# Forgive but not Forget: The Behavior of Relationship Banks when Firms are in Distress*

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**Abstract**

Do relationship banks help firms in financial distress? Combining a new survey-based measure of relationship lending with unique credit registry data, I examine the effect of relationship lending on ex-post loan performance. I find that the *same firm* is more likely to become temporary delinquent on a relationship-based loan relative to a transaction-based loan. Higher delinquencies do not, however, result in more defaults or losses for relationship banks when loans mature. Consistent with theory, relationship banks tolerate temporary bad results, yet extract rents in the long run, that is, they forgive but do not forget. When firms are in distress, relationship banks adjust contract terms and allow drawdowns on credit lines and overdrafts but do not inefficiently roll over loans. Overall, the paper uncovers how relationship banks help distressed firms to bridge liquidity shortages.

JEL Classification: G21, G30

Keywords: Bank Financing, Relationship Lending, Loan Performance, Firm Distress, Liquidity Insurance

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# 1 Introduction

Relationship lending constitutes one of the most important comparative advantages of bank lending to firms. When engaging in relationship lending, banks gather propriety information about their customers through repeated interactions (Boot, 2000). Some theories suggest that banks use their superior knowledge to extend loans at favorable contract terms and provide firms with better access to finance (Boot and Thakor, 1994; Petersen and Rajan, 1995). In contrast, alternative theories point out that relationship lending is associated with possible "hold-up" problems and extraction of rents from firms (Sharpe, 1990; Rajan, 1992). While the empirical literature has mostly focused on contract terms and credit availability, far less is known about bank behavior when firms are in financial distress. This paper fills the gap by examining the effect of relationship lending on ex-post loan performance.

Understanding bank behavior when firms are hit by idiosyncratic liquidity shocks is important for practitioners and academics alike. Firms and their sources of funding when faced with liquidity shocks are vital for the economy as a whole. Moreover, insights into banks' reactions to idiosyncratic shocks to firms will help design policies to foster financial stability. While the theoretical literature has shown that informed banks provide financial flexibility when firms are in need, the empirical literature is still lagging behind. This paper shows that relationship banks provide liquidity insurance for firms in distress.

Studies on relationship lending face several empirical challenges. First, a bank's use of relationship lending is not observable to the econometrician. Empirical studies often use the length, strength, and depth of a bank-firm relationship or the geographical distance between firms and banks as measures of relationship lending.[1] These measures could, however, be endogenous to firm decisions. Second, the use of relationship lending is likely correlated with firm and bank characteristics. Relationship lending centres around the acquisition of "soft" information which plays a more important role when small and decentralized banks lend to small and opaque firms (Stein, 2002). Ideally, one would like to observe variation in the use of relationship lending *within* banks and firms in order to eliminate biases coming from confounding effects of bank and firm characteristics. Third, one needs some randomization in the use of relationship lending across banks and firms to avoid selection and composition biases.

[1] See, among others, Petersen and Rajan (1994), Berger and Udell (1995), Harhoff and Körting (1998), Machauer and Weber (1998), Degryse and Ongena (2005), Agarwal and Hauswald (2010) and Bharath, Dahiya, Saunders, and Srinivasan (2011). Elsas and Krahnen (1998) are one of the few to rely on self-evaluations of credit managers on the house bank status of a bank for a particular client.

Combining survey data on banks' lending policies with unique credit registry data from Armenia allows me to address the identification challenges and provide new insights into bank behavior when firms are in distress. First, I use survey answers of banks that provide a new and direct measure of relationship lending, defined as the importance of the knowledge of a client for the lending process. Relative to previous measures in the literature, this measure is not endogenous to firm decisions and not a firm characteristic. Second, the use of relationship lending varies across banks. Firms can thus receive both relationship-based and transaction-based loans from different banks. Third, a bank rule helps me assign whether a loan of a firm is based on relationship or transactional lending. Since banks indicate the rule in the survey that is not publicly available, a firm is unlikely to know and influence the rule, creating exogenous variation (from a firm's perspective) in the use of lending techniques within a firm across banks.[2] Lastly, detailed credit registry data allow me to evaluate the effect of relationship lending within firms over time.

For the analysis, I use a bank rule to link a lending technique to each loan from the private credit registry of Armenia for the period between January 2009 and June 2013. The credit registry data covers virtually all loans to firms during the sample period, containing detailed data on every loan such as date of origination, maturity date, contract terms and loan performance as well as data on firm characteristics such as legal status, industry, location, and banking relationships. Armenia provides an ideal setting to examine the effects of relationship lending on loan performance. By 2004, Armenia was completely privatized, leaving no government banks and only few government firms that should not distort the analysis.[3] The credit market is still at a developing stage with banks dominating the financial system.[4] Since few outside financing options exist and bank lending is of high importance, outside financing options do not contaminate the analysis. While 97.7% of all registered legal entities in 2009 were small and medium-sized enterprises (SMEs), even large firms in Armenia are rather comparable to SMEs (World Bank, 2014).[5] Most importantly, I show that stylized facts from other banking

[2]In Appendix B I find that some manipulation is present, probably by loan officers. However, in Section 4.4.1 I show that identification comes from loans further away from the threshold for which the main results continue to hold.

[3]In particular, firms with private domestic ownership make up 89.9% of all firms, followed by firms with private foreign ownership (7.7%) and with state ownership (0.7%) (World Bank, 2011).

[4]The loans-to-GDP ratio was around 40% in 2013 compared to 96% and 198% in developed markets such as Germany and the United States. According to a report by CBA (2014), banks were holding almost 90% of financial assets in 2013 and earned most of their income from lending.

[5]Relative to the European Union and the United States, Armenian SMEs are much smaller, with employee numbers below 100 compared to 250 and 500 employees (SME DNC, 2010).

markets also hold for Armenia such as the reliance of relationship banks on "soft" information and a contract menu of high interest rates, fewer collateral requirements and longer maturities compared to more transaction-based banks.

To evaluate the effect of relationship lending, I rely on survey answers of banks on the importance of lending techniques. I distinguish between "Relationship Banks" that state to always rely on relationship lending, meaning to highly value their knowledge of a client, and "Transactional Banks" that employ transactional lending based on firm fundamentals and collateral for most of their loans. Since banks directly state the importance of relationship lending, the measure captures the actual reliance on relationship lending by banks and is not driven by firm decisions. Now, imagine a firm that receives a relationship-based loan from a relationship bank and a transaction-based loan from a transactional bank. First, I examine differences in temporary delinquencies of such a firm. This test reveals which bank offers financial flexibility, allowing the firm to become temporary delinquent when the firm experiences liquidity shortages. In contrast, when a firm receives two relationship-based loans from two banks, differences in delinquencies should disappear if lending techniques drive bank behavior. Second, I evaluate long-term effects of relationship lending to show that relationship banks provide liquidity to firms and do not inefficiently roll over loans. Lastly, I investigate bank behavior when firms are in financial distress.

The effect of relationship lending on ex-post loan performance is ambiguous. Theories on financial intermediation advocate that banks mitigate asymmetric information problems by acquiring propriety information through screening and monitoring of clients in repeated interactions (see, e.g., Diamond, 1984; Ramakrishnan and Thakor, 1984; Allen, 1990). If relationship lending results in more efficient screening and monitoring, better ex-post loan performance, meaning less delinquencies, should be the outcome. If banks use their knowledge to be more lenient towards a client, they might allow the client to temporarily become delinquent when the client is in financial distress. Von Thadden (1995) suggests that banks might tolerate short-term bad results as long as they can extract long-term rents. The reasoning for this is that banks learn the firm's quality through monitoring, and hence will not interpret short-term bad results as signs of bad quality and prematurely terminate good projects. Similarly, Rajan (1992) suggests that informed banks offer financial flexibility to firms at the cost of a share in their profits. This paper brings these theories to the data, examining short-term loan performance and long-term effects of relationship lending.

My findings demonstrate that the *same firm* is 50% more likely to become temporary delinquent on a relationship-based loan relative to a transaction-based loan, indicating that relationship banks tolerate short-term bad results. When both banks rely on relationship lending, differences in loan performance disappear. The result continues to hold when I control for loan characteristics, bank characteristics, loan origination and firm×time fixed effects. I show that alternative explanations such as the size of the overdue amounts, unobservable bank characteristics, sample selection, the definition of relationship lending or relationship variables used in the previous literature do not drive the results.

Next, I examine the long-term effects of relationship lending. Results reveal that, while delinquency rates are higher, relationship banks do not face higher defaults or lower recovery rates when loans mature relative to transactional banks. The results indicate that relationship banks indeed provide liquidity to good firms in distress since firms do not become insolvent when loans mature. Relationship banks, however, enjoy higher returns on loans in return. In line with theory, relationship banks tolerate temporarily bad results of good firms as long as they can secure long-term rents, that is, they forgive but do not forget. The findings uncover how relationship banks help firms to bridge temporary liquidity shortages.

What do relationship banks do differently relative to transactional banks that enables them to offer liquidity insurance? Empirical evidence suggests that relationship banks acquire information about their clients through monitoring. Not having an ex-ante riskier customer base, relationship banks continue to lend to customers that have been delinquent with them since they know their inherent quality better than transactional banks. Relationship banks also allow firms to bridge liquidity shortages with drawdowns on their credit lines or overdrafts and by adjusting interest rates and maturities. Relationship banks do not, however, inefficiently roll over loans more often than transactional banks. Overall, the results give an indication of the behavior of relationship banks when firms are in distress.

The paper is related to an extensive literature on relationship lending.[6] Some authors advocate that relationship lending provides better access to finance and favorable contract terms in the form of lower interest rates and fewer collateral requirements (see, e.g., Petersen and Rajan, 1994; Berger and Udell, 1995), the more so in crisis times (see Bolton et al., 2013; Beck et al., 2014a). Others, however, indicate that banks might lock in borrowers and raise interest rates when borrowers face transportation costs and low bank competition (Degryse and Ongena,

[6]For a more detailed review, see Degryse, Kim, and Ongena (2009) and Kysucky and Norden (2015).

2005) or informational hold-up and switching costs (Ioannidou and Ongena, 2010). While previous literature mostly uses approximations of relationship lending and focuses on contract terms and credit availability, this paper combines a new and direct measure of relationship lending with credit registry data to test bank behavior when firms are in distress. A related paper by Elsas and Krahnen (1998) shows that relationship banks increase their credit volume when firms experience small rating deteriorations. This paper draws a more complete picture by revealing that relationship banks allow temporary delinquencies yet require long-term rents in return.

The paper also contributes to the literature on the effects of relationship lending and use of soft information on loan performance. Papers on consumer credit markets show that relationship lending leads to lower default risk because of better screening and monitoring by banks (Puri, Rocholl, and Steffen, 2013). In mortgage markets, securitization may adversely affect screening standards of banks and result in higher default rates (Keys, Mukherjee, Seru, and Vig (2010)), while the involvement of risk managers alongside loan officers reduces default rates (Berg, 2015). Other papers show that hierarchical and physical distances decrease the use of soft information and make loan defaults more likely (Liberti and Mian, 2009; Agarwal and Hauswald, 2010; Skrastins and Vig, 2014). This paper shows that relationship banks treat firms differently than consumers, allowing for temporary delinquencies with future rents in sight. Some papers also explore defaults of firms but focus rather on strategic choices of firms to default on lenders with which they have personal interactions and long relationships or that are geographically and culturally close to them (Baele et al., 2014; Morales, 2014; Schoar, 2014). Berlin and Mester (1999) show that banks provide insurance against credit shocks through loan rate smoothing, especially when banks rely on core deposits as a funding source. A recent paper by Li, Lu, and Srinivasan (2013) investigates contract terms during firm distress, showing that relationship banks offer similar interest rates to outside banks but keep collateral requirements low after firm distress. This paper, in contrast, exploits the time series of each loan and examines bank behavior when firms experience temporary repayment problems, revealing that relationship banks provide liquidity insurance through financial flexibility and better access to finance.

# 2 Data

## 2.1 Bank survey data

The first data source is the Banking Environment and Performance Survey (BEPS) II that provides information on banks' internal lending policies and organizational structures in central and eastern Europe, Central Asia and North Africa as of 2011. Since I have only credit registry data from Armenia, I focus on Armenian banks.[7] The survey data allows me to construct a direct measure of relationship lending, relying on the answers by bank CEOs to questions Q6 and Q10 from 17 Armenian banks. In their answers, banks indicate the importance (frequency of use) of four lending technologies on a five-point Likert scale for SME and corporate loans separately (ranging from 1 "very unimportant" to 5 "very important"): relationship lending (knowledge of the client), fundamental/cash flow analysis (financial information), collateral (personal assets pledged by entrepreneur), and collateral (business assets). Additionally, in questions Q4 and Q8 banks report the number of layers that need to be passed for loan approval if the bank grants an SME or corporate loan. In a follow-up questionnaire banks report the loan amount threshold at which they differentiate between an SME and a corporate loan.

For the main empirical analysis, I use survey answers on the absolute importance of relationship lending. In Section 4.4, I also experiment with an alternative measure of the importance of relationship lending relative to other lending technologies. In contrast to previous literature, I do not approximate relationship lending with the strength, length, depth or distance of bank-firm relationships, which are more endogenous to firm decisions. I directly observe the self-reported importance of relationship lending of each bank for two loan types.[8] The survey specifies relationship lending as knowledge of the client, which is similar to Boot (2000)'s definition of relationship lending as the acquisition of propriety information over multiple interactions with a customer. Although banks report their lending technologies for 2011 only, it should not pose a problem, since Fahlenbrach et al. (2012) confirm that bank business models stay relatively constant over time. Still, I show that the relationship lending measure captures the use of "soft" information when pricing loans in Section 5 and that results hold after 2011 in

[7] The BEPS II survey was jointly undertaken by the European Bank for Reconstruction and Development (EBRD) and European Banking Center (EBC) at Tilburg University in 2011. CEOs of 611 banks in central and eastern Europe, Central Asia and North Africa were interviewed by a specialized team of senior financial consultants with considerable banking experience on topics such as activities, funding and risk management, lending technologies, competitive environment, the influence of foreign parent banks and perceptions of legal and regulatory systems.

[8] Based on the same survey, Beck et al. (2014a) construct the share of relationship banks in the vicinity of firms and test how it affects access to finance for these firms over the business cycle.

Section 4.4.1. Moreover, Beck, Degryse, De Haas, and van Horen (2014a) provide cross-country evidence for the validity of the relationship lending measure.

Based on banks' survey answers I define nine "Relationship Banks" that report relationship lending (knowledge of the client) to be "very important" for both SME and corporate loans, and six "Transactional Banks" that rely on fundamental/cash flow analysis and collateral for SME loans but find relationship lending "very important" for corporate loans. Since 95% of the loans are SME loans, I can assume that transactional banks mostly rely on transactional lending. However, I exploit the variation of lending technologies across and within banks for identification. Figure 1 shows the two bank types, loan types and the corresponding lending techniques.[9] It might seem surprising that transactional banks rely on transactional lending for SMEs. Survey evidence by De la Torre et al. (2010), however, shows that banks offer standardized products, sometimes combined with tailor-made features, to a group of SMEs with similar needs such as adjusting the credit line to the business cycle of a specific industry. Standardization of the lending process is also more likely because average loan amounts in the sample are relatively small, making relationship lending too costly for such small clients.

