



WORKING PAPERS

RESEARCH DEPARTMENT

WORKING PAPER NO. 04-20
TRANSACTIONS ACCOUNTS AND LOAN MONITORING

Loretta J. Mester

Federal Reserve Bank of Philadelphia
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Université du Québec à Montréal

September 2004

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TRANSACTIONS ACCOUNTS AND LOAN MONITORING

Abstract

We provide evidence that transactions accounts help financial intermediaries monitor borrowers by offering lenders a continuous stream of data on borrowers' account balances. This information is most readily available to commercial banks, but other intermediaries, such as finance companies, also have access to such information at a cost. Using a unique set of data that includes monthly and annual information on small-business borrowers at an anonymous Canadian bank, we provide empirical evidence that transactions account information helps the bank to monitor commercial borrowers' operating loans and we show the direct mechanism through which an intermediary can use this information in monitoring and controlling moral hazard problems associated with a rising probability of bankruptcy.

JEL Codes: G10, G20, G21

Keywords: Collateral, Asset-based lending, Operating loan, Monitoring, Transactions account

TRANSACTIONS ACCOUNTS AND LOAN MONITORING

1. Introduction

Do transactions accounts help financial intermediaries monitor borrowers? We provide evidence that information on the cash flows into and out of a borrower's transaction account can help an intermediary monitor the changing value of collateral — namely, accounts receivable and inventory — that a commercial borrower has posted for an operating loan. In this paper, we analyze a unique set of data that includes monthly and annual information on transaction account balances, accounts receivable, and inventories for small-business borrowers at a Canadian bank that wishes to remain anonymous. In particular, we test the hypothesis that the lender uses information from borrower transaction accounts to ascertain that operating loans are being used for normal operating purposes (financing inventory and accounts receivable) rather than financing unanticipated cash shortfalls and to detect and control moral hazard problems associated with a rising probability of bankruptcy.

We establish that the transaction account provides useful information to the lender and characterize how the lender responds to the information. Specifically, we find first that monthly changes in accounts receivable are quite transparently perceivable in movements in the transaction account, when the borrower has an exclusive banking relationship with the lender. This transparency diminishes for borrowers who have relationships with more than one lender. Our second finding is that borrowings not accounted for by inventory and accounts receivable are clear predictors of credit downgrades and loan write-downs, and the lender uses such information promptly. Our third finding is that the lender intensifies monitoring as loans deteriorate – loan reviews become lengthier and are more frequent.

Taken together, these findings establish a set of links showing that financial intermediaries can, and do, use transactions accounts to monitor accounts receivable and inventories; and we show how this one particular bank does so. Our finding on the transparency of changes in accounts receivable and transaction accounts cover more than 1200 firm-months of data. Even though our data come from a

particular bank, the bank does not control these cash flow movements (most obviously for healthy borrowers). Thus, in our view, the results based on this data set are likely to be broadly representative of how transaction account information can be used to monitor collateralized asset-based loans to small-business borrowers in general.

Such information is most readily available to commercial banks via borrower checking accounts, but it is also available to other types of lenders, such as finance companies. According to Udell (forthcoming), finance companies and other asset-based lenders require their borrowers to establish special bank accounts in order to keep track of loans collateralized by accounts receivable. This deposit account, called a cash collateral account, is used strictly for the purpose of receiving all remittances on collected receivables. If the asset-based lender is not a bank, then the account is set up at a bank that works with the asset-based lender. Remittances are sent to this bank and typically are held for several days by the bank to cover deposit collectibility. Then the asset-based lender draws down these funds and applies them to reducing the loan. The borrower sets up a separate checking account from which it makes disbursements. The asset-based lender can monitor the cash flows into and out of these accounts to obtain the same kind of information on its borrowers that a commercial bank lender can obtain from the borrower's checking account.¹

Since the asset-based lender needs to contract with another intermediary to maintain the transactions accounts while the bank lender maintains the checking account on its own, it is likely that the asset-based lender faces slightly higher costs for accessing the transaction account cash-flow information than would a bank. In general, the bank's advantage would be highest for loans to relatively small borrowers whose only account is with the particular bank, since all of the borrower's cash flows would flow through that account, offering maximum information. The bank's advantage over an asset-backed

¹Indeed, by segregating the flow of funds from accounts receivable from other flows, these accounts allow the asset-based lender to more easily keep track of accounts receivable than in the checking account at the Canadian bank that we describe, which is a single account for payments in and out.

lender is also expected to be higher when lending to less risky borrowers. That's because the bank faces higher regulatory costs than the asset-backed lender, which means that any cost advantage from the checking account information may be offset by higher regulatory costs the bank faces when lending to risky borrowers. This could be one of the factors leading to finance companies' specialization in lending to riskier borrowers, particularly more leveraged borrowers, as shown by Carey, et al. (1998).

That a commercial bank gleans information from transaction accounts at a slightly lower cost than a finance company supports the view of Black (1975) and Fama (1985) that banks are "special" monitors of borrowers because of their role in the payments mechanism. However, that "specialness" has likely fallen over time. The commercial banks' advantage over financial companies may be declining, since declines in the cost of information processing and communication over the postwar period have likely lowered the cost of the duplication of bank services. This could be one of the factors that has contributed to the substantial increase in finance company lending relative to commercial bank lending to businesses over the past 30 years.²

To our knowledge, this paper is the first direct empirical test of the usefulness of transactions account information in monitoring commercial borrowers. Previous empirical research has documented the value of lending relationships to firms by examining loan rates (e.g., Petersen and Rajan, 1994; Berger and Udell, 1995; and Berlin and Mester, 1998). Other studies have documented a positive abnormal stock-price reaction to announcements of new or continuing bank loan agreements or loan commitments (e.g., Lummer and McConnell, 1989; Billet, Flannery, and Garfinkel, 1995; and Preece and Mullineaux, 1996). Berlin and Mester (1999) present empirical evidence for an explicit link between banks' liability structure and their distinctive lending behavior. Yet none of these previous papers directly examines the

² Data from the Federal Reserve Flow of Funds Accounts show that the ratio of finance company loans to commercial bank C&I loans has risen from about 17 percent in 1975 to 43 percent in 2003.

mechanism through which a financial intermediary with access to transaction account data is able to gain an information advantage over other types of lenders. And this is the focus of our paper.

Recent papers by Kashyap, Rajan, and Stein (2002) and Diamond and Rajan (2001) offer alternative, complementary theoretical rationales for combining deposits and lending under a single roof. Kashyap, Rajan, and Stein argue that taking deposits and offering lines of credit are forms of liquidity provision that are optimally bundled together as long as they are not perfectly correlated. With such bundling, a bank is better able to hedge the risk of withdrawal. Gatev and Strahan (2003) provide additional evidence on the value of banks' ability to hedge liquidity risk from the commercial paper market. Diamond and Rajan argue that by taking deposits, banks commit themselves to bearing withdrawal risk. This commitment is beneficial, since it commits the bank to using its skill to collect from borrowers to repay depositors. (If a lender did not try to collect payment from borrowers, a run would be precipitated and the bank would fail.) This commitment means that deposits that are withdrawn from the bank to meet unforeseen liquidity needs can be replaced by new deposits, since new depositors are confident the bank will work to collect from borrowers to repay depositors. At the same time, borrowers are insulated from unforeseen liquidity needs of direct investors.

In this paper, we explore detailed micro data that show transactions account information is indeed relatively transparent for monitoring borrowers' collateral and that such monitoring is useful in detecting problems with loans.

2. The Mechanics of Loan Monitoring

When a borrower suffers unexpected losses, its probability of bankruptcy rises and, by a familiar moral hazard mechanism, its incentive to invest optimally falls (Myers and Majluf, 1984). A lender who monitors the borrower's account and is able to detect such losses may be able to create incentives for the borrower to take actions that improve expected return (Nakamura, 1993a). In particular, the lender may

strive to ensure that the operating loan extended by the lender finances operations and does not finance unexpected equity losses. It is thus an important advantage to a lender to be able to detect changes in normal seasonal borrowing needs, i.e., flows of inventory and accounts receivable.

