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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. Collateral spread is defined as the difference in collateralization rates between high- and low-risk borrowers. The average collateral spread is large but declines rapidly with improvements in financial development driven by stronger institutions. We also show that the composition of collateralizable assets shifts towards non-specific assets (e.g., land) with borrower risk. However, the shift is considerably smaller in developed financial markets, enabling risky borrowers to use a larger variety of assets as collateral.

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 (1993) among others). 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 for a cross-section of countries.

In this paper, we explore how the level of financial development in a country affects the collateral cost of capital using a novel cross-country data set containing small and medium business loans issued by a multinational bank in 15 countries, where the countries differ widely in their level of institutional and financial development, ranging from India, Turkey, and Chile, to Korea, Malaysia, and Hong Kong. This data set contains information on the value as well as type of collateral pledged as security for each loan. The data also include the bank's ex ante assessment of risk for a loan, along with ex post loan performance 2 years after issuance.

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Following previous work that shows that financial development lowers the interest rate and contracting costs of financing (Qian and Strahan (2007) and Lerner and Schoar (2005)), we estimate the collateral cost of financing and estimate how it varies with financial development. We estimate the cost of collateral using two measures. The first is the *dollar* cost of collateral, that is, 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, account receivables) as collateral. The current U.S. credit crisis highlights the severe problems in financing that can arise when lenders no longer feel comfortable accepting a particular class of assets (in this case, mortgage backed securities) as collateral.

Although loan-level measures of the cost of collateral are useful to address the question of interest, an important econometric issue must be resolved before collateral costs can be compared across countries in a meaningful sense. In particular, differences across countries in the level of risk and choice of collateral may be driven by 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 collateral choice and the level of loan risk in an economy. Using country fixed effects, we estimate a country's collateral spread as the difference in collateralization rates between high- and low-risk loans within the same economy.[1] The expected risk of a loan is estimated as its predicted default probability, which uses the ex ante bank risk assessment to predict ex post loan default. The use of objective default probabilities as a measure of loan risk makes collateral spreads comparable across countries.

A simple example helps illustrate our empirical methodology. Consider two economies E and F (for English and French origin, respectively), where E has better financial institutions. Each economy has two types of borrowers, high default risk and low default risk. Both borrower types have access to a positive net present value (NPV) project. However, because 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 in equilibrium. However, the spread will be *smaller* in E due to stronger financial institutions. For instance, E can 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

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

of seized collateral in the event of bankruptcy. By focusing on the collateral spread, we difference 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 1% increase in the probability of default increases the rate of collateralization by 2.1% points. Although our within-country estimation technique takes care of spurious country-specific factors, there may be a concern that the estimate of collateral spread is driven by changes in the firms' supply of collateralizable assets, rather than changes in the demand for collateral from banks. However, in a subsample of firms we show that variables proxying for the supply of collateral at the 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.

Next, we find that 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 a country's collateral spread by almost one-half. Using legal origin, 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 the assets 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 assets as collateral. The latter result suggests that better protection of legal and creditor rights 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, pledging a lower amount of collateral and with 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. Because firms that lie on the frontier of the aggregate production possibilities set are likely to be riskier, our findings also provide a channel through which financial development spurs growth.

The work of Stiglitz and Weiss (1981) shows that 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 (e.g., 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.

Although 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 United States. This work consistently finds that the incidence of collateral increases with firm risk (e.g., Orgler (1970), Hester (1979), Berger and Udell (1990, 1995), John, Lynch, and Puri (2003) and Carey, Post, and Sharpe (1998)).

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 whereas they focus on maturity, ownership, and interest rates. Furthermore, their data consist of large publicly held borrowers, whereas ours comprise small and medium firms that are likely to be more affected by institutional weaknesses.

The remainder of the paper is organized as follows. In Section I, we describe the data. In Section II, we discuss the conceptual framework and empirical strategy. In Section III, we present our main results. In Section IV, we present robustness checks. In Section V, we conclude.

I. Data Description

Our data come from the small and medium-sized firm lending division of a large multinational bank that operates in 15 emerging economies. The data contain every loan issued by the bank and follow each loan over a 2-year period (on average) from 2002 to 2004, with information updated every 6 months. Although the original data set has 12,591 firms, we are left with a cross-sectional sample of 8,414 firms after applying several 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 excluded 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 hence are dropped because there is no collateral information on these firms.[2]

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

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

Table I

Data Description by Country

The table presents the distribution of data by country along with a country's financial and economic development indicators. The Internet Appendix reports the sample distribution of firms by the 87 industries. The data comes from a sample of 8,414 small and medium-sized firms in 15 emerging markets borrowing from a large multinational bank. Countries are reported in alphabetical order. See Appendix B, Table B.I for variable definitions.

	Avg. Loan			Private					
Country	Number of Firms	Size ('000US$)	No. of Industries	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

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 a large number of observations. Accordingly, we carefully test for this in the analysis section below. There are a total of 87 (finely defined) industries in our sample. The full list of industries, and the number of firms belonging to each industry, is reported in the Internet Appendix.[3]

For every loan we observe the borrower's identity, industry, and country. We also observe the total approved loan, loan outstanding, loan default status, the firm's size and risk as determined by the bank, and both the type and liquidation value of the collateral used to secure the loan. We use the first observation for each loan in our sample to represent the initial loan characteristics at the time of origination. We then determine for each loan its end-of-sample period default status. This variable is one if a firm goes into default by the end of the sample period (i.e., within 2 years), and zero otherwise. Table II provides summary statistics for all the variables in our data set. Because our empirical methodology uses country and country-industry fixed effects, we report country and country-industry demeaned standard deviations as well.