The other important information that I exploit is the bank-specific definition criteria for SME and corporate customers. Most banks base the customer type on the loan amount.[10] Using the loan amount threshold, I can assign a loan to be an SME or corporate loan and then the corresponding lending technique the bank uses for the loan type (see Figure 1). The loan amount thresholds differ in size and currency across banks and are not publicly available, making manipulation for firms more difficult. Therefore, I can assume that at least from the firm' perspective exogenous variation in the assignment to different loan types and the corresponding lending techniques exists.[11] Such bank policies can still be subject to manipulation by loan officers. In Appendix B I additionally test whether manipulation around the threshold is present. I find that some manipulation is present which disappears once I exclude loans exactly at the threshold. Manipulation should not be of a concern since the main analysis compares relationship-based and transactions-based loans across banks within the same firm, which do not

[9] Two banks drop from the sample because one bank grants SME loans only and the other one never considers relationship lending as "very important" for both loan types.

[10] Although there is a law on "State Support to SMEs" that specifies annual assets and turnover as well as the number of employees for different firm categories, banks use their own rules of thumb to classify a firm as SME or corporate firm. Discussions with bank employees, ACRA and CBA employees, confirmed that banks classify firms mostly by loan amount. An IFC survey also shows that the loan amount is a good proxy for firm size (IFC, 2013).

[11] Liberti and Mian (2009) also use 19 bank rule variables that determine the hierarchical level to which a firm is sent in order to investigate the effect of hierarchical distance on information production.

need to be close to the threshold. In Section 4.4.1, I additionally confirm that results continue to hold for loans further away from the threshold.

## 2.2 Credit registry data

The second unique dataset is the Armenian private credit registry from the Armenian Credit Reporting Agency (ACRA) that allows me to assess the effect of relationship lending on loan outcomes.[12] Founded in 2004, the credit registry covers all loans to firms (without a loan amount restriction) from 21 Armenian banks between January 2009 and June 2013 on a semiannual basis.[13] For each loan, I have information on the origination and maturity dates, contract terms, ex-post loan performance, location of the loan issue and the economic sector of the loan. For each firm, I have information on the legal status, industry, physical location, and banking relationships. The private credit registry is used by the Central Bank of Armenia (CBA) for the analysis of the banking sector as well as for supervision purposes. Since all banks are members of the private credit registry and have paid a flat rate membership fee, they mostly rely on the more complete data from the private credit registry for screening and monitoring firms. In almost 99% of cases banks asked for information in a standardized format that included details of a firm's current and past loans dating back five years without revealing the other bank's identity.[14]

The CBA has merged the BEPS II survey data with the credit registry data, keeping the bank and firm names anonymous. Using the loan amount thresholds, I assign a bank-level lending technique to each loan of a firm. The final sample consists of 15 banks that report the importance of use of the relationship lending, and account, on average, for 84% (87%) of all banks' credit contracts in terms of value (number). The credit registry covers different contract types such as loans, credit lines, factoring, leasing, guarantees, letters of credit, overdrafts,

[12] Armenia also has a public credit registry managed by the Central Bank of Armenia (CBA), which, however, covers only large loans above 1.5 million Armenian drams (US$ 3,704 as of December 2013) that do not receive the highest credit rating, while the private credit registry covers virtually all loans to firms. Based on the law "Procedure for Creation of Information System of Creditworthiness of Customers of Banks, Credit Organizations, Branches of Foreign Banks operating in the Republic of Armenia, that is of Credit Registry, and Procedure for Participation in Credit Registry", banks are obliged to report to all credit registries about all their loans within three business days. Discussions with ACRA and CBA staff confirm that banks report on their loan portfolio almost on a daily basis.

[13] I received access to the credit registry by way of a collaboration of the CBA, the EFSE Development Facility and Tilburg University.

[14] Typical information includes contract terms, ex-post loan performance, firm characteristics and some information on borrower-affiliated parties. Information in a non-standardized format additionally covers details on firm owners, participants, and guarantors but requires additional consent from involved parties and is only available against a much higher fee than the usual membership fee and is therefore only rarely requested.

repurchase agreements, and swaps. I focus on loans and refer to them as "standard credit contracts" to have a more homogenous and representative set of loans.[15] These contracts account for 73% (70%) of all credit contracts in terms of value (number). Most loans are issued either in Armenian drams (AMD) or US dollars (49% and 48%, respectively) with only few loans in euros, British pounds and Russian rubles. I convert all loan amounts into US dollars based on the monthly exchange rate of the CBA.[16] To ensure the use of timely information, I only study "new loans" that were issued between January 2009 and June 2013.[17] The few loans that are not rated or have a written-off status at the date of loan issue and loans that have a zero interest rate (but possibly non-zero fees) are dropped. The resulting data set consists of 53,780 loan-time observations of 19,332 loans to 6,649 firms with an average loan maturity of almost three years.

Differences in firm composition might influence the effect of relationship lending on loan performance. For example, high-risk firms might self-select themselves to relationship banks, expecting that these banks will grant them more freedom to become delinquent on their loans. Therefore, I focus on firms that received loans from both banks – relationship and transactional – and saturate the regressions with firm fixed effects to account for time-invariant unobserved firm heterogeneity and loan demand effects. The sub-sample consists of 10,656 loan-time observations of 4,441 loans to 621 firms which constitutes nearly 40% of the total lending amount of the entire sample. To account for time-varying firm characteristics, I also experiment with a sample of 3,790 loan-time observations of 1,952 loans to 318 firms that received loans from both bank types in the same six-month period. Although I constrain the analysis to a sub-sample for cleaner identification, main results continue to hold for the total sample as well as the sample of firms that exclusively borrow from relationship or transactional banks (see Section 4.4.1).

### 2.3 Descriptive statistics

In order to gain some insights into banks' survey responses as well as other characteristics of Armenian banks, Table 1 reports bank types (relationship versus transactional banks), survey responses on the importance of relationship lending and the average number of hierarchical layers for loan approval by loan type as well as bank level summary statistics on the average

[15] I use other credit contracts to calculate the exposure of firms to banks as well as relationship characteristics.

[16] Note that base interest rates might differ across loans of different currencies. Since I focus on loan performance in Section 4.1 and the variation in interest rates in Section 5, it should not affect the results. Still, I control for differences in currencies and conduct robustness tests for loans of different currencies.

[17] I exclude loans that were originated before January 2009 but stayed in the system because of past default.

loan amount threshold in US dollars, the market share in terms of loan number and loan value, the average borrower size based on the total borrowing amount across all banks in US dollars, bank size based on total assets as of 2009 and foreign ownership that equals one if more that 50% of equity is foreign-owned. Since bank names remain anonymous, I rely on bank characteristics from the BEPS II survey or reported by the CBA. A first look reveals that bank characteristics vary across the two bank types – transactional and relationship. Unreported results suggest that no specific bank characteristic is correlated with the importance of relationship lending in Armenia, confirming that the two bank types are not driven by other bank characteristics. The only difference between the two groups is generally lower loan amount thresholds for relationship banks.[18] The differences in loan amount thresholds rather facilitate the analysis as it allows for more variation in loan types within one firm across the two bank types.

Table 2 shows ex-post loan performance measures, loan characteristics, relationship characteristics, and firm characteristics by bank type for the total sample of 19,332 loans to 6,649 firms and for the sub-sample of 4,441 loans to 621 firms that borrow from both bank types. Definitions of the variables can be found in Table A.1 of Appendix A. To capture temporary loan delinquencies, I mainly rely on performance measures "Non-Performance 0-90 days" that is equal to one if a loan goes overdue for less than 90 days and zero otherwise, as well as "Non-Performance 90 days" that is equal to one if a loan goes overdue for more than 90 days and zero otherwise. Other measures of loan performance indicate if a loan has any overdue principal or interest payments (Non-Performance), goes overdue for more than 180 days (Non-Performance 180 days), or is completely written off/lost (Default).

Descriptive statistics and graphical analysis on loan performance offer first evidence that relationship banks temporarily experience higher delinquency rates without more loan defaults. For the total sample, loan delinquencies are significantly higher by 0.8% to 2.6% for relationship banks compared to transactional banks. For the sub-sample, the differences in loan delinquencies for less and over 90 or 180 days increase, while the differences in loan defaults vanish. Figure 2 shows average delinquency rates over 90 days over time for the sub-sample by bank type (relationship versus transactional banks) and loan type (Figure 2a for SME loans and Figure 2b for corporate loans). Delinquency rates over 90 days are always higher for relationship banks compared to transactional banks for SME loans (Figure 2a), the case when relationship banks

[18] In unreported regression results of the determinants of loan amount thresholds, I find that larger banks are more likely to have higher loan amount thresholds.

rely on relationship lending and transactional banks on transaction-based lending. In case of corporate loans (Figure 2b), when both employ relationship lending, no consistent differences in delinquency rates are present. The figures confirm that relationship lending leads to temporarily higher delinquencies independent of time.

Apart from firm compositional and selection biases, differences in contract terms between relationship and transactional banks might influence loan performance. For the total sample, relationship banks give out smaller loans (US$181,000 versus US$225,000) at higher interest rates (15.4% versus 15.1%) that are less likely to be collateralized (82% versus 88%) or guaranteed (5% versus 10%) but are granted with maturities of almost three months longer (36 months versus 33 months) without differences in credit ratings compared to transactional banks. The findings are consistent with Beck, Ioannidou, and Schaefer (2014b) who show that domestic banks are more likely to give out unsecured loans at higher interest rates and longer maturities than foreign banks. Except for collateral and guarantees, most of the differences in contract terms disappear for the sub-sample, suggesting that differences in loan characteristics should not be driving differences in loan performance.

If contract terms do not significantly differ across bank types within the same firm, then I can isolate the effect of relationship lending on loan performance. Keys, Mukherjee, Seru, and Vig (2010) claim that when a firm applies for a loan, banks collect "hard" information (e.g., credit rating) and "soft" information (e.g., knowledge of the client or future repayment ability). When studying loan performance around a FICO score threshold, they assume that after controlling for hard information any differences in default rates on either side of the threshold should be coming from the effect of securitization on the use of soft information. Similarly, the results above show that there are no significant differences in loan characteristics for the sub-sample. Still, in the main analysis, I control for observable hard information variables (loan characteristics) and unobservable soft information (firm and firm×time fixed effects). The relationship lending measure thus should capture some of the unobservable soft information "extracted" from the firm or firm×time fixed effects and the residual. In Section 5 I show more formally that relationship lending is indeed associated with higher use of soft information.

Differences in other loan characteristics (location, industry and currency), relationship characteristics (bank-firm relationship in months, scope, primary bank, number of relationships) and other firm characteristics (firm location, industry, legal type) do not completely disappear for the total sample compared to the sub-sample. Since the main analysis focuses on variation

within a firm, these differences will not play a role. Moreover, I control for these characteristics in different specifications of the model and in robustness tests.

# 3 Empirical methodology

In order to identify the effect of relationship lending on ex-post loan performance, I distinguish between "Relationship Banks" that always rely on relationship lending and "Transactional Banks" that mostly employ transactional lending based on firm fundamentals and collateral for SME loans. Figure 1 illustrates the idea, presenting bank types, loan types and corresponding lending techniques. SME loans from transactional banks are the reference group since only in this case banks rely on transactional lending. I compare their performance with SME loans from relationship banks, the main treatment group, as well as with corporate loans from transactional and relationship banks. Using the loan amount threshold, I assign SME and corporate loan types to each loan. The loan type then determines the lending technique for each loan.

Now, imagine a firm that receives a transaction-based loan loan from a transactional bank and a relationship-based loan from a relationship bank (SME loans). Controlling for loan characteristics, I examine differences in loan performance of such a firm when lending techniques differ (left arrow in Figure 1). In contrast, if the firm receives two relationship-based loans from a relationship and transactional bank (corporate loans), I expect no differences in loan performance (right arrow in Figure 1). Empirically, I estimate the following model:

$$\begin{aligned} \text{Loan Performance}_{ijkt} = {} & \beta_1 \text{Corporate Loan}_{ijk} \\ & + \beta_2 \text{Relationship Bank}_k \\ & + \beta_3 \text{Corporate Loan}_{ijk} \times \text{Relationship Bank}_k \\ & + \theta\text{'Controls}_{ijk} + \alpha_j + \gamma_t + \varepsilon_{ijkt}, \end{aligned} \tag{1}$$

where $i$, $j$, $k$, $t$ index loans, firms, banks, and time (semiannually). Notice that regressions are on loan-time level, that is $t$ stands for each period a loan is observed. $\text{Loan Performance}_{ijkt}$ equals 1 if a loan becomes delinquent for less than 90 days (or for more than 90 days) in a given half year and zero otherwise. $\text{Corporate Loan}_{ijk}$ equals one if a firm receives a corporate loan from a transactional bank. $\text{Relationship Bank}_k$ equals one if a firm receives an SME loan from a relationship bank. $\text{Corporate Loan}_{ijk} \times \text{Relationship Bank}_k$ equals one if a firm receives a corporate loan from a relationship bank. All these loans are based on relationship lending.

The reference group are SME loans from transactional banks that are based on transactional lending.

Coefficient $\beta_2$ is the main coefficient of interest that gauges the differences in performance between relationship-based and transaction-based loans (SME loans from relationship and transactional banks). A positive coefficient implies that relationship-based loans have higher delinquencies than transaction-based loans. This would be in line with theoretical predictions that relationship banks allow for temporary delinquencies of their customers. Coefficient $\beta_1$ indicates whether there are more or fewer delinquencies for relationship-based (corporate loans) relative to transaction-based loans (SME loans) of transactional banks. A positive coefficient would imply that even for transactional banks, relationship lending leads to more temporary delinquencies. Coefficient $\beta_3$ measures the difference in performance when both banks employ relationship lending (corporate loans from transactional versus relationship banks). No difference here would imply that once both banks rely on relationship lending, differences in performance disappear.

$\text{Controls}_{ijk}$ consists of loan, firm and bank characteristics. Loan characteristics include contract terms such as the credit rating at loan initiation ($\text{Credit Rating}_{ijk}$), loan interest rate ($\text{Interest Rate}_{ijk}$), the natural logarithm of one plus the loan amount ($\text{Loan Amount}_{ijk}$), two dummy variables that indicate whether the loan is collateralized ($\text{Collateral}_{ijk}$) or has a guarantee ($\text{Guarantee}_{ijk}$), and the natural logarithm of one plus the loan maturity in months ($\text{Loan Maturity}_{ijk}$). Although results in Section 2.3 show that most contract terms do not differ across relationship and transactional banks, I still control for them in the regressions. I assume that contract terms are hard information variables that explain the performance of a loan. Controlling for hard information variables within the same firm ensures that the effect on loan performance is coming from differences in the importance of relationship lending and thus the use of unobservable soft information (see, e.g., Keys et al., 2010).[19] If an omitted variable bias is driving the results it will affect relationship and transactional banks in the same way since contract terms do not differ across the two bank types.

To account for observable firm characteristics, I include dummy variables that indicate whether a firm is located in the capital Yerevan, whether it is associated with the trade or other fields of service industries and whether the firm is a private firm. Since bank characteristics

[19] In Section 5 I confirm that relationship lending is indeed associated with higher use of soft information in loan pricing.

might also influence bank behavior, I use indicators of bank size, ownership and average hierarchy for loan approval. Finally, I also include dummy variables that indicate loan location, industry and currency. Definitions of the variables can be found in Table A.1 of Appendix A.

