Uncovering Collateral Constraints

Jose Maria Liberti*

Abstract

Collateral may be used as *commitment* against ex-ante agency risk, or for *hedging* against ex-post realized risk. Using a panel data of 12,000 small and medium firms in 17 countries with direct measures of ex-ante agency risk and ex-post realized default, we find that the commitment motive alone explains collateralization. Going from the lowest to highest quintile of ex-ante agency risk distribution increases initial collateralization by 16 percentage points, but the same change in ex-post realized default leads to no change in collateralization. We also uncover a collateral "pecking order" driven by commitment concerns. While the bank is willing to accept firm-specific assets susceptible to agency risk (e.g. plant machinery and inventory) for low agency risk firms, it prefers non-specific assets (e.g. real estate and liquid securities) for firms prone to agency risk.

*DePaul University, The Charles H.Kellstadt Graduate School of Business. Corresponding Address: 1 East Jackson Boulevard, Chicago, Illinois, 60604. E-mail: jliberti@depaul.edu. I thank Jim Booth, Gabriella Bucci, Doug Diamond, Atif Mian, Steven Ongena, Luigi Zingales and seminar participants at DePaul University, Kellogg School of Management, and London Business School for helpful comments and suggestions.Scott Noorthhoek provided superb research assistance. All errors are my own.

Collateral is one of the most common characteristics of loan contracts. Many influential theories use the presence of collateral to explain a wide variety of phenomena ranging from business cycles to poverty traps.[1] But why does collateral exist?

Explanations for the use of collateral can be conceptually divided into two categories. The *commitment view* suggests that collateral provides a credible mechanism for commitment against agency risk such as moral hazard and asymmetric information. *Hedging view* on the other hand suggests that collateral provides a convenient hedge against realized ex-post risk of default.

The two views differ substantially on how one should perceive collateral. While *commitment view* credits collateral with preventing many costly risks altogether, *hedging view* treats collateral as a passive instrument used only for transferring existing risk from one economic agent to another. This paper constructs new tests that empirically separate these two views and finds *commitment* to be the primary motive for collateralization.

Our empirical design to separate commitment from hedging is based on the simple observation that if borrowers use collateral to credibly commit themselves against an agency risk, then one should *not* observe that particular risk in equilibrium ex-post. Suppose there are two types of risks that a bank faces from a borrower ex-ante: agency risk and production risk. Agency refers to the usual risk that borrower may be of bad type or that he might misbehave in future. Production risk refers to the natural business risk inherent in all projects. For the sake of simplicity, assume that ex-ante agency and productions risks are uncorrelated with each other. Then if collateral is used to *commit* against agency risk then collateral should be positively correlated with measures of ex-ante agency risk, but uncorrelated with ex-post realized risk. Conversely if collateral provides a *hedge* against realized risk ex-post, then collateral should be positively correlated with ex-post realized risk and uncorrelated with ex-ante agency risk.

The data requirements to implement this empirical design are quite specific. We need ex-ante measures of both agency and production risk, as well as measures of ex-post realized risk (i.e. default). In addition one needs information regarding the size of loan and the fair market value of any collateral used to secure the loan. Fortunately, we have access to such data in this paper.

Our data is a panel of almost 9,000 small and medium-sized firms from fifteen emerging markets.

[1] An incomple list of such work includes explanations for business cycles, transmission and amplification of macro shocks (Bernanke and Gertler (1989), Kiyotaki and Moore (1997), Aghion, Banerjee and Piketty (1999)); income inequality (Banerjee and Newman (1993)); and poverty traps (Mookherjee and Ray (2002)).

It comes from the portfolio of a large multinational bank and covers the period from 2002 to 2004 at six-monthly frequency. The inclusion of small and medium sized firms in the sample is useful as both agency and production risks are likely to be high, making commitment and hedging relevant issues for these firms. Similarly, coverage of a wide spectrum of emerging markets, including Argentina, Chile, Czech Republic, Hong Kong, India, Korea, Malaysia, Pakistan, Romania, Singapore, Slovakia, South Africa, Sri-Lanka, Taiwan and South Africa adds to the robustness and generalizablity of our results.

The key variables in our sample include an ex-ante measure of firm risk computed by the bank. This measure is derived from an information template that includes the bank loan officer's assessment of production risk (such as profitability, ability etc), as well as agency risk (such as reliability of information, management character etc.). The sample also contains information on collateral, including the current assessed liquidation value of collateral and the type of asset put up for collateral. Finally, the data also includes information on approved loan amount, outstanding loan amount, ex-post default status, firm size, and industry.

The availability of both ex-ante and ex-post risk measures enables us to implement our empirical design. We first purge from the ex-ante measure of overall firm risk, its component that predicts ex-post realized default. Since the original ex-ante measure takes into account both preventable agency risk and the expected realized risk (i.e. production risk in the example earlier), focusing on the component orthogonal to realized ex-post risk allows us to isolate ex-ante agency risk. We can then use the ex-ante agency and ex-post realized risk measures to test commitment and hedging view predictions.

The paper finds that consistent with the *commitment view*, initial collateralization is strongly and positively correlated with ex-ante agency risk but completely uncorrelated with ex-post realized risk. Both these results reject the *hedging* motive for collateralization. The magnitude of the commitment effect is also quite large. Going from the lowest to highest quintile of ex-ante agency risk distribution increases the rate of initial collateralization by 16 percentage points when the mean rate of collateralization is 54 percent.

We also uncover an interesting "pecking order" of collateralized assets that lends further support to the commitment view that collateral limits agency risk. We find that the bank is more likely to accept firm-specific assets that are prone to agency concerns from firms with low agency concerns. Examples of agency prone assets include inventory, machinery, and accounts receivables since their value is susceptible to bad actions such as stealing or neglect by firm management. On the other hand

bank only accepts non-specific assets not susceptible to agency concerns from firms with high ex-ante agency risk. Non-specific assets include land, industrial buildings, and liquid securities as they are difficult to hide or abscond with, and their value is less susceptible to management neglect.

The paper also performs a number of additional robustness checks for alternative explanations and endogeneity concerns. However, we postpone this discussion till section V. in the interest of brevity.

Our work is the first to empirically separate commitment and hedging motives of collateralization. A number of theoretical papers have highlighted the role of collateral as commitment against agency risk. Our empirical results are consistent with papers such as Barro (1976), Stiglitz and Weiss (1981), and Chan and Thakor (1987) which argue that the threat of agency risk in the form of unobserved borrower attribute or action leads to greater use of collateral as a commitment device[2]. Although papers such as Bester (1985) make the opposite prediction by suggesting that low risk firms might sort on high collateral - low interest rate contracts, our empirical results do not favor such explanations.

Our results are also in line with the standard principal-agent result that it is inefficient for principal (banks) to try and transfer realized risk to the agent (borrower). However, a priori there might have been other reasons for banks to transfer at least some of the realized risk to borrowers through collateral. These include risk-shifting as a mechanism for inducing greater effort by the borrower (see e.g. Jensen and Meckling (1976), Innes (1990), and Dewatripont, Legros, and Matthews (2003)). Another reason could be a conscious effort by loan officers to be excessively risk-averse due to intra-organizational agency and career concerns (e.g. Holmstrom (1999) and Zwiebel (1995)).

The rest of the paper proceeds as follows. Section I describes the data of our paper. Section II analyzes the theoretical framework and discusses the identification strategy for the empirical tests. Section III provides results on the demand for collateralization and tests for endogenous alternative explanations. Section IV uncovers a pecking order for collateral requirements and provides a calibration exercise in terms of real economic measures. Section V concludes raising some important questions for future research suggested by our findings.

[2]Rajan and Winton (1995), and Park (2000) suggest that collateral may also be used as commitment by the *lender* to provide monitoring effort. However, these models are written in the context of institutional loans with other public bond-holders, an environment different from the one our firms belong to. Our pecking order result also goes against such explanations.

I. Conceptual Framework

A. *Defining Ex-post Realized Risk and Ex-ante Agency Risk*

Since banks hold debt claims on their borrowers' assets, default is their primary measure of risk. There are two fundamental sources of potential default risk facing a bank. We define one as ex-ante preventable *agency risk*, and the other as ex-post *realized risk*.

Consider an economy with a continuum of firms each wanting to invest 1$ by borrowing from a bank. Loan contract between a bank and firm takes the form of an interest rate $r > 1$ and a collateral amount $w < 1$ pledged by the firm. Firms vary by their risk attributes denoted by the pair (α, β), where α and β are both between 0 and 1. β captures the production risk inherent in a firm's technology. It can produce $Y > 1$ with probability $(1 - \beta)$ and 0 otherwise. α on the other hand captures the degree of agency risk inherent in a firm. If a firm produces an output Y, it can choose to repay the promised interest rate $r < Y$ to the bank or declare default strategically. In case of default, the firm looses part of its future productivity due to a loss of reputation in financial markets given by $(1 - \alpha)Y$. It also loses its initial collateral worth $w < 1$ in case of default. Hence the firm chooses not to default only if the following IC condition holds:

$$Y - r \geq \alpha Y - w \tag{1}$$

Our measure of agency risk, α, in (1) effectively represents the fraction of firm assets that borrower can abscond with. Figure I summarizes the above set up.

B. *The Dual Role of Collateral: Commitment and Hedging*

In the above framework, a bank can use collateral w either to receive commitment against agency risk (α), or to hedge against realized risk (β). Papers such as Barro (1976), Stiglitz and Weiss (1981), and Chan and Thakor (1987) argue that in the face of agency risk of the sort captured by α, a bank may impose collateral requirements to minimize risk. This can be seen from (1) where collateral worth $w = r - (1 - \alpha)Y$, guarantees no agency risk in equilibrium.

A second potential use of collateral comes as a hedge against realized risk. It is common among practitioners to think of collateral as a hedge against actual default by a firm. Theory also provides a number of rationales for why a banker may want to do so. For example, work by Jensen and Meckling

(1976), Innes (1990), and Dewatripont, Legros, and Matthews (2003) suggests that banks may want to transfer more of the risk towards the firm for incentivizing managers. Similarly, organizational literature such as Holmstrom (1999) and Zwiebel (1995) suggests that loan officers within a bank hierarchy might be excessively risk averse due to intra-firm agency issues and career concerns. Consequently the higher β is, the more attractive collateralization appears to the bank under the hedging hypothesis. Under the pure hedging hypothesis, high α firms cannot commit against agency risk and hence will not be given financing.