A key variable in our analysis is the ex ante risk grade of a borrower. The grade varies from "A" (best) to "D" (worst) and represents the riskiness of the borrower at the time of loan origination as determined by the bank's loan officer. The risk grade is based upon two 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 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 terms such as collateral, interest rates, and maturity. This is important because otherwise firms with a high level of collateral may be given a safe grade due to the collateral, and not because the firm's cash flows are less risky. Table II shows that all four grades are fairly well represented in the data and that there is significant variation in grades not only across countries but also within country and country-industry categories.

The bank also constructs a variable on firm size using firm sales. Specifically, the bank categorizes firms into four sales size groups, where a grade of "0" corresponds to smaller firms and a grade of "3" corresponds to larger firms. We find that firms in our sample are skewed towards smaller-sized firms, which is consistent with the focus of the lending program.

An important dimension of our data is its information on loans and loan collateralization in particular. The mean outstanding loan amount is $351,000,

[3]An Internet Appendix for this article is online in the "Supplements and Datasets" section at http://www.afajof.org/supplements.asp.

[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?" and other questions related to management and firm performance that are subjective in nature.

Table II

Summary Statistics: Cross-Country Firm-Level Data

This table presents summary statistics of all the variables used in the empirical analysis for the sample of 8,414 firms at the beginning of the sample (except the default rate, which is computed at the sample's end). Standard deviation (SD) within country and country-industry bins is computed after demeaning variables at country and country-industry levels respectively. See Appendix B, Table B.I for variable definitions.

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 Loan Approved (in '000US$)	570.00	980.00	847.50	782.83	8,414
Log Total Loan Approved	12.00	1.91	1.52	1.33	8,414
Loan Outstanding (in '000US$)	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
Breakdown of Collateralization Rate by:					
Nonspecific Assets	16.82	33.55	29.53	27.10	8,414
Firm-Specific Assets	37.08	43.75	28.29	25.36	8,414
Breakdown of Non-Specific Assets:					
Land/Real Estate	11.10	28.91	26.08	24.25	8,414
Liquid Assets	5.72	20.01	16.83	15.10	8,414
Breakdown of 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 Receivables	0.78	5.84	5.60	5.01	8,414
Guarantees	0.35	4.88	4.84	4.60	8,414
Letters of Credit	0.49	6.71	6.56	5.28	8,414

and 5.41% of the firms enter into default by the end of our sample period. More important for our analysis, for each loan, the bank records the *liquidation value* of collateral pledged for the loan. This reflects the bank's assessment of the market value of the collateral in the event of bankruptcy, assuming the lender receives full ownership of the collateral. We divide the liquidation value of collateral (in the beginning of the sample period) by the approved loan amount to construct the collateralization rate 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 include the *type* of asset pledged as collateral. Asset types correspond 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 guarantee, or other bank guarantee, (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.[5]

Table II shows the composition of collateral by summarizing the percentage of collateral value that belongs to each of the seven collateral categories. Other 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, whereas 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 the return on lending assets while minimizing defaults. Thus, none of our findings on the relationship between collateralization rates and firm risk are "hard wired" by bank rules.

One downside of the cross-country data set 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] Although our primary cross-country data set comes from the central computer archives of the bank, this second database is hand-collected from credit dossiers in Argentina. The hand-collected data include information on a firm's ex ante risk grade, annual balance sheet, income statement, and interest rates. However, the credit files made available to us did not contain information on collateralization. We therefore use this second data set not for computing collateral spreads, but for

[5]Discussion with loan officers indicates that this category captures collateral that does not merit classification in any of the other categories but is specific to the operational business of the firm under consideration.

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

estimating how other firm attributes such as interest rate, profitability, and supply of collateralizable assets vary with firm risk.

II. Empirical Methodology

A. Conceptual Framework

We present a simple model to illustrate the link between financial development and collateral spread. Although our model is built upon the 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. The probability p is distributed uniformly over the interval $[0.9, 1]$, with $0.9 * R > 1$. We normalize the cost of capital to one, which implies that all firms in the economy have a positive 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 the firm's expected default rate.

Financial frictions however may prevent firms from getting the first-best level of financing. We model these frictions in a moral hazard setting where firms may shift risk onto banks once a loan is issued. Firms may engage in such risk-shifting 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 the case of a successful outcome but has a negative expected return. For illustrative purposes, we set $R = 1.2$, $R' = 2$ and $p' = 0.4$.[7]

The access to a risky project creates a moral hazard problem because 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 $(R - r) * p = (1.2p - 1)$, whereas its payoff from investing in the risky project is $(R' - r) * p' = (0.8 - \frac{0.4}{p})$. Because $(1.2p - 1) < (0.8 - \frac{0.4}{p})$ 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 breaks 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.

Because the risky project has a greater likelihood of default, an obvious and—often used—commitment device is collateral. Suppose a borrower pledges $Y < 1$ as collateral such that it stands to lose this amount to the bank in the case of

[7] Our exact choice of numbers is not important. We assign values 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 setup.

default. Then the borrower can credibly commit to pursuing the genuine project if the following investment compatibility (IC) 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) into (1), and recognizing that (1) must bind in equilibrium to provide the lowest cost to firms, we get that the collateralization rate (Y) and interest rate (r) are increasing functions of the firm's expected default risk X. Let $X = (1 - p)$ be the expected default risk (see Appendix A at the end of the text for details). An increase in the 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, that is, $\frac{\partial Y}{\partial X} > 0$.