Firm fixed effects, $\alpha_j$, eliminate firm heterogeneity and compositional biases, comparing differences in loan performance within the same firm across different banks. Time of loan origination fixed effects, $\gamma_t$, are included to control for the timing of loan origination. In some specifications, I also use firm×time fixed effects ($\alpha_{jt}$), where time stands for the current period, to account for changes in firm characteristics over time. Standard errors are always clustered at firm level to control for possible correlations in the residuals across observations of the same firm.[20] In the main regressions, I rely on a linear probability model since logit models with a large number of fixed effects suffer from the "incidental parameter problem".[21] Still, in Section 4.4.1 I confirm the main results using a logit model.

# 4 Relationship lending and loan performance

In this section I first show that relationship lending results in temporarily higher delinquencies. Second, I reveal that, given previous delinquencies, relationship banks are not worse off in the long run, are able to extract rents and continue to lend to firms afterwards. Third, I examine the behavior of relationship banks that enables them to offer liquidity insurance. Lastly, I present several alternative explanations and robustness tests.

## 4.1 Relationship lending and loan delinquencies

In Figure 2 we have already observed that firms are more likely to become delinquent on relationship-based loans relative to transaction-based loans. Tables 3 and 4 document more formally that temporary delinquencies are more likely for relationship-based relative to transactions-based loans (coefficient of "Relationship Bank"). Table 3 uses delinquencies for less than 90 days and Table 4 delinquencies over 90 days as dependent variables for the sub-sample of 621 firms that receive 4,441 loans from both relationship and transactional banks. Columns (2) of both tables suggest that the *same firm* is 2.5 (1.6) percentage points more likely to become

[20] In Section 4.4.1 I show that results survive clusters at bank level and double clustering at bank×time and firm levels.

[21] Because of the large number of fixed effects in the model relative to the smaller number of periods for which a borrower is observed, a non-linear model could give inconsistent estimates; this is known as the "incidental parameter problem" (see, e.g., discussion in Cameron and Trivedi, 2005, pp. 726-727).

delinquent for less (more) than 90 days on a relationship-based loan relative to a transaction-based loan. Given an average delinquency rate for less (more) than 90 days of 4.9% (3%) for the sub-sample, the results imply that a firm is around 50% more likely to become temporary delinquent on a relationship-based loan, an economically meaningful effect.[22]

In all specifications, I control for loan contract characteristics to isolate the effect of relationship lending on loan performance from observable hard information variables that explain loan performance. Still, results also hold if I exclude endogenous loan characteristics. To show the consistency of results, I run a pooled regression with firm characteristics in column (1) to control for hard information variables on borrower level; in columns (2)-(5) I use firm fixed effects to account for any unobservable firm characteristics and in column (6), I add firm×time fixed effects to additionally control for changes in firm characteristics over time. In columns (3)-(5), apart from firm fixed effects, I add loan origination fixed effects, bank characteristics and other loan characteristics.

Comparing columns (1) and (2) in Tables 3 and 4, it becomes evident that adding firm fixed effects does not alter the main coefficient $\beta_2$, suggesting that the effect is not driven by differences in firm characteristics but rather differences in lending technologies (transactional lending versus relationship lending). Even when firm×time fixed effects are added in column (6), the main effect remains significant for delinquencies below 90 days but loses its significance for delinquencies above 90 days.[23] While loan origination fixed effects in column (3) and other loan characteristics in column (5) do not change the magnitude of the main coefficient, adding bank characteristics in column (4) increases the effect to 3.2 (1.9) in Table 3 (4). Overall, the main coefficient remains statistically significant and similar in size throughout all specifications.

The coefficient of "Corporate Loan" is mostly positive and often significant at the 5% significant level. This result indicates that even for transactional banks, delinquencies are more likely for relationship-based loans (corporate loans) relative to transaction-based loans (SME loans). The interaction term "Corporate Loan × Relationship Bank" is never significant, implying that there is no difference in performance between corporate loans from transactional versus relationship banks (both relationship-based loans).

Turning to loan characteristics, I find that initial credit ratings have the highest economic effect, being a natural predictor of future loan performance. A one-unit increase in the credit

[22]Results continue to hold for a logit model with similar magnitudes of the odds ratios of the main effect (see Section 4.4.1 and Table 10).

[23]For the logit model, however, the effect is significant for both delinquency measures.

rating is associated with a 18 to 39 percentage points lower delinquency rate. Loans that have high interest rates, are collateralized and have longer maturities are more likely to become delinquent. Higher loan amounts are generally associated with higher delinquency rates over 90 days but seem to lead to fewer delinquencies for loans within the same firm. To consume space, I do not report the coefficients of other control variables. Unreported results reveal that most of them are insignificant, except that more hierarchal levels for loan approval have a slightly significant positive effect on delinquencies for less than 90 days, while loans in other service industries experience lower delinquency rates.

All in all, results indicate that relationship lending leads to temporarily higher delinquencies. Von Thadden (1995) and Rajan (1992) suggest that banks might tolerate short-term bad results and thus offer financial flexibility as long as they can extract long-term rents. Banks learn a firm's quality through monitoring and therefore do not consider bad short-term results as a sign of bad quality and prematurely terminate good projects. In the next section, I explore what happens in the long run.

### 4.2 Relationship lending and long-term effects

In this section, I examine long-term effects by looking at defaults, recovery rates and losses, as well as return on loans when loans mature. If Von Thadden (1995)'s and Rajan (1992)'s theories hold, I should not find differences in loan performance when loans mature, despite temporary higher delinquencies for relationship-based loans. Knowing the quality of the firms, relationship banks will allow temporary delays in loan repayment for firms that are not likely to default when loans mature. Relationship banks might, however, extract higher rents in order to be compensated for providing liquidity insurance.

Descriptive statistics in Table 2 have already shown that, for the sub-sample, relationship banks have significantly higher delinquency rates but not higher default rates (in loss/written-off status) compared to transactional banks. In Table 5 I examine only SME loans from relationship and transactional banks, the case when one relies on relationship lending and the other on transactional lending. To account for right-censoring, I select SME loans that are observed until maturity and condition them to have been delinquent during the loan spell. Since many observations are lost, I present results for both the total and the sub-sample, also because the effect of higher delinquencies of relationship banks continues to hold for the total sample (see Section 4.4.1). To measure long-term performance, I calculate loan defaults that equal one if

a loan is in loss or written-off status at maturity, recovery rates that equal one if a loan has had overdue payments during the loan spell but did not default at maturity and losses defined as written-off amounts relative to the contract amount. As I do not have a direct measure of written-off amounts, I use the overdue principal (plus interest rate amount) given delinquencies. Since I am interested in looking at long-term effects for the two lending technologies, I focus on cross-sectional tests for differences in long-term performance.

Panel A of Table 5 reports univariate tests of default rates, recovery rates, and losses at the loan maturity for SME loans that have been delinquent for less than 90 days. Although SME loans from relationship banks seem to default more often after delinquencies for the total sample, the difference is not highly statistically significant and disappears for the sub-sample. Recovery rates always remain insignificant for the total sample and sub-sample. Interestingly, the losses in percentage of the contract amount are smaller for relationship than transactional banks, indicating that despite higher delinquency rates relationship banks are not losing more on average.

Panel B repeats the analysis for SME loans that have been delinquent for more than 90 days. While loan defaults are higher and recovery rates lower for the total sample at the 10% significance level only, differences again disappear for the sub-sample. Losses given delinquencies over 90 days do not differ for both samples. However, the lost amounts are much higher for delinquencies over 90 days than for short-term delinquencies below 90 days, since the former are more likely to turn into actual defaults. In unreported regression results, I confirm that results continue to hold when I use regression analysis. Overall, the results indicate that relationship lending does not lead to worse long-term performance at maturity, despite higher temporary delinquencies. This means that relationship banks indeed offer liquidity insurance to good firms that do not default long term.

Loan performance at loan maturity might, however, be correlated if firms default across all banks. For this reason, I also calculate returns on loans a bank gains at loan maturity or until the loan is observed. Table 2.3 has already revealed that relationship banks charge higher interest rates for the total sample, suggesting that relationship banks require higher rates for the financial flexibility they offer. Following Haselmann, Schoenherr, and Vig (2013), I calculate the return on a loan (ROL) by bank $j$ to firm $i$ for the entire loan spell:

$$\text{ROL}_{ij} = \sum_{t=1}^{T} \frac{\text{Loan Balance}_{ijt}}{\sum_{t=1}^{T} \text{Loan Balance}_{ijt}} \left[ (1 - \mathbb{1}_{\{NPL=1\}}) r_{ijt} + \mathbb{1}_{\{NPL=1\}} \text{Loss}_{ijt} \right], \tag{2}$$

where the first term stands for the ratio of the outstanding loan amount from bank $j$ to firm $i$ at the beginning of period $t$ ($\text{Loan Balance}_{ijt}$) to the sum of the outstanding loan amounts over the loan spell ($\sum_{t=1}^{T} \text{Loan Balance}_{ijt}$). The indicator function ($\mathbb{1}_{\{NPL=1\}}$) equals one when a loan has overdue amounts between $t$ and $t+1$, $r_{ijt}$ is the interest rate charged by bank $j$ to firm $i$ and $\text{Loss}_{ijt}$ is the loss of the bank, which is defined as the (negative) of the written-off amount over the contract amount. The weights ensure that returns or defaults receive more weight at the beginning of the loan spell and less weight at the end of the loan spell, when most of the loan has been repaid.[24] Since I do not observe the actual written-off amounts, losses are defined as the overdue principal (plus overdue interest) amount in case a loan is in a loss/written-off status or delinquent over the contract amount.[25]

Table 6 shows univariate tests and regression estimates of ROLs of relationship and transactional banks for the total sample and the sub-sample. Unconditional ROLs are significantly higher for relationship banks relative to transactional banks for the total sample but not any more significant for the sub-sample. While ROLs, given delinquencies below 90 days, are 2.5 percentage points higher for relationship banks and statistically significant for both samples, ROLs, given delinquencies over 90 days, are not significantly different for both samples but economically meaningful. The last panel presents pooled regression results of the ROL measure on a relationship bank dummy for the total sample and sub-sample of SME loans, unconditional and conditional on delinquencies below and over 90 days. Results are similar to univariate tests with significantly higher ROLs for the total sample for all SME loans and given delinquencies below 90 days as well as for the sub-sample for delinquencies below 90 days. Although differences in ROLs between relationship and transactional banks are not always statistically significant, they are always larger in size for relationship banks.

In sum, results in this section are in line with theoretical predictions. Relationship banks allow their customers to become temporarily delinquent yet are able to extract long-term rents, not facing higher defaults or losses but extracting higher return on loans at maturity. These findings imply that relationship lending provides a liquidity insurance for firms in distress, offering greater financial flexibility without incurring higher losses and earning higher rents. Relationship banks are thus forgiving when it comes to temporary delinquencies but not forgetting,

[24] Haselmann, Schoenherr, and Vig (2013) additionally discount the weights to account for the time value of money. Unreported results using discounted ROLs confirm that the findings are not affected.

[25] In unreported results, I also use the overdue principal (plus overdue interest) amount over the contract amount only in case a loan is in a loss/written-off status and zero otherwise. This measure yields virtually the same results.

requiring higher rents.

### 4.3 Relationship lending and bank behavior

Results in the previous sections suggest that relationship banks must have some superior technology that allows them to be more flexible and forgiving to their customers. What do relationship banks do differently relative to transactional banks that enables them to offer liquidity insurance? This section tries to answer this question by examining the distribution of borrowers' ex-ante riskiness, loan rescheduling and drawdowns on credit lines and overdrafts as well as the monitoring behavior of banks.

Differences in borrowers' ex-ante riskiness might drive the behavior of relationship banks when firms are in distress. Relationship banks might be able to offer liquidity insurance to customers simply because they have an overall better customer base than transactional banks. In turn, relationship banks might also have a worse customer base that makes them adjust their lending behavior. Therefore, panel A of Table 7 compares ex-ante non-performance with the bank a firm borrows from (Past NPL Bank), with any bank (Past NPL Any Bank) including the former, and with other banks (Past NPL Other Banks) between relationship and transactional banks on bank-borrower-time and bank-borrower level for the total sample of firms. Results reveal that customers of relationship banks have a worse performance history with their relationship bank relative to customers of transactional banks with their transactional bank. This indicates that relationship banks are more likely to continue to lend to firms despite past non-performance, which is another proof for the insurance function of relationship lending. There are, however, no statistically significant differences in ex-ante loan performance with any bank or other banks for the customer base of both bank types. This implies that relationship banks must have some additional unobservable information about their clients that allows them to be more lenient and not make losses long term.

Another way to explore the behavior of relationship banks is to look at loan rescheduling and renegotiations. Are relationship banks more likely to roll over loans and renegotiate contract terms when firms are in trouble? Panels B and C of Table 7 show the average percentage of rollover loans within one-month, two-month and three-month windows around the loan maturity given less or more than 90-day delinquencies.[26] Rollovers occur, in general, in 1.2% to 2.7% of

[26] As I do not know for sure whether a loan has been rolled over, I declare a loan to a firm to be a rollover loan if the loan has been non-performing and a new loan has been issued within one, two, or three months before or after the the non-performing loan with the same bank.

the cases for both samples but there are no highly significant differences between relationship and transactional banks despite higher delinquencies among relationship banks. This suggests that relationship banks do not evade defaults by issuing new loans.

Panels B and C also report the average percentage of increases and decreases in the interest rate, loan amount and loan maturity for the total sample and sub-sample given delinquencies below or above 90 days, respectively. In particular, changes in contract terms are measured on loan-time level at the period and up to three periods after delinquencies and then collapsed to loan level. Relationship banks are more likely to increase maturities upon delinquencies than transactional banks for both samples. Although lengthening maturities might suggest that relationship banks avoid delinquencies, Table 7 also shows that they shorten maturities almost as often. They are also more likely to increase or decrease interest rates for the total sample. This indicates that relationship banks are in general more active in adjusting contract terms upon delinquencies which might help them alleviate the liquidity shortages of firms.

Since firms often have other contracts such as credit lines and overdrafts with banks, relationship banks might allow firms to draw down on them once in distress, mitigating future defaults. Panel D of Table 7 reports whether firms with SME loans and credit lines or overdrafts with the same bank draw down on them upon delinquencies or up to three periods later on loan-time level and then collapsed to loan level. Since these restrictions reduce the sample size, I only look at the total sample of SME loans and additionally report drawdowns given both delinquency types (less or more than 90 days). Clients of relationship banks draw down on credit lines or overdrafts in around 37% to 42% of delinquency cases of over or/and below 90 days, while clients of transactional banks only in around 23% to 32% of delinquency cases. The differences are large in magnitude but not that significant due to the low number of observations. Conditioning on any overdue payments or overdue days in the last row yields more observations and a similar difference of 10% that is highly significant. Confirming Von Thadden (1995)'s predictions, relationship banks seem to combine normal contracts with credit lines and overdrafts to allow firms to draw down on them in distressed times.

