cash, marketable securities, accounts receivables, inventory and net fixed assets. Collateralized liabilities include senior and subordinated short and long term debt.[16] Since we are interested in risk at the time of loan origination, taking out the loan given by our bank for a bank's total liabilities does not change any of our results. We also normalize each of the two measures of collateralizable assets by total assets and sales in order to get a sense of the supply of collateral per borrowing need of the firm. Appendix table 2 shows the summary statistics of these new measures, as well as other firm attributes such as profitability and interest rates.

Appendix table 3 tests how different measures of the supply of collateralizable assets vary with ex-ante firm risk grade, and includes industry fixed effects as controls. Regardless of the exact definition used, collateral supply is negatively correlated with firm risk, *i.e.* supply decreases as measure of firm risk goes up. The bottom panel reports raw correlation between dependent variables and firm risk, where risk is coded as 1 through 4 for grades "A" through "D". The correlation is always negative and statistically significant.

Another concern highlighted in section II C was that unobserved latent demand for loans might spuriously generate a positive collateral spread. However, columns (1) and (2) in appendix table 4 show that (as expected) firm productivity and hence latent demand for loans is positively negatively correlated with firm risk. The raw correlations reported in the bottom panel are also negative and significant. Since firm profitability goes down with firm risk, the latent loan demand should also

[16] Excluding subordinated debt does not change our results significantly.

decrease with firm risk. We have already seen that all else equal, larger loans get higher rates of collateralization (Table V, column (4)). Thus a negative correlation between firm risk and profitability (or latent demand for loan) also biases our estimate of collateral spread downwards. Overall both unobserved collateral supply and unobserved latent demand for loans imply that our estimates of collateral spread are on the conservative side.

Finally, columns (3) and (4) of appendix table 4 test for the correlation of lending rates with firm risk grade. We use two measures of interest rate: (i) a "lending interest rate" computed by dividing the total lending revenue generated from a firm by the average loan amount given to that firm during a year, and (ii) an "all-in interest rate" computed by dividing the total lending and non-lending revenue generated from a firm during a year by its average borrowing in that year. The result indicates that interest rates are positively correlated with firm risk as in our conceptual framework (section II a). The coefficients are estimated with reasonable precision as standard errors are small in terms of economic magnitude.

C. Generalizability of Results

The variation in financial development in our sample was driven by fifteen countries. This can raise concerns that our results may not be representative of the broader sample of emerging markets in the world. We therefore test for the representativeness of our sample of countries in a number of ways.

First, even a casual look at the list of countries in our sample shows that there is significant variation in financial development (Table I). The standard deviation of private credit to GDP in our sample is 0.47, which compares very favorably with the standard deviation of 0.40 in the broader sample of countries used by DMS.

While the variation in financial development is similar in our sample and the full sample of emerging markets, is the variation also representative? There is a simple test for this question. If our sample is truly representative of the broader sample of countries, then the primary findings of the law, finance, and growth literature should also hold in our sample. We therefore, replicated the results of two most widely cited papers on finance and growth: Rajan and Zingales (1998) and Levine and Zevros (1998). While there are other papers in this area as well, these are the two papers for which we could find publicly available data.

A replication of the main Rajan and Zingales (1998) result (Table 4 in their paper) to our sample of countries shows that *all* of their results hold in our sample in terms of coefficient magnitude as well as statistical significance[17]. Similarly, Levine and Zevros (1998) find a robust correlation of 0.35 between financial development and output growth, while we find this correlation to be 0.6 and highly significant in our sub-sample.

We also replicated the main findings of the law and finance literature in our sub sample. The first stage of our IV estimates shows that the connection between legal origins, creditor rights, and informational institutions uncovered in LLSV (1997) and DMS (2007) holds in our sub-sample as well. The variation in financial development, and the replication of results in law, finance and growth literature suggests that our sample of countries is very representative of the full sample. It is therefore reasonable to assume that our finding are more broadly representative of the link between collateral costs and financial development.

D. Alternative models of default/collateral

We motivated the theoretical framework in Section IIa with the assumption that the expected default risk of a firm is pre-determined, say due to inherent business risk or managerial ability. We did not make default a strategic choice of the borrower.

In the absence of strategic default, default rate effects the rate of collateralization, but not the other way around. However, when borrowers can default strategically then collateral also has a feedback effect on future default. In particular, an increase in collateral makes it less likely for a borrower to default strategically.