How should collateral spread vary with financial development? La Porta et al. (1997, 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 the case of default. Suppose a bank can successfully liquidate collateral with probability F in the case of borrower default. The probability F changes the incentive compatibility condition (1) by replacing Y with its expected value (YF). Because the expected realized value of collateral increases with creditor protection, it follows that collateral spread would decline as financial development (F) goes up, that is, $\frac{\partial^2 Y}{\partial X \partial F} < 0$ (see Appendix A for a formal proof).

An alternative way to model financial development is through the cost that borrowers face in the case of default. A strong legal system will impose greater costs on a borrower for default, which we can introduce as $c(F)$ on the right-hand side of the IC equation (1). Here, the probability 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 that lenders can afford to reduce collateral spread in stronger legal regimes, that is, $\frac{\partial^2 Y}{\partial X \partial F} < 0$ (see Appendix A for a formal proof).

B. Regression Specification

Let Y_{ic} denote the 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:

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

In (3), $\hat{\beta}_1$ is an unbiased estimate of β_1 if the error term in parentheses is uncorrelated 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, $\hat{\beta}_1$ 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 to a grade of "A" in another.

We address the concern 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-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 difficult variable to observe. However, our data present a novel opportunity to compute an estimate of expected default risk using the bank's ex ante assessment of loan risk and realized ex post loan outcomes. We can predict loan default using ex ante firm characteristics observable to the bank including internal risk assessment grade, industry, and 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) is an unbiased estimate of the full private information of the bank, $\hat{D}_{ic}$ 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 in default risk across countries due to macro factors, as well as differences in grading schemes across countries, are factored out. We can therefore set $X_{ic} = \hat{D}_{ic}$ in equation (4).

[9]Equation (5) can also be estimated using a nonlinear probability model that replaces the right-hand side of (5) with a non-linear function $\Phi(.)$ of the arguments. However, this is not essential in our case because all variables on the right-hand side of (5) are indicator variables such as country-industry fixed effects, firm size category fixed effects, and risk grade fixed effects. Thus, estimating (5) using a 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 risk grade.

Equation (4) is run on loan-level data using a cross-section of countries. Because the cross-sectional data are constructed around the same time period for all countries, country fixed effects also absorb any contemporaneous or expected shocks hitting various economies. Thus, our coefficient of interest is not affected by time-varying factors such as business cycles or growth opportunities.

The use of in-sample predicted probabilities in (5) as default likelihoods in (4) gives us 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, that is, whether $\beta_3 = \frac{\partial^2 Y_{ic}}{\partial X_{ic} \partial F_c}$ is negative, through the equation:

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

C. Identification Concerns

Although fixed effects at the country and country-industry levels address concerns of potentially omitted factors at country and country-industry levels, additional identification concerns remain. First, the default prediction equation (5) implicitly assumes that risk scales are similar across countries. For example, the equation imposes the restriction that going from grade "B" to "C" leads to the same change in default rate in Korea relative to Turkey. This need not be true, however; that is, there may be heterogeneity in risk scales across countries. We explicitly test for this in the robustness section.

Second, we implicitly assume that $\hat{\beta}_1$ captures how the bank's *demand* for collateralization varies with expected default risk. One could argue instead that $\hat{\beta}_1$ is spuriously affected by supply-side firm-specific factors. For example, perhaps firms with a greater (or cheaper) supply of collateralizable assets are more willing to put up collateral per dollar borrowed in exchange for a lower interest rate, *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 to cover agency risk, but because these firms find it cheaper to substitute collateral for lower interest rates.

Although 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. We provide direct evidence of negative correlation between firm-level measures of collateral supply and risk using firm financial data from Argentina. We measure possible supply of collateral using assets such as firm inventory, property, and liquid securities (see Section IV.B for more details).

A third and 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 in fact the opposite holds. Controlling for other firm attributes, banks demand higher rates of collateralization for larger loans. This is not surprising because a loan officer worries about his total exposure to a single client and will get increasingly risk averse as exposure to a single client rises.

A final identification concern centers on whether other unobserved features of the loan contract 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 rates of collateralization. Indeed, this 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 risk assessment of 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% 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%. Column (2) includes country-industry fixed effects (a total of 782 fixed effects), thus forcing comparisons across firms that belong to the same industry in the same country. Although the R^2 increases by 11% points, the coefficients on the risk grade dummies remain qualitatively unchanged.

Column (3) adds firm size controls and shows that the 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 the log of the approved loan amount (and dropping the decile fixed effects). The coefficient on the log of approved loan amount is large and highly significant. Thus, all else equal, the bank demands greater collateralization for larger loans, possibly reflecting the

Table III

Collateral Spread with Respect to Overall Ex-Ante Firm Risk

This table reports estimates of the collateral spreads with respect to overall ex-ante firm risk grade. There are 15 country fixed effects, 782 country-industry fixed effects and five firm sales fixed effects, wherever specified. All fixed effects are denoted as FE. See Appendix B Table B.I for variable definitions. Standard errors are reported in parentheses and are computed after allowing for correlation across observations in a given country.

	Collateralization Rate			
Dependent Variable	(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 × Industry FE		Yes	Yes	Yes
Sales Size Indicator FE			Yes	Yes
Approved Loan Amount Deciles FE			Yes	
No of Obs.	8,414	8,414	8,414	8,414
R^2	0.39	0.50	0.52	0.51

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 the 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 and ε_{ic} is the 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. Although 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 a lower ex ante assessment of risk. A move from grade "A" to

Table IV
Predicting Default Rate

The table estimates the predictability of default by initial firm risk grade assigned by loan officers at the beginning of the sample, country-industry characteristics, and firm/loan size (first-stage regression). By construction no firm is in default at the beginning of the sample. The dependent variable is default, which has a value of either 0 or 100. Default records whether the loan enters default status by the end of the sample period, that is, after 2 years. Grade "A" is the omitted grade category. The unit of observation is a firm (bank-loan). All fixed effects are denoted by FE. Standard errors are reported in parentheses and are computed after allowing for correlation across observations in a given country.