Since relationship banks do not have an ex-ante different customer base, they must be screening or monitoring firms to acquire superior knowledge about their clients. Although I do not directly observe the behavior of banks, I have data on the use of the credit registry by banks to request information on firms for loan granting and loan monitoring purposes between June 2012 and June 2013. Since the data offer just the numbers of enquiries on firm level, I

focus on firms that received loans either only from relationship or transactional banks to be able to disentangle the effect for these two bank types. Table 8 reports regression results for the number of enquiries for loan monitoring in columns (1)-(3) and loan granting purposes in columns (4)-(6) for a sample of 2,737 firms that exclusively borrow either from relationship or transactional banks and for which data on banks' use of the credit registry exists. The main independent variable is the "Relationship Bank Firm" dummy that tests for differences in the use of credit registry between the firms that received loans just from relationship relative to transactional banks. To control for firm heterogeneity, I add firm size measured as the average total outstanding firm debt across banks, past non-performance measures with the same bank, any bank and other banks as presented above as well as firm location, industry and ownership fixed effects. The coefficient of "Relationship Bank Firm" is positive and significant in columns (1)-(3), suggesting that relationship banks are around 26 to 33 percentage points more likely to inquire the credit registry to monitor firms. For enquiries to the credit registry regarding loan granting, the "Relationship Bank Firm" dummy is never significant and small in size. These results suggest that relationship banks are more likely to monitor firms but do not request additional information when granting loans.

In line with Von Thadden (1995)'s theoretical predictions, relationship banks seem to acquire information about their clients through monitoring. Not having an ex-ante riskier customer base, relationship banks continue to lend to customers that have been delinquent only with them, knowing their inherent quality better than transactional banks. Relationship banks also allow firms to bridge liquidity shortages with drawdowns on credit lines or overdrafts and by adjusting interest rates and maturities but not rolling over loans more often than transactional banks. Overall, results give an indication of how relationship banks behave differently to transactional banks which constitutes the difference in lending technologies. Section 5 additionally confirms that relationship lending is based on the use of soft information about clients.

### 4.4 Alternative explanations

So far, we have established that relationship banks allow their customers to temporarily become delinquent but do not suffer from higher defaults, and often enjoy higher returns when loans mature. In this section I explore whether the effect of relationship lending on delinquencies

below 90 days survives alternative explanations.[27] For all tests in Tables 9 and 10, I use specifications in columns (1) and (2) of Table 3 with firm characteristics and with firm fixed effects. To consume space, Table 10 reports only the main coefficient of "Relationship Bank" that measures delinquencies of relationship-based versus transaction-based loans as well as its standard error and the number of observations.

A first concern might be that firms might be more likely to delay repayments with relationship banks because the delayed repayments are small in size. To this extent, I create three ratios that capture the relative size of delayed repayments: all measures use the overdue principal and interest rate amount in the numerator and set it relative to the total loan amount (NPL Amount over Contract Amount), the total outstanding firm debt with the particular bank in a period (NPL Amount over Bank Exposure) or the total outstanding firm debt with all banks in a period (NPL Amount over Total Exposure). For each dependent variable, I use firm characteristics or firm fixed effects to control for unobserved firm heterogeneity and restrict the sample to loans that have been delinquent for less than 90 days. Results in Table 9 show that there is never a statistically significant difference of relative overdue amounts for transaction-based and relationship-based loans, even within the same firm. This result confirms that higher delinquencies with relationship banks cannot be explained by smaller delayed repayment amounts.

Although repayment size does not matter, the importance of relationship lending might differ across banks, such that a 5 for "very important" (in the survey) might mean different things to different banks. Therefore, I construct a measure of the relative importance of relationship lending compared to other lending technologies (fundamentals, private and business collateral) which is defined as the importance of relationship lending (Likert number) over the sum of the importance of all all lending technologies (sum of Likert numbers). For all transactional banks the relative importance of relationship lending is always higher for corporate than for SME loans. The importance of relationship lending stays constant across loan types for only four out of nine relationship banks and is always higher compared to transactional banks. Row "Alternative relationship lending" in Table 10 reveals that for the reduced sample of banks the main result continues to hold, although somewhat reduced in magnitude and significance. Still, the relationship lending measure might simply capture relationship variables used in the

[27] In unreported results, I confirm that alternative explanations also hold when I use logit models instead or delinquencies over 90 days as the dependent variable.

previous literature. In row "Relationship variables" I therefore add relationship variables to the main regressions such as the natural logarithm of one plus the bank-firm relationship in months, a dummy variable that equals one if a firm has more than 50% of its outstanding debt with a bank, and a dummy variable that equals one if a firm has other products with the bank (e.g., credit lines, factoring, guarantees). Although, in unreported results, the dummy variable for the main bank of a firm significantly lowers delinquencies below 90 days, the positive effect of relationship lending on loan performance is not affected. This finding confirms that the relationship lending measure captures something beyond typical relationship lending proxies, most likely the use of firms' unobserved soft information.

Another concern might be that the main test does not capture differences in lending techniques but rather unobserved differences across banks. To exclude this explanation, I introduce bank fixed effects to the main regression in equation (1), such that only the "Corporate Loan" coefficient remains. The coefficient gauges the differences in lending techniques within a bank when a firm receives a transaction-based and relationship-based loan from a transactional bank. To make loans more comparable, I estimate the regressions for loan amounts 50% below and above the threshold at which loans switch from transaction-based to relationship-based lending (see Figure 1). Row "Bank fixed effects" shows results with firm characteristics and with firm fixed effects, revealing that only when I introduce firm fixed effects relationship lending has a large and positive effect on delinquencies. The result implies that a firm enjoys more financial flexibility when it receives relationship-based loans compared to transaction-based loans from the same bank.[28]

Lastly, the main results in Tables 3 and 4 rely on a sub-sample of firms that receive loans from both relationship and transactional banks. Since results might suffer from a selection bias, in row "Full/Opposite Sample" in Table 10 I estimate specification (1) of Table 3 with firm characteristics for the full sample of 6,649 firms and 19,332 loans in column "Table 3, specification (1)" and for the opposite sample of 6,028 firms that receive 14,891 loans from either relationship or transactional banks only in "Table 3, specification (2)". The effect is smaller in magnitude (2.0 and 1.6 percentage points for the full and opposite sample) but remains highly statistically significant, suggesting that the main result is not driven by sample selection.

[28] Note that the result also goes through when I explicitly control for the timing of loans, meaning first receiving transaction-based, smaller loans and then relationship-based, larger loans.

### 4.4.1 Additional robustness tests

Apart from alternative explanations, I also explore a battery of additional robustness tests in Table 10.[29] Panel B of Table 10 reports results for alternative non-performance measures, namely "Non-Performance" that equals one if a loan has any overdue payments or overdue days and zero otherwise as well as "Non-Performance 180" that equals one if a loan becomes delinquent for more than 180 days and zero otherwise. While there is no systematically significant effect of relationship lending on loan performance with firm characteristics, I find statistically significant effects with firm fixed effects that are similar in magnitude relative to their average values. The same firm is around 40% and 56% more likely to become delinquent on any payments and for more than 180 days on a relationship-based loan, respectively.

In panel C of Table 10, I test for different loan characteristics. When splitting loans into local currency and US dollar loans in rows "Local currency loans" and "US dollar loans" the effect becomes stronger for US dollars and loses significance and magnitude for local currency loans. This suggests that either relationship banks offer more flexibility in US dollars based on their dollar-denominated funding structure or that firms have more problems repaying US dollar denominated loans, having less income in US dollars. When splitting loans issued before and after 2011 in rows "Loans between January 2009-2011" and "Loans after January 2011", the effect remains significant for loans after 2011, but is somewhat reduced in significance for loans between January 2009-2011. This might be due to the reduced number of observations and thus less statistical power.

In row "W/o loans 50%" of panel C, I exclude loans outside a range of 50% around the loan amount threshold that determines SME and corporate loans. I assume that, for transactional banks, the change from transaction-based to relationship lending does not switch from one to the other exactly at the threshold but happens gradually with larger loan amounts. This implies that differences in lending techniques between relationship and transactional banks should be stronger further away from the threshold. As expected, the main effect continues to hold.

Panel D of Table 10 investigates different firm characteristics. In particular, I examine whether relationship banks are particularly helpful for firms in more opaque industries. Therefore, I distinguish between the main industries in Armenia such as trade, manufacturing and construction as well as other fields of services and other industries. While the positive ef-

[29] In unreported results, I confirm that robustness tests also hold when I use logit models instead or delinquencies over 90 days as the dependent variable.

fect of relationship lending on delinquencies disappears for more transparent industries in rows "Trade, manufacturing, construction" and "Other industries", the effect increases to 3.3 and 3.6 percentage points in row "Other fields of services", a more opaque industry. In rows "New customers" and "Old customers", I distinguish between loans to new customers from a bank and customers with which a bank has had a previous relationship since relationship banks are more likely to know these old customers better and thus be more lenient towards them. In line with this prediction, the main effect increases to 2.7 percentage points for old customers but becomes almost completely insignificant for new customers.

The last panel E of Table 10 compares different estimation techniques. In row "Logit model", I estimate a logit model instead of a linear probability model for the benchmark specifications and confirm that results hold. In row "Matching on firm and loan amount", I rely on a matching technique similar to Ioannidou and Ongena (2010) and Beck et al. (2014b). Since matching is a nonparametric estimation technique, it does not impose a functional form on the relationship between matching variables and the dependent variable. In particular, I match SME loans from relationship and transactional banks of the same firm from the sub-sample of 4,441 loans and 10,656 loan-time observations. Then I match on differences in loan amounts between SME loans from relationship and transactional banks, conditioning them to be in 0.5 or 0.25 standard deviations of the average loan amount of SME loans from the two bank types. In row "Matching on firm and loan char.", I additionally match on differences in interest rates, maturity and credit ratings in the same way and exact matching of collateralized and non-collateralized loans. Specifications (1) and (2) in Table 10 correspond to a 0.5 and 0.25 standard deviation radius for each of the matching variables. While matching on firm and loan amounts yields similar results as for the main regression with a 2.6 percentage points effect, matching on more variables increases the positive effect to 4.3 and 6.2 percentage points, yet only significantly in the former case which might be due to the small number of observations in the latter case. In the last two rows of Table 10, I implement clusters at bank level and double clustering at bank×time and firm level to account for the fact that observations within a bank and time period might be correlated. Although standard errors increase, the main effect remains significant.

# 5 Relationship lending and information use

Since the measure of relationship lending is new to the literature and relies on survey responses, this section shows that it captures the use of soft information when pricing loans. Similar to Rajan, Seru, and Vig (2014) and Skrastins and Vig (2014), I assume that in a state with just hard information and no soft information available, hard information variables will perfectly predict the loan interest rate. In a state with additional soft information, hard information variables will not be able to completely explain interest rates and the unexplained part becomes a measure of soft information.

For the analysis, I use a regression model with multiplicative heteroskedasticity introduced by Harvey (1976) and applied to banking by Cerqueiro, Degryse, and Ongena (2011). The model estimates mean effects on the interest rate and the determinants of the residual variance in interest rates. The model consists of an equation for the mean of interest rates, and a second one for the residual variance of interest rates:[30]

$$\text{Loan Spread}_{ijk} = \theta\text{'Controls}_{ijk} + \alpha_j + \varepsilon_{ijk}, \tag{3}$$

$$\begin{aligned} Log(\sigma^2_{ijk}) = {} & \alpha_0 + \delta_1 \text{Corporate Loan}_{ijk} \\ & + \delta_2 \text{Relationship } Bank_k \\ & + \delta_3 \text{Corporate Loan}_{ijk} \times \text{Relationship Bank}_k, \end{aligned} \tag{4}$$

where $i$, $j$, $k$ index loans, firms, and banks. Note that different from equation (1) I only use information at loan initiation such that each loan appears only once in the data set. The $\text{Loan Spread}_{ijk}$ equals the loan interest rate minus the refinancing rate of the Armenian banks with the Armenian Central Bank. $Log(\sigma^2_{ijk})$ stands for the natural logarithm of the residual variance of the loan spread. The other variables are defined as in equation (1). By including loan contract terms as well as firm fixed effects, I control for all hard information variables that explain the variation in interest rates for the *same firm*. The remaining unexplained variation should capture the use of soft information. A positive effect on the variance of the unexplained part means that the variance increases, hard information variables are less predictive of interest rates and more soft information is used and vice versa for a negative effect. The coefficient $\delta_2$ estimates the effect of relationship lending on the variation in interest rates (soft information use) relative to transactional lending (SME loans from relationship versus transactional banks).

[30] A more detailed description of the methodology can be found in the Appendix A.

Since I am interested in the effect of relationship lending on the variation in interest rates, Table 11 only shows estimation results of the variance equation (4), where the columns correspond to the specifications of the columns in Table 3. Results on mean equation (3) are available upon request. All specifications in 11 reveal a positive effect of relationship lending on the variation in interest rates (SME loans from relationship banks). Relationship lending increases the unexplained part of interest rates and leads to more use of soft information relative to transactional lending.

# 6 Conclusions

Although the empirical literature on relationship lending is quite extensive, little is known about the behavior of banks when firms are in distress. Combining survey data on banks' lending policies with unique credit registry data, this paper fills the gap by examining the effect of relationship lending on ex-post loan performance. In line with Von Thadden (1995) and Rajan (1992), I find that relationship banks tolerate temporary delinquencies without facing higher defaults and earning higher rents in the long run. When firms are in distress, relationship banks adjust contract terms and offer drawdowns on credit lines and overdrafts but do not inefficiently roll over loans. Moreover, relationship banks are more likely to continue to lend to firms after past non-performance. The paper presents a new channel of how relationship lending serves as a liquidity insurance for firms in distress, offering greater financial flexibility and better access to finance.

The findings of the paper have several broader implications. Relying on soft information, relationship lending constitutes a critical tool to target SMEs which are the backbone of most economies.[31] This paper shows that relationship lending is especially beneficial when firms experience liquidity shortages. In the long run, firms will thus have longer investment horizons which should lead to more investments, employment and economic growth. From a financial stability perspective, relationship lending appears to be an efficient lending technique to help firms in need without incurring higher losses for banks. Finally, the results can also be useful for other markets such as the labor market or insurance market in which close relationships help reduce existing information asymmetries.

[31] According to the website of the Global Alliance of SMEs, SMEs have provided nearly 50% of jobs in most countries (53% in the United States and 78% in Germany) and account for 75% and 39% of GDP in Germany and the United States (Global Alliance of SMEs, 2014).