Should the possibility of strategic default change any of the interpretations of our empirical findings? We do not think so for the simple reason that strategic default only works against finding an effect. For example, suppose that all borrowers are alike in terms of business profitability and the only difference between them is in terms of their propensity to declare strategic default. Then the entire variation in risk grades will be driven by the bank's expectation of strategic default. The bank will correspondingly impose higher collateral requirement for firms with worse grades to prevent them from defaulting strategically. However, having done so, *there will be no differences across firms in ex-post*

[17] There are 9 countries that are common between Rajan-Zingales sample and ours (Chile, India, Korea, Malaysia, Pakistan, Singapore, South Africa, Sri Lanka and Turkey). A comparison of the exact coefficient estimates between our sample and the full sample is available upon request.

default performance. In other words, there is no predictive power left in ex-ante firm risk grades for predicting default if strategic default is the primary reason for default, and collateralization demand by the bank prevents any such default.

V Concluding Remarks

Ever since the seminal work of Stiglitz and Weiss (1981), academics have realized that risks associated with agency problems in financially under-developed economies cannot be priced by interest rates. The moral hazard concern inherent in higher interest rates implies that lenders must resort to costly commitment devices with collateral being the most salient one. Thus if one is interested in estimating the "cost" of financial under-development, collateral spreads should be more relevant than interest rate spreads.

This paper estimated the cost of financial-underdevelopment in terms of its impact on the value and specificity of collateral spread. We were able to do so for the first time (to our knowledge) because of the unique cross-country loan-level data set covering smaller firms that are the most relevant set of firms given the question at hand. Our ability to observe collateral value, objective measures of firm risk, as well as composition of pledged assets gave us a rare opportunity to understand how the magnitude and nature of collateral varies with firm risk, and across different institutional regimes.

Since our data comes from a single multi-national bank, it might raise concerns regarding generalizability of our results. However, holding the lender (and nature of lending program) constant also makes borrower comparisons more reliable, and as already mentioned, the high level of local decentralization means that none of our results are "hard-wired" by bank rules. Nonetheless our hope is that the new set of results that we document will lead to more fruitful work understanding the link between factors that limit the dependence of lending on collateral and internal net worth. Everyone recognizes that in a perfect world credit should only depend on profitability of future cash-flows, not past accumulation of wealth.

Appendix

Result 1 Proof:

Plugging (2) in (1), and recognizing that (1) must bind in equilibrium to provide the lowest cost to firms, we get

$$Y = \frac{1.8p - 0.4 - 1.2p^2}{(p - 0.4)} \tag{7}$$

and,

$$r = \frac{1}{p} - \left(\frac{1-p}{p}\right) Y \tag{8}$$

It follows that collateral spread is positive, i.e. $\frac{\partial Y}{\partial(1-p))} > 0$, and interest rate spread is also positive, i.e. $\frac{\partial r}{\partial(1-p)} > 0$ for $p \in [0.9, 1]$.

Result 2 Proof:

Case 1 - F measures creditor rights protection.

Since lenders now expect (YF) back in case of default, we can replace Y with (YF) in (7) and get $Y = \frac{1}{F}\left[\frac{1.8p-0.4-1.2p^2}{(p-0.4)}\right]$. It follows that collateral spread declines with better creditor protection, i.e. $\frac{\partial^2 Y}{\partial(1-p)\partial F} < 0$.

Case 2 - F measures cost of cheating, $c(F)$

The IC condition (1) changes to:

$$(R - r) * p - Y * (1 - p) \geq (R^{'} - r) * p^{'} - Y * (1 - p^{'}) - c(F) \tag{9}$$

Plugging (2) into (9), we get

$$Y = \frac{1.8p - 0.4 - 1.2p^2 - p * c(F)}{(p - 0.4)} \tag{10}$$

It follows that collateral spread declines with higher cost of cheating, i.e. $\frac{\partial^2 Y}{\partial(1-p)\partial F} < 0$.

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TABLE I

DATA DESCRIPTION BY COUNTRY

The table presents the distribution of data by country (Table 1 in Appendix reports distribution by the 87 industries), along with a country's financial and economic development indicators. The data comes from a sample of 8,414 small and medium-sized firms in 15 emerging markets borrowing from a large multinational bank.