	End of Sample Default Status (0/100)			
Dependent Variable	(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 × Industry FE		Yes	Yes	Yes
Sales Size Indicator FE			Yes	Yes
Approved Loan Amount Deciles FE			Yes	
No of Obs.	8,414	8,414	8,414	8,414
R^2	0.19	0.28	0.29	0.29

"D" on average increases the propensity to default after 2 years by 6.9% points. This is a large increase given that the mean default rate in the sample is only 5.4%. Comparing the results of column (1) with the corresponding column in Table III also reveals that the increase in collateralization is 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 below makes 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 concerns, larger approved loans are more likely to enter default. As reported 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 1% point increase in the probability of default increases the

Table V

Collateral Spread with Respect to Predicted Default

The table estimates collateral spreads with respect to predicted default estimated in Table IV. Columns (1) to (4) use the respective predicted default probabilities from columns (1) through (4) of Table IV. Regression in column (5) excludes firms with a risk grade of "D", reducing the sample size to 6,793 firms. Column (6) runs a regression at the country-level with the country level estimate of collateral spread as the dependent variable. In columns (1) to (5) the unit of observation is a firm (bank-loan). In column (6) the unit of observation is a country. All fixed effects are denoted by FE. Standard errors are reported in parentheses and are computed after allowing for correlation across observations in a given country for columns (1) to (5).

	Collateralization Rate					Country-Level Collateral Spread
Dependent Variable	(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 × Industry FE		Yes	Yes	Yes	Yes	
Sales Size Indicator FE			Yes	Yes	Yes	
Approved Loan Amount Deciles FE			Yes			
No of Obs.	8,414	8,414	8,414	8,414	6,793	15
R^2	0.40	0.44	0.48	0.47	0.47	0.20

collateralization rate by 2.1% points (columns (2) through (6)), and the result is always significant at the 1% level. The increase of 2.1% 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 the 19% of observations with grade "D" gives very similar estimates.

Although collateral spread is robust to controls such as country, country industry, and size fixed effects, as well as exclusion of grade "D" firms, there may be a concern that the estimate is primarily driven by one or two countries. Table I shows that the distribution of loans across countries is highly skewed, with countries such as the Czech Republic having over 1,400 loans whereas others such as Pakistan have only 96. The regressions in columns (1) through (5) weigh each loan equally, in effect giving a lot more importance to the Czech Republic relative to Pakistan. We test whether 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. To do so, we replace β_1 with β_{1c} in equation (3) and estimate the country-specific collateral spread $\hat{\beta}_{1c}$. We then use this country-specific collateral spread as the dependent variable in column (6), which is run at the country level. The equal country-weighted collateral spread is almost identical to earlier estimates, and significant at the 1% level.

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 (3) and column (5) report OLS estimates. Columns (4) and (6) report IV estimates. *Private Credit to GDP*, *Creditor Rights*, and *Information Sharing* are used as proxies for financial development in columns (1), (2) and (3), respectively. Columns (1) through (4) include country fixed effects and the unit of observation is a firm (bank loan). Regressions in columns (5) and (6) are run at the country level, with country level estimate of collateral spread as the dependent variable. Columns (4) and (6) use *Legal Origin*, *Creditor Rights*, and *Information Sharing* as instruments for "Private Credit to GDP". See Appendix B, Table B.I for variable definitions. Standard errors are reported in parentheses and are computed after allowing for correlation across observations in a given country for columns (1) to (4).

Dependent Variable	Collateralization Rate				Country-Level Collateral Spread	
Instrument for Private Credit to GDP	(1)	OLS (2)	(3)	IV All Three (4)	OLS (5)	IV All Three (6)
Predicted Default	−5.84	−3.17	0.66	−6.11		
	(1.88)	(1.57)	(1.40)	(1.87)		
Private Credit to GDP ×	−3.62			−3.76		
Predicted Default	(0.67)			(0.68)		
Creditor Rights ×		−1.89				
Predicted Default		(0.40)				
Information Sharing ×			−1.08			
Predicted Default			(0.53)			
Log GDP per Capita ×	1.19	1.13	0.23	1.23		
Predicted Default	(0.26)	(0.26)	(0.17)	(0.26)		
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 Obs.	8,414	8,414	8,414	8,414	15	15
R^2	0.40	0.40	0.39	0.40	0.20	0.19

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 may be driven by cross-country differences in income per capita that are proxying for a host of factors other than financial development. We

therefore include log of income per capita as a control by interacting it with expected default in column (1).[10]

Higher private credit to GDP might be an eventual outcome of better institutions, but if collateral spreads are fundamentally driven by differences in institutions, then we should also see a direct relationship between collateral spread and measures of the quality of institutions. A recent paper by Djankov, McLiesh, and Shleifer (2007, henceforth DMS) introduces two new measures of the quality of financial institutions in a country. The first is a "creditor rights" index that measures the ease with which creditors 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 capture the relative power of secured creditors in the event of bankruptcy: (i) the requirement of creditor consent when a debtor files for reorganization, (ii) the ability of a 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 for each of these creditors' protections afforded under a country's laws and regulations. Thus a score of "0" suggests very poor creditor rights whereas "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, our results do not change if we use the average creditor rights index over a different time period.

The information sharing index records a value of one if a country has either a public registry or a private bureau for sharing credit information across financial institutions. Table II 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 15 countries in our sample.