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Table 1: Bank level descriptive statistics

The Table reports bank level summary statistics for 15 Armenian banks on the importance of relationship lending and the average number of hierarchical layers for loan approval by loan type, the average loan amount threshold in US$, the market share in terms of loan number and loan value, the average borrower size based on the total borrowing amount across all banks in US$ between January 2009 and June 2013 as well as bank size based on total assets as of 2009 and foreign ownership that equals one if more than 50% of equity is foreign-owned.

| Bank ID | Bank Type | Relationship Lending | Average Hierarchy | Relationship Lending | Average Hierarchy | Average Threshold (US$) | Share in Number of Loans (%) | Share in Value of Loans (%) | Borrower Size | Bank Size | Foreign |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | SME Loans | | Corporate Loans | | | | | | | |
| 38 | Transactional | 3 | 2 | 5 | 2 | 2,751,486 | 0.027 | 0.029 | 1,727,395 | Small | 0 |
| 59 | Transactional | 4 | 2 | 5 | 2 | 1,500,000 | 0.065 | 0.216 | 3,033,712 | Big | 0 |
| 70 | Relationship | 5 | 1 | 5 | 1 | 518,444 | 0.061 | 0.041 | 1,0679,69 | Medium | 0 |
| 219 | Transactional | 4 | 3 | 5 | 1 | 166,639 | 0.076 | 0.032 | 529,078 | Medium | 0 |
| 274 | Relationship | 5 | 2 | 5 | 3 | 837,301 | 0.054 | 0.036 | 466,309 | Medium | 1 |
| 457 | Transactional | 4 | 2 | 5 | 3 | 2,751,486 | 0.089 | 0.136 | 2,133,701 | Big | 0 |
| 470 | Transactional | 4 | 3 | 5 | 3 | 500,000 | 0.169 | 0.067 | 721,984 | Medium | 0 |
| 520 | Relationship | 5 | 2 | 5 | 1 | 1,000,000 | 0.037 | 0.108 | 3,756,655 | Big | 0 |
| 523 | Relationship | 5 | 2 | 5 | 2 | 1,355,53 | 0.025 | 0.017 | 1,211,437 | Medium | 0 |
| 662 | Relationship | 5 | 1 | 5 | 2 | 500,000 | 0.137 | 0.068 | 313,301 | Big | 0 |
| 702 | Relationship | 5 | 1 | 5 | 1 | 271,106 | 0.122 | 0.055 | 790,899 | Medium | 0 |
| 772 | Transactional | 4 | 1 | 5 | 3 | 661,568 | 0.026 | 0.024 | 1,833,290 | Small | 0 |
| 776 | Relationship | 5 | 3 | 5 | 3 | 300,000 | 0.040 | 0.028 | 1,748,996 | Small | 1 |
| 798 | Relationship | 5 | 2 | 5 | 2 | 200,000 | 0.037 | 0.029 | 1,319,247 | Small | 0 |
| 995 | Relationship | 5 | 5 | 5 | 5 | 500,000 | 0.035 | 0.112 | 2,471,792 | Big | 1 |

Table 2: Loan level descriptive statistics

The Table reports loan level summary statistics on ex-post loan performance measures, loan characteristics, relationship characteristics, and firm characteristics by bank type between January 2009 and June 2013. The two bank types are "Relationship Banks" that always rely on relationship lending and "Transactional Banks" that mostly rely on transactional lending. Definitions of the variables can be found in Table A.1 of Appendix A. The left panel "Total Sample" reports summary statistics for the total sample of 19,332 loans to 6,649 firms. The right panel "Sub-Sample" reports summary statistics for a sub-sample of 4,441 loans to 621 firms that received loans from both relationship and transactional banks. The columns "Difference $t$-test" in both panels report $t$-statistics for differences in means between the two bank types and indicate significance at the 1%, 5%, and 10% significance levels with ***, **, *.

| | Total Sample | | | | | Sub-Sample | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Relationship Bank | | Transactional Bank | | Difference | Relationship Bank | | Transactional Bank | | Difference |
| Variable Names | Mean | Std | Mean | Std | $t$-test | Mean | Std | Mean | Std | $t$-test |
| **Ex Post Loan Performance** | | | | | | | | | | |
| Non-Performance | 0.058 | 0.233 | 0.061 | 0.238 | -0.002 | 0.051 | 0.220 | 0.046 | 0.209 | 0.005 |
| Non-Performance 0-90 days | 0.100 | 0.300 | 0.075 | 0.263 | 0.026*** | 0.088 | 0.284 | 0.058 | 0.234 | 0.030*** |
| Non-Performance 90 days | 0.046 | 0.210 | 0.037 | 0.188 | 0.010*** | 0.041 | 0.199 | 0.023 | 0.150 | 0.018*** |
| Non-Performance 180 days | 0.029 | 0.168 | 0.021 | 0.144 | 0.008*** | 0.025 | 0.156 | 0.015 | 0.123 | 0.010** |
| Default (loss/written-off) | 0.020 | 0.139 | 0.012 | 0.110 | 0.008*** | 0.012 | 0.109 | 0.009 | 0.095 | 0.003 |
| **Loan Characteristics** | | | | | | | | | | |
| Credit Classification | 4.99 | 0.17 | 4.99 | 0.14 | -0.002 | 4.98 | 0.18 | 4.99 | 0.13 | -0.007 |
| Interest Rate | 15.37 | 3.88 | 15.10 | 3.72 | 0.264*** | 13.81 | 3.73 | 13.76 | 3.56 | 0.045 |
| Loan Spread | 8.00 | 4.37 | 7.62 | 4.08 | 0.380*** | 6.41 | 4.21 | 6.25 | 3.98 | 0.152 |
| Loan Amount in US$ | 181,386 | 606,152 | 224,708 | 714,815 | -43,322*** | 352,903 | 963,534 | 341,802 | 752,242 | 11,100 |
| Collateral | 0.82 | 0.38 | 0.88 | 0.32 | -0.062*** | 0.76 | 0.43 | 0.87 | 0.33 | -0.108*** |
| Guarantee | 0.05 | 0.22 | 0.11 | 0.31 | -0.053*** | 0.11 | 0.31 | 0.16 | 0.37 | -0.051*** |
| Loan Maturity in Months | 36.32 | 21.37 | 33.38 | 22.46 | 2.940*** | 32.39 | 22.65 | 32.00 | 24.42 | 0.389 |
| **Other Loan Characteristics** | | | | | | | | | | |
| Loan Location in Yerevan | 0.59 | 0.49 | 0.75 | 0.43 | -0.163*** | 0.72 | 0.45 | 0.77 | 0.42 | -0.051*** |
| Wholesale and Retail Trade Loan | 0.46 | 0.50 | 0.42 | 0.49 | 0.041*** | 0.51 | 0.50 | 0.44 | 0.50 | 0.070*** |
| Other Fields of Service Loan | 0.13 | 0.34 | 0.22 | 0.41 | -0.083*** | 0.11 | 0.31 | 0.14 | 0.35 | -0.037*** |
| Loan in US$ | 0.46 | 0.50 | 0.51 | 0.50 | -0.051*** | 0.58 | 0.49 | 0.61 | 0.49 | -0.026* |

Table 2 (continued): Loan level descriptive statistics

| | Total Sample | | | | | Sub-Sample | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Relationship Bank | | Transactional Bank | | Difference | Relationship Bank | | Transactional Bank | | Difference |
| Variable Names | Mean | Std | Mean | Std | $t$-test | Mean | Std | Mean | Std | $t$-test |
| **Relationship Characteristics** | | | | | | | | | | |
| Relationship in Months | 15.63 | 18.16 | 15.92 | 17.65 | -0.291 | 17.43 | 19.27 | 16.22 | 17.27 | 1.211** |
| Scope | 0.18 | 0.38 | 0.24 | 0.43 | -0.062*** | 0.30 | 0.46 | 0.31 | 0.46 | -0.012 |
| Primary Bank | 0.93 | 0.26 | 0.90 | 0.30 | 0.032*** | 0.79 | 0.41 | 0.74 | 0.44 | 0.049*** |
| Number of Relationships | 1.93 | 1.39 | 1.94 | 1.47 | -0.012 | 3.41 | 2.08 | 3.24 | 2.01 | 0.176*** |
| Multiple Relationships | 0.53 | 0.50 | 0.51 | 0.50 | 0.025*** | 1 | 0 | 1 | 0 | 0 |
| **Firm Characteristics** | | | | | | | | | | |
| Firm Location in Yerevan | 0.59 | 0.49 | 0.75 | 0.43 | -0.163*** | 0.72 | 0.45 | 0.77 | 0.42 | -0.051*** |
| Wholesale Retail Trade | 0.23 | 0.42 | 0.16 | 0.36 | 0.075*** | 0.24 | 0.43 | 0.18 | 0.39 | 0.057*** |
| Industry Firm | | | | | | | | | | |
| Other Fields of Service | 0.54 | 0.50 | 0.63 | 0.48 | -0.087*** | 0.54 | 0.50 | 0.60 | 0.49 | -0.057*** |
| Industry Firm | | | | | | | | | | |
| Private Firm | 0.54 | 0.50 | 0.65 | 0.48 | -0.104*** | 0.53 | 0.50 | 0.61 | 0.49 | -0.076*** |
| Observations | 10,598 | | 8,734 | | 19,332 | 2,151 | | 2,290 | | 4,441 |

Table 3: Relationship lending and loan performance (NPL 0-90 days)

The Table reports regression results from a linear probability model for a sub-sample of 10,656 loan-time observations of 4,441 loans to 621 firms that received loans from both relationship and transactional banks between January 2009 and June 2013. The dependent variable is Loan Performance$_{ijkt}$ that equals one when a loan is delinquent for less than 90 days. The main independent variable is "Relationship Bank" which measures the performance of relationship-based relative to transaction-based loans, that is, SME loans from relationship versus transactional banks (the reference group). "Corporate Loan" measures the differences between SME and corporate loans from transactional banks (transactions-based versus relationship-based loans), while "Corporate Loan × Relationship Bank" measures the differences between corporate loans from transactional and relationship banks (when both rely on relationship lending). Column (1) reports results with loan characteristics and firm characteristics. In columns (2)-(5) firm fixed effects are added. Column (3) adds loan origination fixed effects, column (4) bank characteristics, and column (5) other loan characteristics. Column (6) introduces firm×six-month period fixed effects. The sample reduces to 3,790 loan-time observations of 1,952 loans to 318 firm that received loans from both bank types in *each six-month period*. Definitions of the variables can be found in Table A.1 of Appendix A. Standard errors are clustered at firm level and presented in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% significance levels.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| **Bank Lending Technologies** | | | | | | |
| Corporate Loan | 0.014 | 0.029** | 0.026* | 0.029** | 0.029** | 0.019 |
| | (0.016) | (0.013) | (0.013) | (0.013) | (0.013) | (0.019) |
| Relationship Bank | 0.025*** | 0.025*** | 0.025*** | 0.032*** | 0.024*** | 0.027** |
| | (0.009) | (0.008) | (0.008) | (0.012) | (0.009) | (0.013) |
| Corporate Loan × Relationship Bank | 0.021 | -0.004 | -0.001 | -0.009 | -0.004 | 0.001 |
| | (0.021) | (0.017) | (0.017) | (0.017) | (0.017) | (0.020) |
| **Loan Characteristics** | | | | | | |
| Credit Rating | -0.191*** | -0.178*** | -0.178*** | -0.175*** | -0.182*** | -0.091 |
| | (0.061) | (0.062) | (0.062) | (0.062) | (0.062) | (0.154) |
| Credit Interest Rate | 0.005*** | 0.002 | 0.003* | 0.001 | 0.003 | 0.008* |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.004) |
| Loan Amount | 0.004 | -0.002 | -0.001 | -0.003 | -0.003 | 0.008 |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) | (0.006) |
| Collateral | 0.029*** | 0.015 | 0.012 | 0.015 | 0.018* | -0.001 |
| | (0.009) | (0.010) | (0.012) | (0.011) | (0.010) | (0.023) |
| Guarantee | 0.006 | 0.001 | -0.001 | -0.001 | 0.003 | -0.036 |
| | (0.017) | (0.025) | (0.025) | (0.026) | (0.025) | (0.023) |
| Maturity | 0.016*** | 0.013** | 0.015** | 0.013** | 0.012** | 0.002 |
| | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.007) |
| Firm Characteristics | Yes | No | No | No | No | No |
| Bank Characteristics | No | No | No | Yes | No | No |
| Other Loan Characteristics | No | No | No | No | Yes | No |
| Firm Fixed Effects | No | Yes | Yes | Yes | Yes | No |
| Loan Origination Fixed Effects | No | No | Yes | No | No | No |
| Firm×Time Fixed Effects | No | No | No | No | No | Yes |
| Constant | 0.786** | 0.866*** | 0.812*** | 0.844*** | 0.865*** | 0.292 |
| | (0.316) | (0.320) | (0.313) | (0.320) | (0.322) | (0.797) |
| $R^2$ | 0.044 | 0.293 | 0.294 | 0.293 | 0.294 | 0.633 |
| Observations (Loan-Time Level) | 10,656 | 10,656 | 10,656 | 10,656 | 10,656 | 3,790 |

Table 4: Relationship lending and loan performance (NPL 90 days)

The Table reports regression results from a linear probability model for a sub-sample of 10,656 loan-time observations of 4,441 loans to 621 firms that received loans from both relationship and transactional banks between January 2009 and June 2013. The dependent variable is Loan Performance$_{ijkt}$ that equals one when a loan is delinquent for more than 90 days. The main independent variable is "Relationship Bank" which measures the performance of relationship-based relative to transaction-based loans, that is, SME loans from relationship versus transactional banks (the reference group). "Corporate Loan" measures the differences between SME and corporate loans from transactional banks (transactions-based versus relationship-based loans), while "Corporate Loan × Relationship Bank" measures the differences between corporate loans from transactional and relationship banks (when both rely on relationship lending). Column (1) reports results with loan characteristics and firm characteristics. In columns (2)-(5) firm fixed effects are added. Column (3) adds loan origination fixed effects, column (4) bank characteristics, and column (5) other loan characteristics. Column (6) introduces firm×six-month period fixed effects. The sample reduces to 3,790 loan-time observations of 1,952 loans to 318 firm that received loans from both bank types in *each six-month period*. Definitions of the variables can be found in Table A.1 of Appendix A. Standard errors are clustered at firm level and presented in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% significance levels.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| **Bank Lending Technologies** | | | | | | |
| Corporate Loan | 0.016 | 0.022** | 0.021** | 0.020** | 0.022** | -0.001 |
| | (0.017) | (0.010) | (0.009) | (0.010) | (0.010) | (0.009) |
| Relationship Bank | 0.016*** | 0.016*** | 0.016*** | 0.019*** | 0.015*** | 0.012 |
| | (0.006) | (0.005) | (0.005) | (0.007) | (0.005) | (0.007) |
| Corporate Loan × Relationship Bank | -0.012 | -0.021* | -0.021* | -0.022* | -0.020* | 0.000 |
| | (0.023) | (0.011) | (0.011) | (0.012) | (0.011) | (0.013) |
| **Loan Characteristics** | | | | | | |
| Credit Rating | -0.388*** | -0.206*** | -0.208*** | -0.206*** | -0.209*** | -0.146*** |
| | (0.037) | (0.044) | (0.044) | (0.044) | (0.045) | (0.039) |
| Credit Interest Rate | 0.004*** | -0.000 | 0.001 | 0.000 | 0.001 | 0.002 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.002) |
| Loan Amount | 0.007** | -0.003* | -0.003* | -0.003 | -0.003** | 0.000 |
| | (0.003) | (0.002) | (0.002) | (0.002) | (0.002) | (0.001) |
| Collateral | 0.021** | 0.019** | 0.018*** | 0.020*** | 0.020*** | 0.016 |
| | (0.009) | (0.007) | (0.006) | (0.007) | (0.008) | (0.013) |
| Guarantee | -0.002 | 0.003 | 0.003 | 0.004 | 0.004 | -0.007 |
| | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.011) |
| Maturity | 0.002 | 0.005* | 0.005* | 0.006** | 0.005 | 0.003 |
| | (0.005) | (0.003) | (0.003) | (0.003) | (0.003) | (0.005) |
| Firm Characteristics | Yes | No | No | No | No | No |
| Bank Characteristics | No | No | No | Yes | No | No |
| Other Loan Characteristics | No | No | No | No | Yes | No |
| Firm Fixed Effects | No | Yes | Yes | Yes | Yes | No |
| Loan Origination Fixed Effects | No | No | Yes | No | No | No |
| Firm×Time Fixed Effects | No | No | No | No | No | Yes |
| Constant | 1.784*** | 1.053*** | 1.045*** | 1.039*** | 1.057*** | 0.708*** |
| | (0.185) | (0.214) | (0.220) | (0.211) | (0.215) | (0.193) |
| $R^2$ | 0.186 | 0.480 | 0.482 | 0.480 | 0.481 | 0.847 |
| Observations (Loan-Time Level) | 10,656 | 10,656 | 10,656 | 10,656 | 10,656 | 3,790 |

Table 5: Relationship lending and long-term performance

The Table reports performance statistics of SME loans selected from the total sample of 19,332 loans to 6,649 firms and the sub-sample of 4,441 loans to 621 firms that received loans from both relationship and transactional banks between January 2009 and June 2013. For SME loans relationship banks rely on relationship lending and transactional banks on transactional lending. Both panels show loan defaults (loss/written-off), recovery rates, the percentage of the loan and interest amount not repaid in time or lost/written-off for SME loans that are observed until maturity. Loan default equals one if a loan is in loss or written-off status at the end of the loan spell and zero otherwise. Recovery rate equals one if a loan has been delinquent during the loan spell but did not default at the end of the loan spell. The percentage of loan and interest amount not repaid in time (lost/written-off) stands for the ratio of the principal and interest rate amount over the total contract amount in case of delinquencies below/over 90 days or default, conditional on non-performance at the end of the loan spell. While panel A conditions loans to have been delinquent for less than 90 days during the loan spell, panel B conditions loans to have been delinquent over 90 days during the loan spell. For all panels, the column "Difference $t$-test" reports $t$-statistics for differences in means between the two bank types and indicates significance at the 1%, 5%, and 10% significance levels with ***, **, *.

