How and why do small firms manage interest rate risk?[a]

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Abstract

Although small firms are particularly sensitive to interest rates and other shocks, empirical work on corporate risk management has focused instead on large public companies. This paper studies fixed-rate and adjustable-rate loans to see how small firms manage their exposure to interest rate risk. Credit-constrained firms are found to match significantly more often with fixed-rate loans, consistent with prior research that shows the supply of credit shrinks during periods of rising interest rates. Banks originate a higher share of adjustable-rate loans than other lenders, ameliorating maturity mismatch and exposure to the lending channel of monetary policy. Time-series patterns in the fixed-rate share are consistent with recent evidence on debt market timing.

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1. Introduction

Empirical research on corporate risk management has generally focused on large public companies, most often studying firms' use of financial derivatives.[1] This paper instead examines fixed-rate and adjustable-rate commercial loan contracts to study how small firms adjust their exposure to interest rate risk. Small and medium-size firms are important to the US economy; firms with fewer than five hundred employees generate half of non-farm private gross domestic product[2]. Small firms are often financially constrained, which is considered a key theoretical rationale for why firms engage in risk management (e.g., Froot, Scharfstein, and Stein, 1993, hereafter FSS). Moreover, work on the credit channel of monetary policy shows directly that small firms are sensitive to interest rate shocks (e.g., Gertler and Gilchrist, 1994; Ehrmann 2000).

Although small and medium-size firms make little use of derivatives, they do borrow extensively from financial institutions. In some cases the interest rate on these loans is fixed, while in other cases it adjusts with market interest rates. I study this variation in fixed-versus-adjustable outcomes as a window into how small firms adjust their exposure to interest rate risk.

I firstly examine the relationship between fixed-versus-adjustable outcomes and firm financial constraints. FSS show that optimal risk management policy should aim to generate cash in states of nature in which an additional dollar of internal funds is most valuable. Empirically, research

[1] Cross-industry studies of the determinants of firms' use of derivatives include Purnanandam (2007), Covitz and Sharpe (2005), Lin and Smith (2003), Rogers (2002), Graham and Rogers (2002), Géczy, Minton, and Schrand (1997), Mian (1996) and Fenn, Post, and Sharpe (1996). Some studies focus on particular types of derivatives, e.g., Géczy, Minton, and Schrand (1997) concentrate on foreign currency derivatives, while Covitz and Sharpe study interest rate contracts. Allayanis and Weston (1998) study the relationship between derivatives use and firm value. Guay (1999) examines how derivatives hedging affects firm risk. Guay and Kothari (2003) examine the quantitative relevance of firms' derivatives holdings. Other papers take an industry-specific approach. Faulkender (2005) studies chemicals firms, Haushalter (2000) focuses on oil and gas, and Tufano (1996) studies gold mining firms. The literature is also broadening to consider other dimensions of risk management. For example, Bartram, Brown, and Minton (2006) and Pantzalis, Simkins, and Laux (2001) present evidence that firms use operational hedging (e.g., matching foreign sales to foreign production) to manage exchange rate risk. Petersen and Thiagarajan (2000) study two gold mining firms that achieve a similar reduction in exposure to gold price risk, one using derivatives, and the other using a combination of operating, financial, and accounting decisions.
[2] Source is the Small Business Administration. See http://www.sba.gov/advo/research/rs211tot.pdf.

on the credit channel of monetary policy finds that the availability of finance to bank dependent firms becomes scarcer relative to investment opportunities during periods of rising interest rates, causing lower investment and output amongst credit-constrained firms. (Section 2 reviews this literature in detail.) Correspondingly, I test the hypothesis that credit-constrained firms match with fixed-rate debt, thereby maximizing net cash flows during periods of rising interest rates when the shadow value of internal funds is high.[3]

A related implication of FSS is that risk management outcomes should reflect variation across firms in the correlation between interest rates and pre-interest firm cash flows. In sectors in which industry output or cash flows covary positively with interest rates, firms have a partial or complete natural hedge against interest rate risk, and thus fixed-rate debt is less likely to be optimal. I test the hypothesis that the share of adjustable-rate loans is higher in such industries, using an estimated index of industry interest rate procyclicality.

Although plausible, there are several reasons for why these two FSS hedging hypotheses might fail to hold empirically. One alternative hypothesis is that fixed-versus-adjustable outcomes are set by the firm's banks (e.g., perhaps the firm's relationship lender originates only fixed-rate loans or only adjustable-rate loans, so the firm does not have a choice between contracts). Another possibility is that small firms prefer to amplify volatility in the shadow value of internal funds. Adam, Dasgupta and Titman (2007) presents a model in which such behavior could be optimal in an imperfectly competitive industry setting. A third possibility is that small firms are financially unsophisticated or the fixed-versus-adjustable margin is unimportant, so no systematic correlations exist in the data.

Using data from the Federal Reserve Board's Survey of Small Business Finance (SBF) I find evidence consistent with the two FSS hedging hypotheses. First, as predicted, matching with a fixed-

[3] In the FSS framework, a non-credit-constrained firm would be simply indifferent between fixed and adjustable-rate loans, in line with the Modigliani and Miller theorem. However, I argue in the body of the paper that when lenders are also exposed to interest rate risk (consistent with a large body of empirical evidence) unconstrained firms could strictly prefer adjustable-rate debt.

rate loan is positively correlated with several different proxies for financial constraints. Fixed-rate debt is most popular amongst smaller firms, younger firms, firms switching from their primary lender, and firms with low cash flows (measured by current profits) or high investment opportunities (measured by sales growth). These results are economically as well as statistically significant. For example young, small firms in the SBF are about twice as likely to match with fixed-rate debt as old, large firms (69% compared with 38%). Second, fixed-rate debt is less prevalent in two-digit standard industrial classification (SIC) sectors in which industry output comoves most positively with interest rates, and thus when firms have a partial natural hedge against interest rate risk.

Next, I study how lender characteristics influence fixed-versus-adjustable outcomes. Several theoretical papers on loan contract design and bank risk management suggest that the share of interest rate risk in a loan borne by the borrower should depend in part on the lender's interest rate risk profile (Arvan and Brueckner, 1986; Edelstein and Urosevic, 2003; Froot and Stein, 1998). These models predict that lenders who are exposed ex ante to rising interest rates optimally originate a smaller share of fixed-rate loans, because the present value of such loans declines by comparison with adjustable-rate loans when interest rates rise.

I test this prediction by comparing bank loans with loans from nonbank institutions. Banks are exposed to rising interest rates in two ways that are specifically tied to their reliance on deposit finance. First, banks are affected by the lending channel of monetary policy (Stein, 1998; Kashyap and Stein, 2000; Ashcraft, 2006), in which tight monetary policy reduces the insured deposit base, raising banks' cost of funds. Second, banks are subject to maturity mismatch, in which demand deposits and short-term time deposits fund long-duration assets such as mortgages.

Correspondingly, I test the hypothesis that bank loans are more likely to involve an adjustable interest rate than loans from other lender types. This lender risk management hypothesis receives strong support in the data. I find that a loan from a commercial or savings bank is 14 percentage points more likely to involve an adjustable interest rate compared with a loan from a nonbank financial institution.

Because many small bank-dependent enterprises are closely held and owner-managed, it also seems plausible that owner characteristics play a significant role in fixed-versus-adjustable outcomes. Somewhat surprisingly, I find that variables such as the owner's age and the concentration of ownership are nearly uncorrelated with the loan type chosen. I do find some evidence that adjustable-rate loans are more common amongst firms with wealthier owners, consistent with the view that risk aversion is declining in wealth.

The last part of the paper studies time-series patterns in the aggregate share of fixed-rate loans. Using data from the Survey of Terms of Business Lending (STBL), I construct and study a 28-year quarterly time series of the fixed-rate share for business loans originated by commercial banks. I find that high real interest rates and a steep yield curve are correlated with a lower proportion of fixed-rate loans, consistent with previous work on debt market timing by Faulkender (2005) and Baker, Greenwood, and Wurgler (2003). To my knowledge, this paper is the first to show these results also extend to small, bank dependent firms. Implications of these findings for theoretical explanations of market timing patterns are discussed.

The rest of this paper proceeds as follows. Section 2 reviews existing literature on the sensitivity of small firms to interest rate shocks. Section 3 describes the Survey of Small Business Finance and discusses the measures of financial constraints I use. Section 4 presents cross-sectional empirical evidence from the SBF. Section 5 presents time-series evidence on the share of fixed-rate commercial loans. Section 6 presents cross-sectional evidence from the STBL. Section 7 concludes.

2. Small firms and interest rate shocks

Research on the credit channel of monetary policy argues that higher interest rates lead to a decline in the availability of internal and external finance relative to investment opportunities, resulting in lower investment and output amongst credit-constrained firms. This channel is considered to be most important for small, informationally opaque, bank-dependent firms, which are most likely to be constrained in their access to finance. Consistent with this view, Gertler and Gilchrist (1994) show that small US manufacturing firms are disproportionately affected during periods of rising interest rates. Small firms reduce external borrowing, shed inventories, and experience sharp falls in sales growth. In contrast, larger firms maintain debt levels, increase inventories, and experience a substantially smaller decline in sales growth. Ehrmann (2000) finds similar evidence using data on German firms.

The broad credit channel can be decomposed into balance sheet and lending effects. The balance sheet channel is that higher interest rates weaken firm balance sheets, partially by reducing expected future profits and partially because small firms have long-lived physical assets but mainly short term or adjustable-rate liabilities (bank loans, credit lines, etc.). This maturity mismatch implies that net current cash flows decline when interest rates increase, and also that the present value of assets declines relative to the present value of liabilities. The latter makes the firm less creditworthy, reducing its ability to raise external finance.

Consistent with the balance sheet channel, Bernanke and Gertler (1995) show that firms' balance sheet strength, proxied by interest coverage, declines during periods of high interest rates. Greenwood (2003) finds that firm investment is most sensitive to interest rates when maturity mismatch is high and that this relation is most pronounced for financially constrained firms. Ashcraft and Campello (2007) find commercial lending is more sensitive to monetary policy in geographic regions where firm balance sheets are weak.

The lending channel is that contractionary monetary policy reduces the ability of banks to lend by shrinking the supply of bank deposits. Stein (1998) presents a formal model of the lending channel. Kashyap, Stein, and Wilcox (1993) show the bank lending as a share of total debt finance falls during periods of contractionary monetary policy. Kashyap and Stein (1995, 2000) present further empirical evidence on the lending channel for the US.