Columns (2) and (3) 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. Because 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

[10]Although all of our specifications in Table VI control for income per capita, our results are also robust to excluding income per capita as a control. Furthermore, the coefficient on the interaction of GDP per capita with predicted default is small and insignificant in the absence of the private credit to GDP interaction. In other words, the bivariate relationship between collateral spread and income per capita is small and statistically insignificant from zero. This result was provided in an earlier draft of the paper.

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

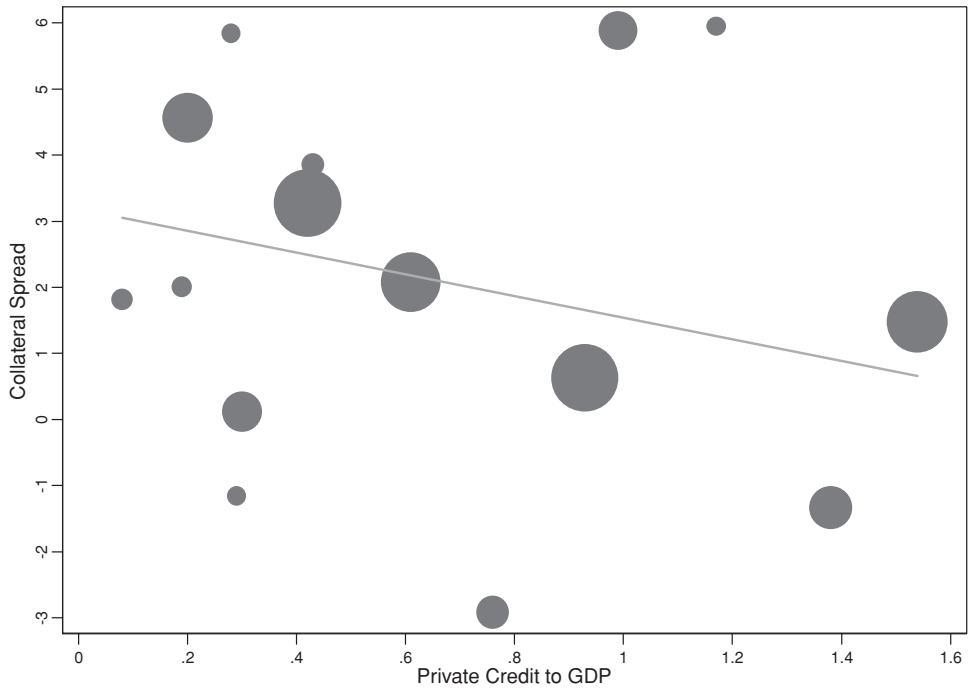

Figure 1. Collateral spread and financial development. This figure plots collateral spread estimated for each country against private credit to GDP. The size of each dot represents the number of loans in that country used to estimate the collateral spread.

an instrument for financial development. Column (4) does so by using creditor rights, information sharing, and legal origin 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 (5) and (6) use country-level estimates of collateral spread as the dependent variable and regress it on the private credit to GDP ratio to illustrate that our results in earlier columns are not subject to weighting concerns. Column (5) runs the OLS specification, whereas column (6) instruments for financial development using the three instruments in column (4).

The magnitude of the decrease in collateral spread due to financial development is large. If we take −3.0 as the average effect, then a one-standard deviation increase in financial development (i.e., 0.47) lowers the collateral spread by −1.4. This reflects a drop of 66% from the average collateral spread of 2.1 estimated in Table V.

Figure 1 plots collateral spreads estimated for each country against private credit to GDP and shows the negative relationship between the two along

[12]Using these instruments separately also gives similar results. The results are reported in the Internet Appendix.

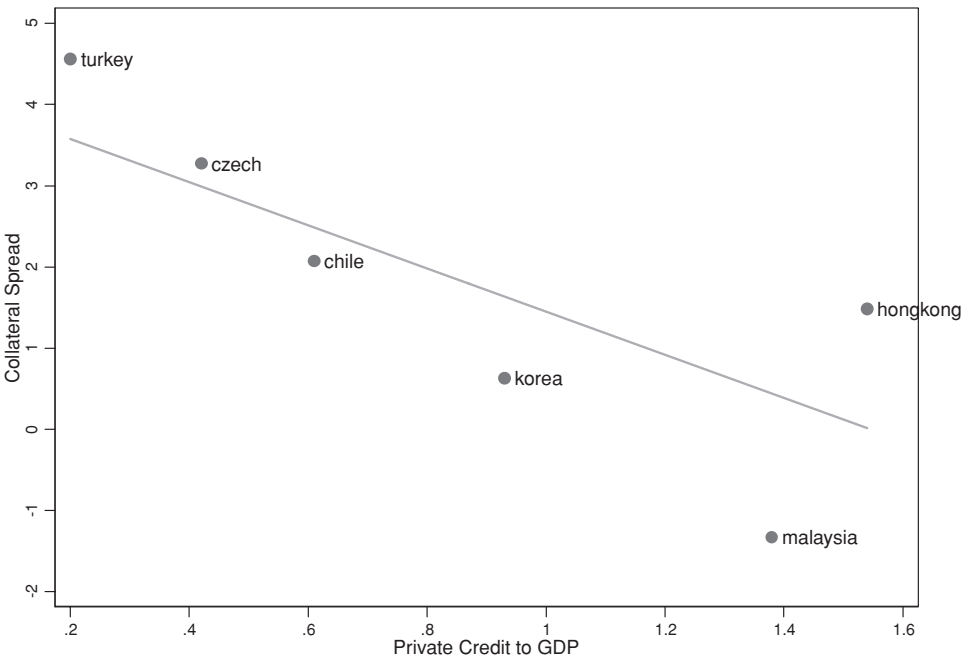

Figure 2. Collateral spread and financial development. This figure plots the line for the six countries with over 500 loans.