The commitment and hedging views differ dramatically in their perception of collateral. Commitment view sees collateral as an effective tool for minimizing agency risk in the economy. Hedging view on the other hand treats collateral as a passive tool used only for sharing existing risk across agents.

Our conceptual framework provides some simple predictions that can help separate commitment and hedging views empirically. These predictions are summarized in the proposition below.

Proposition 1 *Under commitment view, collateralization is uncorrelated with realized risk β, but positively correlated with ex-ante agency risk α (i.e. $w = r - (1-\alpha)Y$). Under hedging view, collateralization is positively correlated with realized risk β, but uncorrelated with ex-ante agency risk α.*

II. Empirical Estimation

We first describe the data used to test proposition 1 and then go into the details of estimation procedure.

A. Data

Our data comes from the Emerging Local Company division of a large multinational bank. Although the original data is a panel with 4 six-monthly observations spread over 2 years for each firm, for most of our analysis we will only be using the cross-sectional variation after picking the first observation in time for each firm.

In all, the data has information on 8,820 firms. These firms come from 15 different emerging markets and cover 87 different industries (Table I). Thus our data covers a wide spectrum of countries in terms of geographic location and economic status. This cross country and industry variation allows

us to test the generalizability of our results across economies of different types and firms operating in different industries.

For each firm the data contains information on the identity of the firm, its total approved loan, the actual outstanding amount of loan, whether the loan is in default, a size category of the firm determined by sales, firm risk grade, amount of secured and supported collateral, type of collateral, industry, and country. Table IIA provides summary statistics for these variables. When reporting these statistics we also present standard deviation of variables after demeaning them at the country and country-industry level. The rationale is that most of our regression specifications include country or country-industry fixed effects. As such we report the demeaned standard deviations to give an idea of how much of the total variation of the variable is left after taking out the corresponding fixed effect.

While some of the variables in Table II A are self explanatory, others require a more detailed description. One of the most important variables in the data is RISK GRADE. The grade (from A [Best] to D [Worst]) represents the riskiness of the firm as determined by the bank. It is calculated after collecting various quantitative and qualitative pieces of information by the bank such as firm financials, interviews, site visits, and third party verifications.[3] More importantly the variable explicitly takes into account measures of agency as well as business risk.

We have seen the credit manuals that explain the construction of this risk measure. While we are not at liberty to divulge all the variables collected and procedure used by the bank to construct this risk measure, it contains information related to both agency and business risks. For example, the information grid used to compute risk grade include information on business risk such as profitability, industry outlook and other financial ratios. Similarly, it also includes direct measures of agency risk such as the quality and reliance of information and management business practices. Table II A shows, all four types of grades are fairly well represented in the data. Moreover, there is significant variation in grades not only across countries but also within country and country-industry categories.

The variable TIER takes on four values (0 to 3) capturing the size of the firm as determined by its sales. The firms in our sample are skewed towards smaller sized categories which is consistent with the focus of this lending program on small and medium size firms. Also, there is significant variation in this variable not only across countries but within country and country-industry bins. The mean of total approved loan is $557,000 while the total outstanding is $343,000.

[3] See Liberti and Mian (2005) for a more detailed description of the information gathering process as well as the effectiveness of the information collected in predicting future firm performance.

Although all firms in the sample are by construction not in default at the beginning of the sample period, they may default subsequently. The variable EOP DEFAULT captures the default status of the 8,820 firms at the end of the two year sample period. It shows that 4.75% of the firms had defaulted by then.

For each firm collateralization of its loans is recorded as follows. The variable SECRATIO represents the percentage of the loan that is covered by secured collateral. The liquidation value of the collateral is estimated by the bank under the assumption that the firm will be in a state of distress at the time the collateral is being forced to liquidate.[4] About 54% of a loan is covered by secured collateral under this definition. Notice that the current market value of the collateral is likely to be larger than the liquidation value assessed by the bank. The percentage of the loan not covered by the liquidation value but covered by the current market value of the collateral is referred to as "supported". The variable SUPRATIO represents this percentage and shows that 17% of a loan is supported by this collateral. The remaining portion of the loan (i.e. the amount beyond the current market value of the collateral) is called unsecured and represented by UNSECRATIO.

Our data also contains information on the type of collateral used by a firm. Collateral types are bundled in seven categories: (i.) Asset Based Financing (ABF) refers to collateral representing a firm's own specialized assets such as machinery and inventory. Use of vehicles and equipment as collateral is acceptable only when it is used by the firm in their core business operation[5] (ii.) Account Receivables (AR) refer to discounting of receivables financing, contract orders and post-dated checks (iii.) Cash or liquid securities held by the firm (CASH) includes cash, bonds, shares and any other type of liquid investments (iv.) Guarantees (GUA) include any type of promissory note or third-party or other bank guarantees (v.) Letter of credit (LOC) includes stand-by, import and export letters of credit (vi.) (LAND) includes fixed assets such as land or industrial building, and (vii.) (FS) that includes unspecified firm-specific collateral that does not qualify in any of the other categories under consideration.[6] See Appendix A for a complete list of the types of collateral in each category.

It is also important to keep in mind that a given firm can offer multiple collateral types for its

[4] Liquidation values are reviewed after 3, 6 and 12 months depending on the type of lending product. For example, mortgage products are reviewed on a yearly basis, while vehicles, inventory, equipment and other specific asset are reassessed on shorter terms due to the nature of the asset.

[5] For example, tractors of an integrated agricultural production company, trucks of a transportation company or cars of a limousine fleet.

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

borrowing. Notice that the collateral types differ in some important aspects such as their specificity to the firm's operations and performance. For example, while the value of ABF collateral is highly firm-specific, the value of LAND collateral is quite unspecific. This specificity implies that some types of assets are much more sensitive to firm-specific agency concerns than others. For example, while firm inventory might be stolen or damaged right before default, land is not subject to such concerns.

All variables specified in Table IIA are collected in each country under the same information gathering system. This information is collected and provided in a uniform manner across countries. Nevertheless, each country follows its own set of rules and characteristics in its screening and credit approval processes. Moreover, loan officers have complete discretion in terms of the value and type of collateral they want to demand from a firm.

The sample of 8,820 firms shown in Tables I and IIA is obtained after applying some basic screening rules on the original data set we received. The original data had 12,591 firms. 766 firms were dropped as they were already in default by the time they first appear in the data. Since these firms are not actively borrowing during our sample period, we do not know their ex-ante firm risk grade, nor do we know the rate of collateralization demanded by the bank when the firm was actively borrowing. Another 1,599 firms were dropped as they reported a risk grade of "other". Since risk grade is a key variable in our analysis, and there is no obvious interpretation of "Other" in terms of firm quality[7], we dropped these observations. Finally, another set of 1,406 firms was dropped as they did not draw any loan from the bank during our sample period and hence have no collateral information.[8]

The cross-country data described above does not have information on firm financials. However for one of the countries in our sample (Argentina), we also have information on firm financials and interest rates. This data is part of the same cross-country lending program that we described above. The information from Argentina was hand-collected by the authors by going through the credit files of 601 small and medium Argentinian firms under the small and medium lending program from 1995 to 2001. As such we not only have information on grades and their computation but also have annual balance sheet, income statement, and interest rate information. See Liberti and Mian (2005) for a detailed description of this data. Table IIB shows summary statistics for some key new variables that this data provides. The extra information on collateralizable assets, profitability, and interest rates

[7] This is based on our discussions with a relevant bank official.

[8] The bank has approved some loan amount for these firms, but as such firms chose 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.

will be useful in testing for endogeneity concerns in the remaining analysis.

B. Basic Estimation Equation

In order to test proposition 1, we need measures for ex-ante agency risk (α) and ex-post realized risk (β). The data contains a direct measure of ex-post realized default risk. However as explained above, our ex-ante risk measure contains both agency risk and "expected" realized risk. Fortunately though, we can extract the ex-ante agency risk component from this overall measure by purging it of the component that predicts future realized risk. In particular, let R_i^0 be the initial ex-ante risk measure and Z_i^T be the final ex-post realized default risk for firm i in our sample. Then by projecting R_i^0 on Z_i^T, one can separate R_i^0 into the component R_i^{Z0} that predicts Z_i^T, and the orthogonal residual component $\widehat{R}_i^0$ that only contains ex-ante agency risk information. $\widehat{R}_i^0$ thus becomes our measure of ex-ante agency risk, and Z_i^T the ex-post realized risk measure.

Proposition 1 can then be tested by running the initial rate of collateralization Y_i^0 on ex-ante agency and ex-post realized risk measures:

$$Y_i^0 = \alpha + \beta_1 R_i^0 + \beta_2 Z_i^T + \varepsilon_i \tag{2}$$

We do not have to directly put in $\widehat{R}_i^0$ in (2) since the covariate Z_i^T automatically absorbs the projection of R_i^0 on Z_i^T. According to proposition 1, if the *commitment view* of collateral is correct, then $\beta_1 > 0$ and $\beta_2 = 0$. Alternatively, $\beta_1 = 0$ and $\beta_2 > 0$ if only the *hedging view* is correct.

Before taking equation (2) to data, we make a few adjustments motivated by data considerations. For example, instead of imposing a linear relationship between risk measure and collateralization, we shall adopt a more non-parametric approach. Similarly, equation (2) in its current form side steps issues of cross-country differences. In reality since our data comes from a number of different economies we need to make sure that none of the estimated coefficients are driven by spurious correlations across countries. For example, a grade "A" firm in one country may not be fully comparable with a grade "A" firm in another economy. There may also be regulatory and institutional differences across economies affecting the rate of collateralization of loans. We account for such differences across countries by including country fixed effects in all our regressions. The fixed effects ensure that we only compare loans within the same economy. We can also put in other controls that we will describe in more detail in the results section.