For the purposes of this paper, the key implication of both the lending and balance sheet channels is that for the average small firm, the supply of internal finance plus external finance declines relative to investment opportunities during periods of rising interest rates. This fall in credit availability has no real effects if credit constraints are not binding. For firms that are credit-constrained, such a shrinkage in the availability of finance induced by rising interest rates reduces investment and output and raises the shadow value of internal funds. Correspondingly, I test the hypothesis that credit-constrained firms match with fixed-rate loans instead of adjustable-rate loans, maximizing cash flows during periods of rising interest rates, when internal funds are most valuable.

What about financially unconstrained firms? In FSS, such firms would be indifferent between the two loan types, in line with the Modigliani and Miller theorem. However, a substantial amount of evidence suggests lenders, too, are exposed to interest rate risk, via the bank lending channel as well as maturity mismatch (Sierra and Yaeger, 2004). In such an environment, the optimal contract involves a financially unconstrained firm bearing the interest rate risk of the loan (Arvan and Brueckner, 1986; Edelstein and Urosevic, 2003; Froot and Stein, 1998). In subsection 4.2 I present direct evidence that lender types exposed to rising interest rates originate a higher fraction of adjustable-rate loans, consistent with this view. Alternatively, unconstrained firms could match with adjustable-rate debt to signal firm quality, in line with the model of Guedes and Thompson (1995). Even without these effects, it still holds that unconstrained firms have no explicit incentive to protect cash flows against rising interest rates, unlike constrained firms.

3. Survey of Small Business Finance data

The SBF is a cross-sectional survey conducted approximately every five years by the Federal Reserve Board, containing detailed microeconomic information on firm characteristics and financing behavior for a representative sample of US small and medium-size enterprises, defined as firms with fewer than five hundred employees at the end of the reference year. The SBF provides detailed information on the firm's most recent loan, including the size of the loan, interest rate and fees paid, category of loan (e.g., line of credit, business mortgage, etc.), maturity, and collateral posted against the loan. Most important for this paper, the SBF also records whether the most recent loan was issued at a fixed or adjustable interest rate.

I pool data from the 1987, 1993 and 1998 SBF surveys, for a total of 11,422 firm observations. Of these, 4,000 firms had received a loan within three years of the end of the survey reference year. (I use three years as a cutoff because the 1993 and 1998 surveys do not collect information on the most recent loan if it was originated more than three years ago.) I then drop firms when data are missing for one or more key variables: total assets, firm age, profits, total debt, sales growth, years with primary lender, or the amount, maturity or fixed-versus-adjustable status of the most recent loan. This yields a final sample of 3248 loans matched with firm characteristics. (The SBF is not a panel dataset, so each of these observations relates to a different firm.)

[INSERT TABLE 1 NEAR HERE]

Table 1 presents descriptive statistics for this final sample of 3248 observations. Because the survey oversamples large firms and minority-owned firms, I present weighted averages based on the SBF sampling weights, as well as unweighted statistics for comparison. Seventy percent of unweighted observations are S- or C-corporations. Average assets are $939 thousand ($2.7 million on an unweighted basis). Comparing the last two columns of the table, firms in the final sample are of similar age although substantially larger than the overall SBF sample. Relatively fewer observations in the final sample are from the 1998 survey. This is partially due to a change in survey design; in 1998 the survey does not consider renewals of existing credit lines to be new loans.

Thirty-eight percent of loans are lines of credit (43% on an unweighted basis). The distinction between credit lines and other loan types is important for the fixed-versus-adjustable dimension of the loan contract. A fixed-rate credit line creates a potential arbitrage opportunity, because any change in market interest rates affects the wedge between the market rate and the rate on the commitment. For example, if interest rates rise sharply, the firm could aggressively draw down the credit line, investing the proceeds at the higher market rate. For this reason, only 29% of lines of credit in the SBF are fixed-rate, compared with 70% for other loan types. Moreover, most fixed-rate credit lines are short term; 70% have a maturity of one year or less. For these short term commitments, interest rates are unlikely to shift enough before the line is renegotiated for the arbitrage opportunity described above to be profitable after transaction costs. A second point of difference is that the interest rate risk of a credit line is contingent, because the firm faces risk only to the extent that it actually draws down the line in the future. Given these differences, but also taking into consideration the moderate sample size, I always present two sets of empirical estimates, one based on the full sample, and the other based on a subsample excluding credit lines.

Loans in the sample have an average maturity of four years, and the average weighted loan size is $324,000 (around one-third of average firm assets). Most important, substantial variation exists in firms' choices between fixed- and adjustable-rate loans. Fifty-two per cent of loan observations in the sample were drawn at a fixed rate (59% on a weighted basis), the rest at an adjustable-rate. Ninety-two per cent of variable rate loans are indexed to a commercial prime lending rate.

[INSERT TABLE 2 NEAR HERE]

Table 2 breaks down the fixed-rate share by type and source of loan. Because loan type dummies are included in most regressions, it is important that a mix of fixed- and adjustable-rate contracts exists within each loan type. Credit lines have the lowest fixed-rate share (29%), while capital leases and vehicle mortgages are most likely to be fixed (89% and 88% respectively).[4] Bank loans are less likely to involve a fixed rate (46% compared with 80% for nonbank loans).

[4] Beyond the earlier discussion of credit lines, this paper does not propose a complete rationale for why the fixed rate share varies across loan types. Differences in securitization rates are a potential explanation, however. For example, a vehicle mortgage, backed by a standardized, easy-to-value asset, could be easier to securitize than a business mortgage secured by assets that are difficult for outsiders to value and monitor. (There is an active secondary market for auto loans in the US, consistent with this argument.) This could in

3.1. *Measuring financial constraints*

The SBF contains several potential measures of financial constraints. I use firm size, firm age, the strength of banking relationships, and cash flows relative to investment opportunities.

3.1.1. *Firm size*

Small firms are generally thought to face more severe financial constraints than large firms, because of scale economies in monitoring and information acquisition. Within the class of bank dependent firms, the focus of this paper, Petersen and Rajan (1995) show that smaller firms pay higher interest rates and take lesser advantage of attractive early-payment discounts on trade credit, signs that such firms are short of cheap, liquid funds (Footnote 5 replicates these findings for my sample). Eisfeldt and Rampini (2004) show that small firms invest more often in used capital, which they argue stems from credit constraints. Evans (1987) finds that small firms have more volatile growth rates. Finally, the credit channel evidence cited earlier suggests that smaller firms are more sensitive to interest rate shocks (Gertler and Gilchrist, 1994; Ehrmann, 2000). On the theory side, Albercurque and Hopenhayn (2004) present a dynamic limited commitment model of firm growth in which small and young firms are credit rationed until they grow sufficiently. Cabral and Mata (2003) show that a related model fits the dynamics of the size distribution of Portuguese firms.

3.1.2. *Firm age*

The actions of a firm over time can help to reveal private information and build a reputation (Diamond, 1991) and develop relationships with financial institutions (Sharpe, 1990; Petersen and Rajan, 1994). Over time, profitable firms also accumulate capital and internal funds to finance investment (Albercurque and Hopenhayn, 2004). Petersen and Rajan (1995) find that young firms are less likely to take advantage of early payment discounts on trade credit and also that loan interest rates decline with firm age.

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turn promote the availability of fixed-rate vehicle mortgages, analogous to the argument that securitization underpins the popularity of the US fixed rate residential mortgage (Green and Wachter, 2005).

3.1.3. Banking relationships

A large theoretical literature argues that incumbent banks over time become more efficient monitors or accumulate private information about firms they lend to (Sharpe, 1990; Rajan, 1992; see also Von Thadden, 2004, who highlights an error in Sharpe and provides a corrected analysis). This implies firms with strong relationships have greater access to finance and that changing to a new lender involves some switching costs because of a winner's curse effect (because the new lender must have outbid an existing informed lender). Petersen and Rajan (1994) show that firms with long or concentrated banking relationships repay trade credit more quickly. Consistent with the winner's curse effect, Degryse and Van Cayseele (2000) show that firms that switch lenders pay higher interest rates after switching.

3.1.4. Cash flows relative to investment opportunities

Financial constraints are less binding if internal cash flows are high or investment opportunities are low. I use profits scaled by firm size as a measure of current cash flows and sales growth as a proxy for investment opportunities. Profits likely contain information about investment opportunities as well as current cash flows, as argued by Kaplan and Zingales (1997). However as some supporting evidence in the current context, Petersen and Rajan (1995) find that more profitable firms in the SBF take greater advantage of early-payment discounts on trade credit, consistent with the view that such firms are less credit rationed (I replicate this result in Footnote 5).

4. Evidence from the Survey of Small Business Finance

I begin by estimating a simple probit regression to study the cross-sectional determinants of firms' matching to fixed-rate or adjustable-rate loans. The probit takes the form

$$P(\text{fixed}) = \Phi(a_0 + a_1 \,.\, \text{financial constraints} + a_2 \,.\, \text{lender type} + a_3 \,.\, \text{lender controls} + \\ + a_4 \,.\, \text{loan controls} + a_5 \,.\, \text{other firm controls} + a_5 \,.\, \text{year dummies} + e). \quad (1)$$

The dependent variable is equal to one for a fixed-rate loan, and zero for an adjustable-rate loan. Financial constraints includes the proxies for credit constraints discussed in Section 3: firm size (log (1+assets)), firm age (log(1+age in years)), return on assets (profits / assets), annual sales growth, and three measures of the strength of lending relationships, namely the number of financial institutions the firm uses, the log of the length in years of the firm's relationship with its primary lender, and a dummy equal to one if the most recent loan is not from the firm's primary lender (this variable, positive for 23% of the sample, captures the switching mechanism discussed in Section 3 that changing lenders conveys negative private information about the firm).

Lender type consists of two dummy variables, respectively equal to one if the loan provider is a bank (either a commercial or savings bank) or a nonfinancial institution. The omitted category is nonbank financial institution, which includes finance companies, leasing firms, insurance companies and credit unions. Lender controls includes other controls relating to the provider of the most recent loan: the log(distance) between this lender and the firm, and two dummy variables reflecting the main type of interaction between the firm and this lender (face to face, telephone, or other). Distance and the form of interaction are widely used to measure the importance for lending decisions of nonverifiable soft information about the firm (Liberti and Mian, 2006; Degryse and Ongena, 2005; Berger, Miller, Petersen, Rajan, and Stein, 2005; Petersen and Rajan, 2002; Stein, 2002). Loan controls includes the maturity of the loan, loan size scaled by firm assets, five dummy variables for the loan type (e.g., line of credit, business mortgage and vehicle loan), and seven dummies for types of collateral pledged.