Although the banking literature cites a commercial bank's ability to monitor borrowers as one of its special talents, the literature rarely describes what gives the bank its monitoring advantage over other types of lenders. We argue that a commercial bank loan officer (or finance company lender) has access to fine-grained information about a borrower's activities through its operating account, as he or she can observe transactions on an item-by-item basis and compare them to the borrower's pro forma business plan. The continuing operation of a business demands that the business be able to meet its financial requirements, which means that the business must have enough cash to pay its employees, suppliers, and others. The cash flows of the business are recorded in its transactions account. This account information is likely to be one of the timeliest sources of information available to the lender. Moreover, as Nakamura (1993a,b) has argued, checking account information is relatively more transparent and complete for a small-business borrower whose banking relationship is exclusive to a single lender.

The flow of information about accounts receivable and inventory at our bank is provided for contractually. A representative loan contract for the bank we study included the following language:

“Total outstandings are not to exceed 75% of good accounts receivable, excluding accounts over 90 days and inter-company accounts plus 50% of inventory, up to a maximum of \$5 million dollars, including raw material, work in process and finished products, less priority claims.”

“The Borrower will deliver to the Bank such financial information as the Bank may reasonably request including but not limited to the following:

- a) audited annual financial statements of the Borrower, within 90 days after the fiscal year end;
- b) in-house monthly financial statements of the Borrower within 20 days after the end of the month;
- c) monthly aged listing of accounts receivable and inventory reports within 20 days after the end of month.”

This loan contract restricts the amount of the loan to a certain percentage of accounts receivable and inventory. It also requires the borrower to report shipments to customers that constitute new accounts receivable, as well as customer payments on accounts receivable. A borrower whose business is floundering may be tempted to submit false statements, particularly if these reports lie within the bounds of plausible error. For example, an account that has already been paid may be included among receivables. Or an order that has not yet been shipped may be called a receivable. However, by observing the detailed flow of payments received, the loan officer can verify that each receivable is followed, within 90 days, by a payment. In fact, every month, the loan officer can do an item-by-item reconciliation of the account receivables: beginning of month receivables + sales (operating revenues) – cash inflows (checks) = end of month receivables. This is a check not just on the veracity of the borrower but on how carefully the business manages accounts receivables, itself a telling sign. If the borrower were to open a checking account with a different bank without informing the lending bank, the absence of the borrower’s payments for inventory and of payments received for accounts receivable would quickly reveal this chicanery. As we note below, when exclusive borrowers become troubled and their incentive to hide information rises, the information content of their transaction accounts deteriorates somewhat but remains high.

A lender who did not have the borrower's transactions account business itself would not have access to this verification in the same timely manner or at as low a cost. A nonbank lender is usually not able to easily discern that a troubled borrower is continuing to post accounts receivable after they have been collected. A bank's access to this information is a necessary byproduct of the checking account technology.³ Finance companies, as we have pointed out, can establish relationships with banks that enable them to have similar access to bank lenders, but this does add an additional layer of expense.

Before continuing, it may be worthwhile mentioning that in the Canadian bank being studied, an operating loan is supplied as a negative-balance checking account, a typical practice in English banking. In the U.S., by contrast, the operating loan and the checking account are separated, with the checking account balance, at least in principle, required to be positive. Thus, the operating loan balance plus the checking account balance in the U.S. would be equal to the operating loan balance in this Canadian bank.

U.S.-style Bank Account		English-style Bank Account (used by our Canadian bank)	
<u>Assets</u>	<u>Liabilities</u>	<u>Assets</u>	<u>Liabilities</u>
Transactions Account Balance = C_t	Loan = L_t		Bank Account = B_t

A lender without access to transaction account information in either the U.S. or Canada would observe only the loan balance. This would consist of a series of debits and credits between the firm's checking account at the firm's bank and the loan account at the firm's lender. In general, this lender does not see the individual payments the firm makes from its bank transaction account that pay suppliers, workers, and other creditors, nor those payments that are made into the account by clients. A bank lender (or other lender with access to transaction account data) on the other hand, using the English-style

³The importance of proprietary information and banking, using the example of R&D contests, is explored in Bhattacharya and Chiesa (1995).

account, observes B_t , the payments between the borrower and the rest of the world, but there is no separate loan account. In contrast, a bank lender using the system prevalent in the U.S. observes C_t and L_t . Thus, the U.S.-style bank lender observes both the payments between the borrower and the rest of the world, and between the loan account and the transaction account. The U.S. bank accounting system provides somewhat more information than this Canadian bank's system, and it is possible that drawdowns of the operating loan may represent signals the bank can interpret. Thus, if anything, the results found using our Canadian data should indicate the lower bound on the information available in U.S.-style banking systems. On the other hand, the gross liability of the bank to the borrower and vice versa are greater under the U.S.-style banking practice because the transaction account and loan account are not netted.

3. A Monthly Model of an Operating Loan

The loans we are describing – whether from a bank lender or an asset-backed lender – generally follow a standard sequence of purchase, shipment, and receipt of revenue. We will show that under normal circumstances, this sequence is revealed transparently: assets in the form of inventory and accounts receivable are mirrored in a sequence of payments in the bank operating account. A change in these normal patterns of cash flows into and out of the operating account are a signal to the bank that the borrower may be experiencing unanticipated operating losses or other problems. This signal can trigger additional monitoring by the bank and renegotiation with the borrower.

A simple accounting model shows the relationship between changes in accounts receivable, inventories, and bank account balance. In month t , the borrowing firm makes expenditures x_t to make products that increase the firm's inventories. It also makes shipments, y_t , which reduce inventories and increase accounts receivable. Then if the firm sells its products at a constant markup of m , shipments will increase accounts receivable by $y_t(1+m)$. At time t , the firm will also receive some payments z_t on past

shipments, which decrease accounts receivable. Net operating outlays are then $x_t - z_t$. Let all other net outlays be w_t ; these will include liquidity declines caused by unanticipated operating losses or expenditures.

Let the firm's bank balance (i.e., what it owes the bank lender, on net) be B_t , and let the monthly interest rate on the loan (assumed constant over time) be r . Then $B_t = B_{t-1}(1+r) + x_t - z_t + w_t$. Similarly, let R_t be accounts receivable and S_t be inventories. Then $R_t = R_{t-1} + y_t(1+m) - z_t$ and $S_t = S_{t-1} + x_t - y_t$.

The changes in bank balances, accounts receivable, and inventories are:

$$\Delta B_t = B_{t-1}r + x_t - z_t + w_t, \quad (1)$$

$$\Delta R_t = y_t(1+m) - z_t, \quad (2)$$

$$\Delta S_t = x_t - y_t. \quad (3)$$

The sum of changes in accounts receivable and inventories will approximately equal changes in bank balance, depending on the relative size of interest accruals (which depend on r), markup (m), and net other outlays (w_t). The size of interest accruals are, of course, known to the lender, as is the expected markup. Thus, if the lender knows the changes in inventories and accounts receivable, then knowledge of the bank balance is equivalent to knowledge of other net outlays.

The reverse is true too. If movements in w_t are infrequent, the bank balance can generally be used to monitor changes in inventory and accounts receivable.

The individual payments a borrower makes would be available to the borrower's bank lender. However, our data set does not include transaction account or accounts receivable information detailed enough to verify individual payments in this manner. But it does allow us to demonstrate that the account balance provides a relatively transparent window on accounts receivable and inventory. In the empirical work described below, we use correlations between inventory, accounts receivable, and bank balance to judge how easily the bank balance can be used to monitor operations. We then show how this bank uses unexpected movements in the operating loan relative to inventory and accounts receivable to determine

credit risk, intensify monitoring, and declare a loan troubled. We now describe our data set more fully and then turn to our empirical implementation and results.

4. The Data Set

The data contain information on 100 small-business borrowers who are customers of the Canadian bank. A small business is defined as one with authorized credit between C\$500,000 and C\$10,000,000 and whose shareholders are managers of the firm. The average sum actually borrowed in our sample is about C\$1,500,000. The selected firms have been active for at least three years; public utilities, management firms, and financial companies are excluded. Fifty of these loans were declared troubled by the bank during the period studied (which falls between 1988 and 1992), and these loans constitute substantially all of the bank's troubled loans during this period that meet our criteria. Declaring a loan troubled is a highly consequential act for the lender, as it is the point when the bank acknowledges a high probability of loss on the loan. The other 50 loans in the sample were loans that remained healthy over the period studied and that matched the troubled loans along certain dimensions. That is, for each troubled loan, we found a loan that remained healthy over the period studied and that matched the troubled loan by industry, level of annual sales, credit rating at the start of the three-year period, and loan amount.