	Country	Number of Firms	Avg. Loan Size ('000US$)	No. of Industries	Private Credit to GDP	Creditor Rights	Legal Origin	Public Registry	Private Bureau	GDP per Capita
1	Argentina	120	86	18	0.19	1	French	1	1	3,650
2	Chile	1,124	142	77	0.61	2	French	1	1	4,390
3	Czech	1,440	296	73	0.42	3	German	0	0	6,740
4	Hong Kong	1,169	618	65	1.54	4	English	0	1	25,430
5	India	494	626	49	0.30	2	English	0	0	530
6	Korea	1,427	94	71	0.93	3	German	0	1	12,020
7	Malaysia	552	411	48	1.38	3	English	1	1	3,780
8	Pakistan	96	599	35	0.28	1	English	1	0	470
9	Romania	135	191	47	0.08	1	French	0	0	2,310
10	Singapore	100	991	30	1.17	3	English	0	0	21,230
11	Slovakia	140	466	43	0.43	2	German	1	0	4,920
12	South Africa	307	269	59	0.76	3	English	0	1	2,780
13	Sri Lanka	102	468	17	0.29	2	English	0	1	930
14	Taiwan	443	723	54	0.99	2	German	1	1	13,320
15	Turkey	765	358	54	0.20	2	French	1	0	2,790
	Total / Average	8,414	352	87	0.64	2.3		0.47	0.53	7,019

TABLE II

SUMMARY STATISTICS: CROSS-COUNTRY FIRM LEVEL DATA

This table presents summary statistics for the sample of 8,414 firms at the beginning of sample (except default rate which is computed at sample's end). Standard deviation (SD) within country and country-industry bins is computed after demeaning variables at country and country-industry levels respectively. Collateralization rate is measured as the percentage of loan that is covered by the estimated liquidation value of collateral.

Variable	Mean	SD	SD Within Country	SD Within Country-Industry	Obs
Risk Grade	2.58	0.97	0.88	0.80	8,414
A	0.15				1,287
B	0.31				2,580
C	0.35				2,926
D	0.19				1,621
Sales Size Indicators	0.90	0.94	0.76	0.69	8,414
0	0.40				3,383
1	0.38				3,194
2	0.14				1,166
3	0.07				616
Others	0.00				55
Total Approved (in `000 $)	570.00	980.00	847.50	782.83	8,414
Log Approved	12.00	1.91	1.52	1.33	8,414
Total Outstanding (in '000 $)	351.00	674.00	638.80	594.92	8,414
Default by end of sample?	5.41	22.61	20.43	19.22	8,414
Collateralization Rate	53.90	44.69	34.83	31.94	8,414
Break down of Coll. Rate By:					
Non-specific Assets	16.82	33.55	29.53	27.10	8,414
Firm-Specific Assets	37.08	43.75	28.29	25.36	8,414
Break down of Non-Specific Assets:					
Land	11.10	28.91	26.08	24.25	8,414
Liquid Assets	5.72	20.01	16.83	15.10	8,414
Break down of Non-Specific Assets:					
Firm Inventory/Machinery	11.35	28.80	25.25	20.27	8,414
Other Firm Assets	24.12	40.35	26.88	21.41	8,414
Account Receivable	0.78	5.84	5.60	5.01	8,414
Guarantee	0.35	4.88	4.84	4.60	8,414
Letter of Credit	0.49	6.71	6.56	5.28	8,414

TABLE III

COLLATERAL SPREAD WITH RESPECT TO OVERALL EX-ANTE FIRM RISK

The table estimates collateral spreads with respect to overall ex-ante firm risk grade. Risk grade is assessed from "A" to "D" by the loan officer at the time of loan origination. Grade "A" is the omitted grade category. Collateralization rate is measured as the percentage of loan that is covered by the estimated liquidation value of collateral. There are 15 country fixed effects, 782 country-industry fixed effects and 5 firm sales size based fixed effects whereever specified. Approved loan amount decile fixed effects are indicator variables for the decile of approved loan amount distribution that a given loan belongs to. A unit of observation is a firm (bank loan).

Dependent Variable	Collateralization Rate			
	(1)	(2)	(3)	(4)
Grade=B	2.76	2.00	1.63	1.74
	(1.21)	(1.24)	(1.21)	(1.22)
Grade=C	3.42	3.85	5.62	5.31
	(1.26)	(1.30)	(1.29)	(1.30)
Grade=D	13.43	12.55	13.92	13.86
	(1.40)	(1.48)	(1.46)	(1.47)
Log Approved Loan				5.17
				(0.29)
Country FE	Yes			
Country X Industry FE		Yes	Yes	Yes
Sales Size Indicator FE			Yes	Yes
Approved Loan Amount Decile FE			Yes	
No of Obs	8,414	8,414	8,414	8,414
R-Sq	0.39	0.50	0.52	0.51

TABLE IV

PREDICTING DEFAULT RATE

The table estimates the predictability of default by initial firm risk grade assigned by loan officers in the beginning of sample, country-industry characteristics, and firm/loan size. By construction no firm is in default at the beginning of sample. The dependent variable (0/100) records whether the loan enters default status by the end of sample period, i.e. after 2 years. The unit of observation is a firm (bank-loan).