Controls in the lender type, lender controls, and loan controls categories all reflect different characteristics of the most recent loan. Endogeneity is thus a potential concern, because these features are jointly determined with the fixed-or-adjustable component of the loan contract. Although no convincing instruments are available, as a robustness check I present empirical results estimated two different ways. The first specification excludes nearly all these potentially endogenous loan characteristics (I control only for the loan type), while the second specification includes all the controls. Although some coefficients are estimated less precisely when these potentially endogenous loan characteristics are included, the main results are robust.

Other firm controls consists of firm leverage (book debt / book assets), a dummy equal to one if the local bank Herfindahl Index (HHI) is > 1800, industry dummies at the two-digit SIC level, a dummy for whether the firm had recently been solicited by financial institutions, two dummies for whether the firm is an S-corp or C-corp (unincorporated is the omitted category), and three dummy variables for the geographic region of the firm. I also include calendar year dummies for each year a loan is observed in the SBF sample.

It is important to check that the results are robust to excluding credit lines (because the properties of these loans are different) and robust to including or excluding endogenous loan controls such as maturity, loan size, and lender type. Thus, I estimate four specifications reflecting each combination along these two dimensions. Results are presented in Table 3. Estimates are based on a weighted probit using the SBF sampling weights. Coefficients are normalized to reflect marginal effects, and White robust standard errors are used.

[INSERT TABLE 3 NEAR HERE]

4.1. Financial constraints

The first hypothesis I test is that firms identified as credit constrained minimize their exposure to rising interest rates by matching with fixed-rate debt. The results in Table 3 provide consistent support for this hypothesis, based on the proxies for financial constraints discussed in Section 3 (firm size, age, lending relationships, and cash flows relative to investment opportunities).

First, the estimates show that smaller and younger firms are significantly more likely to match with a fixed-rate loan. A doubling of firm size reduces the probability of matching with a fixed-rate loan by between 4.7 and 9.2 percentage points depending on the specification. Doubling firm age reduces the probability of matching to a fixed-rate loan by 4.7 to 5.2 percentage points. The firm size coefficient is always statistically significant at the 1% level, with z-statistics generally above 5. Firm age is statistically significant at the 2% or 3% level depending on the specification.

To illustrate the economic significance of these estimates, I take the regression data set and set firm assets and firm age for all firms equal to their 10th percentile sample values (assets = $34,200, age = 4.2 years). Under this scenario, the average predicted probability of matching to fixed-rate debt is 69% (based on Column 1 coefficients). When firm size and age are replaced with their 90th percentile values (assets = $695,000, age = 30.4 years), this predicted probability falls to 34%. In other words, holding other characteristics fixed, small, young firms in the SBF match more than twice as often to fixed-rate loans as large, mature firms.

Examining results for the lending relationship variables, number of financial institutions and years with primary lender are statistically uncorrelated with matching to a fixed- or adjustable-rate loan. However, the switch dummy, equal to one if the loan is not from the firm's primary lender, is positive and significant at the 1% level in columns 1 and 2. Thus, firms switching from their primary lender appear use fixed-rate debt more often, consistent with the hypothesis modelled in Sharpe (1990) and Von Thadden (2004) that switching conveys negative private information about firm quality and creditworthiness.

Turning to the accounting variables, firms with lower cash flows (measured by return on assets) or more growth opportunities (measured by sales growth) are more likely to be financially constrained. I find such firms also match more frequently with fixed-rate loan contracts, consistent with previous results. The coefficient on return on assets is negative and significant at the 5% level in Columns 1 and 2 and close to significant (p-value between 10% and 15%) in Columns 3 and 4. The sales growth coefficient is always positive although significant at the 10% level in Column 1 only.

As an additional check on the proxies for financial constraints used in Table 3, I estimate a linear model of the percentage of early payment trade credit discounts taken by the firm as a function of the explanatory variables in Table 3, following Petersen and Rajan (1995).[5] I find that variables correlated with matching to a fixed-rate loan are also correlated with the firm taking fewer trade credit early-payment discounts. Specifically, smaller firms, younger firms, and less profitable firms take fewer discounts, significant at the 5% level for size and age, and the 10% level for return on assets. Sales growth is correctly signed although not statistically significant. The main difference is the relative impact of different bank relationship variables. Firms with many lenders or a short primary relationship length take fewer trade credit discounts, but the switching dummy (i.e., most recent lender is not primary lender) is not statisically significant. In contrast, in Table 3 the switching variable is significant, but the other two relationship variables are not. The act of the firm switching from its primary lender appears particularly relevant for fixed-versus-adjustable outcomes, perhaps because switching provides a direct signal to the lender setting contract terms for the new loan.

Table 3 also presents estimates for two measures of firm indebtedness: leverage (book debt / assets) and loan size (most recent loan size / assets). High firm leverage is correlated with a lower probability of matching with fixed-rate debt. Columns 3 and 4 show this result reflects variation in the size of the most recent loan, not the stock of previous debt. In other words, larger loans are more likely to be adjustable-rate, holding all else equal. These measures are not considered amongst the proxies for financial constraints, because it is unclear whether low debt firms are less constrained (because they have a higher reserve of debt capacity) or more constrained (because their smaller loans reflect difficulty in obtaining credit at an acceptable interest rate). Small and young firms in the sample are less indebted on average, consistent with the latter hypothesis, although leverage is not correlated in either direction with trade credit repayment patterns (see Footnote 5).

[5] I regress trade credit discounts taken on proxies for financial constraints. To conserve space, results are reported here instead of a separate table. The dependent variable is the fraction of trade credit early payment discounts taken. A linear regression is estimated. The main coefficient estimates (robust standard errors) are: log(assets): 1.73**, (0.85); log(firm age): 4.48**, (1.94); return on assets: 1.65*, (1.00); sales growth: -1.35, (2.88); leverage: -3.06, (2.38); number of lenders: -2.54***, (0.91); log(years as primary lender): 2.96***, (1.47); switch dummy: 1.92, (3.04). The sample size is 2,087. The sample is smaller than 3,248 partially because not all firms use trade credit and partially because not all who do are offered early payment discounts. ***, ** and * refer to statistical significance at the 1%, 5%, and 10% levels respectively.

4.2. Lender characteristics

An interesting feature of the risk management setting considered in this paper is that both lenders and borrowers are potentially exposed to interest rate fluctuations. It therefore seems plausible that the allocation of risk in the loan contract depends in part on the lender's interest rate risk profile. In this section, I test the hypothesis that lenders with a larger ex ante exposure to rising interest rates originate a lower share of fixed-rate loans, ameliorating their sensitivity to interest rate shocks. Arvan and Brueckner (1986) and Edelstein and Urosevic (2003) make this prediction in the context of models of optimal mortgage contract design. This hypothesis is also consistent with Froot and Stein (1998), who show that investment by financial institutions should take into account how investment returns covary with the institution's existing portfolio risks.

Specifically, I test this hypothesis by comparing bank loans with loans from nonbank financial institutions. Banks are exposed to rising interest rates through two distinct mechanisms that stem directly from their reliance on deposit finance.[6] First, the lending channel literature finds that rising interest rates cause an outflow of deposits from the banking system, which banks cannot costlessly replace by other sources of finance (Stein, 1998; Kashyap and Stein, 2000; Ashcraft, 2006). Second, banks face maturity mismatch in which long-term assets such as mortgages are funded by short-term demand deposits. Sierra and Yaeger (2004) presents direct evidence that commercial banks are liability sensitive (i.e., the duration of assets exceeds the duration of liabilities). Savings banks face more significant maturity mismatch than commercial banks, because of their focus on residential mortgage lending (Wright and Houpt, 1996).

Thus, I test the hypothesis that bank loans are more likely to involve an adjustable interest rate than loans from nonbank financial institutions. This prediction receives strong support in the

[6] Nonbank commercial finance companies are not able to raise deposits insured by the Federal Deposit Insurance Corporation (FDIC). Instead, these firms rely on a combination of commercial paper, medium- and long-term notes and shareholder equity to fund operations and securitize loans when possible. An example is CIT, the world's largest publicly held commercial lending firm, whose balance sheet is available online at www.cit.com/main/InvestorRelations/AnnualReports.htm.

data. Columns 3 and 4 includes two lender dummies, for whether the lender is a bank or nonfinancial institution. Relative to nonbank financial institutions, the omitted category, bank loans are 13.7 percentage points more likely to involve an adjustable interest rate based on Column 3, and 12.2 percentage points based on Column 4, both statistically significant at the 1% level.

Also consistent with the hypothesis, the finding that deposit-taking institutions originate a higher share of adjustable-rate debt holds for other types of debt contracts as well. Table 4 compares estimates in Table 3 with Faulkender (2005), who studies debt fundings by a sample of Compustat firms, and Vickery (2007), who analyzes residential mortgages. In both these papers, some debt fundings are originated by banks, while others are funded by an alternative source (the corporate bond market in Faulkender's sample, and finance companies in Vickery's sample).

[INSERT TABLE 4 NEAR HERE]

The negative coefficients in each cell show that, in each case, the debt funding is more likely to involve an adjustable interest rate if the provider of funds is a bank, not the comparison nondepository source of finance listed. The difference is particularly stark for Faulkender's sample. The coefficient of -0.828 essentially summarizes the fact that public corporate debt fundings are nearly all fixed-rate, while the largest commercial bank loans are nearly all adjustable-rate. These results support the view that originating adjustable-rate debt provides a mechanism for depository institutions to minimize their ex ante exposure to rising interest rates.

A potential alternative interpretation is that these results reflect endogenous matching between banks and firms. Perhaps bank borrowers are less financially constrained, which explains why banks originate a higher share of adjustable-rate loans. One piece of evidence that speaks against this view, however, is that the source of finance is not correlated with observable measures of credit constraints. I estimate a simple probit regression of the lender = bank dummy on the right-hand-side variables from Table 3. Apart from primary relationship length, none of the proxies for credit constraints (size, age, return on assets, sales growth, number of lenders, or the switch dummy) is statistically significant even at the 10% level (results available on request). This suggests bank loans do not flow to significantly more creditworthy firms on average.