Table 1 shows the outcomes for the troubled loans. For the vast majority (72 percent) of these loans, the borrowing firms ended up going into bankruptcy or were privately liquidated.⁴ Of the other loans, nine remained troubled, four were repaid, and one was upgraded. The Canadian category

⁴A private liquidation is a cooperative sell-off of assets without a court settlement. When the owner has signed a personal guarantee as a part of the loan agreement, such a private liquidation is likely to be efficient, as the owner is strongly motivated to maximize liquidation value of the firm and minimize his personal liability. Of course, if there are other claimants, liquidation may be complicated and bankruptcy entered into.

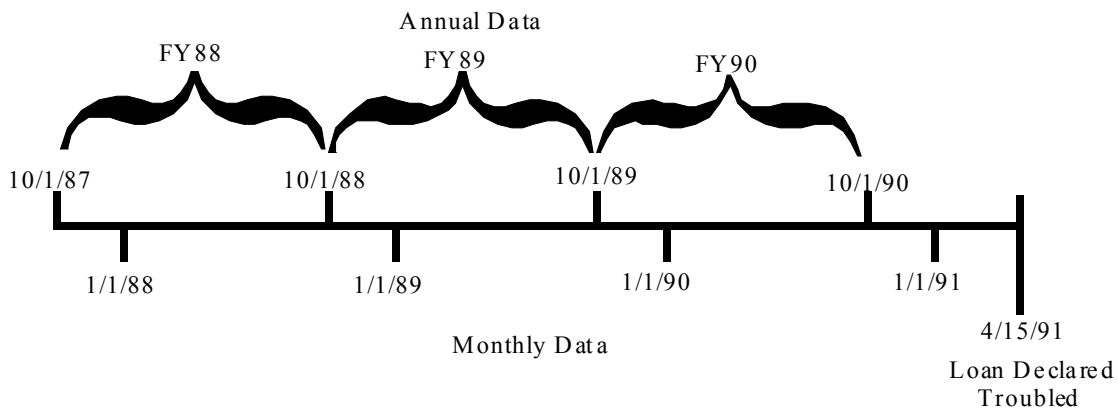
“troubled” matches reasonably well with the U.S. category “doubtful,” and similarly requires a substantial write-down of assets.⁵

Most of these troubled loans were so classified between 1990 and 1992 (only three loans were classified as troubled before 1990); healthy loans were last reviewed by the bank at some date in 1991 or 1992. Six industrial sectors are represented in the data (see Table 2).

For each loan, we have both annual and monthly data. For a troubled loan, the annual data pertain to the firm’s three fiscal years prior to the loan’s being declared troubled, and the monthly data pertain to the three calendar years prior to the firm’s being declared troubled. (The data are not necessarily complete for each loan.) For the matched healthy loan, we have comparable information, with the reference date being the last time the firm’s credit file was reviewed by the bank. For example, consider a firm whose loan was declared troubled in April 1991 and whose fiscal year runs from October to September. Our annual data on this firm would cover the firm’s fiscal years FY1988, FY1989, and FY1990, and the monthly data would run from January 1988 through December 1990.⁶

⁵ “Doubtful” is one of the categories of “regulatory problem assets” identified by Treacy and Carey (1998) in their interviews with large U.S. banks. In the U.S. a “doubtful” loan has a recommended specific reserve of 50 percent. Such a loan has all the weaknesses inherent in a substandard loan and “collection/liquidation in full, on [the] basis of currently existing conditions, is highly questionable or improbable.” For loans in this category, “specific pending factors may strengthen credit.” The loans are treated “as loss deferred until [the] exact status can be determined” (Treacy and Carey, 1998).

⁶ Because the reference dates for a matched troubled loan and healthy loan differ, the data on two matched loans could potentially cover substantially different time periods, with significantly different macroeconomic conditions. But this does not seem to pose a large problem here, since the difference in reference dates was under two years in all but four cases, and the maximum difference was three and a half years for one loan pair.



An important variable included in our data set is whether the firm has an *exclusive* banking arrangement with the bank. This variable allows us to segment the loans into “exclusive” and “nonexclusive” categories, providing a metric against which we can partially measure the quality of the bank’s information. In general, having more than one banking relationship weakens the bank’s information. If a borrower has a nonexclusive relationship with our bank, it is not clear whose primary customer the borrower really is. In some cases, the borrower will have a primary customer relationship with the bank we are studying, in which case the borrower’s operating balance is likely to remain quite informative. In other cases, the borrower’s primary relationship will be with another bank, and the bank we are studying is partially dependent on the other bank for information on the borrower’s creditworthiness. Thus, if transaction account information is valuable, we would expect it to be more valuable for exclusive loans, since the bank’s account balance data on the firm would reflect its entire transaction account activity.

In our data, of the 50 troubled loans, 33 of the borrowers have an exclusive relationship with the bank; of the 50 healthy loans, 26 have an exclusive relationship. There appears to be a definite correlation between the completeness of our data and whether the bank serves as the firm’s exclusive bank. Of the 59 firms with exclusive relationships, we have complete data on 19, i.e., 32 percent, while

of the 41 firms with nonexclusive relationships, we have complete data on only four, i.e., less than 10 percent. In our empirical tests that use accounts receivable and inventories, almost all the “nonexclusive” borrowers with data appear to have primary customer relationships with the bank under study. To that extent, the differences between exclusive and nonexclusive borrowers may be attenuated.

4.1 Annual data

The annual data contain information typically found on a firm’s financial statement, e.g., balance-sheet data, such as the book value of accounts receivable and inventories; income-statement data; some items from the statement of changes in financial position; and information in the firm’s credit file. Our data set also contains some information from the outside auditor’s report on the firm, e.g., whether there were any qualifications in the auditor’s report and the date of the audit. These data would be available to any lender the firm approached for a loan. Nonexclusive borrowers generally tend to have larger sales and often represent borrowers who are being accommodated by our bank because they have a plant or subsidiary outside their primary bank’s territory.⁷

The credit file contains annual information about the firm’s sales, the level of authorized credit the firm has gotten from the bank for an operating loan, additional credit for seasonal loans, and other temporary loans. In addition, there is information on whether the loan has covenants. A crucial datum in each annual credit review is the credit rating assigned to the loan by the bank’s credit department upon completion of the review. This credit rating is arranged on a scale of one through eight, with one being the best, and six through eight being different degrees of “trouble.”

⁷One such borrower with unusually large sales of over \$300 million distorts the data on “nonexclusive-troubled” borrowers. When that borrower is omitted, average sales for all three years falls to \$14.5 million for troubled loans, to \$18.8 million for nonexclusive loans, and to \$24.5 million for nonexclusive-troubled loans. This borrower’s data, fortunately, do not materially affect any of our other results. Indeed, when this borrower is omitted, the results of our statistical tests are, on average, slightly more favorable to our hypotheses.

Tables 3A, 3B, and 4 show some of the annual data on our borrowers. The first three columns in the top panel of Table 3A show the average loan sizes (measured by the average amount actually borrowed) for all the loans and for the healthy and troubled loan subsamples over the entire three-year period covered by the data and over each year individually, where the years are measured relative to the reference date (i.e., for a troubled loan, the three fiscal years prior to the loan being declared troubled; and for a healthy loan, the three fiscal years prior to the firm's last credit review by the bank). It is evident that the bank does not use its information about troubled borrowers to substantially reduce its exposure to loss; rather, if anything, troubled loans rise in average size. The top panel of Table 3B shows the average annual business sales for all firms and for the healthy and troubled loan subsamples. Note that troubled borrowers do not generally have obviously declining average sales compared to healthy ones.