III. Separating Ex-ante Agency Risk from Ex-Post Realized Risk

A. Collateralization and Risk Grade

We start off by estimating (2) using the variable SECRATIO as our measure of collateralization. SECRATIO represents the percentage of loan that is securely collateralized, *i.e.* the percentage of loan covered by the liquidation value of collateral. Our convention will be to keep grade "A" as the omitted category. Thus coefficients on other grade dummies represent average differences from grade "A" firms within a country.

Results in Table III show that collateralization is positively correlated with ex-ante measures of firm risk. In particular, while the difference in collateralization between grade A and grade B firms is not statistically different, collateralization of grade C firms is significantly higher by 2.7 percentage points than grade A firms. The rate of collateralization then shoots up for the worst quality firms. Collateralization rate for grade D (*i.e.* the riskiest firm ex-ante) is 11 percentage points higher than grade A firms. The jump in collateralization is all the more striking given that the mean SECRATIO in our sample is 54%.[9]

The results of column (1) are strengthened once we add firm size controls and country-industry fixed affects in column (2). Firm size controls include indicator variables for the different TIER classifications described in Section I. Country-industry fixed effects are constructed by interacting the 87 industry fixed effects with the 15 country level fixed effects. This construction is quite exhaustive and creates a total of 782 fixed effects. Column (2) results are then further strengthened once we also include dummies for each decile of total approved loan amount (column (3)).

The strengthening of results as we put in more controls, and in a flexible and non parametric way is related to the issue of whether $\widehat{\beta}_1$ is an underestimate of the true elasticity of demand coefficient. We will discuss in detail this concern in Section V. For example column (3) suggests that riskier firms have smaller outstanding loans, and since all else equal smaller loans require lower collateralization, including size controls increases $\widehat{\beta}_1$ coefficient. This view is further supported by column (4) that shows that lower loan size significantly reduces the demand for collateralization. In particular, column (4) suggests that banks are risk averse and try to limit the exposed risk by demanding more collater-

[9] Strictly speaking, our simplified theory predicted zero collateralization for the best quality firms. This is of course not true in the data because, (i) quality is not perfectly measured by grades, and any such mismeasurement will only lead average collateralization away from zero, and (ii) some minimum level of collateralization can be optimal for a risk-averse bank.

alization as the level of exposure to a single party increases. This evidence also suggests that marginal cost of collateralization increases with loan size, leading to convex cost of borrowing for firms.[10]

Since our data covers fifteen economies, a natural question at this point concerns the robustness of our results to the choice of countries. For example, is the result primarily driven by one or two countries or does it hold more generally within the sample? We therefore estimate country specific demand elasticities by estimating the equation in column (3) separately for each country. Since the number of firms varies considerably by country (see Table I), our estimate for some countries will be more precise than others.

Figure IIa plots the demand elasticity coefficient separately for each country. We only plot the country specific coefficient for grade D firms in the figure because our main result was driven by this coefficient in Table III. Countries in Figure IIa are ordered by their number of firms in sample. In addition to the estimated demand elasticity coefficient we also present the 95% confidence interval around it. Although the country specific estimates are sometimes imprecise because of the small number of observations, generally speaking the estimated demand coefficients are not drastically different from the average demand coefficient Table III. For example, 13 of 15 country estimates include the average elasticity of demand estimate, represented by the horizontal line, within their 95% confidence interval. Figure IIb repeats the exercise, but aggregates countries into regions so that we have approximately equal number of observations within each region.

We have identified a strong positive correlation between initial collateralization and ex-ante firm risk. However, we have not been able so far to separate both types of risk. So, how can we separate them?

B. Ex-post Realized Default Predictability

As explained in the conceptual framework, in order to separate agency risk and ex-post realized risk the key identifying assumption is that if collateralization is not correlated with ex-post default then it cannot be compensating the bank for this realized risk; therefore, collateralization must be covering agency risk.

[10] In regressions not reported in the paper, we show that as grade quality worsens, the bank accepts less percentage of loan to be covered by supported collateral, and even lower percentage with no collateral at all. Supported collateral is defined as the fraction of loan above liquidation but below current market value of collateral.This is of course not too surprising since when secured collateral ratio rises with worsening grade quality, the remaining combined categories must go down automatically.

Fortunately our data contains information on default and the available time-series for each firm presents us an opportunity to accurately estimate the predictive power of grades *and* collateralization in forecasting ex-post realized default.

Before proceeding with the relevant identification tests, it is convenient to understand the degree of reliability of the grades as ex-ante measures of risk. So far results on Table III have used subjective risk grades assigned by the bank in respective countries as measures of firm risk. By using country fixed effects we avoided comparing grades across countries which is useful as criteria for grade determination may not be the same in each country. However questions still remain regarding the interpretation of risk grades within each country. For example, what does a grade mean in terms of future default likelihood? How much is a "C" firm more likely to default next year compared to an "A" firm? Knowing the answer will give us confidence in the reliability of grades as measures of risk, and perhaps more importantly will allow us to calibrate our results thus far in terms of some real economic outcome.

This test can be better understood through the following example. Consider two firms with different initial risk grades. Next follow these firms over time and compare their ultimate default probabilities. If risk grades are informative then the difference in default rates of the two firms is likely to capture that.

The downside of the test above is that it is possible to see no difference in default rates even if risk grades are very accurate. The reason is that in equilibrium banks also incorporate the grade information in their actions. Thus they may decide to monitor and collateralize a high risk firm to such an extent that it behave the same as a low risk firm in equilibrium. However, the test mentioned above is still useful to conduct as at worse it gives us an underestimate of the true informational content embedded in risk grades.

We conduct the default predictability test by using the full time-series panel for our 8,820 firms. By our earlier construction, none of these firms are in default at the beginning of their sample period. However, they can default subsequently. We assign each firm its initial risk grade and then follow it at six-monthly intervals over the next two years[11]. We then test if over these two years, firms with lower initial grades are more likely to default than firms with better initial grades. Empirically this translates into running the following regression for firm i in country c at period t:

[11] Or for firms wilth less time-series till available data permits.

$$Y_{it} = \gamma_i + \gamma_{ct} + \beta \ (INITIALGRADE_i * TIME_t) + \varepsilon_{it} \tag{3}$$

where $TIME = 1, 2, ...$ is measured in yearly units, γ_i represents firm fixed effects, γ_{ct} represents country-date fixed effects, and Y_{it} is an indicator variable for whether the firm has declared default by time t or not.[12] Country-date fixed effects absorb all time varying macro shocks hitting an economy.

Column (1) of Table IV estimates (3) without country-date fixed effects and initial grade interaction to show that the average default rate in the data is 6.7% per year. Column (2) then estimates equation (3), and shows that grades significantly predict default even though β is subject to the under-estimation concern highlighted earlier. In particular relative to A grade firms, B grade firms are 1.3% more likely to default after a year. For C grade firms, the same difference goes up slightly to 1.5%. The largest increase in default is for firms classified as D initially. These firms are 5.8% more likely to default after a year compared to A grade firms. All coefficients are significant at the 5% level.

Columns (3), (4) and (5) show that consistent with our earlier conjecture that estimated default differences might be underestimated, coefficients increase in magnitude slightly once we put in time interacted controls using initial rate of collateralization and initial log of approved loan amount. These controls reflect decisions taken by the bank to limit default of worse grade firms. The estimated default differences in Table IV are large in terms of magnitude. For instance a 6.6 percentage points higher default rate for D grade firms represents an almost doubling of default probability when compared to the 6.7% mean default rate after one year (from column (1)).

As a side note, the average default rate in column (1) might appear large at first glance. However, it is important to keep in mind that it reflects the greater likelihood of default for an average firm. The result does not reflect default rate per dollar lent. Since D grade firms are largely responsible for the average default rate and these firms get substantially lower loan amounts (see Table VI), the dollar-weighted average default rate at the end of sample period is 3.84 %.

Perhaps the most compelling result for our propose analysis is the one corresponding to the identification of agency risk from ex-post realized default. Table IV consistently shows that the rate of collateralization is completely uncorrelated with the ex-post default rate measure. The variable (Time*SECRATIO) in columns (3), (4) and (5) has no explanatory power in predicting default rates.

[12] Loans are internally classified in 5 categories: I (Normal),II (Substandard), III (Potential Problems/Non-Performing), IV (Non-Performing) and V (Write-Off). We define default as a loan in category I or in category II with delayed payments of less than 30 days..

Collateralization is *not* covering business risk, but it is therefore covering agency risk. This result is equivalent to column (5) in Table III when we add the ex-post realized measure Ever Default?. This particular specification has both ex-ante agency risk measures and an ex-post default measure as in (2). Consistent with out previous findings, the measure Ever Default? is not correlated with the rate of collateralization suggesting that commitment motives rather than hedging explains collateralization.

The results in Table IV can now be used to calibrate the default elasticities estimated in Table III. For example, we found that getting a risk grade of D increases the rate of collateralization demanded by the bank by 14.7 percentage points. Column (5) in Table IV tells us that a grade of D increases the probability of default after a year by at least 6.6 percentage points. Thus for every 1 percentage point increase in the annual probability of default, the collateralization rate demanded by the bank increases by about 2.2 percentage points.

This is a large increase in collateralization and is likely to more than compensate the bank for the higher probability of default in risk neutral terms. To see this, let $ER = \delta(LV) + (1-\delta)R$ represent the expected return that the bank receives per dollar lent. δ is the probability of default, LV is the collateralization ratio and hence the return (or liquidation value) for bank in case of default, and R is the promised interest rate on loan. Then according to our estimates, for a 1% points increase in default rate (δ), $\Delta ER = 0.033 * LV - 0.01 * R$.[13] Computing ΔER at the mean LV ratio of 0.54, and assuming a gross interest rate[14] of 1.15, we get $\Delta ER = 0.018 - 0.015 = 0.003$ (*i.e.* $\Delta ER > 0$).

IV. Uncovering Pecking Order

As collateralization increases with firm risk, banks may restrict their preferences in terms of the type of marginal asset accepted as collateral. For example, a bank might accept inventory as collateral for low risk firms but as firm risk and required collateralization go up, the bank may accept only a certain type of assets (e.g. land and real estate mortgage) as collateral. Our data on the type of asset used as collateral provides an opportunity to test for the existence of such a pecking order. The main asset types used as collateral are described in Table IIA.