4.3. The natural hedge hypothesis

The credit channel evidence reviewed in Section 2 suggests that, on average, bank-dependent firms become more credit constrained during periods of rising short-term interest rates. However, exposure to interest rate risk also likely varies a great deal across firms. For example, in industries in which output or cash flows covary positively with interest rates, higher internal cash flows will at least partially offset the effects of rising interest rates on the supply of credit. In these industries, firms have a natural hedge against shifts in short-term interest rates, and fixed-rate debt is less likely to be optimal. In this section I test the hypothesis that the share of adjustable-rate loans is higher in such industries.

This test involves two steps. First, I estimate the correlation between industry output and interest rates using two-digit SIC industry data for the period 1960-2000. For each industry, log industry output is regressed on the 12-month nominal risk Treasury interest rate r_t contemporaneous and lagged one period, as well as a constant, time trend and log time trend (results are also robust to using $\ln(y_{it} / y_t)$ as the dependent variable)

$$\ln(y_{it}) = \alpha_0 + \Sigma_{k=0,1} \beta_{ik} r_{t-k} + \alpha_1 t + \alpha_2 \ln(t) + e_{it} \qquad (2).$$

$\Sigma\beta_{ik}$ provides an empirical estimate of the excess correlation of industry i to interest rates. (If output in each industry moves by the same proportion with interest rates, then $\Sigma\beta_{ik}$ would always equal zero.) In the second step, I reestimate the fixed-versus-adjustable regression Eq. (1) after replacing the SIC dummies with the estimated $\Sigma\beta_{ik}$. A negative coefficient on this industry correlation variable would be consistent with the natural hedge hypothesis.

The first step estimates are quite precise. Of 52 2-digit industries for which industry output data are available, the β's are jointly significant at the 1% level in 26 cases, and at the 5% level in 33 cases. Coal mining, petroleum refining, and oil and gas extraction have high β's, reflecting high interest rates during the energy crisis of the 1970s. Industries with negative β's include non-deposit financial institutions, motor vehicles, and personal services.[7]

Results from the second step probit are presented in Table 5.[8] Industry interest rate sensitivity has a negative coefficient as predicted, significant at the 5% level in Columns 1, 2, and 4 and the 10% level in Column 3. The estimated coefficient is around 1.2-1.5, implying that firms in an industry in which the share of total output increases by 1 per cent when short-term interest rates increase by 1 percentage point (i.e., $\Sigma\beta_{ik} = 0.01$) are 1.2-1.5 percentage points less likely to match with a fixed-rate loan compared with an industry in which the share of output is uncorrelated with interest rates. Since most industries have $\Sigma\beta_{ik}$ between –0.02 and 0.02, the estimated cross-industry natural hedge effect is fairly weak. This estimated coefficient is probably attenuated, however, because $\Sigma\beta_{ik}$ is likely subject to substantial measurement error.

[INSERT TABLE 5 NEAR HERE]

Finally, in Column 5, I test whether the natural hedge effect is more pronounced amongst financially constrained firms. I reestimate the baseline specification from Column 1 of Table 3 including an additional variable $\Sigma\beta_{ik}$ * ln(firm size). In this regression, cross-industry variation in the fixed-rate share is absorbed by the two-digit SIC industry dummies, while the interaction term coefficient just captures the extent to which the natural hedge effect is more pronounced for small firms. Although correctly (positively) signed, this coefficient is not statistically significant.

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[7] The five largest $\Sigma_{k=0,1}\ \beta_{ik}$ estimates are 0.232 (holding and other investment offices, SIC 67), 0.187 (oil and gas extraction, SIC 13), 0.103 (coal mining, SIC 12), 0.065 (petroleum refining, SIC 29) and 0.040 (metal mining, SIC 10). The five smallest are -0.102 (non-depository institutions, SIC 61), -0.030 (motor vehicles, SIC 37), -0.030 (personal services, SIC 72), -0.029 (education services, SIC 82) and -0.029 (transportation by air, SIC 45).

[8] The interest sensitivity variable is a generated regressor in the sense of Pagan (1984). The hypothesis test that the interest coefficient is equal to zero is still consistent even without adjusting the standard error, however (see Pagan, 1984, p. 226).

4.4. Owner characteristics

Because firms in the SBF are generally closely held, it seems likely that the personal characteristics of the firm's owner or managers should influence loan contract outcomes. Also, failing to control for owner variables could bias other estimates. For example, the result that small firms match with fixed-rate debt may simply reflect the fact that large firms have wealthier owners, who are perhaps less risk averse or less likely to face personal borrowing constraints.

Fortunately, the SBF contains a substantial amount of owner and manager data to investigate this possibility. First, I reestimate each specification from Table 3 including five owner characteristics: a dummy for whether the owner is also the firm's primary manager, the primary owner's age, years of business experience and ownership share, and a dummy for whether the firm is majority-owned by a single family. (The sample size for these regressions is only 2,033, because not all firms answer the owner questions, and because this set of questions are not asked in the 1987 SBF. This is why these variables are excluded from the regressions in Table 3.) I find these owner characteristics have surprisingly little explanatory power. Of 20 coefficients (five variables x four specifications), none is significant at the 5% level, and an f-test of joint significance fails to reject the null in all four specifications. Given this lack of significance, I do not report these results in a separate table. Results are available on request.

I next include a direct measure of owner wealth, available in the 1998 SBF only. For this survey year, I construct a measure of total owner wealth by summing the primary owner's nonfirm wealth and their equity stake in the firm (net book equity x the primary owner's ownership share). If fixed-versus-adjustable outcomes covary with firm size only because size is correlated with owner wealth, then if both are included as explanatory variables only the wealth variable should be statistically significant. I estimate three different specifications. In each case a baseline regression is estimated that excludes owner wealth, then an otherwise identical model in which the natural logarithm of owner wealth is added as a regressor. Results are presented in Table 6.

[INSERT TABLE 6 NEAR HERE]

Inferences are somewhat imprecise because of the small 1998 SBF sample. However, the results suggest the conclusion that small firms match with fixed-rate loans is robust to controlling for owner wealth. The coefficient on log assets drops by about one-fifth when owner wealth is included, but it is still negatively signed and statistically significant at either the 5% or 10% level. The coefficient on log wealth is negative as predicted and statistically significant at the 10% level in the parsimonious third specification. This constitutes some weak evidence that wealthier owners are less concerned about interest rate volatility, consistent with the model of household interest rate risk management developed by Campbell and Cocco (2003) to study household mortgage choice.

4.5. Robustness checks

Fixed-versus-adjustable outcomes are jointly determined with other loan characteristics such as the loan term, size, lender, and so on. This raises an important question: Do firms actively adjust the fixed-versus-adjustable component of the loan, or is the interest rate exposure just determined passively as a function of other parts of the loan package? For example, perhaps firms actively choose a lender and loan type but are then just presented with a standardized boilerplate loan contract, leaving the firm with no effective decision regarding the loan's interest rate exposure.

The results presented so far already include several specification checks to help address these concerns. The results are robust to the inclusion or exclusion of an exhaustive set of loan characteristics: loan type dummies, lender type dummies, maturity, loan size, collateral dummies, distance between lender and firm, and dummies for the primary form of lender-firm interaction. Thus, the results still hold even when comparing only firms of different sizes or ages that all have the same type of loan (e.g., a business mortgage), all used the same lender type (e.g., a commercial bank), and so on. Estimates are also robust to excluding credit lines from the sample.

This section presents some additional robustness checks to help rule out alternative explanations for the empirical results. As a first simple test of the hypothesis that the choice of lender or loan type dictates the fixed-versus-adjustable component of the loan, I visit the small business websites of ten large US commercial banks and study online documentation for two types of loans, unsecured term loans and commercial mortgages. In each case I record whether the bank offers firms a choice between a fixed and adjustable loan contract. I find that firms are offered this choice in 12 of 15 cases in which this information could be determined from the website. (In the other three cases, only a fixed-rate contract is offered.)[9] This speaks against the view that firms are shoehorned into a given interest rate exposure once the lender or loan type has been determined.

Further supporting evidence is presented in Section 6, which estimates cross-sectional fixed-versus-adjustable regressions using data from the Survey of Terms of Business Lending, a quarterly survey of banks conducted by the Federal Reserve Board. Unlike the SBF, this survey uniquely identifies the provider of each loan. I find that loan size, a close proxy for firm size, is significantly negatively correlated with matching to a fixed interest rate, even after controlling for bank fixed effects. This result confirms that individual banks do offer both types of loans and also demonstrates that small firms match with fixed-rate loans even just by comparison with larger firms who borrow from the same bank.

A final set of robustness checks are presented in Table 7. The first of these considers the hypothesis that the lender dictates the interest rate exposure of the loan. One implication of this hypothesis is that results are expected to look different for captive firms, which have no viable choice between lenders, and noncaptive firms, which can easily switch if the terms of the loan are not as desired. I consider three different proxies for firm captivity: (1) the firm has not recently been solicited by financial institutions, (2) the firm has only a single lending relationship, and (3) the firm is located in a concentrated local banking market (HHI > 1800). I then reestimate the baseline model from Column 1 of Table 3, interacting each captivity proxy in turn with the measures of credit

[9] I collect data for the commercial banking arm of the ten largest US bank holding companies by deposits: Bank of America, Citigroup, JP Morgan Chase, Wachovia, Wells Fargo, HSBC, US Bancorp, SunTrust, Citizens Financial, and National City. The three cases in which firms are not offered an adjustable-rate option are Bank of America (term loan), Bank of America (commercial mortgage), and Wells Fargo (term loan).

constraints used earlier. I then test the significance of each of the interaction terms. Results from this exercise are presented in the first three columns of Table 7.

[INSERT TABLE 7 NEAR HERE]

As the table shows, the interaction terms are almost never statistically significant. In 21 hypothesis tests, the interaction term is significant at the 5% level only twice. Thus, credit constraints are correlated with use of fixed-rate debt for both captive and noncaptive firms, suggesting previous results are not simply driven by lenders forcing firms to use a particular contract type.

In similar vein, the fourth column of Table 7 adds to the baseline model interactions between each measure of financial constraints and two lender type dummies (14 interaction terms in all). I then test the joint significance of each set of lender type interaction terms. Column 5 repeats the same exercise except the financial constraints variables are instead interacted with five loan type dummies. Results presented in Columns 4 and 5 show that none of the sets of interaction terms is statistically significant at the 5% level. Thus, even though lender type and loan type dummies are themselves statistically significant, the relation between firm credit constraints and the matching to fixed- or adjustable-rate debt is independent of loan type or lender type. In other words, the results are broadly based, instead of being driven by a single loan category or lender type.

