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The institutional memory hypothesis and the procyclicality of bank lending behavior

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Abstract

We test a new hypothesis that may help explain the procyclicality of bank lending. The institutional memory hypothesis is driven by deterioration in the ability of loan officers over the bank's lending cycle that results in an easing of credit standards. We test this hypothesis using data from individual US banks over 1980–2000: over 200,000 bank-level observations on commercial loan growth, over 2,000,000 loan-level observations on interest rate premiums, and over 2000 bank-level observations on credit standards and loan spreads from bank management survey responses. The empirical analysis supports the hypothesis, although there are differences by bank size class.

JEL classification: G21; G28; E32; E44

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1. Introduction

The linkage between the financial system and the business cycle has been the subject of much investigation. Arguments that the financial system is procyclical are quite consis-

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tent with economic events, such as the credit crunch in the US during the early 1990s, the Russian and Asian financial crises in the late 1990s, and the large corporate bankruptcies of the early 2000s. Many theories focus on explaining two stylized facts of procyclicality widely observed by central bankers, regulators, practitioners, and researchers. One stylized fact is that lending often increases significantly during business cycle expansions, and then falls considerably during subsequent downturns, sometimes dramatically enough to be labeled a "credit crunch." These changes in lending are generally more than proportional to the changes in economic activity, suggesting that they are changes in bank loan supply that tend to accentuate the business cycle.

A second stylized fact is that observed measures of bank loan performance problems appear to follow a distinct pattern over the business cycle. Past due, nonaccrual, provisions, and charge-offs are generally very low during most of the expansion, start to appear at the end of the expansion, then rise dramatically during the downturn. This suggests that banks may take significantly more risks during the expansion, but these risks are revealed only later because it takes time for loan performance problems to appear.

Consistent with these stylized facts, Federal Reserve Chairman Alan Greenspan noted that regulators agree that "the worst loans are made at the top of the business cycle" (Chicago Bank Structure Conference, May 10, 2001). Practitioners often echo this sentiment, "Human nature being what it is, lenders and borrowers frequently assume that strong growth will continue unabated. Loans made towards the end of an economic cycle are often underwritten based upon unrealistic assumptions concerning growth" (Furth, 2001). Greenspan also noted that at the bottom of the cycle, "the problem is not making bad loans . . . it is not making any loans, whether good or bad, to credit-worthy customers," consistent with the sometimes dramatic fall in lending during cyclical downturns. Timing patterns consistent with these stylized facts are also evident in other nations (e.g., Borio et al., 2001; Horvath, 2002; Borio and Lowe, 2002).

The specific causes behind these fluctuations in bank loan supply and performance are the subject of considerable debate. In this paper, we test a new hypothesis that may explain in part why bank lending follows this procyclical pattern. We hypothesize that an "institutional memory" problem may drive a pattern of business lending. Specifically, a deterioration in the ability of bank loan officers to recognize potential loan problems may lead to an easing of credit standards as time passes since the bank's last loan "bust," i.e., its last significant experience with problem loans. The deterioration in loan officer ability is partly due to a proportional increase in officers that have never experienced a loan bust, and partly due to the atrophying skills of experienced officers as time passes since their last problem-loans experience. As a result of this deterioration, officers may be less able to differentiate low-quality from high-quality borrowers as time passes since the bank's last bust. The deterioration would apply mostly to the accumulation and processing of soft nonquantitative information about borrowers (e.g., character and reliability), as opposed to hard quantitative information (e.g., financial ratios and credit scores).[1]

[1] See Rajan (1992) and Stein (2002) for theoretical models specific to the lending decision based on soft information.

A bank might accommodate this deterioration in loan officer skills by allowing an easing of credit standards until the next bust. When the next bust arrives, standards can be tightened as loan officers' memories are restored and they are better able to differentiate between high- and low-quality borrowers and between positive and negative net present value (NPV) loans. This strategy may be value-maximizing for the bank in the long run despite the extension of some negative NPV loans in the short run. This is because the alternative strategy of tightening standards when loan officer skills have deteriorated likely bears the cost of eliminating some positive NPV loans and destroying some positive NPV bank-borrower relationships. Although the institutional memory hypothesis is rooted in the bank's own loan performance problems rather than the aggregate business cycle, it may help explain the stylized facts about bank lending over the aggregate cycle because problem loans are highly correlated with the aggregate cycle.