A natural pecking order to expect is that banks will accept firm specific assets prone to agency

[13] To see this, note that $\Delta ER = (\delta + 0.01)(LV * 1.022) + (1 - \delta - 0.01)R - \delta(OLV) - (1-\delta)R$, which simplifies to $\Delta ER = 0.033 * LV - 0.01 * R$

[14] Notice that we are being conservative by assuming a fixed interest rate. If interest rate also goes up with higher default probability, it will only further increase the ΔER.

concerns (e.g. inventory, machinery and account receivables) from good risk ratings firms. But as agency risk increases the marginal asset required for collateralization is more likely to be not susceptible to agency concerns. These type of non-specifc assets include land, real estate mortgage and liquid securities. For example collateral that is mobile and hence not perfectly secured (such as inventory, commodity pledges and account receivables) may be stolen by managers in bad states of the world, while, on the contrary, it is more difficult to run away with land and liquid securities. Since the liquidation value of the asset is already controlled for in the SECRATIO measure, we can be bolder in suggesting that the pecking order is driven by agency concerns as well.

One rationale for such a pecking order could be that firm specific assets are subject to suffer from moral hazard and hence largely dependent on the quality of firm. Similarly the value of firm-specific assets might fall faster for lower quality firms. Non-specific assets do not share these concerns. For example, the price of land or value of liquid securities collateral is independent of firm performance and future behavior.

We can uncover the pecking order by testing which type of asset is more likely to serve as collateral when firm risk deteriorates (*i.e.* what is the marginal type of collateral required when firm risk increases). This test can be conducted by regressing an indicator variable for each type of collateral on firm risk grade and our usual set of control fixed effects.

The results in columns (1) through (5) of Table VIII show an interesting and systematic pattern. As firm quality deteriorates, bank is less likely to use firm specific collateral such as FS (which includes firm-specific assets), ABF (which includes inventory, equipment, vehicles and plant machinery), and AR. On the other hand with deteriorating firm quality, the bank is more likely to use non-specific collateral types such as land, buildings (LAND) and liquid securities (CASH). Column (6) reports the same pattern of results but using as dependent variable an aggregate measure of collateral (AGG. ASSETS) which combines the previous definitions. This measure takes a value of either 0 for no collateral, 100 for FS, 200 ABF and AR and 300 for LAND and CASH.[15]

Thus as firm quality deteriorates, a bank relies less on firm-specific and more on non-specific collateral. In fact, the pecking order can be more explicitly seen when we plot the marginal impact of one grade downgrades on the probability of collateral use. Figure III A shows that for initial grade downgrades (*i.e.* from A to B, and B to C), the bank actually *reduces* the percentage of FS form of

[15] Results without controls are also very similar, but are not shown for brevity.

collateral allowed. For initial grade downgrade (*i.e.* A to B), the bank allows the firm to increase collateralization by putting up more ABF (which is firm specific). However further deterioration from B to C means that the increase in collateralization must be covered by less firm specific collateral in the form of accounts receivable. Accounts receivables are less firm specific since they also depend on the partner firm owing the amount. Both ABF and AR are firm specific at some level, but presumably less soft than the FS type of collateral. As the grade deteriorates further from C to D, the bank only accepts non-specific and hard types of collateral at the margin such as land and liquid assets. Thus we get an interesting "pecking order" in terms of which assets the bank is willing to accept as collateral. While various forms of collateral are acceptable for the very best firms, as firm risk goes up, the bank stops accepting unspecified forms of collateral. Further deterioration stops the bank from accepting ABF, and then AR. Finally for very high risk firms, the bank only accepts hard and non-specific forms of collateral such as cash and land. Figure III b adds up all the marginal effects shown in III a to show the cumulative effect of the bank's pecking order.

The concern at this stage is that worse quality firms have less supply of firm-specific assets or account receivables. This is possible in practice, therefore we address this issue. In particular, can the supply side be a possible explanation to understand the reason of moving away from firm-specific assets? Table VI shows that worse quality firms are borrowing between 7.7% and 11.1% less than the best quality firms. These results suggest that the supply side explanation seems unlikely.

We also have direct measures to suggest that firm specificity goes down as implied by the pecking order above. This measure is based on Shleifer and Vishny (1992), who argue that as specificity of an asset goes up, the liquidation value of the asset as a fraction of current market value should drops. Since we know both the liquidation value and current market value for a collateral, we can construct a measure of non-specificity as the liquidation value of an asset divided its current fair market value.[16] Constructing this non-specificity measure shows the following pattern. Compared to FS collateral, ABF is 17 percentage points higher; CASH is 17.3 percentage points higher than ABF while LAND is 7.4 percentage points higher than CASH. All differences are statistically significant.

[16] It is a bit more complicated because the fair market value only goes up to the outstanding amount. Thus we can overestimate the liquidation ratio, but such bias is unlikely to be correlated with collateral type.

V. Identification Issues

The ideal experiment to test equation (2) is to pick a set of firms, randomly assign each firm a risk grade and then measure how the *demand* for collateralization differs across low and high risk firms. Unfortunately nature is seldom this accommodating. We must therefore pay particular attention to factors that might affect a firm's risk rating and its equilibrium rate of collateralization at the same time. We discuss four such factors and then test how they actually co-vary with firm risk and collateralization in the data.

First, there may be an incidental correlation between firm grade and collateralization driven by endogenous movements in a firm's loan amount. Suppose all firms start off with the same risk rating and degree of collateralization. Over time, firms experience different idiosyncratic shocks and their risk ratings adjust accordingly. This can automatically lead to changes in the value of collateralization, as measured in our data, even if there is no change in the demand for collateralization by the bank. For example, suppose that when the riskiness of a firm deteriorates its bank borrowing declines but the initial collateral remains in place. Then looking at the cross section of firms at any future point in time it would appear that bank demands higher rates of collateralization from riskier firms, while in reality the correlation is driven by endogenous movements in firm's loan amount.

Second, the equilibrium rate of collateralization may be affected by the supply of firm's collateralizable assets as well. For example, firms with greater (or cheaper) supply of collateralizable assets may be willing to put up more collateral per dollar borrowed in exchange for lower interest rate charged by the bank. We only need to worry about this concern if the supply of collateralizable assets is negatively correlated with risk grade, *i.e.* as grade deteriorates, firms have more collateralizable assets available to them.

Third, the equilibrium rate of collateralization can also be affected by productivity or latent demand for loan by firms. Since the average bank worries about its total exposure to a single client, firms with larger loan demand are likely to face higher rates of collateralization. This observation is a concern for us only if firm productivity or latent demand for loans is negatively correlated with firm risk, *i.e.* firms with worse risk grades are more productive.

The fourth factor of concern in terms of identification may be the substitutability between interest rate and rate of collateralization. For example, a bank may be willing (to some extent) to trade off lower rates of collateralization for a higher interest rate. However this potential trade off only biases

our coefficient towards zero and thus should not be of great importance.

The second and third concerns mentioned above are also unlikely to hold in practice. For example, as firm risk deteriorates, its supply of collateralizable assets is likely to go down as opposed to increase. Nevertheless, since one may come up with specialized stories to raise these concerns, we shall explicitly test for these in the empirical section. Testing the above concerns in the data will guide us on how close $\widehat{\beta}_1$ is to the true demand elasticity.

A. Testing for Endogenous Time-Series Fluctuations

First we test for the concern that correlation between risk grade and collateralization is incidentally generated due to time-series endogenous fluctuations in loan amount and collateral value. Since we have up to four six-monthly observations per firm we can directly test for this concern. In particular, instead of using our cross sectional sample that had picked the first available observation for each firm, we now use the entire available time series for firms. Using firm fixed effects we then test how collateral value and loan size varies over time when a firm's risk grade fluctuates. The standard deviation of firm grades after de-meaning at the firm level is 0.36, while the cross-sectional variation in country demeaned firm grades is 0.92. This result indicates that there is significant variation in firm grades over time and we can conduct a meaningful time series test. We also control for possible macro shocks hitting an economy by including country interacted with six monthly period fixed affects (i.e. country-date fixed effects).

The empirical specification for measuring the endogenous fluctuations in loan amount and collateral value with risk grade over time thus becomes:

$$Y_{ict} = \sum_k \beta^k \gamma_{ict}^k + \gamma_{ct} + \gamma_i + \varepsilon_{ict} \tag{4}$$

where Y_{ict} is a variable such as log of loan amount and outstanding for firm i in country c and date t. γ^k represents the k risk grade dummies, γ_i represents firm fixed effects, while γ_{ct} country-date fixed effects.

Column (1) in Table VII shows that deterioration in firm grade is negatively correlated with approved loan amount. In particular relative to A grade firms, B grade firms have 6.1% less amount of loans approved. For C grade firms, the same difference goes up to 11.1%. The largest differences is for firms classified as D. These firms have 28.0% less loans approved compared to A grade firms. Thus

credit approval declines over time if firm grade deteriorates. Column (2) shows that the outstanding loan amount also decreases with firm quality. Worse grade firms experience the highest decrease. This result is consistent with a firm getting more financially constrained as firm grade deteriorates, and withdrawing higher percentage of its available credit line.

B. Testing for Endogenous Collateral Supply

The second identification concern suggests that perhaps our elasticity of demand coefficient is being spuriously affected by the correlation of unobserved supply of collateral with risk grade. This is a valid concern if the supply of collateralizable assets increases with deteriorating quality; an unlikely occurrence.

Nonetheless using data from one of the countries in the sample Argentina with detailed firm level financials (described in Section I), we test how measures of the supply of collateralizable assets are correlated with firm risk grade. A number of firm assets such as Cash, Marketable Securities, Accounts Receivables, Inventory and Property Plant and Equipment are collateralizable. However, *net* collateralizable assets available for borrowing also depend on senior liabilities already held by a firm. As such we construct different measures of the supply of collateralizable assets.

Our first measure (NETWORTH) is the total book net worth of the firm (*i.e.* total assets minus total non-equity liabilities). Our second measure (NETCOLLATERAL) 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.[17] 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.