4.6. Comparison with existing literature

How do these results compare with existing research on large, public firms? Chava and Purnandanam (2006) study the floating-to-fixed ratio of the debt of around 1,800 public companies. They find firms close to financial distress use a higher share of fixed-rate debt, consistent with the results from this paper that credit-constrained firms match with fixed-rate loans. A notable point of difference, however, is that Chava and Purnandanam find managerial and corporate governance variables, particularly the incentives facing the firm's chief financial officer (CFO), to be key determinants of a firm's floating-to-fixed ratio. Related research finds that managerial characteristics also play an important role in the decision to hedge using derivatives (e.g., Rogers, 2002; Tufano, 1996). In contrast, this paper finds that owner and manager variables are relatively unimportant in determining the interest rate exposures of small firms. A plausible reconciliation of these differences is that small firms have simple organizational structures, in which the incentives of owners and managers (often the same person or family) are well aligned. Thus, managerial agency problems are likely to be relatively less important for risk management outcomes. In contrast, credit constraints are likely to be more important, because financial frictions are most likely to bind for small, bank-dependent firms.

Also closely related is Faulkender (2005), who studies incremental fixed-versus-adjustable outcomes for debt fundings by a panel of publicly traded firms from the chemicals industry. Unlike this paper, Faulkender finds weak evidence for hedging theories of risk management, consistent with the notion that hedging motivations are most important for small, private firms. Faulkender's main result is that firms engage in market timing, meaning that they switch between fixed- and adjustable-rate debt exposures depending on the shape of the yield curve. In section 5, I show that these patterns also extend to small firms, by analyzing a long (26-year) time series of the fixed-rate share for commercial loans.

Regarding the source of capital, Faulkender and Chava and Purnandanam both note that bank loans are significantly more likely to involve an adjustable interest rate than public debt fundings.[10] Neither paper suggests an explanation for this stylized fact, however. This paper presents evidence that bank loans are more likely involve an adjustable-rate even compared with other, private sources of finance. It also proposes a unified explanation for these facts, arguing that depository institutions originate a higher share of adjustable-rate debt as a way of ameliorating exposure to maturity mismatch and the lending channel of monetary policy.

[10] Chava and Purnandanam find that firms with a public debt rating (a proxy for greater reliance on public debt instead of bank loans) have a 36% higher fixed rate share. Faulkender finds a positive relationship between firm size and fixed rate exposures, which he argues reflects the fact that large firms originate more of their debt in public markets.

A final question is, how important quantitatively is the fixed-versus-adjustable decision as a margin for risk management? The Appendix presents simple calculations of how much fixed-versus-adjustable outcomes affect small firms' cash flow sensitivity to interest rate movements. I then compare these with corresponding calculations for the use of interest rate derivatives by large firms, given that derivatives are the margin of risk management most often studied in the literature. (These derivatives calcuations are based on information from Guay and Kothari, 2003.) Scaled by firm size, I find the fixed-versus-adjustable margin has a significantly greater effect on firm interest rate sensitivity than the use of derivatives, often larger by an order of magnitude or more depending on assumptions. This finding is consistent with other recent papers that emphasize the importance of operational hedging and other non-derivatives-related decisions for firm risk management outcomes (e.g., Bartram, Brown and Minton, 2006; Chava and Purnandanam, 2006; Petersen and Thiagarajan, 2000).

5. Time-series patterns in fixed- and adjustable-rate lending

Recent work by Baker, Greenwood, and Wurgler (2003) and Faulkender (2005) shows that the interest rate exposure of firms' new debt fundings fluctuates over time in response to changes in debt market conditions such as the level of interest rates and the shape of the yield curve, an empirical regularity they refer to as debt market timing. For example, both these papers find firms are more likely to borrow short term or at a floating interest rate when the yield curve is steep. Baker, Greenwood, and Wurgler study time-series variation in aggregate debt maturity, while Faulkender examines the final interest rate exposure of debt fundings by a sample of Compustat firms. This exposure takes into account whether the funding was initially fixed or floating as well as whether an interest rate swap was used.

I extend this previous research by testing whether these time-series patterns also apply to the share of fixed-rate commercial loans. I use two data sources, the SBF data employed earlier and the

Survey of Terms of Business Lending. To preview the results, I find similar time-series patterns to previous research, even when restricting the sample to loans to small firms or loans made only by commercial banks. I discuss implications of these findings for theories of debt market timing.

5.1. Evidence from the Survey of Terms of Business Lending

The STBL is a quarterly survey of around two hundred US commercial banks, which report on all commercial loans greater than $1,000 extended during a given reference week. Banks report information on the loan size, maturity, interest rate, fees charged, commitment status, whether or not collateral was posted against the loan, and, where available, the bank's internal risk rating on the loan.

From the initial STBL sample, I drop loans with maturity under a year, or with no stated maturity, because the distinction between fixed- and adjustable-rates is negligible for very short-term loans. I also exclude loans made under commitment, because of the issues associated with fixed-rate lines of credit discussed in Section 3, and also because commitments are reported differently in the STBL than in the SBF (the STBL does not report new commitments made, only amounts drawn down on the credit line). Using the remaining term loans, I construct value-weighted and volume-weighted quarterly time series of the proportion of fixed-rate loans for the period 1977-2004. These are presented in Fig. 1.

[INSERT FIGURE 1 NEAR HERE]

The thick line in the upper panel of the figure is the volume of fixed-rate loans as a fraction of the total sample. The thin line is the dollar value of fixed-rate loans as a proportion of the value of all loans. In both time-series, the proportion of fixed-rate loans fluctuates substantially over time. For example the volume-weighted share falls from 0.8 in 1977 to around 0.3 by 1985, then drifts upward on average over the rest of the sample. The lower panel shows how the federal funds rate and 10-1 year yield spread evolved over the same period.

I now estimate how the aggregate share of fixed-rate loans is correlated with three measures of debt market conditions, using a similar approach to Baker, Greenwood, and Wurgler (2003). Namely, I regress the fixed-rate loan share on the real interest rate, quarterly inflation rate, and the 10-1 year Treasury yield spread, as well as controls consisting of a time trend and the average log real loan size and log maturity of loans extended in the quarter. I also include a lagged dependent variable to capture any residual autocorrelation in the fixed-rate share. Results are presented in Table 8. The estimates in the table reflect the long-run effect of changes in the right-hand-side variables on the fixed-rate share (this differs from the short-run coefficients resulting from the presence of a lagged dependent variable).

[INSERT TABLE 8 NEAR HERE]

Baker, Greenwood, and Wurgler (2003) find the share of long-term debt relative to short-term debt is lower when inflation, the real interest rate, or the slope of the yield curve is high. Table 8 demonstrates that these variables also in general predict a lower share of fixed-rate loans, consistent with Baker, Greenwood and Wurgler's findings.

Results in Column 1 are based on the proportion of fixed-rate loans. Column 2 uses the value-weighted series. In Column 1, a 1 percentage point increase in the real interest rate is estimated to reduce the fixed-rate share by 4.8 percentage points, while a 1 percentage point increase in the 10-1 year interest rate spread reduces the fixed-rate share by 7.4 percentage points. Both estimates are significant at the 1% level. The inflation rate coefficient is close to zero and not statistically significant. The value-weighted series is noisier, probably because it can be easily skewed by a few very large loans in any given quarter. Reflecting this, the r^2 in Column 2 drops from 0.84 to 0.23, and the yield spread variable is smaller and now significant only at the 10% level. However, the inflation coefficient becomes negative and statistically significant at the 10%, consistent with its sign in Baker, Greenwood, and Wurgler (2003).

Columns 3 and 4 use the same specifications, except that the two time-series are constructed only from smaller loans (a cutoff of $250,000 in year 2000 dollars is used). The results are similar.[11] The results in these two columns suggest that debt-market timing is prevalent amongst small firms, which make up a disproportionate share of small loans studied in Columns 3 and 4.

5.2. Evidence from the SBF

As additional evidence specifically relating to small firms, I reestimate the four baseline SBF regressions from Table 3 after replacing the year dummies with the three debt market variables used above (i.e., the real federal funds rate, 10-1 year Treasury yield spread, and inflation rate). Although it is a cross-sectional survey, the SBF does contain a substantial time-series dimension, because I consider data from three survey vintages, in which loans in each survey are originated in a window between the survey date, normally six to twelve months after the end of the survey reference year, and three years prior to the end of the survey reference year. The SBF reports the year and month on which the loan was originated, so each loan is matched against debt market conditions at the time of origination.

Estimates for the three debt market variables are presented in Table 9 (other coefficient estimates are similar to Table 3). Similar to the STBL results, the table shows that SBF firms, which by definition are all small and medium-sized enterprises, match more often with fixed-rate debt when the yield curve is flat or real interest rates are low. The yield curve coefficient is significant at the 1% level in three of four specifications and at the 5% level in the other. The real federal funds rate coefficient is less precisely estimated but is significant at the 10% level in two of the four specifications. Finally, in unreported regressions, I interact the debt market conditions variables with

[11] As a sensitivity check of whether the results are driven by the large decline in the fixed rate share in the early part of the sample, I generate a dummy equal to one in the second half of the sample and reestimate all four specifications including the dummy as well as its interaction with the variables of interest (yield spread, inflation rate, and real interest rate). Out of 12 cases (three interaction terms x four regressions) the interaction term is significant at the 5% level twice, the inflation coefficient in Columns 1 and 3. In both cases the interaction term is negatively signed, suggesting in fact a stronger relationship in the second half of the sample.

firm size, to see whether market timing patterns are more or less pronounced amongst the smallest, potentially most credit constrained firms. These interaction terms are not statistically significant.

[INSERT TABLE 9 NEAR HERE]

5.3. Discussion

The two sets of estimates presented above provide a consistent picture, namely that firms are more likely to borrow at an adjustable interest rate when the yield curve is steep or the real federal funds rate is high. These results still apply even if we consider a sample of only small firms or small loans, or an alternative sample of loans originated only by commercial banks.

What is learned from these findings? First, previous results on debt market timing patterns are not simply an artifact of firms substituting between public and private debt over the business cycle. Market timing regularities are present even using STBL data that reflect only a single source of finance, term loans from commercial banks. This is significant, because the Baker, Greenwood, and Wurgler (2003) and Faulkender (2005) samples include a mix of different types of debt, and, as shown earlier, the source of finance is highly correlated with the debt contract's final interest rate exposure.