The bottom panels of Tables 3A and 3B show the average loan amounts and average annual business sales, respectively, over time for exclusive and nonexclusive loans, and for these categories separated into healthy and troubled loan subcategories. As might be expected, firms that are larger, as measured by sales, tend to deal with more than one bank and so do not have an exclusive relationship with the bank under study. Since the bank has very good information on exclusive borrowers, one might have thought that the bank would restrain lending to exclusive borrowers as they get into trouble. But we find that such loans continue to rise in size, on average, despite the deterioration of the borrowers.

Table 4 shows the evolution of the borrowers' credit ratings over time. At the dates when the loans were matched (i.e., at $t-3$), there are 19 loans rated superior or standard in the group of loans that do not become classified as troubled loans and 31 such loans with substandard credit ratings. At the final rating period ($t-1$), there are 23 loans rated superior or standard. Remember that healthy loans in the sample were chosen to be approximately as creditworthy as the troubled loans at the beginning of our data period. So one way to think about these loans is that rather than their starting out as good loans and remaining good over time, these loans start out with some qualifications, but then improve over time. By

contrast, although 18 of the troubled loans are rated superior or standard in the initial period, only one is so rated two reviews later. These credit ratings are effective on the date the credit department signs off on the credit review. This sign-off date is typically later than the planned credit review date, as the loan officer doing the review may ask the borrower for additional information. In addition, the interval between planned credit reviews is not always one year but may be shorter or longer.

4.2 Monthly data

The monthly data contain information on the value that the bank assigns to the firm's accounts receivable and inventories, as well as the end-of-month balance in the firm's bank account. The bank's *valuation* of accounts receivable and inventories are important ingredients in determining how much the bank is willing to lend to a commercial borrower. To restrict the use of the operating loan to purely operational ends and to ensure that the borrower has adequate collateral for the loan, the bank verifies on a monthly basis that the amount borrowed does not exceed the estimated value of the firm's operating assets that serve as collateral. The underlying data on dated accounts receivable and inventories are reported to the bank by the borrower, as provided for in the loan contract, detailed on pages 5-6 above.

The bank's valuations include subjective discounts (haircuts) from book value (note, we do not have monthly information on these book values). These haircuts provide a comfort level for the lender; they also reflect the liquidity and quality of accounts receivable and inventories. For example, as accounts receivable remain uncollected, their quality (i.e., the probability they will ultimately be collected) may deteriorate. Also, the point to which the inventory is processed reflects its liquidity – works-in-progress inventory is the least valuable, since it is the most difficult to convert to other uses and, therefore, to sell to other producers. In general, our data indicate that this bank values accounts receivable at two-thirds to three-quarters of book value, while it values inventories at between one-quarter and two-fifths of book value. The low valuation on inventories also reflects binding ceilings on the amount of inventory on which the bank permits the firm to borrow. On the other hand, credit rating does

not seem to have much impact on the size of haircut, although borrowers with a credit rating in the “troubled” range may receive a bigger haircut on their accounts receivable than do other borrowers. This presumably reflects the aging of some proportion of the accounts receivable.⁸

5. Feasibility of Using Bank Account Information for Monitoring Borrowers: The Relationship Between Loan Balances and the Bank’s Valuation of Accounts Receivable

Next, we turn to the transparency of the bank balance in providing information on accounts receivable. If we had complete data on loan balances, accounts receivable, and inventories, then, under the hypothesis of transparency, almost all the movements in bank balances would be accounted for by movements in accounts receivable and inventories. However, in our data, it appears that there is a limit on the amount the bank is willing to lend against inventory. That is, there is a binding ceiling on the bank’s inventory valuation, so that changes in inventory are typically not reflected in our inventory valuations data. For this reason, we focus on the relationship between loan balances and accounts receivable. As indicated in section 3, to the extent that there is a high correlation between bank account balances and changes in accounts receivable and inventories, changes in the firm’s bank account balance can be used to monitor a firm’s operations. But how high can we expect this correlation to be? Obviously, this will depend on the distribution of the underlying variables defined in section 3, x_t , y_t , z_t , and w_t , i.e., expenditures, shipments, payments on past shipments, and other net outlays, respectively. When inventory is shipped, the borrower writes down its finished goods inventory, but the loan balance is unaffected. Loan balances change only in response to payments, which represent only half of the changes in accounts receivable. This suggests that the correlation between accounts receivable and loan balances should be positive and roughly one-half. In the appendix, we formalize this conjecture. Note that a

⁸The mean haircut on accounts receivable was 0.29 for borrowers rated superior or standard and 0.36 for borrowers rated as troubled (with one of the three worst credit ratings). The mean haircut on inventories was 0.62 for borrowers rated superior or standard and 0.66 for borrowers rated as troubled.

similar calculation can be performed for the correlation between the change in bank account balance and the change in inventories.

To see whether the bank account balance gives the bank useful information for monitoring the firm's operations, we examined the correlations between changes from the beginning to the end of each month in the firm's checking account balance, and the bank's valuations of the firm's accounts receivable and inventories. As discussed in section 3, we hypothesize that the correlation would be stronger for firms that have an exclusive relationship with the bank than for firms that do not. So we repeat the correlation analysis for the exclusive and nonexclusive subsamples, and we also divide these subsamples into their healthy and troubled loan subgroups, to control for any loan performance effect. Thus, we perform the analysis for seven groups: all loans, exclusive, nonexclusive, exclusive-healthy, nonexclusive-healthy, exclusive-troubled, nonexclusive-troubled. In this analysis we normalize the variables by the firm's annual sales to control for heteroscedasticity.⁹

As shown in the first row of Table 5, the correlation between changes in bank balances and changes in accounts receivable is 0.45 for all loans and is higher for exclusive loans than for nonexclusive loans. Thus, our data are showing about as high a level of correlation as one should expect. We also see that the correlations are stronger for firms that deal exclusively with the bank than for firms that have multiple banking relationships, even when we control for loan performance. This suggests there is more information to be gleaned about a firm's operations from the account balances for firms that deal exclusively with the bank than for those that have other banking relationships.¹⁰ It appears that simply having a continuous record of the borrower's operating balance in an exclusive client relationship

⁹To normalize, we use the earliest annual sales figure available for each firm. For troubled loans, this is sales in the fiscal year three years prior to the loans' being declared troubled, and for healthy loans, this is sales in the fiscal year three years prior to the last credit file review.

¹⁰Not only would the bank have less data on nonexclusive firms, but the value of any information it had might be lower, since the firm would be less under the bank's control.

provides the lender with a substantial amount of information. Of course, the loan officer has access to even better information, as the loan officer can examine individual checks and deposits.¹¹ Finally, note that exclusive-troubled borrowers' correlation between movements in the bank account balance and accounts receivable, at 0.44, is lower than for exclusive healthy borrowers, but remains high. It is significantly greater than the 0.31 correlation coefficient for nonexclusive borrowers. (Based on Fisher z-scores, we can reject the hypothesis of equal correlation with a p-value of 2.3 percent.)

The correlations between changes in inventories and changes in either bank balances or accounts receivable are much smaller than the correlations between changes in bank balances and accounts receivable. This is because there is generally much less variation in changes in inventory valuations than in the other variables, as shown in the bottom panel of Table 5. Indeed, roughly 20 percent of the monthly observations of the bank's valuation of inventories appear to be at an upper limit. These are cases where there are more than two observations at the same valuation and that valuation is the highest observed for that borrower.

This analysis suggests that changes in accounts receivable potentially contain useful information about firm operations; however, our data do not permit us to reach similar confirmation about inventories.

The empirical analysis in the next sections attempts to determine whether indeed there is useful information and how the bank uses such information.

¹¹Note that we also find a stronger correlation for healthy loans than for troubled loans, holding exclusivity constant. This may reflect the fact that when loans become troubled, the bank may lower its valuations and the loan limits may become binding on the firm. (It also suggests that the bank's control is not perfect.) This would disrupt the normal relationship between checking account balances and bank valuations of accounts receivable.