Table VIII runs each of the six measures of collateral supply against firm risk grades, industry fixed effects, and location fixed effects. Since the number of firms is limited in this sample, we exploit full sample variation by running our regressions on pooled data but cluster standard errors at the firm level. It can be seen that regardless of the exact definition used, collateral supply is positively correlated with firm grade, *i.e.* supply increases as grade quality improves.[18] Given this positive

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

[18] Although, we only report regressions with controls in Table V, the results are very similar for regressions without the industry and location fixed effects.

correlation or at least no evidence for any negative correlation, endogenous collateral supply cannot explain our elasticity coefficients.

C. Testing For Endogenous Firm Productivity

The third identification concern is that firm productivity, or latent demand, can bias our elasticity of demand estimates upward if firm productivity is negatively correlated with firm quality and larger loans require higher rates of collateralization. We have already seen in columns (1)-(4) of Table III that larger loans attract higher rates of collateralization. However, columns (1) and (2) in Table IX shows that firm productivity whether measured through ROA or EBITDA/Sales is positively correlated with firm grade. Consequently as with collateral supply, endogenous firm productivity or latent demand for loans cannot explain our elasticity of demand coefficients.

D. Testing for Endogenous Interest Rates

Table IX tests for the extent of substitutability between interest rates and rates of collateralization. Since we have detailed information on the type of revenue generated from a firm, we construct two measures of interest rates. Our first measure is computed by dividing the total lending revenue generated from a firm by the average lending given to that firm during a year. Our second measure is computed by dividing the total lending and non-lending revenue generated from a firm during a year by its average borrowing in that year.

Columns (3) and (4) in Table IX show that there is little substitutability between interest rates and collateralization. The coefficients are estimated with reasonable precision as the standard errors are small in terms of economic magnitude. Intuitively higher interest rates are not very useful in guarding a bank against the threat of ex-post repudiation, while collateralization is. This finding can also serve as a possible explanation for why earlier work such as Petersen and Rajan (1994) and Mian (2005) find negligible elasticity of interest rates with respect to measures of firm risk.

Based on the above evidence Table III provides an accurate estimate of the elasticity of collateralization demand and on separating agency risk from ex-post realized default. One natural implication of the elasticity coefficients, and the fact that collateral supply and firm productivity decline with firm quality is that total approved loan also declines with firm quality as confirmed in Table VI.

VI. Concluding Remarks

The use of collateral predominantly as a commitment device to prevent agency risk raises a number of interesting questions for further inquiry. At one end of the spectrum, existing macro literature treats collateral as one of the main causes for frictions that lead to volatility, contagion, and poverty traps. At the other end however, micro theory coupled with the evidence presented in this paper perceives collateral as a critical factor in limiting agency risk. It may not be unreasonable therefore to think of collateral as the "necessary evil" needed to sustain financing in a less than perfect world.

This view of collateral raises a number of interesting research questions regarding alternative mechanisms available to an economy for limiting agency concerns. Even a cursory look across economies suggests that there are other potential avenues for dealing with agency risk. Such alternatives include more efficient enforcement of laws, market discipline through the use of credit registries, social or venture networks with better enforcement and information tools, and better social norms. At least some of these alternative mechanisms for dealing with agency risk are likely to be more efficient than collateral from a macro perspective. There is also apparent variation across economies in the availability and use of these alternative mechanisms. What explains such variation? Why do some economies adopt different and potentially superior mechanisms for dealing with agency risk than others? We hope that future work will guide us towards the answers.

A Appendix: Variable Definition

- Risk grade represents the ex-ante determination of firm riskiness by the bank, and A through D is coded 1 through 4.
- Tier represents classification of firms by their total sales.
- Total approved is the overall credit line aproved by the bank.
- Total outstanding is the actual amount withdrawn by the firm.
- EOP default (0/1) indicates whether a firm defaults in the beginning of sample period.
- SECRATIO represents the percentage of loan covered by the assessed liquidation value of collateral.
- SUPRATIO is the fraction of loan above liquidation but below current market value of collateral.
- UNSECRATIO is the fraction of loan not covered by collateral.

Below is the complete list of the type of assets used as collateral:

- Asset Based Financing (ABF): Includes all kinds of new or used specific and non-specific equipment, machineries, vehicles, warrants, inventory and leasing.
- Account Receivables (AR): Includes post-dated checks from suppliers and clients of the company, account receivables and contract or purchase orders.
- Cash or Liquid Securities (CASH): Includes local and foreign currency cash deposits and pledges, bonds pledges and share pledges.
- Guarantees (GUA): Includes promisory notes, guarantees from other banks, third-party guarantees, personal guarantees, life insurance policies, bid bonds and other guarantees.
- Letter of credits (LOC): Includes stand-by L/Cs, import L/Cs, export L/Cs, export orders and export credit insurance.
- Fixed assets (LAND): Includes real estate mortgage, industrial building, and land. The commercial and industrial properties are acquired for operating use of the company or as an investment.

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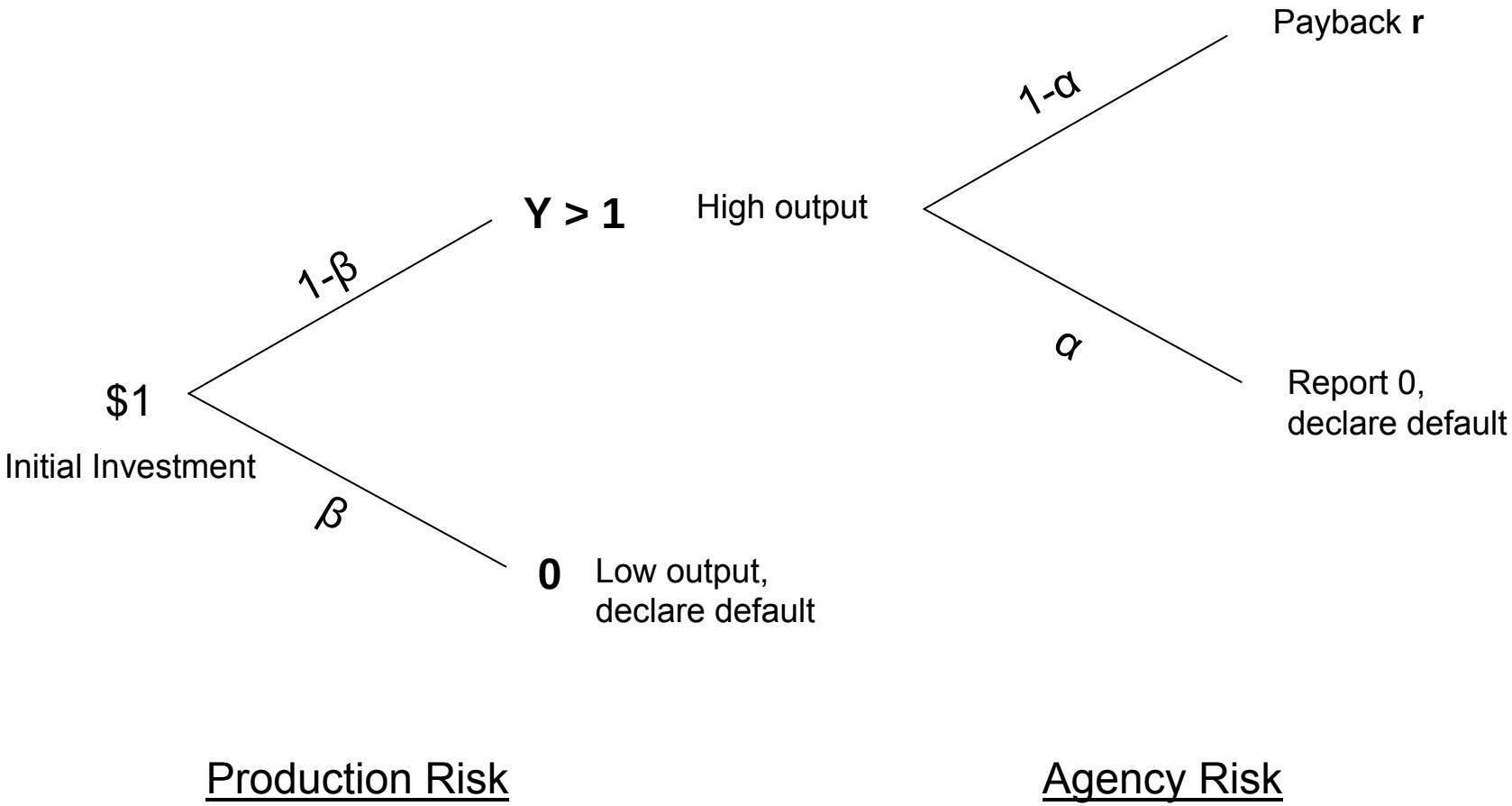
Figure 1. Defining Production and Agency Risk



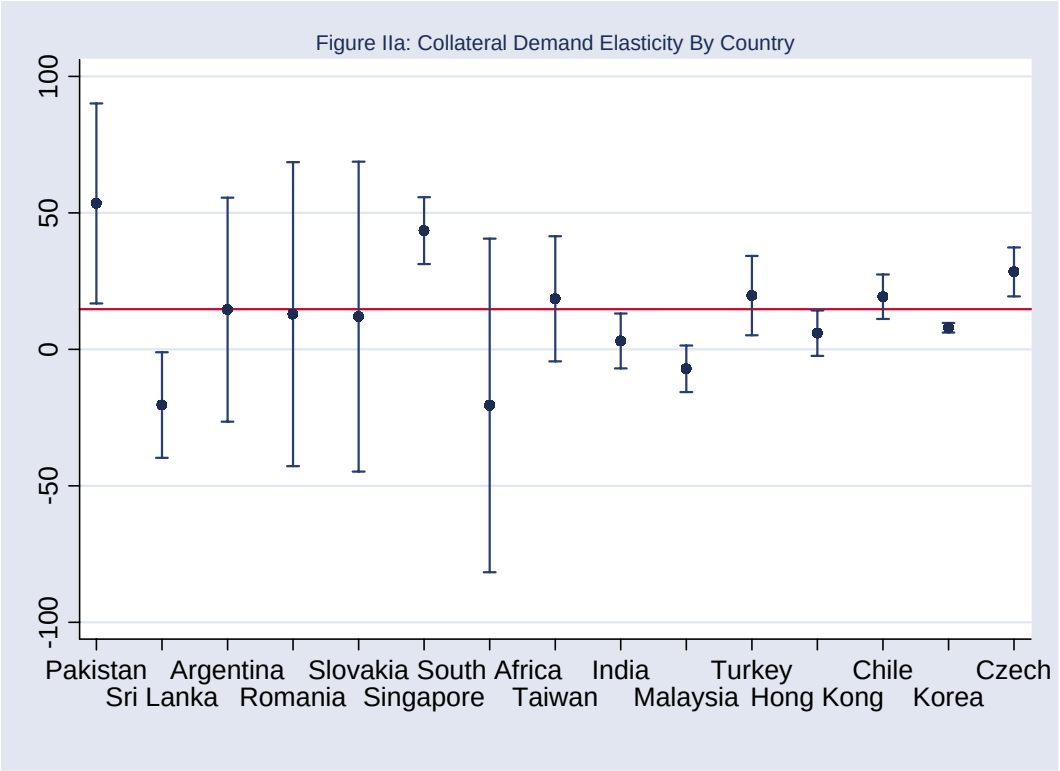


Figure IIa: Collateral Demand Elasticity By Country
100
50
0
-50
-100
Pakistan
Sri Lanka
Argentina
Romania
Slovakia
Singapore
South Africa
Taiwan
India
Malaysia
Turkey
Hong Kong
Chile
Korea
Czech