Second, these results show that debt market timing patterns extend to small, privately held firms. This is to my knowledge a new result and is not obviously implied by previous research. For example, Baker, Greenwood, and Wurgler (2003) find that, within the Compustat universe, debt market timing patterns are most pronounced amongst the largest, most mature firms. The fact that these patterns extend to small firms sheds some light on the underlying economic explanations for market timing patterns. For example, Chernenko, Faulkender, and Milbourn (2006) argue that debt market timing is driven by firms' attempts to meet consensus earnings forecasts and by the compensation structure of the firm's management, especially the CFO. The results presented in this paper suggest this cannot be a complete explanation, since market timing patterns are also prevalent amongst small firms, in which owner and manager incentives are generally well aligned.

Baker, Greenwood, and Wurgler (2003) present a different interpretation of their results. They suggest firms are successfully timing the debt market by issuing short-term debt during periods when excess bond returns are high. Although it seems unlikely that the small firms in the SBF are financially sophisticated enough to successfully forecast future bond returns, it is perhaps possible that firms follow rules of thumb, such as borrowing short-term whenever short rates are significantly below long rates, that historically have been associated with systematic excess returns.

To summarize, understanding the sources of market timing behavior remains an active area of research. Although not the main focus of this paper, the results presented here suggest that any unified explanation of debt market timing patterns must be able to rationalize why such patterns are prevalent among both large, public companies as well as small closely held firms.

6. Cross-sectional evidence from the STBL

As a final robustness exercise, I use the STBL microdata to analyze cross-sectional patterns in fixed-versus-adjustable outcomes. An attractive feature of the STBL is that it identifies the commercial bank that provided each loan, enabling the use of controls for bank characteristics or bank fixed effects. Hence, I am able to check whether previous results are robust to the inclusion of these additional lender controls, which are not available in the SBF. Because the STBL does not report any of the proxies for firm credit constraints used earlier (size, age, bank relationships, etc.), I focus on the coefficient on loan size, viewing loan size as a proxy for firm assets. In the SBF, the correlation between loan size and firm assets is $\rho=0.75$, suggesting the proxy is good.

The regression sample period is Q1:1997 to Q3:2004. (STBL data on loan risk ratings begin only in 1997.) The total sample size is 40,658. Forty-five percent of these loans are fixed-rate, and about 80% are collateralized. The average loan size is $764,000, larger than the weighted SBF sample, which draws only from small firms. Average loan maturity is four years. The data include banks' internal risk rating of the loan, which are classified on a 1-5 scale (1 is the safest, 5 refers to a workout loan). Seventy-seven per cent of sample loans are assigned a risk rating, and 94% of rated loans are assigned a middle rating of 2, 3, or 4. Analogous to the SBF regressions, I estimate the linear probability model

$$P(\text{fixed}) = \Phi(a_0 + a_1 \,.\, \log(\text{loan size}) + a_2 \,.\, \text{loan controls} + a_3 \,.\, \text{loan risk rating} + \\ + a_4 \text{ bank controls} + a_5 \,.\, \text{time-series controls} + e)\,. \qquad (3)$$

Loan controls includes log(loan maturity) and a dummy for whether the loan is collateralized. Loan risk rating includes dummies for each value of the rating, a dummy for whether the bank branch uses risk ratings, and a dummy equal to one if the branch uses ratings for some loans but not the loan in question. Column 1 includes bank fixed effects (533 institutions in total). In Column 2 these fixed effects are replaced by two bank characteristics: bank size (the log of bank assets) and liquidity (liquid assets / total assets, where liquid assets is the sum of cash and Treasury securities as in Kashyap and Stein, 2000). Standard errors in both columns are clustered by bank.

Results are presented in Table 10. Column 1 includes bank fixed effects. In Column 2, these fixed effects are replaced with two bank characteristics drawn from bank Call Reports data: log(bank assets) and (liquid assets / total assets).

[INSERT TABLE 10 NEAR HERE]

The first row of results shows that small loans are significantly more likely to involve a fixed interest rate. The coefficient on log(loansize) is -0.034 and -0.055 in Columns 1 and 2, respectively, significant at the 1% level. Interpreting loan size as a proxy for firm size, this result therefore is consistent with previous findings from the SBF that small firms match with fixed-rate debt. Because I obtain this result even after controlling for bank fixed effects (i.e., comparing loans of different sizes all originated by the same bank), this suggests the earlier result is not somehow an artifact of failing to control adequately for lender characteristics. Estimated coefficients are somewhat smaller than the log assets coefficient from the SBF regressions in Table 3. This likely in part reflects attenuation bias, given that loan size is a noisy proxy for firm size.

Results for two measures of loan default risk, collateral and loan risk rating, are somewhat inconsistent. On one hand, collateralized loans are found to be more likely to involve a fixed interest rate. Berger and Udell (1990) show that loan collateral is associated with high-default-risk borrowers as well as riskier loans, so this positive coefficient is evidence that high-risk firms match with fixed-rate debt. However, the risk-rating estimates suggest if anything an opposite result. In both columns, the middle three risk rating categories are not distinguishable statistically, because the coefficients on risk=2 and risk=4 are not significant. However, in Column 1 firms in the lowest risk bucket are found to be more likely to match with fixed-rate loans (significant at the 5% level), while loans in the workout loan risk bucket are less likely to be fixed-rate (significant at the 10% level).

It is difficult to clearly disentangle these findings given the lack of detailed firm controls. The risk-rating results apply only in the tails, which make up only a small percentage of loans (risk=5 loans are 3.8% of rated loans, and risk=1 loans, 2.2%). Also, STBL risk ratings reflect the rating of the loan itself, instead of an ex ante assessment of the firm's creditworthiness (English and Nelson, 1998). Thus, reverse causality may be a concern. If banks view adjustable-rate loans as risky, they will apply less favorable risk ratings to such loans, leading to a positive correlation between adjustable-rates and risk ex post, even if loans and firms are randomly assigned ex ante. Interpretations should also be tempered by the fact that STBL internal risk ratings are found to be nearly uncorrelated with ex post performance measures such as charge-offs or delinquency (Ashcraft and Morgan, 2003; English and Nelson, 1998).

Finally, the coefficient on bank size is negative and significant at the 1% level. Given the lack of firm controls, this likely reflects the fact that small banks disproportionately lend to small firms, which are also more likely to take out fixed rate debt. The liquid assets variable is not statistically significant.

To summarize, cross-sectional evidence from the STBL shows that small loans are significantly more likely to involve a fixed interest rate, even after controlling for bank fixed effects or bank characteristics. Because loan size and firm size are closely correlated, this provides further evidence that small firms match with fixed-rate debt.

7. Conclusions

This paper finds evidence that small, bank-dependent firms use loan contracts to systematically adjust their exposure to interest rate risk. Credit-constrained firms are more likely to match with fixed-rate debt, consistent with evidence on the credit channel of monetary policy that suggests such firms are most sensitive to rising interest rates. Fixed-rate debt is also less prevalent in sectors in which industry output moves procyclically with interest rates, consistent with the idea that firms in these industries have a partial natural hedge against rising short-term interest rates. Both these results match with a model of risk management motivated by credit constraints, such as Froot, Scharfstein, and Stein (1993).

Time series correlations previously identified in the debt market timing literature amongst large public companies are shown to also apply for bank loans extended to small firms. Namely, fixed-rate loans are most prevalent when the yield curve is flat or real interest rates are high. These findings suggest market timing patterns are not just the result of earnings management or managerial agency problems, because these concerns are likely much less important for small firms, in which the incentives of owners and managers, often the same person, are generally well aligned.

Finally, this paper finds evidence that suggests loan contracts reflect the interest rate risk exposures of lenders as well as borrowers. Savings banks and commercial banks, which are sensitive to rising interest rates because of their reliance on deposit finance, originate a significantly higher proportion of adjustable-rate loans, ameliorating their own ex ante exposure to interest rate risk.

This last finding has potentially interesting implications for the evolution of the credit channel of monetary policy. Monetary shocks affect firm balance sheets (the balance sheet channel) as well as the ability of banks to lend (the lending channel). Cecchetti (1995) notes in discussing these two channels that “with the introduction of interstate banking and the development of more sophisticated pools of loans, it is only the balance sheet effects that will remain." The results in this paper, however, suggest that interest rate exposure decisions of firms and lenders are connected. Thus, improved risk management by lenders could also weaken the balance sheet channel, as banks smooth risk once borne by firms or households. The recent proliferation of flexible and exotic household mortgages and business loans is perhaps evidence of this risk-sharing effect at work.

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Appendix

This Appendix presents estimates of the quantitative effect of fixed-versus-adjustable outcomes on the interest rate risk exposure of a typical small firm. This exposure is compared to the effect on risk exposure of interest rate derivatives hedging by large public firms.

Estimates of the magnitude of interest rate derivatives hedging are taken from Guay and Kothari (2003). These authors estimate how much cash would be generated by the derivatives portfolios of a representative sample of top one thousand US public companies following a 3.6 percentage point shock to short-term interest rates. Using the 1998 SBF, I then produce comparable estimates for the fixed-versus-adjustable decision. That is, I estimate the additional interest expense incurred by an average or median SBF firm on its most recent loan following this same 3.6 percentage point change in interest rates, assuming the firm selects an adjustable-rate rather than a fixed-rate loan. These two sensitivity estimates are compared side-by-side below. Column 1 is based on the average derivatives positions of Guay and Kothari's entire sample. Less than half of Guay and Kothari's firms report any use of interest rate derivatives, which is why the median sensitivities are equal to zero. Column 2 is based on just the subsample of 243 derivatives users.[12] Column 3 presents SBF estimates.

Sensitivity measure	Interest rate derivatives, sample of top one thousand public firms		Most recent loan, 1998 SBF
	All firms (1)	Users only (2)	(3)
Mean sensitivity of cash flows to shock, as fraction of			
Mean interest expense	< 0.039	< 0.069	0.205
Mean assets x10^{-2}	< 0.091	< 0.161	0.956
Mean cash flows from operations	< 0.009	< 0.016	0.029
Median sensitivity of cash flows to shock, as fraction of			
Median interest expense	0.0	< 0.046	0.235
Median assets x10^{-2}	0.0	< 0.112	0.876
Median cash flows from operations	0.0	< 0.013	0.030

As the table shows, the fixed-versus-adjustable margin has a significantly larger effect on the firm's cashflow sensitivity to interest rates. For example, the mean sensitivities are greater by a factor of between 2 and 8 compared with the subsample of derivatives users (Column 2), and between 3 and 11 compared with the whole sample (Column 1). Moreover, these calculations understate the true difference, for two reasons. One, we consider only the firm's most recent loan, not the entire stock of debt. Two, Guay and Kothari err on the side of overestimating the sensitivity of firm's cash flows to derivatives (their aim is to provide a conservative upper bound).