with the regression line. The size of each dot represents the number of loans in that country used to estimate the collateral spread. Figure 2 plots the line for the six countries with over 500 loans and again highlights the strong 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 is the type of assets that a bank accepts as collateral.[14]

A key feature of our data set is that it permits us to look at how the *composition* of collateral varies with firm risk. Collateral can be of many types, ranging from firm-specific assets such as inventory, accounts receivables, and plant machinery to non-specific assets, including liquid securities and real estate. Because the value of firm-specific assets is more susceptible to concerns

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

[14]For example, the prevailing credit crunch in the United States has been deepened by the refusal of financial institutions to accept mortgage-backed assets as collateral.

Table VII
Composition of Collateral and Financial Development

The table tests how composition of collateral shifts as firm risk increases within a country and whether the shift varies with financial development. Columns (1) and (4) report OLS estimates. Columns (5) and (6) report IV estimates using *Creditor Rights*, *Information Sharing*, and *Legal Origins* as instruments for *Private Credit to GDP*. See Appendix B, Table B.I for variable definitions. The unit of observation is a firm (bank loan) in all specifications. All fixed effects are denoted by FE. Standard errors are reported in parentheses and are computed after allowing for correlation across observations in a given country for columns (1) to (6).

Dependent Variable	Collateralization Rate of Collateral Type:					
	Non-Specific	Firm-Specific	Non-Specific	Firm-Specific	Non-Specific All Three	Firm-Specific All Three
	OLS				IV	IV
Instruments for Private Credit to GDP	(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 × Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
No of Obs.	8,414	8,414	8,414	8,414	8,414	8,414
R^2	0.36	0.67	0.36	0.66	0.36	0.66

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 relationship.

We begin by collapsing the collateral types in our sample into two categories, "non-specific collateral" and "firm-specific collateral." Non-specific collateral includes land and liquid securities, whereas firm-specific collateral includes inventory, accounts receivable, plant and machinery, and other firm-specific assets. We then decompose the collateralization rate into its non-specific and firm-specific components. Thus, the original collateralization rate variable is a sum of these two components. As reported in Table II, the mean collateralization rate in our sample is 53.9%. A breakdown of the collateralization rate shows that 16.8% points are due to non-specific collateral and the remaining 37.1% points are due to firm-specific collateral.

Although 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 the coefficients of columns (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 the 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 the interaction of financial development with predicted default is negative). Therefore, if the interaction terms in columns (3) and (4) were both negative, this would not be a big surprise—all that it would have meant is that as collateral spread decreases 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. Although the coefficient on the interaction in column (3) is negative and significant, the interaction term in column (4) is 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 specific assets. This suggests that financial development not only reduces the reliance on collateral, but also enables banks to accept firm-specific forms of assets as collateral. This result is intuitive as 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 three of our main instruments (legal origin, creditor rights, and information sharing institutions). The results are essentially unchanged. Finally, note that all of the aforementioned results are robust to the addition (and subtraction) of our usual set of controls. These results are not reported for the sake of brevity but are available in the Internet Appendix.

The results in columns (1) and (2) of Table VII are also robust to collapsing data at the country level and regressing the 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.[15]

[15]These results are reported in the Internet Appendix.

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 of restrictions put on assets acceptable as collateral. However, improvements in financial institutions that promote creditor rights and contractual enforcement reduce 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, for example, Beck, Demirguc-Kunt, and Maksimovic (2005)). Moreover, recent evidence from China and Taiwan, as well as more systematic evidence in Beck, Demirguc-Kunt, and Levine (2005) suggests that helping small and medium enterprises is likely to have important effects on economic growth as well.[16]

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 enable 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 the log of approved credit as the left-hand side variable. Columns (1) and (2) show that, as expected, firms with a higher ex ante probability of 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 instrument 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 whereas riskier firms have to put up relatively less additional collateral in financially developed economies, they are able to borrow more. We would like to emphasize that we measure firm risk in an objective manner, that is, propensity to default. Thus, "high risk" versus "low risk" has the same meaning across countries, particularly in light of our robustness tests that allow for heterogeneity in risk scales across countries, reported in the next section.

IV. Robustness Checks

A. Heterogeneity in Risk Scales

The default prediction regression in equation (5) regresses ex post default rates on ex ante risk grades with country fixed effects. The fixed effects absorb any average differences across countries in their default rate or risk grades. However, the equation implicitly assumes that the risk scales are similar across

[16]The small- and medium-sized firms in our sample should not be understood as "mom and pop" operations. The average loan amount in our sample is US $570,000 for a set of countries with mean GDP per capita of $7,000 in 2003. Because the contemporaneous GDP per capita for the United States is around $37,000, a rough GDP-adjusted benchmark would be firms in the United States with an average loan size (from a single bank) of around $3 million.

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 to firm risk differs with financial development. Columns (1) through (3) and (5) to (6) report OLS estimates. Columns (4) and (7) report IV estimates using *Creditor Rights*, *Information Sharing*, and *Legal Origins* as instruments for *Private Credit to GDP*. There are 15 country fixed effects, and 782 country-industry fixed effects, wherever specified. The unit of observation is a firm (bank loan) in columns (1) to (4). Specifications in columns (5) through (7) are run at the country level, with country level estimate of *Approved Credit* as the dependent variable. See Appendix B Table B.I for variable definitions. All fixed effects are denoted by FE. Standard errors are reported in parentheses and are computed after allowing for correlation across observations in a given country for columns (1) to (4).