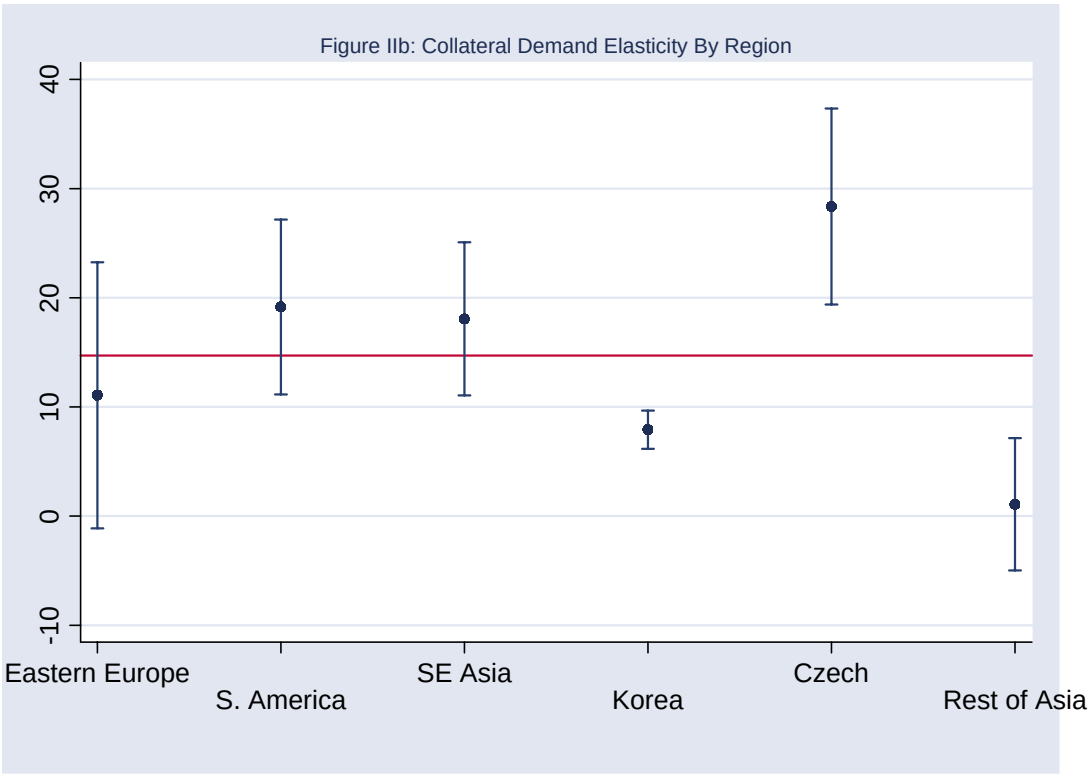
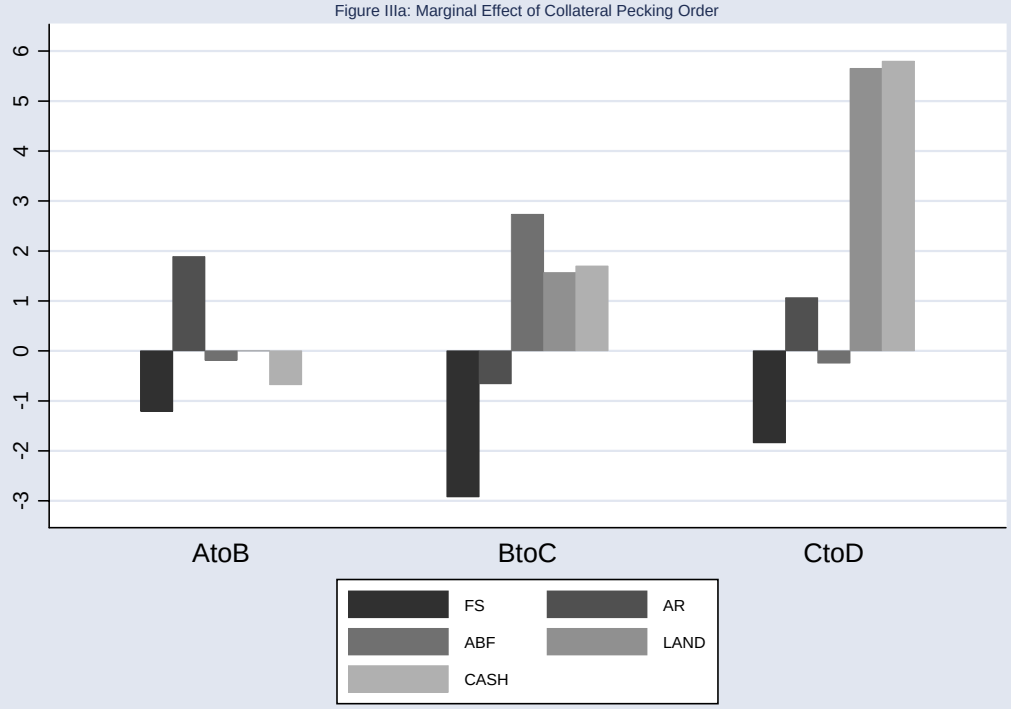


Figure IIb: Collateral Demand Elasticity By Region
40
30
20
10
0
-10
Eastern Europe
S. America
SE Asia
Korea
Czech
Rest of Asia

Figure IIIa: Marginal Effect of Collateral Pecking Order



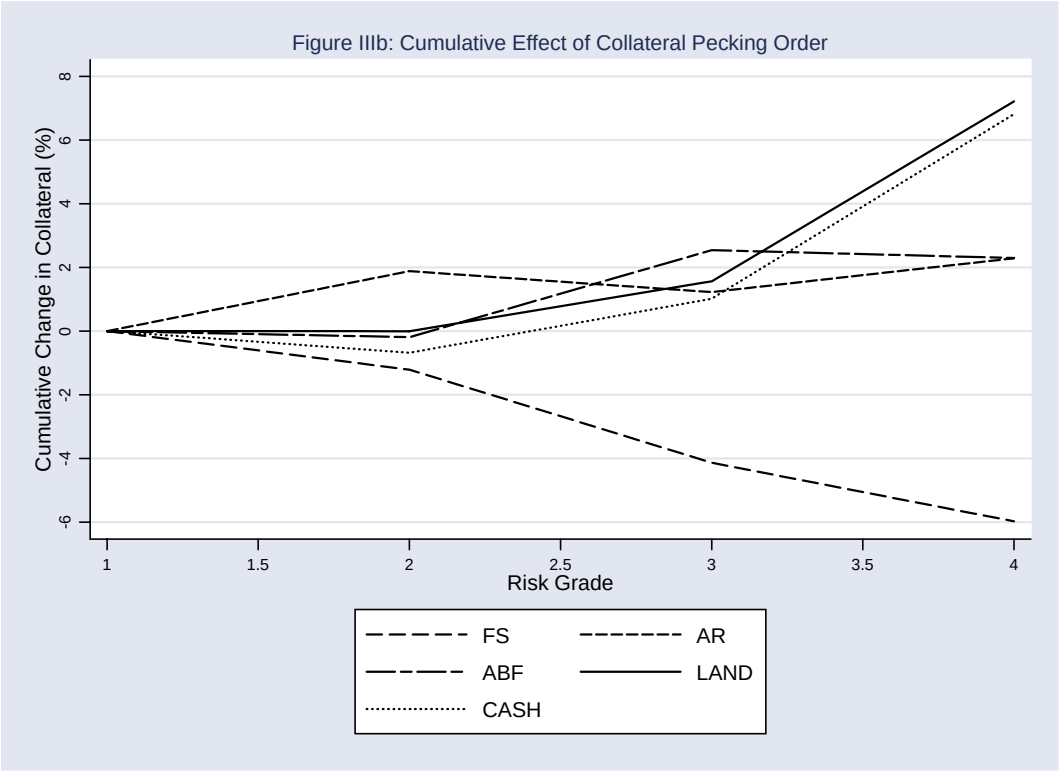


Figure IIIb: Cumulative Effect of Collateral Pecking Order
Cumulative Change in Collateral (%)
8
6
4
2
0
-2
-4
-6
1
1.5
2
2.5
3
3.5
4
Risk Grade
FS
AR
ABF
LAND
CASH

TABLE I
DATA DESCRIPTION BY COUNTRY & INDUSTRY

This table presents the distribution of data by country (PanelA) and indusrty (PanelB). The data comes from a sample of 8,820 small and medium-sized firms in 15 different emerging markets borrowing from a large multinational bank. Although the original sample is a six-monthly panel over 2 years, this table only uses information from the first observation for each firm in the sample.