6. Information Available from the Monthly Valuations: The Relationship Between Signals of Firm Trouble, Credit Downgrades, and Troubled Firms

The monthly data allow the lender to detect two signals of potential trouble at the firm. The first signal is when the bank's loan balance exceeds the bank's valuation of collateral, i.e., valuations of account receivables and inventory. The second signal is whether the borrower is consistently borrowing an amount close to or exceeding the credit line authorized at the beginning of the credit year. These two signals differ sharply on what kinds of lenders can use them. The first type of signal is likely to be accurate only for lenders with access to transaction account data, since only such a lender can track the high frequency movements in collateral valuations and thus can create a reliable signal based on them. Monthly monitoring and valuation of accounts receivable and inventories are likely to be very difficult for a lender who does not have access to the transaction account data we have documented as providing useful information. On the other hand, a signal based just on information on the firm's account balance would be available to any lender. Presumably any lender will know the extent to which the borrower is using or even exceeding the authorized credit line. We compare the informativeness of these two types of signals and are specifically interested in what *additional* information is provided by our bank's valuations of collateral.

Our measures of these two types of signals are *exceed* and *utilization*. *Exceed* is the amount the firm has borrowed less the firm's collateral (as measured by the bank's valuation of the firm's accounts receivable and inventories and other guarantees posted by the firm), as a percent of the firm's authorized credit line. *Utilization* is the firm's borrowing as a percent of its authorized credit line. *Exceed* is a signal of trouble available to only a transaction-based lender, while *utilization* is available to any lender. Troubled firms are likely to have higher, and possibly positive, values of *exceed* and higher values of *utilization*. These higher valuations are usually due to excessive borrowing but also may on occasion be

due to declines in the bank's valuations of accounts receivable and inventory and in the borrower's credit line.

Both *exceed* and *utilization* are computed using the monthly data on the firm, and thus, they are likely to be better signs of trouble for exclusive borrowers than for nonexclusive borrowers, since the bank has more accurate monthly data on exclusive borrowers. As expected, we found higher mean values of *exceed* and *utilization* for exclusive-troubled firms than for exclusive-healthy firms.

When *exceed* turns positive, the bank is at risk, in that the borrower's ability to relatively quickly pay off the loan has become stretched. This is a warning signal to the loan officer and to the bank. How useful is this signal? We define a variable, *violations*, which equals the number of months for which *exceed* is positive over the three years prior to our reference date (either the date when a loan was declared troubled or the date of a healthy loan's last credit review). We also define *violations_i*, $i=1,2,3$, which is the number of months *exceed* is positive in the i^{th} year before the reference date. Similarly, we define *nonviolations* and *nonviolations_i*, $i=1,2,3$, which are the number of months for which *exceed* is negative. Note that *violations* and *nonviolations* will not necessarily sum to 36. This can happen either because data are missing or because the firm is just borrowing an amount equal to the bank's valuation of its collateral. Months for which our data are incomplete so that *violations* and *nonviolations* cannot be computed, or months in which the firm's borrowing equals the bank's valuation of its collateral, do not count as positive or negative *exceed* and, therefore, do not increase either *violations* or *nonviolations*. Thus, the sum of *violations* and *nonviolations* would not equal 36. Therefore, we are able to include both *violations* and *nonviolations* in the regressions. This provides us meaningful information because lack of data has a different meaning from either violations or nonviolations, as suggested by the negative coefficients on nonviolations.

We are interested in two nested types of outcomes: downgrades of a loan's credit rating and, among these, downgrades to "troubled." The declaration that a borrower is troubled requires an

immediate write-down of the loan and is also tantamount to failure of the borrower; in almost all cases, the ultimate outcome is bankruptcy (see Table 1). Failure of the borrower is a more clearly objective event than a credit downgrade, which is explicitly subjective, and need not have immediate consequences. Thus we expect that signals of trouble will have quick and full impacts on credit downgrades – and that is what we find.

6.1 Usefulness of the bank balance data for monitoring borrowers

We ran OLS regressions and logit regressions of whether a loan was eventually declared troubled on *violations*, *nonviolations*, and *utilization*. The OLS results are shown in Table 6.¹² First note that the coefficients have the expected signs: the coefficients on *violations* and *utilization* are significantly positive and that on *nonviolations* is significantly negative. Taking all loans, including those on which we have no information on violations or nonviolations, we find that the additional information on violations and nonviolations adds 13 percentage points to the ability to separate troubled loans from untroubled loans. (While the level of the adjusted R² suggests there is still much to be explained, the adjusted R² increases from 0.11 to 0.24 when *violations* and *nonviolations* are included in the OLS regression equation.) Note that this information is useful for both exclusive clients and nonexclusive clients – it seems generally true that the nonexclusive clients about which the bank collects this type of information are clients with whom the bank has a strong relationship. On the other hand, the results are little changed if we exclude those borrowers for which the bank lacks information about violations.

6.2 Speed with which the lender acts on signals from the bank balance

How quickly is this information used? Two pieces of evidence suggest that the information is used relatively soon after it is available. Most of the information that determines whether a loan is declared troubled is in violations in the most recent fiscal year before a declaration of trouble, as shown in Table 7. Here we use our disaggregated measures of violations, *violations_1*, *violations_2*, and

¹²The logit results are qualitatively the same and are available upon request from the authors.

violations_3, which give separate counts of the number of violations according to how far in advance they took place before the loan was declared troubled (or before the final fiscal year for healthy borrowers).

The first column of Table 7 shows the regression results for the sample of loans excluding those for which there was no information on violations during the third year prior to declaration. The third column excludes loans only where there is no information on violations at all. In both cases, the bulk of the information is derived from the latest year: there is little difference in the adjusted R^2 when only the number of violations in the year just prior to the “troubled” declaration is included in the regression compared to when violations in each of the three years prior are included.

Now consider downgrades of loans at the second review date, i.e., at least a year prior to when the loan was declared troubled.¹³ Here we would expect that the most important information would be violations that occurred in the second year prior to the declaration that the loan is troubled, i.e., in the year prior to this particular downgrade. Table 8 shows that is indeed the case. Almost all the information provided by violations in explaining downgrades in the second year is contained in violations that occurred in the year prior to the downgrade. The adjusted R^2 increases from 0.12 to 0.19 when the second-year violations are included. Here the information content of the second-year violations is somewhat lower when only information on violations in the second year is included, but the information remains significant both statistically and economically.

7. Information Available from the Monthly Valuations: How the Lender Reacts to Signs of Trouble Gleaned from Checking Account Information

The last two tables show that the lender intensifies its monitoring of risky loans by spending more time in loan review and by reducing the time between loan reviews. We examined the date on which a

¹³Since the results for downgrades at the final review date are virtually identical to the results for declarations of “trouble,” we omit them here for brevity; they are available upon request from the authors.

credit review was completed relative to the date the review was planned to be completed and changes in the frequency of planned reviews.

We expect that for loans that remain healthy, the completion of the credit review should be closer to the planned completion date than for loans that have deteriorated in quality, since for healthy loans the reviewer is less likely to find troublesome information that takes longer to evaluate. A credit review is typically prolonged by the bank's requests for additional information, such as more complete financial statements and more detail about projected future disbursements from the bank account. Higher ranking and presumably more experienced credit officers may become involved in the review, as the bank puts more resources into monitoring. The bank may negotiate changes in the terms of the loan (for example, asking for personal guarantees, such as the pledge of property), and such negotiations may take time. Thus a lengthy delay between the expected loan review date and the sign-off by the loan officer is a strong sign that monitoring has been intensified. Similarly, we expect that as a loan's quality deteriorates, a bank would want to examine the loan more frequently. Clearly, more frequent loan reviews are signs of more intensive monitoring, as they require more data collection and analysis per unit of time.

7.1 Delayed completion of loan reviews

At the beginning of our data (t-3), healthy loans were chosen to be approximately as creditworthy as the troubled loans. Over time, the healthy loans, on average, improve in apparent quality, while the troubled loans, by definition, deteriorate. Table 9 shows that among healthy loans, delays in loan reviews decrease compared to planned dates. This suggests that for loans that improve in quality, loan officers are able to sign off on them closer to the review date, while for troubled loans, a delay remains. For example, in the third year prior to our reference date, 90 percent of healthy loans have a delayed review, while, in the first year prior, only 69 percent do. Moreover, the length of delay is cut by three-fourths – from about 120 days to 38 days, on average. In contrast, for loans that remain troubled, there is little lessening in the number of delayed reviews or average length of delay.