Dependent Variable	End of Sample Default Status (0/100)			
	(1)	(2)	(3)	(4)
Grade=B	0.77	1.39	1.45	1.54
	(0.56)	(0.61)	(0.62)	(0.62)
Grade=C	2.97	2.46	3.06	3.11
	(0.65)	(0.70)	(0.75)	(0.74)
Grade=D	6.92	6.23	6.86	6.85
	(0.89)	(0.98)	(1.01)	(1.01)
Log Approved Loan				1.26
				(0.20)
Country FE	Yes			
Country X Industry FE		Yes	Yes	Yes
Sales Size Indicator FE			Yes	Yes
Approved Loan Amount Decile FE			Yes	
No of Obs	8,414	8,414	8,414	8,414
R-Sq	0.19	0.28	0.29	0.29

TABLE V

COLLATERAL SPREAD WITH RESPECT TO PREDICTED DEFAULT

The table estimates collateral spreads with respect to predicted default estimated in Table IV. Collateralization rate is measured as the percentage of loan that is covered by the estimated liquidation value of collateral. There are 15 country fixed effects, 782 country-industry fixed effects and 5 firm sales size based fixed effects whereever specified. Approved loan amount decile fixed effects are indicator variables for the decile of approved loan amount distribution that a given loan belongs to. A unit of observation is a firm (bank loan). Regression in Column (5) excludes firms with a grade of "D", and column (6) runs regression at the country level with country level estimate of collateral spread as the dependent variable.

Dependent Variable	Collateralization Rate					Country-level Collateral Spread
	(1)	(2)	(3)	(4)	(5)	(6)
Predicted Default	1.74	2.08	2.12	2.11	2.09	
	(0.28)	(0.40)	(0.38)	(0.38)	(0.69)	
Log Approved Loan				2.53	1.72	
				(0.68)	(1.08)	
Constant						2.14
						(0.72)
Country FE	Yes					
Country X Industry FE		Yes	Yes	Yes	Yes	
Sales Size Indicator FE			Yes	Yes	Yes	
Approved Loan Amount Decile FE			Yes			
No of Obs	8,414	8,414	8,414	8,414	6,793	15
R-sq	0.40	0.44	0.48	0.47	0.47	

TABLE VI

COLLATERAL SPREAD AND FINANCIAL DEVELOPMENT

The table tests how collateral spreads vary with financial development. Collateralization rate is measured as the percentage of loan that is covered by the estimated liquidation value of collateral. Columns (1) through (5) include country fixed effects, a unit of observation is a firm (bank loan). Regressions (6) and (7) are run at the country level, with country level estimate of collateral spread as the dependent variable. Columns (5) and (7) use legal origins, creditor rights, and information sharing index as instruments.

Dependent Variable	Collateralization Rate					Country-level Collateral Spread	
					IV	OLS	IV
Instrument for Private Credit to GDP					All Three		All Three
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Predicted Default	2.83	0.84	3.65	2.48	3.27		
	(0.40)	(1.37)	(0.68)	(0.45)	(0.40)		
Private Credit to GDP * Predicted Default	-1.43				-2.02		
	(0.41)				(0.43)		
Log GDP per Capita * Predicted Default		0.10					
		(0.15)					
Creditor Rights * Predicted Default			-0.73				
			(0.23)				
Information Sharing * Predicted Default				-0.91			
				(0.48)			
Private Credit to GDP						-3.11	-3.72
						(1.44)	(2.19)
Log GDP per Capita						1.38	1.55
						(1.01)	(1.17)
Constant						-7.31	-8.27
						(8.02)	(8.97)
No. of Observations	8,414	8,414	8,414	8,414	8,414	15	15
R-Squared	0.40	0.40	0.40	0.39	0.40	0.20	0.19

TABLE VII

COMPOSITION OF COLLATERAL AND FINANCIAL DEVELOPMENT

The table tests how composition of collateral shifts as firm risk increases within a country, whether the shift varies with financial development. Collateralization rate is measured as the percentage of loan that is covered by the estimated liquidation value of collateral. Columns (5) and (6) use creditor rights index, information sharing index, and legal origins as instruments for private credit to GDP.