Panel A

	COUNTRY	No. of Firms	Avg. Loan Size ('000US$)	% of Total Firms	% of Total Lending	No. of Industries	Period
1	Argentina	120	86.41	1.4	0.3	18	05/02
2	Chile	1,248	127.25	14.2	5.2	77	6/02-12/03
3	Czech	1,440	295.53	16.3	14.0	73	6/02-12/03
4	Hong Kong	1,169	617.75	13.3	23.8	65	6/02-12/03
5	India	494	625.55	5.6	10.2	49	6/02-12/03
6	Korea	1,427	93.53	16.2	4.4	71	6/02-12/03
7	Malaysia	697	339.21	7.9	7.8	62	6/02-12/03
8	Pakistan	96	599.14	1.1	1.9	35	9/03-9/04
9	Romania	135	190.76	1.5	0.8	47	1/04-5/05
10	Singapore	237	680.40	2.7	5.3	58	6/02-12/03
11	Slovakia	140	471.62	1.6	2.2	43	6/02-12/03
12	South Africa	307	268.68	3.5	2.7	59	8/02-12/03
13	Sri Lanka	102	468.50	1.2	1.6	17	12/03-12/04
14	Taiwan	443	723.36	5.0	10.6	54	6/03-12/04
15	Turkey	765	357.76	8.7	9.0	54	6/02-12/03
	TOTAL	8,820		100.00	100.00	782.00	

Panel B

	INDUSTRY	No. of Firms	Agg. Lending ($ Million)	Av. Loan Size ('000s)	% of Total Firms	% of Total Lending	No. of Countries
1	Transportation	447	78.10	174.71	5.1	2.9	14
2	Apparel	438	328.00	748.44	5.0	8.8	14
3	Construction	409	89.10	217.79	4.6	2.4	11
4	Consruction materials	400	121.00	301.28	4.5	4.2	13
5	Wholesale-Apparel	318	143.00	450.03	3.6	3.9	12
6	Wholesale- Elec. Goods	276	144.00	521.96	3.1	5.0	10
7	Machinery	267	73.10	273.65	3.0	3.2	13
8	Textiles	266	114.00	426.73	3.0	3.1	14
9	Consumer Goods	260	129.00	497.77	3.0	3.6	13
10	Wholesale- Groceries	256	90.20	352.16	2.9	3.4	11
11	Chemicals	227	69.60	306.75	2.6	3.2	15
12	Rubber and Plastic	222	75.50	340.21	2.5	2.3	12
13	Healthcare	218	18.40	84.30	2.5	0.5	9
14	Wholesale-Pro. & Comm. Goods	204	70.70	346.76	2.3	2.1	15
15	Wholesale-Non-Dur. Goods	196	89.40	455.91	2.2	2.5	11
16	Food Products	174	90.20	518.24	2.0	2.8	13
17	Wholesale- Machinery	174	65.80	378.35	2.0	3.8	12
18	Wholsale- Chem. Goods	173	78.30	452.52	2.0	2.1	12
19	Wholesale- Dur. Goods	154	31.80	206.53	1.8	0.9	12
20	Bus. Serv.- Misc.	153	30.40	198.45	1.7	2.1	14
21	Wholesale- Lumber	134	48.70	363.74	1.5	1.7	12
22	Bus. Serv.- Equip. Rental	125	7.43	59.46	1.4	0.2	6
23	Bus. Serv.- Printing	121	57.30	473.42	1.4	1.6	10
24	Electrical Equip.	116	45.50	392.50	1.3	1.3	13
25	Electronic Equip.	110	61.80	561.39	1.3	1.7	10
26	Toys	96	46.10	479.92	1.1	1.3	12
27	Retail- Misc.	95	25.10	264.28	1.1	0.9	12
28	Software	93	31.40	337.49	1.1	2.1	9
29	Automobiles and Trucks	92	46.20	502.48	1.0	1.3	13
30	Wholsale- Plumb. & Heat. Equip.	92	44.50	483.34	1.0	1.4	10
31	Retail- Gas Stations	89	4.25	47.73	1.0	0.4	6
32	Bus. Serv.- Engineers & Acc.	83	13.40	161.94	0.9	0.4	13
33	Wholesale- Paper Prod.	80	31.00	387.96	0.9	1.0	12
34	Wholsale- Auto Parts	78	26.70	342.31	0.9	1.1	8
35	Steel Works	77	36.90	479.50	0.9	1.2	12
36	Business Supplies	76	39.60	521.34	0.9	1.2	13
37	Personal Services	76	9.02	118.73	0.9	0.3	8
38	Retail- Auto Dealers	74	22.10	298.87	0.8	0.7	10
39	Wholesale- Sporting Goods	73	18.10	248.01	0.8	0.6	9
40	Real Estate	70	7.67	109.58	0.8	0.2	6
41	Wholesale- Home Furnish.	65	52.30	804.78	0.7	1.5	5
42	Fabricated Prod.	61	33.30	546.33	0.7	2.9	12
43	Printing & Publishing	60	19.40	323.11	0.7	0.5	12

Panel B (continued)

44	Bus. Serv.- Advertising	59	7.38	125.14	0.7	0.7	7
45	Wholesale- Drugs	56	17.90	319.65	0.6	0.7	8
46	Wholesale- Metals & Minerals	54	21.50	398.75	0.6	0.6	10
47	Bus. Serv.- PR & Consulting	53	6.08	114.74	0.6	0.3	9
48	Wholesale- Misc.	51	20.10	393.98	0.6	1.2	13
49	Pharmaceutical Prod.	50	34.80	696.22	0.6	0.9	10
50	Trading	47	6.25	132.94	0.5	0.2	8
51	Shipping Containers	46	15.90	346.21	0.5	0.4	11
52	Retail- Apparel	46	14.70	320.25	0.5	0.4	9
53	Restaurants & Hotels	44	12.80	291.77	0.5	0.3	9
54	Wholesale- Petro. Prod.	41	30.80	751.02	0.5	0.9	8
55	Entertainment	38	1.84	48.51	0.4	0.0	4
56	Hardware	38	19.40	509.30	0.4	0.5	9
57	Wholesale- Farm Prod.	34	19.60	575.80	0.4	0.5	15
58	Bus. Serv.- Comp. Serv.	32	6.12	191.29	0.4	0.2	5
59	Industrial Metal Mining	30	5.32	177.40	0.3	0.2	5
60	Candy & Soda	30	21.30	711.07	0.3	0.6	8
61	Wholesale- Beer & Wine	23	6.44	280.13	0.3	0.2	13
62	Shipbuilding, Railroads	22	6.14	279.09	0.3	0.2	6
63	Retail- Electronic Stores	21	3.46	164.53	0.2	0.1	6
64	Medical Equip.	19	5.54	291.81	0.2	0.1	7
65	Telecommunications	19	1.14	60.20	0.2	0.0	9
66	Bus. Serv.- Cleaning	17	0.72	42.14	0.2	0.0	4
67	Measuring & Control Equip.	17	6.10	358.75	0.2	0.2	9
68	Agriculture	16	9.12	570.05	0.2	0.2	6
69	Beer & Liquor	16	8.33	520.59	0.2	0.2	4
70	Wholesale- Waste Material	16	7.82	488.77	0.2	0.2	6
71	Bus. Serv.- Personal Supply Serv.	14	0.90	64.44	0.2	0.1	5
72	Retail- Home Furnish.	14	0.90	64.27	0.2	0.0	6
73	Wholesale- Jewellery	14	9.54	681.30	0.2	0.3	12
74	Retail- Drug Stores	13	1.28	98.32	0.2	0.0	4
75	Retail- Food Stores	13	2.85	218.92	0.2	0.1	3
76	Retail- Merchandise Stores	12	4.29	357.17	0.1	0.2	8
77	Retail- Home Supply	11	1.49	135.15	0.1	0.1	3
78	Retail- Lumber	10	4.01	401.40	0.1	0.1	7
79	Insurance	8	0.31	38.14	0.1	0.0	2
80	Petro. & Natural Gas	7	3.95	564.39	0.1	0.1	5
81	Utilities	7	0.38	53.74	0.1	0.0	4
82	Banking	5	1.58	315.67	0.1	0.0	4
83	Other	5	0.57	114.44	0.1	0.0	2
84	Retail- Department Stores	3	0.11	35.79	0.0	0.0	1
85	Tobacco Prod.	2	0.13	62.56	0.0	0.0	2
86	Defense	1	0.03	26.32	0.0	0.0	1
87	Not Specified	478	25.00	52.21	5.4	0.8	12
	TOTAL	8,342			100.00	100.0	782

TABLE IIA
SUMMARY STATISTICS: CROSS-COUNTRY FIRM LEVEL DATA

This table presents summary statistics for the main sample of 8,820 firms. The information presented in the table picks the first observation in the original panel data set for each firm. SD within country is computed after demeaning each variable at the 15 country levels, while SD within each country-industry is computed after demeaning each variable at the 782 country-industry categories. Variable definitions are given in the Appendix.

Variable	Mean	Median	SD	SD Within Country	SD Within Country-Industry	Min	Max	Obs
Risk Grade		3.00	0.99	0.92	0.81	1.00	4.00	8,820
A	0.15							
B	0.29							
C	0.33							
D	0.23							
Tier		1.00	1.01	0.87	0.80	0.00	4.00	8,820
0	0.40							
1	0.37							
2	0.14							
3	0.07							
Others	0.02							
Total Approved (in `000 $)	557	188	973			0	16,000	8,820
Log Approved	12.00	11.93	1.96	1.59	1.38	0.00	16.60	8,820
Total Outstanding (in '000 $)	344	100	668			0	10,600	8,820
Log Outstanding	11.42	11.52	2.02	1.80	1.62	-8.44	16.20	8,820
EOP Default	4.75	0.00	21.30			0.00	100.00	8,820
SECRATIO	54.1	65.70	44.7	35.1	32.0	0	100	8,820
SUPRATIO	17.5	0.00	32.8	27.0	24.7	0	100	8,820
UNSECRATIO	27.7	0.00	41.6	32.7	30.0	0	100	8,820
ABF Collateral	18.8	0.00	39.1	31.3	25.4	0	100	8,820
AR Collateral	9.5	0.00	29.3	22.9	21.0	0	100	8,820
CASH collateral	13.4	0.00	34.1	29.3	25.7	0	100	8,820
GUA collateral	1.5	0.00	12.3	12.1	11.1	0	100	8,820
LOC collateral	0.7	0.00	8.6	8.4	6.9	0	100	8,820
LAND collateral	15.3	0.00	36.0	31.9	29.4	0	100	8,820
FS Collateral	31.7	0.00	46.5	31.5	25.9	0	100	8,820

TABLE II B
SUMMARY STATISTICS: FIRM LEVEL ARGENTINE DATA

This table presents summary statistics for the 601 firms (2,080 firm-year observations) from Argentina (1995 to 2004) for which we have detailed financial data.