7.2 Frequency of loan reviews

The lower part of Table 9 shows that over time, as the troubled loans worsen, the time planned between credit reviews shortens on average, while for loans that improve in health, the time between reviews increases. For example, for troubled loans, on average, the time between planned reviews decreases by about 48 days over the three years, whereas for healthy loans, on average, planned reviews become less frequent by about 18 days. Similarly, the number of troubled loans with fewer than 340 days between planned reviews increases from 10 to 19 over the three years, while the number of healthy loans with more than 390 days between planned reviews increases from 5 to 14.¹⁴

Table 10 replicates Table 9, but rather than sort the loans by whether they eventually are declared troubled or not, we sort them on the number of *violations* they eventually have – in particular, we divide the loans into two groups, those with *violations* less than or equal to the median level of *violations* over the sample of loans and those with *violations* greater than the median level. (The median level is 2.5 *violations*.) This is information that the bank can discern from a firm's checking account. In general, we see results similar to those shown in Table 9, albeit a bit weaker. First, loans with greater numbers of *violations* do have their credit reviews delayed relative to loans that have fewer *violations*: for example, in the third year prior to our reference date, 90 percent of loans with fewer *violations* have a delayed review while in the first year prior, only 69 percent do; the length of delay declines from 118 days, on average, to 48 days. For loans with a greater number of *violations*, there is little decline in the number of delayed reviews and a much smaller decline in the average length of delay, compared to loans with fewer *violations*. The bottom panel shows that all loans have an increase in the frequency of their planned reviews over the three years, but loans with a greater number of *violations* have a larger decline in the

¹⁴The modal number of days between planned reviews is about 365, a year. The 340- and 390-day cutoffs were chosen to represent periods significantly less and significantly more than a year.

number of days between planned reviews than do loans with a lower number of *violations* (approximately 17 days vs. 10 days).^{15,16}

Overall, we see that borrowers whose borrowing needs exceed the bank's valuations of accounts receivable and inventories have their credit ratings downgraded at the next credit review. We have also shown that, together with downgrading of credit, scrutiny appears to become stronger, with the credit review itself dragging on and the time between reviews sometimes becoming shorter.

8. Conclusion

This paper has described the efforts of one Canadian bank to use information in transactions accounts to scrutinize the activities of small-business borrowers. It is clear from the evidence that the bank does use instances where borrowings exceed the bank's own valuation of a firm's accounts receivable and inventories as a signal of deterioration in credit. Moreover, movements in checking account balances are closely related to movements in the bank's valuation of accounts receivable and inventories, suggesting strongly that the checking account provides a relatively transparent window on

¹⁵The right side of the bottom panel of Table 10 indicates there is little change over the three years in the number of high-violation loans whose planned reviews are significantly more than a year apart and there is little change in those whose planned reviews are less than a year apart. However, over the three years, the number of low-violation loans whose reviews are significantly more than a year apart increases. This increase is about the same as the increase in the number of low-violation loans whose reviews are significantly less than a year apart.

¹⁶Similar results are obtained if instead of dividing the loans into two groups, we divide them into three groups: $violations = 0$; $0 < violations \leq 10$; and $violations > 10$.

these aspects of a firm's activity. Although our results pertain to only one bank, we believe that these results taken together provide detailed micro-level evidence that transactions account data are useful for monitoring borrowers. While any asset-based lender with access to transaction account data, such as finance companies, could use the information for monitoring the borrowers' operating loans, commercial banks are likely to be the most efficient at doing so, since they offer the transaction accounts.

Table 1. Outcomes of the Troubled Loans

The sample comprises 100 small-business borrowers who are customers of the Canadian bank. A small business is defined as one with authorized credit between C\$500,000 and C\$10,000,000 and whose shareholders are managers of the firm. The average sum actually borrowed in the sample is about C\$1,500,000. The selected firms have been active for at least three years; public utilities, management firms, and financial companies are excluded. Fifty of these loans were declared troubled by the bank and the rest were healthy loans over the period studied, which varies by loan, but generally falls between 1988 and 1992.

This table reports the final outcome of the 50 firms whose loans became troubled: number and percent of the 50 troubled loans in the data set.

	Number of loans	Percent of Loans
Bankruptcy of the firm	10	20%
Private liquidation of the firm	26	52%
Loan remained troubled	9	18%
Loan repaid	4	8%
Loan upgraded to healthy	1	2%

Table 2. Distribution of Loans by Industry

This table reports the distribution across industry category of the 100 loans in the data set and breakdowns by whether the firm has an exclusive relationship with the bank or not. First column percentages also represent the percentages for healthy loans and for troubled loans, since the pairs were matched on industry category. Exclusive loans are loans made to firms that have an exclusive banking relationship with the bank. Nonexclusive loans are loans made to firms that have relationships with other banks as well. Second and third columns do not sum to 100% due to rounding.

	% of sample (100 loans)	% of exclusive loans (59 loans)	% of nonexclusive loans (41 loans)
Manufacturing	42.0%	44.1%	39.0%
Wholesale Trade	20.0%	25.4%	12.2%
Services	20.0%	15.3%	26.8%
Retail Trade	10.0%	8.5%	12.2%
Construction	6.0%	5.1%	7.3%
Primary (Mining, Agriculture, Fishing, Forestry)	2.0%	1.7%	2.4%

Table 3A. Average Loan Size (in thousands C\$)

This table reports the average loan size, in thousands of Canadian dollars, averaged over months and firms and the standard deviation of loan size in parentheses. For healthy loans, the reference date is the last time the firm's credit file was reviewed by the bank. For troubled loans, the reference date is the date when the loan was declared troubled.

	All Loans	Healthy Loans	Troubled Loans			
All three years	\$1496.3 (2485.8)	\$1269.9 (2828.8)	\$1741.1 (2024.3)			
Three years prior to reference date	1250.8 (2216.9)	1126.4 (2546.4)	1400.8 (1730.1)			
Two years prior to reference date	1500.9 (2388.7)	1231.5 (2608.3)	1783.7 (2099.8)			
One year prior to reference date	1679.4 (2745.7)	1426.2 (3229.3)	1938.5 (2113.2)			
	Exclusive Loans	Nonexclusive Loans	Exclusive, Healthy Loans	Nonexclusive, Healthy Loans	Exclusive, Troubled Loans	Nonexclusive, Troubled Loans
All three years	\$1365.8 (1994.6)	\$1745.3 (3207.9)	\$883.4 (1612.5)	\$1849.9 (3945.6)	\$1802.5 (2197.5)	\$1585.9 (1491.1)
Three years prior to reference date	1088.5 (1682.3)	1593.0 (3028.2)	797.3 (1494.6)	1705.7 (3674.8)	1396.6 (1813.2)	1412.2 (1495.1)
Two years prior to reference date	1364.9 (2096.2)	1762.3 (2853.8)	836.7 (1686.6)	1843.7 (3516.8)	1839.7 (2307.0)	1646.6 (1472.2)
One year prior to reference date	1592.1 (2095.8)	1832.9 (3613.7)	1014.2 (1635.3)	1953.8 (4462.9)	2056.4 (2302.1)	1642.8 (1508.6)

Table 3B. Average Business Sales (in thousands C\$)

This table reports annual business sales, in thousands of Canadian dollars, averaged over firms and the standard deviation of business sales in parentheses. For healthy loans, the reference date is the last time the firm's credit file was reviewed by the bank. For troubled loans, the reference date is the date when the loan was declared troubled.