Dependent Variable	Log Approved Credit				Country-Level "Approved Credit"		
	OLS			IV	OLS		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 × Industry FE		Yes					
No of Obs.	8,414	8,414	8,414	8,414	15	15	15
R^2	0.39	0.47	0.39	0.39		0.14	0.14

countries. For example, it imposes 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 hold exactly, it is not clear why this would 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. Specifically, 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 scales. 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).[17] Thus, we find no evidence of heterogeneity in risk scales, and our collateral spread estimate remains essentially unchanged.

[17]The results are available in the Internet Appendix.

B. Firm-Specific Factors

Section II.C outlines firm-specific concerns related to supply-side variables affecting our estimate of collateral spread. One concern is that a positive correlation between collateral supply and risk at the firm level could generate a spurious positive collateral spread. However, using our sample of loans from Argentina, for which we have more detailed firm financial data, we show that the supply of collateralizable assets is in fact negatively correlated with firm risk.

Specifically, 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 the 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.[18] Because we are interested in risk at the time of loan origination, excluding the loan given by our bank from 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 in order to get a sense of the supply of collateral per borrowing need of the firm.[19] The summary statistics of these new measures and other firm attributes such as profitability and interest rates are provided in the Internet Appendix.

Columns (1) through (4) of Appendix, Table BII report how the different measures of the supply of collateralizable assets vary with ex ante firm risk grade. All regressions include industry fixed effects as controls. Regardless of the exact definition used, collateral supply is negatively correlated with firm risk, that is, supply decreases as the measure of firm risk goes up. The bottom panel reports the raw correlation between the 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 is that unobserved latent demand for loans might spuriously generate a positive collateral spread. However, columns (5) and (6) in Appendix, Table BII 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. Because firm profitability goes down with firm risk, the latent loan demand should also decrease with firm risk. We have already seen that all else equal, larger loans are associated with higher rates of collateralization (Table V, Column (4)). Thus, a negative correlation between firm risk and profitability (or latent demand for loans) also biases our estimate of collateral spread downwards. Overall, both unobserved collateral supply

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

[19]We also tried normalizing by total sales, and the results were very similar.

and unobserved latent demand for loans imply that our estimates of collateral spread are on the conservative side.

Finally, columns (7) and (8) 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 is driven by 15 countries. This can raise concerns that our results may not be representative of the broader population of emerging markets. We therefore address the representativeness of our sample of countries.

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.

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

A replication of the main Rajan and Zingales (1998) result (Table IV in their paper) in our sample of countries shows that *all* of their results hold in our sample in terms of coefficient magnitude as well as statistical significance.[20] Similarly, Levine and Zervos (1998) find a robust correlation of 0.35 between financial development and output growth, whereas we find this correlation to be 0.6 and highly significant in our subsample.

We also replicate the main findings of the law and finance literature in our subsample. The first stage of our IV estimates shows that the connection

[20]There are nine countries that are common between the 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 provided in the Internet Appendix. The Internet Appendix also provides some additional discussion on the generalizability of our results given our focus on small and medium-sized firms.

between legal origin, creditor rights, and informational institutions uncovered in La Porta et al. (1997) and DMS (2007) holds in our subsample as well. The variation in financial development and the replication of results in the law, finance, and growth literature suggests that our sample of countries is representative of the full sample. It is therefore reasonable to assume that our findings are more broadly representative of the link between collateral costs and financial development.

D. Alternative Models of Default/Collateral

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

In the absence of strategic default, the default rate affects the rate of collateralization, not the other way around. However, when borrowers can default strategically, 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 requirements 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 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

The seminal work of Stiglitz and Weiss (1981) highlights the fact that risks associated with agency problems in financially underdeveloped economies cannot be priced through 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 underdevelopment, collateral spreads should be more relevant than interest rate spreads.

This paper estimates the cost of financial underdevelopment in terms of its impact on the value and specificity of collateral spread. We are the first to explore this relation (to our knowledge). This analysis is facilitated by the use of a unique cross-country loan-level data set covering smaller firms, which 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 the composition of pledged assets gives us a rare opportunity to understand how the magnitude and nature of collateral varies with firm risk and across different institutional regimes.

Because our data come from a single multinational bank, this might raise concerns regarding the generalizability of our results. However, holding the lender (and nature of lending program) constant also makes borrower comparisons more reliable. Furthermore, as mentioned above, the high level of local decentralization within the bank means that none of our results are "hard-wired" by bank rules.

The reliance on collateral-based lending is a sign of financial imperfections in the economy because, ideally, lending should only be based on future expected cash flows. Our paper takes a step towards understanding the mechanisms that can limit the reliance on collateral-based lending. Further work in this area should deepen our understanding of how financial market efficiency can be improved.

Appendix A: Proofs

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

$$Y = \frac{1.8p - 0.4 - 1.2p^2}{(p - 0.4)} \tag{A1}$$

and

$$r = \frac{1}{p} - \left(\frac{1-p}{p}\right) Y. \tag{A2}$$

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

Proof, Result 2: CASE 1 – F measures the protection of creditor rights. Because lenders now expect (YF) back in the case of default, we can replace Y with (YF) in (A1) and get $Y = \frac{1}{F}[\frac{1.8p-0.4-1.2p^2}{(p-0.4)}]$. It follows that collateral spread declines with better creditor protection, $\frac{\partial^2 Y}{\partial(1-p)\partial F} < 0$.