The institutional memory problem may be exacerbated by agency problems within the bank that prevent management from knowing the extent to which individual loan officers are afflicted by skills atrophy. It may also be aggravated by agency problems between external stakeholders (e.g., outside equity holders, subordinated debt holders, government regulators) and management that prevent these stakeholders from knowing the extent to which the institutional memory problem affects individual banks. As discussed below, both types of these agency problems may worsen as time passes since the bank's last bust due to the lack of observed problem loans. Problem loans provide an important source of feedback to managers and external stakeholders to evaluate the performance of individual officers and banks, respectively. Because of this reduced flow of information, bank managers and external stakeholders may allow an easing of credit standards as time passes since the last bust, and wait until the next bust to tighten standards when they know more about the individual loan officers and banks.

The institutional memory problem may have a number of adverse consequences. First, the procyclical lending behavior it produces can exacerbate the business cycle and increase systemic risk. This may be especially serious for developing countries with relatively fragile and less well-regulated banking systems (Mero, 2002). Second, the procyclical lending behavior could significantly misallocate resources if a large number of negative net present value (NPV) loans are extended during an expansion and positive NPV loans are denied during a downturn. Third, the cyclicality of problem loans may make it difficult for external stakeholders to impose regulatory and market discipline because of the lagged nature of problem loans.

The institutional memory hypothesis implies that credit standards ease as time passes since a bank's last loan bust. Our main tests examine whether a bank increases its commercial lending as time passes since its last bust, controlling for other factors affecting the demand for and supply of its credit. This increase in the supply of bank credit is a necessary condition of the institutional memory hypothesis as an explanation of the stylized facts about bank lending over the aggregate business cycle. We also run secondary tests of whether banks reduce their loan interest rate premiums and whether their senior management reports easing their standards and loan spreads.

The models are estimated using data from individual US banks over the period 1980–2000—approximately two full business cycles. The dependent variables are taken from three different data sets—over 200,000 observations on commercial loan growth measured at the bank level from the Call Report, over 2,000,000 observations on interest rate premiums on individual loans from the Federal Reserve's Survey of Terms of Bank Lending (STBL), and over 2000 observations on credit standards and bank-level loan spreads from responses to the Federal Reserve's Senior Loan Officer Survey (SLOS). The key exogenous variable—the number of years since the bank's last loan bust—is measured as the time since the ratio of the allowance for loan and lease losses to total loans was at its maximum over an interval that includes the current year and the prior 10 years. The regressions include a number of control variables to account for other demand and supply factors, including individual bank and time fixed effects.

The remainder of our paper is organized as follows. In the next section, we explain the institutional memory hypothesis. In Section 3, we review the extant literature on procyclicality in lending and how it relates to the new hypothesis. In Section 4, we discuss the empirical methodology, variables, and data sets. We present our empirical results in Section 5, and offer some conclusions in Section 6.

2. The institutional memory hypothesis

The institutional memory hypothesis is based on deterioration in the ability of loan officers as time passes since the bank's last loan bust or significant experience with problem loans. Early in a bank's lending cycle (i.e., immediately after a loan bust) the lessons of the bank's last bust are still fresh in the memory of loan officers who have just witnessed the ex post realization of their prior loan decisions. These lessons include insights about the complex interaction of soft information about management, local market conditions, and the financial profile of the firm. They also include knowledge about the success of different contract structures in previous loans, the efficacy of different monitoring methods, and the best strategies for managing distressed credits to mitigate losses. The information from these lessons may be used at the loan origination stage, the renewal stage, or at the time of any renegotiation or covenant violation to help mitigate adverse selection and moral hazard problems. Thus, as the bank starts its rebound from its most recent significant experience with problem loans, loan officer skills are maximized as the lessons are fresh in the minds of those officers who survived the experience. The value of these lessons arises mostly with respect to soft information about borrower quality. Hard information, such as the calculation of financial ratios and credit scores, would likely be less affected by institutional memory.