	All Loans	Healthy Loans	Troubled Loans			
All three years	\$16,898.0 (36,811.3)	\$12,805.2 (16,445.5)	\$20,990.8 (49,327.0)			
Three years prior to reference date	15,885.3 (38,803.3)	10,846.5 (10,836.6)	20,924.0 (53,599.2)			
Two years prior to reference date	18,112.0 (42,688.4)	14,028.5 (23,514.0)	22,195.4 (55,631.4)			
One year prior to reference date	16,696.9 (30,621.6)	13,540.6 (17,004.6)	19,853.1 (39,812.2)			
	Exclusive Loans	Nonexclusive Loans	Exclusive, Healthy Loans	Nonexclusive, Healthy Loans	Exclusive, Troubled Loans	Nonexclusive, Troubled Loans
All three years	\$10,108.8 (9,379.2)	\$26,667.9 (55,321.0)	\$10,742.0 (10,363.2)	\$15,040.4 (21,199.6)	\$9,609.8 (8,657.9)	\$43,083.4 (80,721.0)
Three years prior to reference date	9,746.7 (10,120.9)	24,718.8 (58,672.9)	10,405.2 (10,448.1)	11,324.6 (11,448.5)	9,227.8 (9,987.4)	43,628.2 (88,141.0)
Two years prior to reference date	9,934.8 (9,497.2)	29,879.1 (64,333.9)	10,855.6 (10,958.3)	17,465.9 (31,995.2)	9,209.3 (8,272.5)	47,403.6 (91,203.8)
One year prior to reference date	10,644.8 (10,173.4)	25,406.0 (45,154.4)	10,965.2 (9,796.3)	16,330.6 (22,273.3)	10,392.3 (10,605.1)	38,218.2 (63,923.3)

Table 4. Number of Loans with a Given Credit Rating Over Time

This table reports credit ratings given to the loan by the bank, effective on the date the credit department signs off on the credit review. This sign-off date is typically later than the planned credit review date, as the loan officer doing the review may ask the borrower for additional information. The interval between planned credit reviews is not always one year but may be shorter or longer.

Time	Credit Ratings for Loans Not Declared Troubled within Sample				
	Superior 1	Standard 2	---- Reservations ----		
			Mild 3	Average 4	Strong 5
No. of Loans at t-3	4	15	23	0	8
No. of Loans at t-2	3	17	23	0	7
No. of Loans at t-1	4	19	18	0	9

Time	Credit Ratings for Loans Declared Troubled at Time t								
	Superior 1	Standard 2	---- Reservations ----			---- Troubled ----			
			Mild 3	Average 4	Strong 5	Standard 6	Severe 7	Very Severe 8	
No. of Loans at t-3	3	15	28	0	4	0	0	0	
No. of Loans at t-2	1	2	14	1	31	0	0	0	
No. of Loans at t-1	0	1	2	1	6	29	5	6	

Table 5. Correlations and Variances of Monthly Changes in Bank Account Balances, Bank's Valuation of Accounts Receivable and Inventories

This table reports the correlations and variances by category of loan of monthly changes in the borrowers' bank account balances and the bank's valuation of the borrowers' accounts receivable and inventories. A positive bank account balance corresponds to a firm's borrowings exceeding its deposits; a negative bank account balance corresponds to a firm's deposits exceeding its borrowings. Thus, positive bank account balances indicate the firm is borrowing, on net. The correlations are between monthly changes, scaled by dividing by annual sales. For troubled loans, this is sales in the fiscal year three years prior to the loans' being declared troubled, and for healthy loans, this is sales in the fiscal year three years prior to the last credit file review.

	Total	Exclusive Loans	Nonexclusive Loans	Exclusive, Healthy Loans	Nonexclusive, Healthy Loans	Exclusive, Troubled Loans	Nonexclusive, Troubled Loans
Correlations between changes in:							
Bank Account Balances and Accounts Receivable	0.44*	0.49*	0.31*	0.54*	0.34*	0.44*	0.28*
Bank Account Balances and Inventories	0.19*	0.13*	0.28*	0.18*	0.36*	0.11*	0.19*
Inventories and Accounts Receivable	-0.08*	-0.10*	-0.06	-0.10*	0.07	-0.10*	-0.20*
No. of Observations	1327	1024	303	514	142	510	161

*Significantly different from zero at the 5% level.

	Total	Exclusive Loans	Nonexclusive Loans	Exclusive, Healthy Loans	Nonexclusive, Healthy Loans	Exclusive, Troubled Loans	Nonexclusive, Troubled Loans
Variances of changes in:							
Bank Account Balances	0.00233	0.00209	0.00315	0.00207	0.00367	0.00211	0.00270
Accounts Receivable	0.00200	0.00204	0.00178	0.00226	0.00202	0.00182	0.00180
Inventories	0.00053	0.00040	0.00098	0.00023	0.00112	0.00057	0.00085

Table 6. Regression Results of Troubled Loans on Signs of Trouble in All Three Years Prior: Evidence that Warning Signs of Trouble Forecast “Troubled” Loans

The table reports estimates from ordinary least squares regressions. The dependent variable is a dummy variable equal to 1 for loans declared troubled, and equal to 0 otherwise. *Violations* is the number of months in the three years prior to the reference date in which the amount the firm has borrowed is greater than the firm’s collateral (as measured by the bank’s valuation of the firm’s accounts receivable and inventories and other guarantees posted by the firm); the reference date is the date when a loan was declared troubled for troubled loans, and the date of a healthy loan’s last credit review for healthy loans. Similarly, *nonviolations* is the number of months in the three years prior to our reference date in which borrowing is less than collateral. Months in which our data are incomplete so that *violations* and *nonviolations* cannot be computed do not increase either *violations* or *nonviolations*. Thus, if data are missing, or if the firm is just borrowing an amount equal to the bank’s valuation of its collateral, the sum of *violations* and *nonviolations* will differ from 36, and therefore, both variables can be included in the regression. *Credit utilization* is the firm’s borrowing as a percent of its authorized credit line. Standard errors in parentheses.

	All Loans	Exclusive Clients	Nonexclusive Clients	All Loans with Information On Violations or Nonviolations		
Intercept	0.330* (0.134)	0.366 (0.231)	0.397* (0.160)	0.151 (0.195)	0.388* (0.174)	0.278* (0.0684)
Violations	0.0158* (0.007)	0.0137 (0.0094)	0.0239 (0.0147)	0.017* (0.0083)	0.0215* (0.00798)	0.0285* (0.0065)
Nonviolations	-0.010* (0.0046)	-0.0078 (0.0074)	-0.0128* (0.0062)	-0.0071 (0.0060)	-0.00745 (0.0059)	
Credit Utilization	0.236* (0.080)	0.389* (0.143)	0.164* (0.098)	0.353* (0.123)		
Exclusive Client Dummy	Yes	No	No	Yes	Yes	No
Adjusted R²	0.24	0.24	0.21	0.26	0.19	0.19
Adjusted R² if credit utilization is excluded from the regression	0.17	0.14	0.16	0.19		
Adjusted R² if violations and nonviolations are excluded from the regression	0.11	0.15	0.07	0.15		
No. of Observations	86	56	30	78	81	81

*Significantly different from zero at the 5% level.

Table 7. Regression Results of Troubled Loans on Signs of Trouble in Each of Three Prior Years: Evidence that Almost All the Useful Information Is in Recent Warning Signs of Trouble

This table reports estimates from ordinary least squares regressions. The dependent variable is a dummy variable equal to 1 for loans declared troubled, and equal to 0 otherwise. *Violations* is the number of months in the first, second, or third year prior to the reference date in which the amount the firm has borrowed is greater than the firm's collateral (as measured by the bank's valuation of the firm's accounts receivable and inventories and other guarantees posted by the firm); the reference date is the date when a loan was declared troubled for troubled loans, and the date of a healthy loan's last credit review for healthy loans. Similarly, *nonviolations* is the number of months in the three years prior to our reference date in which borrowing is less than collateral. Months in which our data are incomplete so that *violations* and *nonviolations* cannot be computed do not increase either *violations* or *nonviolations*. Thus, if data are missing, or if the firm is just borrowing an amount equal to the bank's valuation of its collateral, the sum of *violations* and *nonviolations* will differ from 12 for any given year, and therefore, both variables can be included in the regression. *Credit utilization* is the firm's borrowing as a percent of its authorized credit line. Standard errors of the regression coefficients are in parentheses.