[12] 143 of the 243 derivatives users had positions in interest rate derivatives (35% of the total sample of 413 firms). Guay and Kothari do not provide any summary statistics for the subsample of 143 interest rate derivative users, which is why I focus on the 243 firms that used some kind of derivatives instrument.

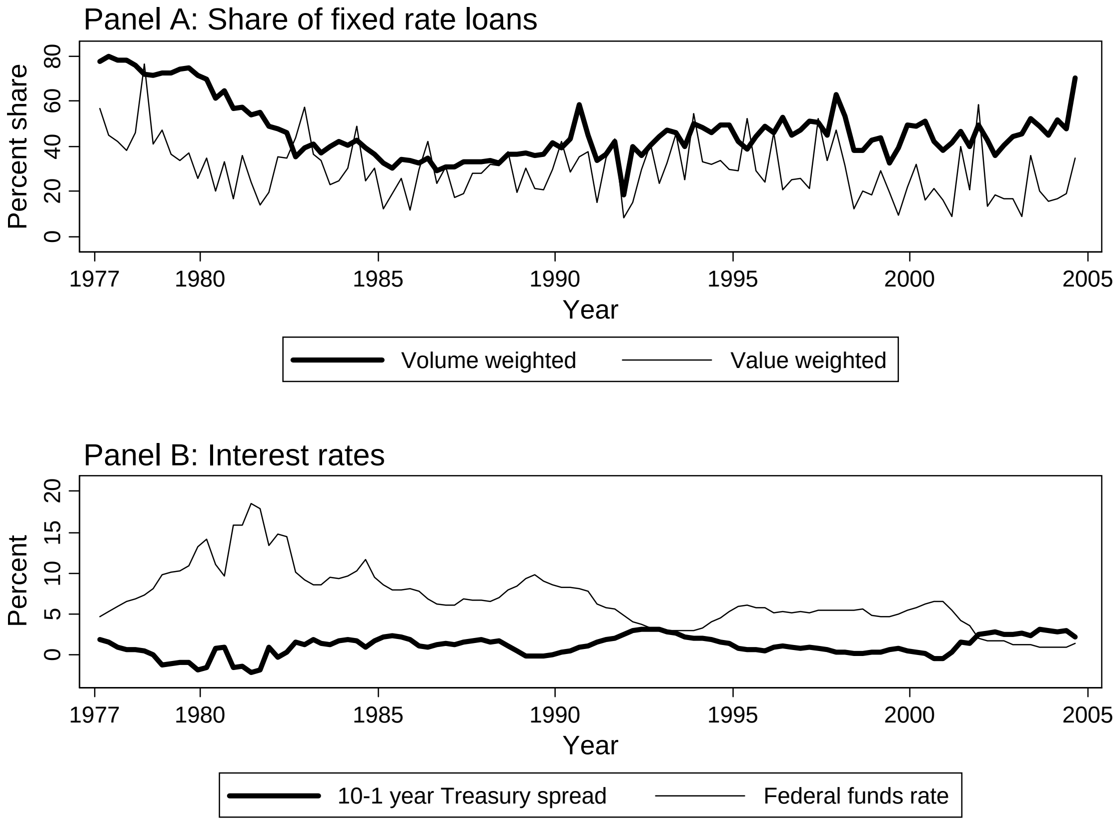

Fig. 1. Time series data on originations of fixed- and adjustable-rate loans. Panel A plots the time-series share of fixed-rate commercial loans between 1977 and 2004. The thick line is the number of fixed-rate loans as a proportion of all loans (fixed and adjustable). The thin line is the value of fixed-rate loans as a proportion of the value of all loans (fixed and adjustable). Data comes from the Survey of Terms of Business Lending, and is based on all non-commitment term loans with maturity of at least 12 months. Panel B plots the federal funds rate and 10-1 year Treasury yield spread (i.e., the difference between the 10 year and 1 year Treasury yield) over the same time period.

Table 1

Descriptive statistics for the Survey of Small Business Finance (SBF) sample. The first five columns present summary statistics for the regression sample of 3248 observations. The sixth column presents weighted summary statistics for all firms in the SBF, including those that have not taken out a recent loan and thus are omitted from the regression subsample. Weighted statistics are calculated using the SBF sampling weights. n/a means the statistic is not separately available for the full SBF sample, because it relates to the most recent loan.

Variable name	Firms in final sample					All SBF firms, weighted
	Individual surveys, unweighted			All years		
	1987	1993	1998	unweighted	weighted	
	(1)	(2)	(3)	(4)	(5)	(6)
Number of firms	1,215	1,335	698	3,248	3,248	11,422
Employment (mean, persons)	36.5	57.5	39.0	45.6	15.0	8.9
Firm age (mean, years)	13.5	17.6	14.8	15.5	13.6	13.7
Firm assets (thousands of dollars)						
Mean	1,732	3,728	2,473	2,712	939	477
Median	259	720	372	414	177	74
Standard deviation	4,151	10,874	6,514	8,057	3,699	2,570
Balance sheet						
Profits / assets	0.36	0.40	0.81	0.47	0.58	0.88
Book debt / book assets	0.59	0.65	0.86	0.67	0.67	0.60
Sales growth (annual)	0.22	0.11	0.25	0.18	0.18	0.16
Corporate form (percent)						
Sole proprietorship	29	18	25	23	33	44
Partnership	7	7	6	7	8	8
S-Corporation	17	29	34	25	22	19
C-Corporation	47	47	35	45	37	29
Characteristics of most recent loan						
Loan is fixed rate (percent)	56	41	68	52	59	n/a
Maturity of loan (years)	3.80	3.23	4.88	3.80	3.87	n/a
Loan is line of credit (percent)	31	60	29	43	38	n/a
Loan size (mean, thousands of dollars)	839	1,285	475	944	324	n/a
Most recent loan provided by a (percent)						
Commercial bank	74	84	71	77	75	n/a
Savings bank	5	3	4	4	5	n/a
Nonbank financial institution	16	11	21	15	16	n/a
Nonfinancial institution	5	2	4	4	4	n/a

Table 2

Summary statistics of the number of loans and percentage of fixed rate loans by loan type from the Survey of Small Business Finance regression sample. The table presents the number of loans of different types according to the source of the loan (bank or nonbank), and in total. The nonbank category includes nonbank intermediaries such as finance companies, credit unions, and so on, as well as lenders that are not financial institutions. The table also presents data on the unweighted proportion of each type of loan for which the loan interest rate is fixed, not adjustable.

Loan type	Number of observations			Percentage of loans with fixed rate		
	Bank	Nonbank	All	Bank	Nonbank	All
Line of credit	1,276	105	1,381	28	39	29
Capital lease	22	48	70	64	100	89
Business mortgage	301	37	338	48	65	49
Vehicle mortgage	367	219	586	84	96	88
Equipment loan	346	130	476	61	86	68
Other	330	67	397	57	70	59
All loans	2,642	606	3,248	46	80	52

Table 3

Determinants of whether a firm matches with a fixed-rate loan. The dependent variable equals one if the firm's most recent loan is a fixed-rate loan, and equals zero if it is an adjustable-rate loan. A weighted probit regression is estimated, using data from the 1987, 1993 and 1998 Survey of Small Business Finance. Coefficients are normalized to display marginal effects. Standard errors in parentheses are adjusted for heteroskedasticity. Amongst the additional controls, endogenous loan characteristics includes maturity and seven collateral dummies, other lender controls includes log(distance between lender and firm) and dummies for main type of lender-firm interaction (face to face, telephone or other), and other controls includes five dummies for the loan type (credit line, capital lease, business mortgage, vehicle mortgage, equipment loan or other), three region dummies, two-digit industry dummies, three organizational form dummies (C-corp, S-corp or unincorporated), a dummy for whether the local bank HHI > 1800, and a dummy indicating whether the firm has been recently solicited by financial institutions. Regressions also include dummies for each calendar year a loan is observed. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels respectively.

Explanatory variable	Dependent variable equals one if fixed-rate loan, zero otherwise			
	Full sample	Exclude credit lines	Full sample	Exclude credit lines
	(1)	(2)	(3)	(4)
Firm size and age				
Log(assets)	-0.065	-0.047	-0.092	-0.064
	(0.009)***	(0.010)***	(0.010)***	(0.011)***
Log(firm age + 1)	-0.051	-0.047	-0.052	-0.046
	(0.021)**	(0.021)**	(0.021)**	(0.020)**
Cash flows relative to investment opportunities				
Return on assets (profits / assets)	-0.024	-0.021	-0.015	-0.015
	(0.010)**	(0.009)**	(0.010)	(0.010)
Sales growth	0.057	0.021	0.042	0.011
	(0.030)*	(0.030)	(0.030)	(0.030)
Lending relationship variables				
Switch dummy	0.105	0.100	0.046	0.029
	(0.032)***	(0.029)***	(0.037)	(0.036)
Log(years with primary institution + 1)	0.020	-0.002	0.021	0.001
	(0.016)	(0.017)	(0.016)	(0.017)
Number of financial institutions	0.003	0.002	-0.005	-0.006
	(0.010)	(0.010)	(0.010)	(0.010)
Source of loan (baseline: lender is nonbank financial institution)				
Lender is bank			-0.137	-0.122
			(0.042)***	(0.037)***
Lender is not financial institution			-0.010	-0.104
			(0.096)	(0.097)
Debt				
Loan size / total assets			-0.168	-0.111
			(0.027)***	(0.029)***
Book debt / book assets	-0.076	-0.063	-0.029	-0.036
	(0.022)***	(0.023)***	(0.025)	(0.026)
Additional controls				
Endogenous loan characteristics	No	No	Yes	Yes
Other lender controls	No	No	Yes	Yes

Other controls	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Pseudo-r^2	0.25	0.20	0.28	0.25
Number of observations	3,248	1,867	3,248	1,867