**Panel A: Defaults, recovery rates, and losses for SME loans if NPL 0-90 days**

| | Total Sample: SME Loans | | | | | Sub-Sample: SME Loans | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Relationship Bank | | Transactional Bank | | Difference | Relationship Bank | | Transactional Bank | | Difference |
| Variable Names | Mean | Std | Mean | Std | $t$-test | Mean | Std | Mean | Std | $t$-test |
| Loan Default (loss/written-off) | 0.249 | 0.433 | 0.198 | 0.399 | 0.051* | 0.169 | 0.377 | 0.212 | 0.412 | -0.043 |
| Recovery Rate | 0.127 | 0.333 | 0.158 | 0.366 | -0.031 | 0.156 | 0.365 | 0.173 | 0.382 | -0.017 |
| % of loan and interest amount not repaid in time | 0.047 | 0.127 | 0.104 | 0.229 | -0.057*** | 0.064 | 0.185 | 0.111 | 0.240 | -0.047 |
| % of lost/written-off loan and interest amount | 0.256 | 0.858 | 0.181 | 0.551 | 0.075 | 0.145 | 0.675 | 0.147 | 0.374 | -0.002 |
| Observations (Loan Level) | 543 | | 303 | | 846 | 77 | | 52 | | 129 |

**Panel B: Defaults, recovery rates, and losses for SME loans if NPL 90 days**

| | Total Sample: SME Loans | | | | | Sub-Sample: SME Loans | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Relationship Bank | | Transactional Bank | | Difference | Relationship Bank | | Transactional Bank | | Difference |
| Variable Names | Mean | Std | Mean | Std | $t$-test | Mean | Std | Mean | Std | $t$-test |
| Loan Default (loss/in written-off status) | 0.608 | 0.489 | 0.522 | 0.501 | 0.087* | 0.512 | 0.506 | 0.600 | 0.498 | -0.088 |
| Recovery Rate | 0.226 | 0.419 | 0.296 | 0.458 | -0.070* | 0.220 | 0.419 | 0.333 | 0.479 | -0.114 |
| % of loan and interest amount not repaid in time | 0.849 | 1.407 | 0.931 | 1.137 | -0.082 | 0.907 | 1.834 | 0.608 | 0.619 | 0.299 |
| % of lost/written-off loan and interest amount | 0.672 | 1.328 | 0.559 | 0.938 | 0.113 | 0.661 | 1.688 | 0.340 | 0.453 | 0.321 |
| Observations (Loan Level) | 301 | | 186 | | 487 | 41 | | 30 | | 71 |

Table 6: Relationship lending and long-term rents

The Table reports summary statistics and regression results of returns on loans for SME loans selected from the total sample of 19,332 loans to 6,649 firms and the sub-sample of 4,441 loans to 621 firms that received loans from both relationship and transactional banks between January 2009 and June 2013. For SME loans relationship banks rely on relationship lending and transactional banks on transactional lending. Returns on loans are defined in equation 2 as the value-weighted interest rate and loss of a bank in case of non-performance. The loss of a bank is defined as the overdue principal plus interest rate amount over the contract amount. The first panel shows the return on SME loans on loan level for the total sample and the sub-sample by bank type. The second and third panels show the return on SME loans that have been delinquent for less than 90 days and over 90 days. For all panels, the column "Difference $t$-test" reports $t$-statistics for differences in means between the two bank types and indicates significance at the 1%, 5%, and 10% significance levels with ***, **, *. The last panel shows results from a regressions of return on loans on a "Relationship Bank" dummy without firm fixed effects for all SME loans ("All Loans"), for SME loans delinquent for less than 90 days ("NPL 0-90=1"), and for SME loans delinquent over 90 days ("NPL 90=1") based on the total sample and sub-sample. Standard errors are clustered at firm level and presented in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% significance levels.

| | Total Sample: SME Loans | | | | | Sub-sample: SME Loans | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Relationship Bank | | Transactional Bank | | Difference | Relationship Bank | | Transactional Bank | | Difference |
| Variable Names | Mean | Std | Mean | Std | $t$-test | Mean | Std | Mean | Std | $t$-test |
| **Return on loans** | | | | | | | | | | |
| Return on Loans | 15.08 | 4.514 | 14.7 | 4.46 | 0.385*** | 13.75 | 4.421 | 13.53 | 4.201 | 0.221 |
| Observations (Loan-Level) | 9,630 | | 8,289 | | 17,919 | 1,770 | | 2,091 | | 3,869 |
| **Return on loans given NPL 0-90 days** | | | | | | | | | | |
| Return on Loans | 13.22 | 5.955 | 10.68 | 6.127 | 2.544*** | 11.95 | 5.495 | 9.521 | 6.048 | 2.443*** |
| Observations (Loan-Level) | 950 | | 620 | | 1,570 | 138 | | 117 | | 255 |
| **Return on loans given NPL 90 days** | | | | | | | | | | |
| Return on Loans | 7.819 | 5.137 | 7.265 | 4.877 | 0.554 | 7.63 | 5.086 | 6.368 | 4.419 | 1.262 |
| Observations (Loan-Level) | 421 | | 294 | | 715 | 67 | | 43 | | 110 |

**Regressions on return on loans**

| | Total Sample: SME Loans | | | Sub-sample: SME Loans | | |
|---|---|---|---|---|---|---|
| | All Loans | NPL 0-90=1 | NPL 90=1 | All Loans | NPL 0-90=1 | NPL 90=1 |
| Relationship Bank | 0.385** | 2.544*** | 0.554 | 0.221 | 2.443** | 1.262 |
| | (0.159) | (0.505) | (0.501) | (0.356) | (1.209) | (1.179) |
| Constant | 14.696*** | 10.676*** | 7.265*** | 13.525*** | 9.512*** | 6.368*** |
| | (0.127) | (0.453) | (0.426) | (0.290) | (1.150) | (1.114) |
| $R^2$ | 0.002 | 0.041 | 0.003 | 0.001 | 0.043 | 0.016 |
| Observations (Loan-Level) | 17,919 | 1,570 | 715 | 3,861 | 255 | 110 |

Table 7: Relationship lending and bank behavior

The Table reports different summary statistics for loans selected from the total sample of 19,332 loans to 6,649 firms and the sub-sample of 4,441 loans to 621 firms that received loans from both relationship and transactional banks between January 2009 and June 2013. Panel A reports summary statistics on past non-performance of any kind with the present bank of the firm (Past NPL with Bank), with any bank including the former (Past NPL with Any Bank) and with other banks of the firm (Past NPL with Other Banks) on bank-firm-time level and bank-firm level. Panel B reports summary statistics on rollover loans as well as increases and decreases in the interest rate, loan amount and maturity during the loan spell for the total sample and sub-sample of SME loans given delinquencies below 90 days. In particular, I declare a loan of a firm to be a rollover loan if the loan has been non-performing and a new loan has been issued within one, two, or three months before or after the non-performing loan with the same bank. Changes in contract terms are measured exactly at the period of delinquencies below 90 days and up to three periods after on loan-time level and then collapsed to loan level. Panel C repeats the same analysis given delinquencies over 90 days. Panel D reports whether firms that have standard contracts as well as credit lines or overdrafts with the same bank draw down on them in periods of delinquencies and up to three periods after on loan-time level and then collapsed to loan level for the total sample of SME loans. For SME loans relationship banks rely on relationship lending and transactional banks on transactional lending. For all panels, the column "Difference $t$-test" reports $t$-statistics for differences in means between the two bank types and indicates significance at the 1%, 5%, and 10% significance levels with ***, **, *.

**Panel A: Distribution of ex-ante borrower risks**

| | Total Sample: Bank-Firm-Time Level | | | | | Total Sample: Bank-Firm Level | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Relationship Bank | | Transactional Bank | | Difference | Relationship Bank | | Transactional Bank | | Difference |
| Variable Names | Mean | Std | Mean | Std | $t$-test | Mean | Std | Mean | Std | $t$-test |
| Past NPL with Bank | 0.016 | 0.126 | 0.011 | 0.103 | 0.005*** | 0.013 | 0.104 | 0.008 | 0.080 | 0.005** |
| Past NPL with Any Bank | 0.017 | 0.128 | 0.018 | 0.132 | -0.001 | 0.014 | 0.116 | 0.017 | 0.124 | -0.002 |
| Past NPL with Other Banks | 0.015 | 0.119 | 0.016 | 0.124 | -0.001 | 0.013 | 0.110 | 0.015 | 0.121 | -0.002 |
| Observations | 7,874 | | 6,322 | | 14,196 | 4,531 | | 3,352 | | 7,883 |

**Panel B: Rollover loans and renegotiations of contract terms given NPL 0-90 days**

| | Total Sample: SME Loans | | | | | Sub-Sample: SME Loans | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Relationship Bank | | Transactional Bank | | Difference | Relationship Bank | | Transactional Bank | | Difference |
| Variable Names | Mean | Std | Mean | Std | $t$-test | Mean | Std | Mean | Std | $t$-test |
| Rollover loans (-\+ 1 months) | 0.005 | 0.072 | 0.005 | 0.069 | 0.000 | 0.007 | 0.085 | 0.009 | 0.093 | -0.001 |
| Rollover loans (-\+ 2 months) | 0.008 | 0.091 | 0.008 | 0.090 | 0.000 | 0.022 | 0.146 | 0.009 | 0.093 | 0.013 |
| Rollover loans (-\+ 3 months) | 0.012 | 0.107 | 0.015 | 0.120 | -0.003 | 0.022 | 0.146 | 0.017 | 0.130 | 0.005 |
| Increase in Interest Rate | 0.053 | 0.223 | 0.032 | 0.177 | 0.020* | 0.044 | 0.205 | 0.051 | 0.222 | -0.008 |
| Increase in Amount | 0.004 | 0.065 | 0.008 | 0.090 | -0.004 | 0.015 | 0.120 | 0.009 | 0.093 | 0.006 |
| Increase in Maturity | 0.041 | 0.199 | 0.015 | 0.120 | 0.0267*** | 0.044 | 0.205 | 0.000 | 0.000 | 0.0435** |
| Decrease in Interest Rate | 0.053 | 0.223 | 0.027 | 0.163 | 0.025** | 0.051 | 0.220 | 0.026 | 0.159 | 0.025 |
| Decrease in Amount | 0.005 | 0.072 | 0.008 | 0.090 | -0.003 | 0.015 | 0.120 | 0.000 | 0.000 | 0.015 |
| Decrease in Maturity | 0.028 | 0.166 | 0.011 | 0.106 | 0.017** | 0.022 | 0.146 | 0.000 | 0.000 | 0.022 |
| Observations (Loan Level) | 950 | | 620 | | 1,570 | 138 | | 117 | | 255 |

Table 7: Relationship lending and bank behavior

**Panel C: Rollover loans and renegotiations of contract terms given NPL 0-90 days**

| | Total Sample: SME Loans | | | | | Sub-Sample: SME Loans | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Relationship Bank | | Transactional Bank | | Difference | Relationship Bank | | Transactional Bank | | Difference |
| Variable Names | Mean | Std | Mean | Std | $t$-test | Mean | Std | Mean | Std | $t$-test |
| Rollover loans (-\+ 1 months) | 0.005 | 0.069 | 0.003 | 0.058 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Rollover loans (-\+ 2 months) | 0.012 | 0.108 | 0.003 | 0.058 | 0.008 | 0.030 | 0.171 | 0.000 | 0.000 | 0.030 |
| Rollover loans (-\+ 3 months) | 0.012 | 0.108 | 0.014 | 0.116 | -0.002 | 0.030 | 0.171 | 0.047 | 0.213 | -0.017 |
| Increase in Interest Rate | 0.097 | 0.297 | 0.024 | 0.153 | 0.074*** | 0.104 | 0.308 | 0.047 | 0.213 | 0.058 |
| Increase in Amount | 0.007 | 0.084 | 0.007 | 0.082 | 0.000 | 0.015 | 0.122 | 0.000 | 0.000 | 0.015 |
| Increase in Maturity | 0.052 | 0.223 | 0.020 | 0.142 | 0.032** | 0.060 | 0.239 | 0.000 | 0.000 | 0.060 |
| Decrease in Interest Rate | 0.105 | 0.306 | 0.027 | 0.163 | 0.077*** | 0.104 | 0.308 | 0.023 | 0.152 | 0.081 |
| Decrease in Amount | 0.010 | 0.097 | 0.010 | 0.101 | -0.000 | 0.030 | 0.171 | 0.000 | 0.000 | 0.030 |
| Decrease in Maturity | 0.045 | 0.208 | 0.007 | 0.082 | 0.038*** | 0.045 | 0.208 | 0.000 | 0.000 | 0.045 |
| Observations (Loan Level) | 421 | | 294 | | 715 | 67 | | 43 | | 110 |

**Panel D: Drawdown on credit lines and overdrafts given non-performance**

| | Total Sample: SME loans | | | | |
|---|---|---|---|---|---|
| | Relationship Bank | | Transactional Bank | | Difference |
| Variable Names | Mean | Std | Mean | Std | $t$-test |
| **Drawdown on Credit Lines/Overdrafts given NPL 0-90 days** | | | | | |
| Drawdown on Credit Lines/Overdrafts | 0.398 | 0.491 | 0.278 | 0.451 | 0.119* |
| Observations (Loan Level) | 166 | | 79 | | 245 |
| **Drawdown on Credit Lines/Overdrafts given NPL 90 days** | | | | | |
| Drawdown on Credit Lines/Overdrafts | 0.368 | 0.486 | 0.231 | 0.43 | 0.137 |
| Observations (Loan Level) | 68 | | 26 | | 94 |
| **Drawdown on Credit Lines/Overdrafts given NPL 0-90 or 90 days** | | | | | |
| Drawdown on Credit Lines/Overdrafts | 0.422 | 0.495 | 0.315 | 0.467 | 0.108* |
| Observations (Loan Level) | 187 | | 89 | | 276 |
| **Drawdown on Credit Lines/Overdrafts given NPL** | | | | | |
| Drawdown on Credit Lines/Overdrafts | 0.18 | 0.384 | 0.076 | 0.265 | 0.104*** |
| Observations (Loan Level) | 384 | | 211 | | 595 |