	All Loans with Information On Violations or Nonviolations in the 3rd year		All Loans with Information On Violations or Nonviolations
Intercept	0.0753 (0.0990)	0.198* (0.0749)	0.0819 (0.0843)
Violations, 1 year prior to declaration of "troubled"	0.0831* (0.0196)	0.0879* (0.0183)	0.0852* (0.0149)
Violations, 2 years prior to declaration of "troubled"	-0.0217 (0.0207)	-0.0218 (0.0210)	-0.0216 (0.0192)
Violations, 3 years prior to declaration of "troubled"	0.0201 (0.0215)	0.0199 (0.0218)	0.0163 (0.0197)
Credit Utilization	0.2273** (0.1257)		0.238* (0.113)
Adjusted R²	0.34	0.32	0.39
Adjusted R² when violations 2 years prior and violations 3 years prior to declaration of "troubled" are excluded from the regression	0.32	0.33	0.37
Adjusted R² violations 1 year prior, violations 2 years prior, and violations 3 years prior to declaration of "troubled" are excluded from the regression	0.10		0.11
No. of Observations	60	61	78

*Significantly different from zero at the 5% level.

**Significantly different from zero at the 10% level.

Table 8. Regression Results of Credit Downgrades in the 2nd Year Before Classification on Signs of Trouble in Each of the Three Prior Years: Evidence that Warning Signs of Trouble Are Used Immediately

This table reports estimates from ordinary least squares regressions. The dependent variable is a dummy variable equal to 1 for loans whose credit rating was lowered in the next to the last credit review before being declared troubled, and equal to 0 otherwise. *Violations* are defined as in table 7. Standard errors of the regression coefficients are in parentheses.

	All Loans with Information on Violations or Nonviolations in the 3rd Year	All Loans with Information on Violations or Nonviolations in the 2nd Year
Intercept	0.1109 (0.0751)	0.2561* (0.0665)
Violations, 1 year prior to classification	0.0375* (0.0184)	
Violations, 2 years prior to classification	0.051* (0.021)	0.0386* (0.0167)
Violations, 3 years prior to classification	-0.0293 (0.0219)	
Adjusted R²	0.19	0.06
Adjusted R² when violations 1 year prior to classification is excluded from the regression	0.15	
Adjusted R² when violations 2 years prior to classification is excluded from the regression	0.12	
No. of Observations	61	75

*Significantly different from zero at the 5% level.

Table 9. Evidence of More Intensive Monitoring as Loans Deteriorate

This table reports statistics on the delay between planned and actual completion of the credit review and on the time between planned reviews, by type of loan – healthy and troubled. A *delayed review* is one in which the credit review is completed after the planned credit review date. The *number of days delayed* is the calendar number of days from the planned credit review date to the credit review completion date. Similarly, the *number of days between planned reviews* is the calendar number of days from one planned credit review to the next.

Delayed Completion of Review

	% of Delayed Reviews			Average Number of Days Delayed			Median Number of Days Delayed		
	3rd year prior	2nd year prior	year prior	3rd year prior	2nd year prior	year prior	3rd year prior	2nd year prior	year prior
Healthy Loans	90%	84%	69%	119.6	89.0	37.8	118.0	99.0	24.0
Troubled Loans	84%	85%	79%	123.2	121.6	115.0	111.0	117.0	92.0

Times Between Planned Reviews

	Average Number of Days Between Planned Reviews		Average Change in Number of Days Between Planned Reviews	Number of Loans Whose Days Between Planned Reviews Are:			
	3rd year prior to 2nd year prior	2nd year prior to year prior		> 390	< 340	> 390	< 340
Healthy Loans	365.0	383.3	Number of days between planned reviews increases, on average, by 18.37 days	5	7	14	6
Troubled Loans	365.8	318.1	Number of days between planned reviews decreases, on average, by 47.96 days	10	10	9	19

Table 10. Evidence of More Intensive Monitoring in Response to Violations Based on the Monthly Bank Account Information

This table reports statistics on the delay between planned and actual completion of the credit review and on the time between planned reviews, by loans categorized by whether the number of violations is greater or less than the median number of violations in the sample. The median number of violations is 2.5. *Delayed reviews, number of days delayed, and number of days between planned reviews* are defined as in table 9. *Violations* are defined as in table 7.

Delayed Completion of Review

	% of Delayed Reviews			Average Number of Days Delayed			Median Number of Days Delayed		
	3rd year prior	2nd year prior	year prior	3rd year prior	2nd year prior	year prior	3rd year prior	2nd year prior	year prior
Loans with \leq Median No. of Violations	90%	80%	69%	118.1	98.9	48.1	118.0	99.0	51.0
Loans with $>$ Median No. of Violations	85%	90%	79%	124.7	111.5	104.5	111.0	105.0	83.0

Times Between Planned Reviews

	Average Number of Days Between Planned Reviews		Average Change in Number of Days Between Planned Reviews	Number of Loans Whose Days Between Planned Reviews Are:			
	3rd year prior to 2nd year prior	2nd year prior to year prior		> 390	< 340	>390	< 340
Loans with \leq Median No. of Violations	367.1	354.6	Number of days between planned reviews decreases, on average, by 9.94 days	5	6	10	12
Loans with $>$ Median No. of Violations	363.6	347.7	Number of days between planned reviews decreases, on average, by 16.98 days	10	11	13	13

Appendix. The correlation between changes in the loan balance and the bank's valuation of accounts receivable

To the extent that there is a high correlation between bank account balances and changes in accounts receivable and inventories, changes in the firm's bank account balance can be used to monitor a firm's operations.

We can derive approximate values of the correlations under certain simplifying assumptions. For example, suppose the bank values the collateral represented by the accounts receivable at vR . (It applies a haircut, since there is some chance the accounts receivable will not be collected.) Then, using equation (2) in the text, the change in the bank's valuation of accounts receivable is $\Delta vR_t = vR_t - vR_{t-1} = v[y_t(1+m) - z_t]$. If m is small, then

$$\Delta vR_t \approx v(y_t - z_t). \quad (\text{A.1})$$

The correlation between the change in the firm's bank account balance and the change in the bank's valuation of the firm's accounts receivable is

$$\text{corr}(\Delta B_t, \Delta vR_t) = \text{covariance}(\Delta B_t, \Delta vR_t) / [\text{variance}(\Delta B_t)^{1/2} \text{variance}(\Delta vR_t)^{1/2}].$$

Using equations (1) in the text and (A.1), and assuming r is small, then

$$\begin{aligned} \text{corr}(\Delta B_t, \Delta vR_t) &\approx \text{cov}(x_t - z_t + w_t, v(y_t - z_t)) / [\text{var}(x_t - z_t + w_t)^{1/2} \text{var}(v(y_t - z_t))^{1/2}] \\ &= \{[v \text{cov}(x_t, y_t) - v \text{cov}(x_t, z_t) - v \text{cov}(z_t, y_t) + v \text{var}(z_t) + v \text{cov}(w_t, y_t) - v \text{cov}(w_t, z_t)]\} / \\ &\quad \{[\text{var}(x_t) + \text{var}(z_t) + \text{var}(w_t) - 2\text{cov}(x_t, z_t) - 2\text{cov}(z_t, w_t) + 2\text{cov}(x_t, w_t)]^{1/2} \times \\ &\quad [v^2 \text{var}(y_t) + v^2 \text{var}(z_t) - 2v^2 \text{cov}(y_t, z_t)]^{1/2}\}. \end{aligned}$$

As an approximation, assume x_t, y_t, z_t, w_t are independent. Then,

$$\text{corr}(\Delta B_t, \Delta vR_t) = [\text{var}(z_t)] / [\text{var}(x_t) + \text{var}(z_t) + \text{var}(w_t)]^{1/2} [\text{var}(y_t) + \text{var}(z_t)]^{1/2}.$$

If other payments are not variable, i.e., $\text{var}(w_t) = 0$ and the variance in goods purchased, goods sold, and payments received are similar, i.e., $\text{var}(x_t) = \text{var}(y_t) = \text{var}(z_t)$, then

$$\text{corr}(\Delta B_t, \Delta vR_t) \approx [\text{var}(z_t)] / [2\text{var}(z_t)]^{1/2} [2\text{var}(z_t)]^{1/2} = 1/2.$$

A similar calculation can be performed for the correlation between the change in bank account balance and the change in inventories.

Obviously, this is a rough approximation, based on a number of simplifying assumptions. But it gives an idea of the magnitude of the correlation we would need to find to anticipate that the bank account balance might be a useful indicator of firm operations.

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