Table 4

Interest rate sensitivity of debt fundings from banks and nonbanks. Coefficients in the table represent the change in probability that the debt contract involves a fixed interest rate if funds are provided by a bank rather than the comparison source of finance listed. The estimate in Column 2 is from Table 1 of Faulkender (2005). Because this is a table of summary statistics, no standard error is available. Estimates in Column 3 are from Table 2 of Vickery (2007). ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Feature of the dataset	Table 3 (1)	Faulkender (2005) (2)	Vickery (2007) (3)	
Type of debt contract	Loans to small and medium-size firms	Debt fundings by public firms	Residential mortgage originations	
Type of banks	Commercial banks and savings banks	Commercial banks	Commercial banks and savings banks	
Comparison source of finance	Loan is from nonbank financial institution	Funding is a corporate bond	Loan is from a finance company	
Change in probability of fixed-rate loan if source of loan is a bank	-0.137 (0.042)***	-0.828 (n/a)	-0.114 (0.037)*** -0.293 (0.020)***	(Commercial bank dummy) (Savings bank dummy)

Table 5
Industry interest rate sensitivity and the share of fixed-rate loans. The dependent variable equals one if the firm's most recent loan is a fixed-rate loan, and equals zero if it is an adjustable-rate loan. A weighted probit regression is estimated, using data from the 1987, 1993, and 1998 Survey of Small Business Finance. Coefficients are normalized to display marginal effects. Standard errors in parentheses are adjusted for heteroskedasticity. Covariates are the same as the corresponding columns of Table 3, except that Columns 1-4 replace the two-digit standard industry classification (SIC) dummies with a variable that measures industry interest rate sensitivity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Explanatory variable	Dependent variable equals one if fixed-rate loan, zero otherwise				
	Full sample	Exclude credit lines	Full sample	Exclude credit lines	Full sample
	(1)	(2)	(3)	(4)	(5)
Industry interest rate sensitivity (two-digit SIC)	-1.455 (0.623)**	-1.251 (0.548)**	-1.212 (0.665)*	-1.204 (0.573)**	
Log(assets) x industry sensitivity					0.036 (0.357)
Endogenous loan and lender controls	No	No	Yes	Yes	No
Two digit SIC industry dummies	No	No	No	No	Yes
Other covariates	As Column 1 of Table 3	As Column 2 of Table 3	As Column 3 of Table 3	As Column 4 of Table 3	As Column 1 of Table 3
Pseudo-r^2	0.22	0.16	0.26	0.21	0.25
Number of observations	3,248	1,867	3,248	1,867	3,248

Table 6
Sensitivity of results to inclusion of owner wealth controls. The dependent variable equals one if the firm's most recent loan is a fixed-rate loan, and equals zero if it is an adjustable-rate loan. Regressions are based on data from the 1998 Survey of Small Business Finance only. A weighted probit regression is estimated. Coefficients are normalized to display marginal effects. Standard errors in parentheses are adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Explanatory variable	Dependent variable equals one if fixed-rate loan, zero otherwise						
	Endogenous loan and lender controls excluded		Endogenous loan and lender controls included		Parsimonious model. Endogenous loan and lender controls excluded		
	No owner wealth	Owner wealth	No owner wealth	Owner wealth	No owner wealth	Owner wealth	Owner wealth
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Firm size and owner wealth							
Log(assets)	-0.033	-0.027	-0.049	-0.043	-0.040	-0.032	-0.030
	(0.013)**	(0.014)*	(0.015)***	(0.016)***	(0.011)***	(0.013)**	(0.013)**
Log(total owner wealth)		-0.019		-0.015		-0.027	-0.029
		(0.015)		(0.016)		(0.015)*	(0.016)*
Owner firm equity / total wealth							0.005
							(0.004)
Other controls	Same as Column 1 of Table 3		Same as Column 3 of Table 3		Log(firm age + 1) Book debt / book assets Dummies for loan type One-digit SIC dummies		
Pseudo-r^2	0.23	0.24	0.29	0.29	0.21	0.21	0.22
Number of observations	698	698	698	698	698	698	698

Table 7
Robustness checks for the Survey of Small Business Finance regressions. The table shows p-values from hypothesis tests on interaction terms added to the probit model from Column 1 of Table 3. These terms interact each measure of credit constraints in turn with various dummy variables as listed below. Contents of the cell are p-values from hypothesis test that the coefficients on the interaction term or terms are equal to zero. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Explanatory variable	Interact measure of credit constraints with				
	Proxies that lender has captured firm			Lender type dummies (lender is bank, lender is nonfinancial institution)	Loan type dummies (credit line, vehicle loan, etc.)
	Dummy, firm not recently solicited by financial institutions	Dummy for single lending relationship	Dummy for HHI>1,800		
p-value, F-test for interaction term on:					
Log(assets)	0.493	0.341	0.025**	0.589	0.151
Log(firm age + 1)	0.179	0.243	0.870	0.675	0.447
Return on assets	0.269	0.594	0.514	0.943	0.368
Sales growth	0.415	0.968	0.866	0.327	0.082*
Switch dummy	0.023**	0.871	0.054*	0.404	0.574
Log(years with primary institution + 1)	0.516	0.880	0.398	0.615	0.373
Number of financial institutions	0.859	0.297	0.111	0.819	0.897

Table 8

Time-series determinants of the share of fixed-rate loans. Regressions are based on quarterly time-series data on business loans from commercial banks drawn from the Survey of Terms of Business Lending. The sample period is 1977:Q1 to 2004:Q3. Results presented below are long-run coefficients from a linear regression that includes a lagged dependent variable [i.e., the regression is of the form $y_t = a.x_t + by_{t-1} + e_t$, and thus the long-run coefficient on x_t is a/(1-b)]. Standard errors on the long-run coefficients are calculated using the procedure outlined in Bewley (1979), and are also adjusted for heteroskedasticity. ***, **, and * represents significance at 1%, 5%, and 10% levels, respectively.

Explanatory variable	Dependent variable = fixed-rate loans / [fixed-rate loans + adjustable-rate loans]			
	Volume-weighted fixed-rate share	Value-weighted fixed-rate share	Volume-weighted fixed-rate share	Value-weighted fixed-rate share
	(1)	(2)	(3)	(4)
Debt market variables				
Real federal funds rate	-0.048	-0.023	-0.049	-0.052
	(0.005)***	(0.008)***	(0.005)***	(0.005)***
10-1 year interest rate spread	-0.074	-0.026	-0.044	-0.062
	(0.018)***	(0.014)*	(0.015)***	(0.014)***
Inflation rate	0.004	-0.018	0.012	-0.004
	(0.010)	(0.010)*	(0.010)	(0.010)
Controls				
log(real loan size)	-0.470	-0.001	-0.598	-0.768
	(0.184)**	(0.019)	(0.216)***	(0.186)***
log(maturity)	0.321	0.083	0.849	0.208
	(0.241)	(0.076)	(0.264)***	(0.158)
Time trend (measured in quarters)	0.002	-0.009	-0.009	-0.003
	(0.004)	(0.003)***	(0.003)***	(0.003)
Lagged dependent variable	0.589	0.056	0.537	0.525
	(0.087)***	(0.077)	(0.080)***	(0.071)***
Sample	All loans	All loans	Loans smaller than $250,000	Loans smaller than $250,000
Number of observations	110	110	110	110
r^2	0.838	0.211	0.841	0.836
Autocorrelation test (p-value)	0.980	0.337	0.944	0.867

Table 9
Time-series determinants of the share of fixed-rate loans, based on Survey of Small Business Finance (SBF) data. The empirical specifications are the same as the corresponding regressions in Table 3, except that the calendar year dummies have been replaced with the three debt market variables listed below. The dependent variable equals one if the firm's most recent loan is a fixed-rate loan, and equals zero if it is an adjustable-rate loan. A weighted probit regression is estimated. Coefficients are normalized to display marginal effects. Standard errors in parentheses are adjusted for heteroskedasticity. ***, **, and * represents significance at 1%, 5%, and 10% levels, respectively.

Explanatory variable	Dependent variable equals one if fixed-rate loan, zero otherwise			
	Full sample	Exclude credit lines	Full sample	Exclude credit lines
	(1)	(2)	(3)	(4)
Real federal funds rate	-0.023	-0.016	-0.022	-0.014
	(0.012)**	(0.012)	(0.012)*	(0.014)
10-1 year yield spread	-0.049	-0.061	-0.046	-0.059
	(0.018)***	(0.019)***	(0.019)**	(0.019)***
Inflation rate	-0.011	0.017	-0.007	0.020
	(0.016)	(0.016)	(0.017)	(0.017)
Endogenous loan and lender controls	No	No	Yes	Yes
Other covariates	As Column 1 of Table 3	As Column 2 of Table 3	As Column 3 of Table 3	As Column 4 of Table 3
Pseudo-r^2	0.24	0.18	0.27	0.22
Number of observations	3,248	1,867	3,248	1,867

Table 10
Determinants of whether the loan involves a fixed interest rate, based on panel data from the Survey of Terms of Business Lending (STBL). The dependent variable equals one if the firm's most recent loan is a fixed-rate loan, and equals zero if it is an adjustable-rate loan. A linear probability model is estimated using least squares. Standard errors in parentheses are adjusted for heteroskedasticity, and clustered by bank. Bank fixed effects are also included in column 1. The sample period is from 1997:Q1 to 2004:Q3. Both regressions also include time dummy variables for each calendar quarter during the sample period, absorbing all time-series variation in the fixed-rate share.

Explanatory variable	Dependent variable equals one if loan does not reprice before maturity, zero otherwise	
	Bank fixed effects (1)	Pooled regression (2)
Loan variables		
Log(1 + loan amount)	-0.034	-0.055
	(0.007)***	(0.012)***
Loan is collateralized (1=yes, 0=no)	0.060	0.102
	(0.023)**	(0.041)**
Maturity (in years)	0.047	0.049
	(0.021)**	(0.039)
Risk rating, omitted category is rating = 3 (average risk)		
=1 (lowest risk)	0.100	0.093
	(0.043)**	(0.065)
=2 (low risk)	0.007	-0.012
	(0.020)	(0.062)
=4 (high risk)	-0.011	-0.090
	(0.020)	(0.069)
=5 (highest risk)	-0.049	-0.110
	(0.026)*	(0.069)
Borrower not classified	0.058	0.144
	(0.044)	(0.052)***
Branch does not use risk ratings	0.078	-0.010
	(0.042)*	(0.091)
Bank variables		
log(1+bank assets)		-0.037
		(0.014)***
Liquid assets / total bank assets		0.343
		(0.328)
Bank fixed effects	Yes	No
Number of of observations	40,658	40,657
r^2 : Within	0.031	
r^2 : Between	0.125	
r^2 : Overall	0.096	0.156