Variable	Mean	Median	SD	Min	Max	Obs
Risk Grade		3.00	0.94	1.00	4.00	2,080
A	0.08					
B	0.26					
C	0.34					
D	0.33					
Total Asset ('000s)	11.49	5.69	16.83	0.04	180.56	2,080
Net Worth ('000s)	5.02	2.33	7.48	-0.19	67.87	2,075
Net Worth/Total Assets	0.45	0.43	0.24	-0.09	4.27	2,075
Net Worth/Total Sales	0.39	0.29	0.37	-0.03	4.53	2,064
Net Collateral ('000s)	6.69	3.49	9.54	-5.94	121.21	2,080
Net Collateral/Total Assets	0.64	0.66	0.21	-2.05	2.06	2,080
Net Collateral/Total Sales	0.52	0.45	0.39	-0.31	6.02	2,069
ROA	0.08	0.06	0.13	-0.41	1.80	2,080
Sales Growth	0.10	0.02	0.42	-1.27	2.82	2,055
EBITDA/Sales	0.14	0.13	0.10	-0.93	0.71	2,069
EBITDA/DEBT	5.41	1.64	2.24	-1.00	10.00	1,951
Sales/Assets	1.67	1.38	1.33	0.00	26.65	2,080

TABLE III
CORRELATION OF RISK GRADE WITH COLLATERALIZATION

This table shows OLS estimates of how different definitions of rates of collateralization vary with the ex-ante firm risk grade. SECRATIO represents the percentage of loan covered by the assessed liquidation value of collateral. Default In Future is a dummy variables that takes a value of 1 if the firm ever defaulted in our sample. Regressions include 15 country fixed effects, and 5 tier fixed effects. Size decile represents the firm decile by approved loan size. Unit of observation is a firm.

Dependent Variable	SECRATIO				
	(1)	(2)	(3)	(4)	(5)
Grade=B	2.11	1.32	1.71	3.02	3.02
	(1.22)	(1.24)	(1.21)	(1.22)	(1.22)
Grade=C	2.74	3.45	5.53	7.24	7.24
	(1.26)	(1.31)	(1.29)	(1.29)	(1.29)
Grade=D	11.05	12.88	14.64	16.04	16.04
	(1.33)	(1.45)	(1.42)	(1.41)	(1.42)
Log Approved Loan				4.46	4.46
				(0.26)	(0.26)
Default In Future?					0.03
					(1.86)
Country FE	Yes			Yes	Yes
Country X Industry FE		Yes	Yes	Yes	Yes
Tier FE		Yes	Yes		
Size Decile FE			Yes		
No of Obs	8,820	8,820	8,820	8,820	8,820
R-Sq	0.39	0.50	0.52	0.51	0.51

TABLE IV
CALIBRATION: FIRM GRADES AND DEFAULT RATE PREDICTABILITY

This table estimates the predictability of default by the initial firm risk grade assigned by the bank in the beginning of sample. By construction no firm is in default at the beginning of sample. The sample includes 20,550 firm-six monthly observations for 8,820 firms. Time is measured in number of years from the start of sample period.

Dependent Variable	Default Rate				
	(1)	(2)	(3)	(4)	(5)
Time * (Initial Grade=B)		1.34		1.35	1.48
		(0.73)		(0.73)	(0.73)
Time * (Initial Grade=C)		1.54		1.56	1.82
		(0.75)		(0.75)	(0.76)
Time * (Initial Grade=D)		5.82		5.85	6.62
		(0.84)		(0.84)	(0.87)
Time	6.73				
	(0.27)				
Time * SECRATIO			0.01	0.00	-0.01
			(0.008)	(0.007)	(0.007)
Time * Log Approved Loan					0.67
					(0.19)
Tier X Date FE					Yes
Country X Date FE		Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
No of Obs	20,550	20,550	20,550	20,550	20,550
R-Sq	0.56	0.70	0.65	0.70	0.70

TABLE V
COLLATERAL PECKING ORDER

This table presents OLS estimates for how the type of asset used as collateral varies with firm risk grade in our main sample of 8,820 firms. FS stands for firm-specific collateral, ABF firm's asset based collateral, AR represents account receivables, LAND stands for land or real estate mortgage, and CASH for cash or other liquid securities. In columns (1) to (5) the dependent variable is either 0 or 100. AGENCY ASSET is an aggregate mesaure of collateral that combines the previous definitions. It takes values of either 0 for no collateral, 100 for FS, 200 for ABF and AR and 300 for LAND and CASH. Regressions include 782 country-industry fixed effects, 5 tier fixed effects, and 10 size decile fixed effects.

Dependent Variable	FS	ABF	AR	LAND	CASH	AGG. ASSETS
	(1)	(2)	(3)	(4)	(5)	(6)
Grade=B	-1.19	-0.20	1.95	0.13	-0.70	1.35
	(1.00)	(0.99)	(0.81)	(1.08)	(1.00)	(3.11)
Grade=C	-4.18	2.63	1.41	1.53	1.03	7.06
	(1.07)	(1.06)	(0.86)	(1.16)	(1.07)	(3.32)
Grade=D	-6.09	2.30	2.55	7.50	6.87	37.97
	(1.18)	(1.16)	(0.95)	(1.27)	(1.18)	(3.65)
Country X Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Tier FE	Yes	Yes	Yes	Yes	Yes	Yes
Size FE	Yes	Yes	Yes	Yes	Yes	Yes
No of Obs	8,820	8,820	8,820	8,820	8,820	8,820
R-Sq	0.70	0.58	0.50	0.41	0.44	0.47

TABLE VI

CORRELATION OF LOAN APPROVAL WITH GRADES AND COLLATERALIZATION

This table presents OLS estimates of how the overall approved loan size varies with firm risk grade in our main sample of 8,820 firms. Regressions include 15 country fixed effects and 782 country-industry fixed effects.

Dependent Variable	Log Loan Approval	
	(1)	(2)
Grade=B	-0.25	-0.21
	(0.054)	(0.053)
Grade=C	-0.79	-0.73
	(0.056)	(0.055)
Grade=D	-1.11	-0.77
	(0.059)	(0.060)
Country FE	Yes	
Country X Industry FE		Yes
No of Obs	8,820	8,820
R-Sq	0.40	0.54

TABLE VII
TESTING FOR GRADE ENDOGENEITY

This table shows OLS estimates of how loan amount (approved and outstanding), collateral value, and rate of collateralization vary over time with risk grade for a given firm. The sample includes 20,550 firm-six monthly observations for 8,820 firms. Secured Collateral represents the liquidation value of collateral as assessed by the bank. SECRATIO represents the percentage of loan covered by the estimated liquidation value of the collateral.

Dependent Variable	Log Loan Approval	Log Outstanding	Log Secured Collateral	SECRATIO
	(1)	(2)	(3)	(4)
Grade = B	-0.061	-0.094	0.082	0.918
	(0.037)	(0.049)	(0.122)	(0.903)
Grade = C	-0.111	-0.058	0.147	2.598
	(0.042)	(0.055)	(0.138)	(1.016)
Grade = D	-0.280	-0.192	-0.146	3.236
	(0.045)	(0.059)	(0.147)	(1.084)
Country X Date FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
No of Obs	20,550	20,550	20,550	20,550
R-Sq	0.93	0.89	0.90	0.90

TABLE VIII
COLLATERAL SUPPLY- RISK SCHEDULE

This table presents OLS estimates of how various proxies for the supply of collateral vary with firm risk category. The regressions are run over a sample of 601 Argentine firms. A unit of observation is firm-year.

Dependent Variable	Log Net Worth	Net Worth/ Total Assets	Net Worth/ Total Sales	Log Net Collateral	Net Collateral/ Total Assets	Net Collateral/ Total Sales
	(1)	(2)	(3)	(4)	(5)	(6)
Grade=B	-0.22	-0.12	-0.11	-0.074	-0.083	-0.067
	(0.12)	(0.028)	(0.033)	(0.12)	(0.025)	(0.035)
Grade=C	-0.47	-0.18	-0.12	-0.25	-0.10	-0.074
	(0.13)	(0.025)	(0.035)	(0.13)	(0.024)	(0.035)
Grade=D	-0.41	-0.21	-0.098	-0.17	-0.14	-0.064
	(0.14)	(0.026)	(0.036)	(0.14)	(0.024)	(0.036)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes	Yes	Yes
No of Obs	2,050	2,059	2,048	2,053	2,064	2,053
R-sq	0.21	0.10	0.14	0.17	0.08	0.10

TABLE IX
PRODUCTIVITY AND INTEREST RATE - RISK SCHEDULE

This table presents estimates of how various proxies for profitability and interest rate vary with firm risk category. The regressions are run over a sample of 601 Argentine firms. A unit of observation is firm-year. Lending interest the ratio of total lending revenues (interst + fees) over the average assets used by the firm on a year basis. Aggregate interest rate is the ratio of total lending (lending/non-lending) over the average assets.

Dependent Variable	ROA	EBITDA/ Sales	Lending Interest Rate	Aggregate Interest Rate
	(1)	(2)	(3)	(4)
Grade=B	-0.017	-0.0009	-0.0041	-0.0030
	(0.010)	(0.011)	(0.0078)	(0.0083)
Grade=C	-0.033	-0.012	-0.0020	-0.0008
	(0.0097)	(0.011)	(0.0081)	(0.0086)
Grade=D	-0.073	-0.028	-0.0082	-0.010
	(0.010)	(0.012)	(0.0085)	(0.0086)
Industry FE	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes
No of Obs	2,064	2,053	1,673	1,661
R-sq	0.16	0.14	0.04	0.04