Table 8: Use of credit registry for loan monitoring and granting purposes

The Table reports regression results for a sample of 2,737 firms that exclusively received loans either from relationship or transactional banks and for which data on banks' use of the credit registry for loan monitoring and granting purposes exists from June 2012 until June 2013. The dependent variables are either "Monitoring" or "Granting", indicating the number of bank enquiries of firm information for loan monitoring or granting purposes. The main independent variable is "Relationship Bank Firm" which measures whether a firm that received loans only from relationship banks was inquired through the credit registry for loan monitoring or granting purposes. The reference group comprises firms that received loans only from transactional banks. To control for differences in firm characteristics, I add firm size based on the average total outstanding debt across banks and past non-performance measures with their bank, any bank and all banks in columns (2) and (4) as well as firm location, industry and ownership fixed effects in columns (3) and (4). Standard errors are clustered at firm level and presented in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% significance levels.

| | # of Loan Monitoring Enquiries | | | # of Loan Granting Enquiries | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Relationship Bank Firm | 0.334*** | 0.257** | 0.263** | 0.037 | -0.006 | -0.004 |
| | (0.109) | (0.109) | (0.119) | (0.062) | (0.061) | (0.065) |
| Firm Size | | 0.303*** | 0.319*** | | 0.146*** | 0.154*** |
| | | (0.034) | (0.037) | | (0.018) | (0.019) |
| Past NPL with Bank | | -0.182 | -0.229 | | -0.143 | -0.153 |
| | | (0.259) | (0.286) | | (0.186) | (0.196) |
| Past NPL with Any Bank | | 0.207 | 0.280 | | 0.274 | 0.260 |
| | | (0.773) | (0.816) | | (0.602) | (0.619) |
| Past NPL with Other Banks | | 1.176 | 1.033 | | 0.210 | 0.272 |
| | | (1.112) | (1.198) | | (0.654) | (0.658) |
| Firm Location Fixed Effects | No | No | Yes | No | No | Yes |
| Firm Industry Fixed Effects | No | No | Yes | No | No | Yes |
| Firm Ownership Fixed Effects | No | No | Yes | No | No | Yes |
| Constant | 1.871*** | -1.597*** | -2.360*** | 2.005*** | 0.445** | 0.345 |
| | (0.090) | (0.358) | (0.783) | (0.049) | (0.186) | (0.535) |
| $R^2$ | 0.008 | 0.122 | 0.160 | 0.000 | 0.041 | 0.078 |
| Observations | 1,295 | 1,295 | 1,295 | 2,245 | 2,245 | 2,245 |

Table 9: Overdue loan repayments

The Table reports regression results for a sub-sample of 1,193 loan-time observations of 323 loans to 126 firms that received loans from both relationship and transactional banks between January 2009 and June 2013 and had overdue principal and interest rate repayments for less than 90 days. In the first two columns the dependent variable is the overdue principal and interest rate amount over the contract amount, the following two columns use the same numerator but set it relative to the total outstanding debt of the firm with the respective bank in a period and the last two columns use the total outstanding debt of a firm in a period. The main independent variable is "Relationship Bank" which measures the overdue exposure of relationship-based relative to transaction-based loans, e.g., SME loans from relationship versus transactional banks (the reference group). For each dependent variable, I use firm characteristics or firm fixed effects to control for firm heterogeneity. Standard errors are clustered at firm level and presented in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% significance levels.

| | NPL Amount over Contract Amount | | NPL Amount over Bank Exposure | | NPL Amount over Total Exposure | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Bank Lending Technologies** | | | | | | |
| Corporate Loan | -0.026 | -0.010 | 0.106 | 0.280 | -0.020* | -0.006 |
| | (0.028) | (0.013) | (0.133) | (0.270) | (0.012) | (0.016) |
| Relationship Bank | -0.015 | 0.007 | 0.234 | 0.854 | -0.011 | -0.019 |
| | (0.023) | (0.015) | (0.234) | (0.836) | (0.013) | (0.019) |
| Corporate Loan × Relationship Bank | 0.013 | 0.003 | -0.310 | -0.927 | 0.007 | 0.004 |
| | (0.032) | (0.012) | (0.316) | (0.936) | (0.014) | (0.013) |
| **Firm Characteristics** | | | | | | |
| Firm Location Yerevan | -0.002 | | -0.235 | | -0.013 | |
| | (0.022) | | (0.195) | | (0.011) | |
| Wholesale Retail Trade Firm | 0.018 | | 0.382 | | 0.006 | |
| | (0.041) | | (0.306) | | (0.017) | |
| Other Fields of Service Firm | -0.018 | | -0.121 | | -0.005 | |
| | (0.024) | | (0.104) | | (0.010) | |
| Private Firm | -0.012 | | 0.197 | | -0.007 | |
| | (0.022) | | (0.176) | | (0.009) | |
| Firm Fixed Effects | No | Yes | No | Yes | No | Yes |
| Constant | 0.076** | 0.044*** | 0.039 | -0.317 | 0.046*** | 0.034** |
| | (0.036) | (0.009) | (0.071) | (0.414) | (0.015) | (0.014) |
| $R^2$ | 0.018 | 0.446 | 0.036 | 0.164 | 0.018 | 0.291 |
| Observations | 1,193 | 1,193 | 1,193 | 1,193 | 1,193 | 1,193 |

## Table 10: Robustness tests of relationship lending and loan performance

The Table reports regression results for a sub-sample (or selection thereof) of 10,656 loan-time observations of 4,441 loans to 621 firms that received loans from both relationship and transactional banks between January 2009 and June 2013. The dependent variable is Loan Performance$_{ijkt}$ that equals one when a loan is in arrears for less than 90 days unless otherwise noted. For each robustness test, I re-run specifications of Table 3 in columns (1) and (2) with firm characteristics or with firm fixed effects. To consume space, I only report the coefficient of "Relationship Bank" which measures the performance of relative relationship-based to transaction-based loans, that is, SME loans from relationship versus transactional banks (the reference group), as well as its standard error and the number of observations. Panel A reports regression results of alternative explanations of the main results: "Alternative relationship lending" defines the importance of relationship lending relative to the importance of other lending technologies and reduces the sample to relationship banks for which the relative importance of relationship lending stays constant for SME and corporate loans (4 out of 9 relationship banks) and transactional banks for which the relative importance of relationship lending is higher for corporate loans compared to SME loans (all 5 transactional banks), and "Relationship variables" adds relationship variables such as length of the bank-firm relationship, a dummy variable that equals one if a firm has other products with the bank and a dummy variable that equals one if a firm's debt exposure to a bank is above 50% and zero otherwise; "Full/Opposite sample" estimates Specification (1) of Table 3 with just loan and firm characteristics for the full sample of 6,649 firms and 19,332 loans in column "Table 3, Specification (1)" and for the opposite sample of 6,028 firms that receive 14,891 loans from either relationship or transactional banks only in column "Table 3, Specification (2)", "Bank fixed effects" introduces a bank fixed effect and compares transaction-based and relationship-based loans within a transactional bank (SME versus corporate loans) with loan amounts 50% below and above the threshold. Panel B presents alternative non-performance measures: "Non-Performance" that equals one if a loan has any overdue payments on the principal amount and interest rate and zero otherwise and "Non-Performance 180 days" that equals one if a loan is delinquent for more than 180 days and zero otherwise. Panel C reports results for different loan characteristics. "Local currency loans" and "US dollar loans" uses only loans denominated in local currency or US dollars; "Loans after January 2011" uses only loans after January 2011; "W/o loans +/-50% threshold" excludes loans with loan amounts 50% below and above the threshold. Panel D investigates different firm characteristics: "Trade, manufacturing, construction" uses only observations of firms from the trade, manufacturing or construction industries, while "Other fields of services" and "Other industries" uses only observations of firms either from other fields of service industries or remaining other industries; "New Customers" and "Old Customers" splits the benchmark regression into first time customers and repeated customers of a bank. Panel D examines different firm characteristics. Panel E relies on different estimation methods of the benchmark regressions. Row "Logit model" uses a logit model instead of a linear probability model for the benchmark specifications and reports odds ratios; "Matching on firm and loan amount" estimates the average differences in delinquencies for less than 90 days between SME loans from relationship and transactional banks using a sub-sample of loans to the same firm with similar loan amounts: "Matching on firm and loan char." additionally matches on collateral, interest rate and rating. Specifications (2) and (3) correspond to a 0.5 and 0.25 standard deviation radius for each of the matching variables; the last two rows "Bank clusters" and "Bank×time and firm clusters" cluster standard errors at bank level only and use double clusters at bank-time and firm level, respectively. Definitions of the variables can be found in Table A.1 of Appendix A. If not otherwise noted, standard errors are clustered at firm level and presented in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% significance levels.

Table 10 (continued): Robustness tests of relationship lending and loan performance

| | Table 3, Specification (1) | | | Table 3, Specification (2) | | |
|---|---|---|---|---|---|---|
| Variable Names | Coeff. | Std. Error | Obs. | Coeff. | Std. Error | Obs. |
| **Panel A: Alternative Explanations** | | | | | | |
| Alternative relationship lending | 0.023** | (0.010) | 5,898 | 0.017* | (0.010) | 5,898 |
| Relationship variables | 0.026*** | (0.009) | 10,656 | 0.026*** | (0.008) | 10,656 |
| Full/Opposite sample | 0.020*** | (0.004) | 53,780 | 0.016*** | (0.005) | 43,124 |
| Bank fixed effects | 0.006 | (0.018) | 2,237 | 0.038** | (0.017) | 2,237 |
| **Panel B: Loan Performance** | | | | | | |
| Non-Performance | 0.005 | (0.007) | 10,656 | 0.013** | (0.005) | 10,656 |
| Non-Performance 180 days | 0.007 | (0.005) | 10,656 | 0.009** | (0.004) | 10,656 |
| **Panel C: Loan Characteristics** | | | | | | |
| Local currency loans | 0.021* | (0.012) | 5,946 | 0.010 | (0.010) | 5,946 |
| US dollar loans | 0.033*** | (0.011) | 4,710 | 0.040*** | (0.014) | 4,710 |
| Loans between January 2009–2011 | 0.027** | (0.011) | 2,881 | -0.020 | (0.015) | 2,881 |
| Loans after January 2011 | 0.025** | (0.011) | 7,775 | 0.022** | (0.011) | 7,775 |
| W/o loans +/-50% threshold | 0.026*** | (0.010) | 9,161 | 0.025*** | (0.009) | 9,161 |
| **Panel D: Firm Characteristics** | | | | | | |
| Trade, manufacturing, construction | 0.007 | (0.017) | 3,367 | 0.014 | (0.013) | 3,367 |
| Other fields of services | 0.036*** | (0.012) | 5,715 | 0.033*** | (0.012) | 5,715 |
| Other industries | 0.022 | (0.017) | 1,574 | 0.020 | (0.016) | 1,574 |
| New customers | 0.020 | (0.014) | 3,389 | 0.025* | (0.014) | 3,389 |
| Old customers | 0.027** | (0.011) | 7,267 | 0.027*** | (0.010) | 7,267 |
| **Panel E: Alternative Estimation** | | | | | | |
| Logit model | 0.565** | (0.225) | 10,656 | 0.812*** | (0.236) | 2,459 |
| Matching on firm and loan amount | 0.026** | (0.010) | 19,207 | 0.026** | (0.013) | 13,615 |
| Matching on firm and loan char. | 0.043** | (0.020) | 2,064 | 0.062 | (0.041) | 404 |
| Bank clusters | 0.025 | (0.018) | 10,656 | 0.025** | (0.012) | 10,656 |
| Bank×time and firm clusters | 0.025*** | (0.008) | 10,656 | 0.025*** | (0.009) | 10,656 |

Table 11: Relationship lending and information use

The Table reports regression results of the variance equation of a multiplicative heteroskedasticity model based on Harvey (1976) and Cerqueiro et al. (2011) for a sub-sample of 4,441 loans to 621 firms that received loans from both relationship and transactional banks between January 2009 and June 2013. The model estimates the determinants of the mean and the residual variance of the Loan Spread$_{ijkt}$, defined as the loan interest rate minus the refinancing rate of the Armenian banks with the CBA in the upper and lower panels. The main independent variable is "Relationship Bank" which measures the effect of relationship lending on the residual variance in interest rates relative to transactional lending, that is, SME loans from relationship versus transactional banks (the reference group). "Corporate Loan" measures the effect of corporate loans from transactional banks and "Corporate Loan × Relationship Bank" the effect of corporate loans from relationship banks. Column (1) reports results with loan characteristics and firm characteristics in the mean equation. In columns (2)-(5) firm fixed effects are added to the mean equation. Column (3) adds loan origination fixed effects, column (4) bank characteristics, and column (5) other loan characteristics to the mean equation. Definitions of the variables can be found in Appendix A, Table A.1. Standard errors are clustered at firm level and presented in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% significance levels.

| **Variance Equation** | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| **Bank Lending Technologies** | | | | | |
| Corporate Loan | -0.205 | -0.197 | -0.238 | -0.216 | -0.236 |
| | (0.189) | (0.272) | (0.228) | (0.267) | (0.284) |
| Relationship Bank | 0.248* | 0.696*** | 0.416** | 0.665*** | 0.741*** |
| | (0.131) | (0.157) | (0.178) | (0.153) | (0.152) |
| Corporate Loan × Relationship Bank | -0.137 | 0.088 | 0.222 | 0.200 | 0.061 |
| | (0.197) | (0.258) | (0.283) | (0.261) | (0.269) |
| **Variables in Loan Equation** | | | | | |
| Loan Characteristics | Yes | Yes | Yes | Yes | Yes |
| Firm Characteristics | Yes | No | No | No | No |
| Bank Characteristics | No | No | No | Yes | No |
| Other Loan Characteristics | No | No | No | No | Yes |
| Firm Fixed Effects | No | Yes | Yes | Yes | Yes |
| Loan Origination Fixed Effects | No | No | Yes | No | No |
| Constant | 2.243*** | 1.344*** | 0.805*** | 1.330*** | 1.238*** |
| | (0.113) | (0.132) | (0.153) | (0.131) | (0.134) |
| Pseudo $R^2$ | 0.087 | 0.204 | 0.323 | 0.208 | 0.221 |
| VWLS $R^2$ | 0.396 | 0.699 | 0.841 | 0.705 | 0.727 |
| Observations (Loan Level) | 4,441 | 4,441 | 4,441 | 4,441 | 4,441 |

Figure 1: Identification strategy

The Figure illustrates the identification strategy for the main analysis, presenting bank types, loan types and corresponding lending techniques. The two bank types are relationship banks (treatment group) and transactional banks (control group). Each bank reports the importance of relationship lending by SME and corporate loans separately. Relationship banks rely on relationship lending for both loan types, while transactional banks use relationship lending only for corporate loans and transactional lending (based on fundamental/cash flow analysis and collateral) for SME loans. The arrows indicate that loan performance of the *same firm* is compared for SME loans from the two bank types, when lending techniques differ (relationship versus transactional lending), and for corporate loans, when both rely on relationship lending.