CASE 2 – F measures the cost of cheating, $c(F)$. The IC condition (1) changes to

$$(R - r) * p - Y * (1 - p) \geq (R' - r) * p' - Y * (1 - p') - c(F). \tag{A3}$$

Plugging (2) into (A3), we get

$$Y = \frac{1.8p - 0.4 - 1.2p^2 - p * c(F)}{(p - 0.4)}. \tag{A4}$$

It follows that collateral spread decreases with the cost of cheating, $\frac{\partial^2 Y}{\partial(1-p)\partial F} < 0$. Q.E.D.

Appendix B
Table B.I
Variable Definitions

The table presents the definitions of variables used in distribution of data by country along with a country's financial and economic development indicators. The variables *Private Credit to GDP*, *Creditor Rights*, *Public Registry*, and *Private Bureau* were downloaded from the Djankov, McLiesh and Shleifer (2007) data source at www.andrei-shleifer.com.

Variable Name	Definition
Approved Loan Amount	A series of indicator variables that take a value of one if the loan belongs to the specific decile of the approved loan amount distribution.
Collateral Type	A classification system with two categories and seven subcategories. The two categories are specific and non-specific assets. The two sub-categories for non-specific assets are: (i) Land and Real Estate, including buildings; (ii) Liquid assets, including cash or liquid securities held by the firm such as bonds and shares. The five subcategories for specific assets are: (i) Firm inventory/machinery and equipment; (ii) Account receivables, including receivables, contract orders, and post-dated checks; (iii) Guarantees, including any type of promissory note, third-party guarantee, or other bank guarantee; (iv) Letters of credit, including stand-by and import and export letters of credit; and (vii) Other firm-specific assets that do not correspond to the five preceding sub-categories.
Collateralization Rate	The percentage of the loan that is covered by the estimated liquidation value of the collateral.
Creditor Rights	An index that reflects the ease with which creditors can secure the assets in the event of bankruptcy. Takes on discrete values of 0 (weak creditor rights) to 4 (strong creditor rights).
Default by End of Sample	An indicator variable that takes a value of one if the firm is in default at the end of the sample period, and zero otherwise.
Information Sharing	An indicator variable that takes a value of one if a "Pubic Registry" or a "Private Bureau" is present in the country, and zero otherwise.
Legal Origin	An indicator variable that indicates the legal origin of each country's code of law. In our sample the three origins are French, German, and English.
Private Bureau	An indicator variable that takes a value of one if a private credit bureau operates in the country, and zero otherwise.
Private Credit to GDP	The ratio of credit from deposits in financial institutions of the private sector relative to GDP expressed in percentage terms. Averaged over 1999 to 2003 in the DMS data set.
Public Registry	An indicator variable that takes a value of one if a public credit registry operates in the country, and zero otherwise.
Risk Grade	An index of the ex-ante assessment rating for a borrower, respresenting the riskiness of a borrower at the time of loan origination as determined by the bank's loan officer. Takes on values of "A" (best) to "D" (worse).
Sales Size	An indicator variable that captures the size of the firm. The indicator depends on the total net sales of the firm as reported in the last available audited financial statement. Indicators 3, 2, 1, and 0 are for firms with net sales >$25 million, <$25 million & >$5 million, >$1 million and <$1 million, respectively.

Table B.II

Collateral Supply, Productivity, and Interest Rate to Risk Schedule

This table shows how ex-ante firm risk assessed by a loan officer is correlated with proxies of collateral supply at firm level (columns (1) through (4)), firm productivity (columns (5) and (6)), and bank interest rate (columns (7) and (8)). Regressions are run over a sample of 587 Argentine firms, corresponding to the same small and medium-sized business lending program. Summary statistics for these variables are reported in the Internet Appendix. The dependent variables in columns (1) to (6) are computed from the last available audited financial statements. *Lending Interest Rate* is the ratio of total lending revenues (interest + fees) over the average assets used by the firm on annual basis. *Aggregate Interest Rate* is the ratio of total lending and non-lending revenues over average assets. The unit of observation is a firm (bank-loan). Grade "A" is the omitted grade category. The two bottom rows present correlations between the corresponding column dependent variable and firm *Risk Grade*, with firm risk grade codes of 1 through 4 for "A" through "D," respectively. Fixed effects are denoted by FE. The differences in the number of observations correspond to missing dependent variables. Robust standard errors are reported in parentheses.

Dependent Variable	Log Net Worth (1)	Net Worth/ Total Assets (2)	Log Net Collateral (3)	Net Collateral/ Total Assets (4)	ROA (5)	EBITDA / Sales (6)	Lending Interest Rate (7)	Aggregate Interest Rate (8)
Grade = B	−0.30	−0.11	−0.131	−0.037	−0.026	−0.020	−0.0026	0.0098
	(0.15)	(0.020)	(0.15)	(0.022)	(0.012)	(0.013)	(0.0081)	(0.0066)
Grade = C	−0.72	−0.16	−0.39	−0.04	−0.046	−0.028	0.0134	0.017
	(0.16)	(0.022)	(0.15)	(0.023)	(0.013)	(0.013)	(0.0085)	(0.0067)
Grade = D	−1.08	−0.12	−0.94	−0.079	−0.127	−0.120	0.0217	0.024
	(0.42)	(0.058)	(0.39)	(0.056)	(0.034)	(0.053)	(0.0186)	(0.019)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No of Obs.	585	586	584	587	587	584	417	389
R^2	0.18	0.10	0.14	0.04	0.15	0.13	0.05	0.04
	Correlation between dependent variable and firm risk grade							
Correlation	−0.262	−0.245	−0.205	−0.070	−0.133	−0.163	0.142	0.105
p-value	0.000	0.000	0.000	0.089	0.001	0.000	0.004	0.039

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