Dependent Variable	Collateralization Rate Of Collateral Type:					
	Non-Specific	Firm-Specific	Non-Specific	Firm-Specific	Non-Specific	Firm-Specific
Instrument for Private Credit to GDP					All Three IV	All Three IV
	(1)	(2)	(3)	(4)	(5)	(6)
Predicted Default	1.77	0.31	2.95	-0.18	3.03	0.04
	(0.19)	(0.18)	(0.38)	(0.37)	(0.39)	(0.38)
Private Credit to GDP * Predicted Default			-1.93	0.55	-2.03	0.26
			(0.37)	(0.40)	(0.38)	(0.42)
Country X Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations	8,414	8,414	8,414	8,414	8,414	8,414
R-Squared	0.36	0.67	0.36	0.66	0.36	0.66

TABLE VIII

CREDIT SUPPLY AND FINANCIAL DEVELOPMENT

The table tests how approved credit amount varies with firm risk within a country, and whether this sensitivity with firm risk differs with financial development. Columns (4) and (7) use creditor rights index, information sharing index, and legal origins as instruments for private credit to GDP. There are 15 country fixed effects, and 782 country-industry fixed effects whereever specified.

Dependent Variable	Log Approved Credit				Country-level "Approved Credit Spread"		
				IV			IV
Instrument for Private Credit to GDP				All Three			All Three
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Predicted Default	-0.11	-0.09	-0.21	-0.20			
	(0.02)	(0.02)	(0.02)	(0.02)			
Private Credit to GDP * Predicted Default			0.13	0.11			
			(0.02)	(0.02)			
Private Credit to GDP						0.13	0.14
						(0.07)	(0.06)
Constant					-0.14	-0.22	-0.23
					(0.04)	(0.08)	(0.06)
Country FE	Yes		Yes	Yes			
Country X Industry FE		Yes					
No. of Observations	8,414	8,414	8,414	8,414	15	15	15
R-Squared	0.39	0.47	0.39	0.39		0.14	0.14

Figure Ia: Collateral Spread and Financial Development

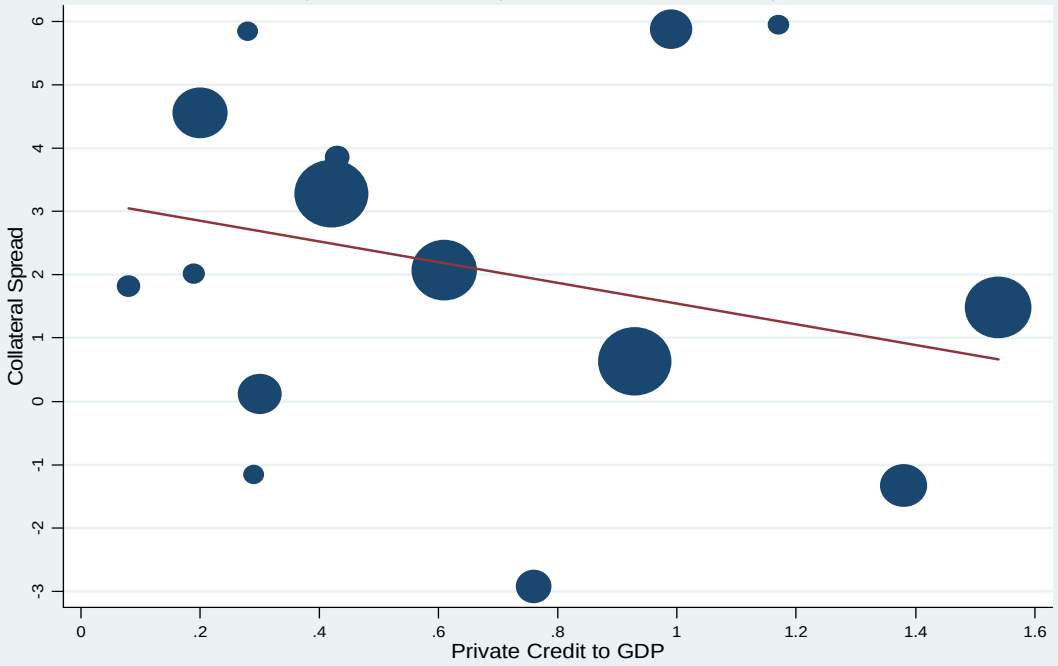

Figure Ib: Collateral Spread and Financial Development (countries with more than 500 loans)