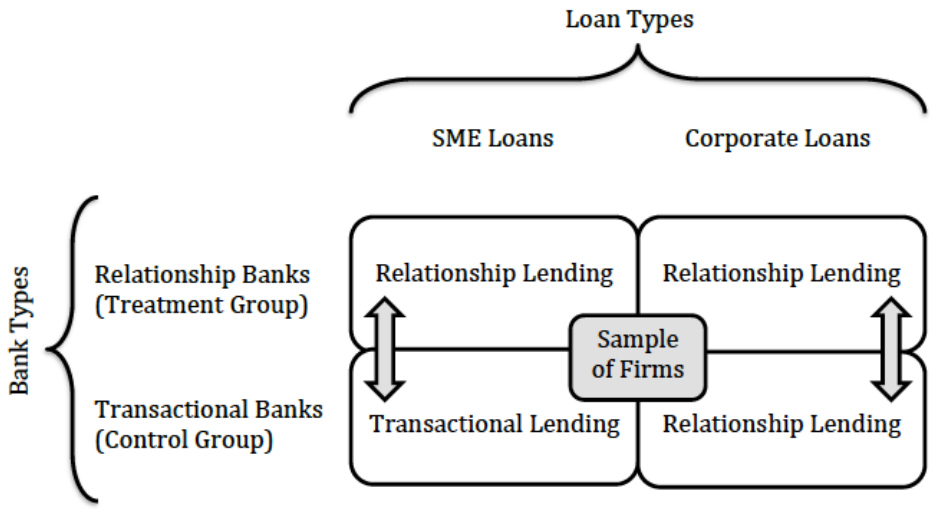
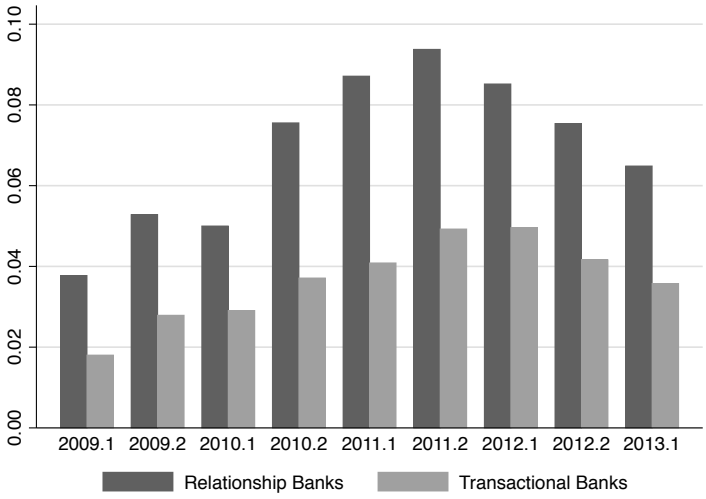


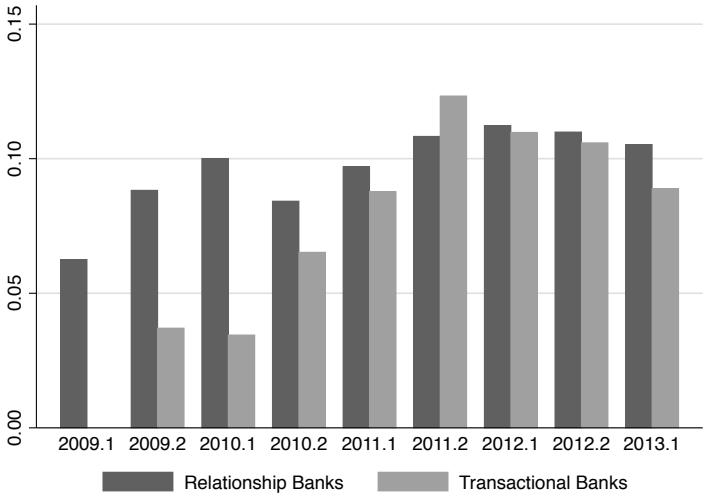
Figure 2: Loan performance over time for sub-sample

The Figure shows average loan delinquencies over 90 days for a sub-sample of 4,441 loans to 621 firms that received loans from both relationship and transactional banks between January 2009 and June 2013. The upper figure shows average non-performance over time for SME loans for both relationship and transactional banks (relationship versus transactional lending), while the lower figure shows average non-performance for corporate loans for both bank types (both relationship lending).

(a) SME loans (relationship versus transactional lending)




(b) Corporate loans (relationship versus relationship lending)



# A Variable definitions

Table A.1: Variable definitions

| Variable Names | Definitions |
|---|---|
| **Loan Performance** | |
| Non-Performance | = 1 if a loan has any overdue payments on the principal and interest rate amount or overdue days, and = 0 otherwise. |
| Non-Performance 0-90 days | = 1 if a loan is non-performing for less than 90 days, and = 0 otherwise. |
| Non-Performance 90 days | = 1 if a loan is non-performing for more than 90 days, and = 0 otherwise. |
| Non-Performance 180 days | = 1 if a loan is non-performing for more than 180 days, and = 0 otherwise. |
| Default (loss/written-off) | = 1 if a loan has a loss/written-off status, and = 0 otherwise. |
| **Loan Characteristics** | |
| SME Loan | = 1 if a loan is classified as an SME loan based on the loan amount definition of a bank, and = 0 otherwise. |
| Corporate Loan | = 1 if a loan is classified as a corporate loan based on the loan amount definition of a bank, and = 0 otherwise. |
| Credit Classification | Credit classification of a loan (1 (worst rating) and 5 (best rating)). |
| Interest Rate | Annual contractual interest rate at loan origination. |
| Loan Spread | Loan interest rate minus the refinancing rate of the Central Bank of Armenia. |
| Loan Amount in US$ | Loan amount at loan origination in US dollars. |
| Collateral | = 1 if collateral was pledged at loan origination, and = 0 otherwise. |
| Guarantee | = 1 if a guarantee was given at loan origination, and = 0 otherwise. |
| Loan Maturity in Months | Number of months between loan origination and maturity. |
| **Other Loan Characteristics** | |
| Loan Location in Yerevan | = 1 if the location of the loan is in Yerevan, and = 0 otherwise. |
| Wholesale and Retail Trade Loan | = 1 if the industry of the loan is in the whole and retail trade industry, and = 0 otherwise. |
| Other Fields of Service Loan | = 1 if the industry of the loan is in other fields of the service industry, and = 0 otherwise. |
| Loan in US$ | = 1 if the currency denomination of the loan is in US$, = 0 otherwise. |
| **Relationship Characteristics** | |
| Relationship in Months | Duration of a bank-firm relationship in months. |
| Scope | = 1 if the firm has additional products (e.g., credit lines, leasing, factoring, overdrafts) with a bank, and = 0 otherwise. |
| Primary Bank | =1 if more than 50% of a firm's outstanding debt is originated by one bank, and = 0 otherwise. |
| Number of Relationships | Number of banks with which a firm has outstanding loans. |
| Multiple Relationships | = 1 if the firm has outstanding loans from multiple banks, and = 0 otherwise. |
| **Firm Characteristics** | |
| Firm Location Yerevan | = 1 if the location of the firm is in Yerevan, and = 0 otherwise. |
| Wholesale and Retail Trade Firm | = 1 if the industry of the firm is in the whole and retail trade industry, and = 0 otherwise. |
| Other Fields of Service Firm | = 1 if the industry of the firm is in other fields of the service industry, and = 0 otherwise. |
| Private Firm | = 1 if the firm is a private firm, and = 0 otherwise. |
| **Bank Characteristics** | |
| Relationship Bank | = 1 if a bank reports a high importance (frequency of use) of relationship lending for SME and corporate loans, and = 0 otherwise. |
| Transactional Bank | = 1 if a bank reports a high importance (frequency of use) of fundamentals/cash flow and collateral for SME loans and high importance of relationship lending for corporate loans, and = 0 otherwise. |
| Large Bank | = 1 if the CBA considered the bank to be large in terms of total assets at the end of 2009. Alternatively, banks are classified as medium-sized and small. |
| Foreign Bank | = 1 if more that 50% of its equity is foreign-owned (excluding investors with Armenian origin). |
| High Average Hierarchy | = 1 if the number of layers a loan has to pass to for approval is above 2. |

# B Test for discontinuity at the threshold

In this section, I examine the distribution of loans around the threshold (based on the loan amount) that determines a loan to be an SME or corporate loan. A natural question that arises is whether banks or firms are manipulating loan amounts in order to give out or receive either SME or corporate loans. Transactional banks, e.g., could intentionally give out loans with loan amounts just below the threshold in order to avoid giving out a corporate loan that might be associated with higher costs since relationship lending becomes more important. Likewise, firms could apply for loans just below the threshold in order to circumvent possibly higher screening and monitoring activities of banks.

In general, only complete manipulation but not partial manipulation results in identification problems. While complete manipulation assumes that the assignment rule is under complete control of agents, partial manipulation occurs when agents can only partially influence the assignment rule and the rest remains idiosyncratic (McCrary (2008, p. 700)).[32] In the present case, threshold definitions are not publicly known and differ across banks in amount and currency. Half of the banks set thresholds in US dollars, while the rest sets it in Armenian dram. At the same time, loans are issued in different currencies. For firms, it is more difficult to manipulate their loan amounts, as they are less likely to know the exact thresholds for each bank. In banks, loan officers might be able to manipulate loan amounts. Exchange rate fluctuations might, however, still add an idiosyncratic component (see Garmaise and Natividad (2015) for similar ideas), suggesting partial manipulation.

Even if complete manipulation occurs, it should not influence the main results, since the identification comes from loans further away from the threshold and not around the threshold. In the main analysis, I compare SME loans from relationship banks to those of transactional banks within the same firm. Most likely, for transactional banks lending techniques do not just switch from transactional to relationship lending once a loan passes the loan amount threshold; rather they become less transaction-based and more relationship-based with the loan size. Therefore, the further away a loan is from the threshold the more prominent the difference in lending techniques will be for transactional banks across loan types and for SME loans between relationship and transactional banks. In unreported results, I confirm that leaving out loans exactly at or around the threshold does not alter the main results.

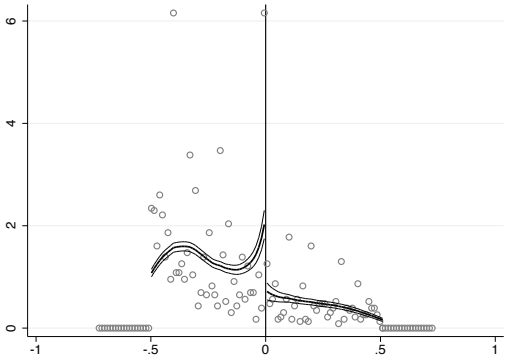
In order to formally check for manipulation around the threshold, I rely on a methodology developed by McCrary (2008) that tests for the discontinuity at the threshold in the density function of the running variable (loan amount threshold). The upper panel of Figure A.1 plots the density functions of loan amounts with the threshold normalized to zero and a range of 50% around the threshold for the total sample and the sub-sample. Both figures reveal a discontinuous jump at the threshold which is confirmed by coefficients of -1.06 (-1.46) and standard errors of 0.14 (0.28). Errors in the assignment of loans to SME and corporate loans might occur since banks do no explicitly specify whether the threshold is an upper or lower bound or might give approximate amounts. The lower panel of Figure A.1 plots the same density functions as above, leaving out loans exactly at the threshold. The discontinuous jump disappears with coefficients of 0.02 (-0.11) and standard errors of 0.14 (0.30).

[32] van der Klaauw (2002), DiNardo and Lee (2004) and Lee (2008) present some examples of plausible partial manipulations that do not influence results.

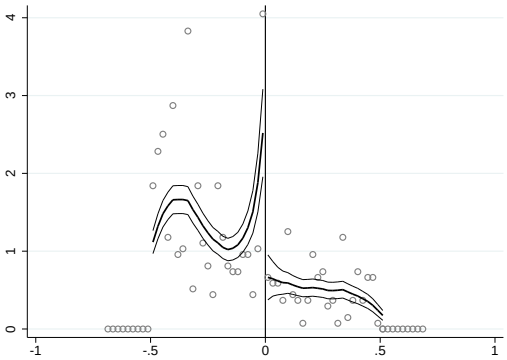
## Figure A.1: Density of loan amounts around threshold

The Figure shows the density of loan amounts at the threshold that is normalized to zero and in a range of 50% based on McCrary (2008). The upper figures show the density for the total sample of 19,332 loans to 6,649 firms and the sub-sample of 4,441 loans to 271 firms that received loans from both relationship and transactional banks between January 2009 and June 2013. The lower figures repeat the analysis for the total and sub-sample, excluding loan amounts directly at the threshold.

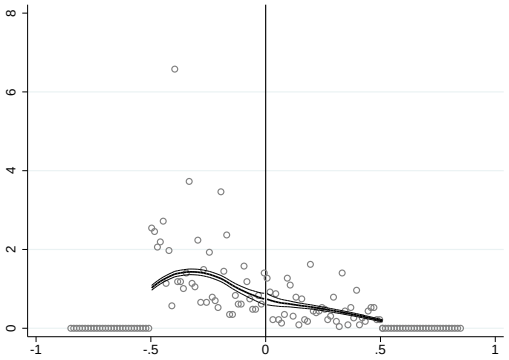
(a) Total sample



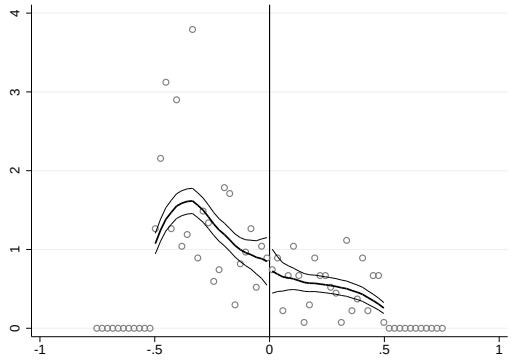

(b) Sub-sample




(c) Total sample




(d) Sub-sample



# C Regression model with multiplicative heteroskedasticity

The regression model with multiplicative heteroskedasticity based on Harvey (1976) is defined as:

$$y_i = \beta' X_i + u_i, \tag{A.1}$$

$$Log(\sigma_i^2) = \gamma' Z_i, \tag{A.2}$$

where (1) is the mean equation and (2) the variance equation. The identifying assumptions for the model are:

$$E(u_i|X_i) = 0, \tag{A.3}$$

$$E^2(u_i|Z_i) \equiv \sigma_i^2 = \exp(\gamma' Z_i), \tag{A.4}$$

where $y_i$ is the depending variable, $X_i$a vector of explanatory variables in the mean equation, $u_i$ is a disturbance term, $\sigma_i^2$ the residual variance, and $Z_i$ a vector of explanatory variables in the variance equation.

Under the normality assumption, the conditional distribution of $y_i$ is given by:

$$y_i|X_i, Z_i \overset{d}{\rightarrow} N(\beta^{'} X_i, \exp(\gamma^{'} Z_i)), \tag{A.5}$$

The heteroskedastic regression model is estimated with Maximum-Likelihood (MLE) by maximizing the following log-likelihood with respect to $\beta$ and $\gamma$:

$$LogL = \frac{n}{2}\log(2\pi) - \frac{1}{2}\sum_{i=1}^{n}\gamma' Z_i - \frac{1}{2}\sum_{i=1}^{n}\exp(-\gamma' Z_i)(y_i - \beta' X_i)^2 \tag{A.6}$$

Harvey (1976) shows that this approach is analogous to estimating the mean Eq. (1), and taking the squared-residuals as the raw estimates of the individual variances, which are subsequently used to estimate Eq. (2). This two-step approach leads to a substantial loss of efficiency vis-à-vis the MLE.