As time passes after the bank's last loan bust, loan officer skills tend to deteriorate and it becomes more difficult to differentiate low-quality from high-quality borrowers. The officers may also do a worse job of structuring their loans, monitoring them after origination, and designing and implementing work-out strategies if and when these loans become distressed.

One factor that may drive this deterioration is a decrease in the fraction of experienced loan officers. New officers are hired and trained to replace experienced officers who leave the bank or are promoted to senior positions elsewhere in the institution. Additional new officers may be hired to service increased loan demand as time passes since the bank's last bust.[2] New officers generally have not had the "learning experience" of a loan bust. Although some of them may have the talent, perceptiveness, and initiative to overcome their lack of experience, others likely do not. Another factor that may drive the deterioration in skills is that some officers who have experienced a loan bust may suffer atrophy of their lending skills as they forget some of the lessons of the past. This may affect some experienced officers more than others.

When a bank's loan boom turns to a bust, its loan officers turn more of their attention to managing their distressed credits. This process of addressing problem loans helps restore institutional memory as new officers have their first "learning experience" and experienced officers "re-learn" how to differentiate low-quality from high-quality borrowers, how to structure and monitor, and how to work-out problem loans. Specifically, loan officers gain knowledge about which combinations of loan contract terms (e.g., business collateral, personal collateral, guarantees, covenants, maturity, etc.) and monitoring strategies (e.g., frequency of borrower contact, field exams, frequency and intensity of collateral reporting) used during the bank's boom minimized losses during its bust, and which did not.[3] That is, officers learn which combinations of contract terms were most and least effective in mitigating the adverse selection problem and which monitoring strategies were most and least effective in mitigating the moral hazard problem through early detection of deteriorating credits and fraud.

Our notion of institutional memory is consistent with a recent memory-based theory of bounded rationality (Mullainathan, 2002). In Mullainathan's model, hard information is retained perfectly as would information embedded in a credit score. Soft information in this model, however, is not retained perfectly as in our notion of soft information about lending. Similarly, the strength of memory fades with time. Our notion of institutional memory is also consistent with the concepts of "vividness" and "evocativeness" used in Mullainathan's model. Vividness refers to the effect of association with similar events. Thus, a loan officer's ability to remember successful strategies for dealing with current borrowers may be stronger when current circumstances are similar to the circumstances confronted in the past. As well, the ability to remember may be stronger when the events are more evocative, i.e., when the average information of the associated events is greater.

Under the institutional memory hypothesis, the bank accommodates the deterioration in loan officer skills by allowing an easing of credit standards as time passes since the last bust. Negative NPV loans may be granted to low-quality borrowers that are no longer differentiable from high-quality borrowers. As noted above, this may be value-maximizing because policies to reduce negative NPV loans would also reduce positive NPV loans to the high-quality borrowers that are not differentiable from the low-quality borrowers. As well, policies that reduce credit may destroy some bank-borrower relationships that are profitable over the long run. Therefore, it may be value maximizing to accommodate the easing of credit standards, and wait until the next bust to sort out the positive and negative NPV

[2] This is similar in some ways to a model of banking in which new entrants are at disadvantage in lending vis-à-vis existing banks because they have not yet acquired knowledge of local markets and borrowers (Bofondi and Gobbi, 2003).

[3] For many risky commercial loans, banks send their own "field examiners" to audit the books and records of the borrower rather than just relying on their customer's auditor (see Kerwin, 1994).

loans and relationships. At that time, institutional memory is restored, credit standards are tightened, and negative NPV loans are rejected.[4]

The institutional memory problem may be exacerbated by agency problems within the bank that also worsen as time passes since the bank's last bust due to the lack of observed problem loans. Although the institutional memory hypothesis may hold in the absence of agency problems,[5] agency problems may make it even more costly for managers and external stakeholders to impose polices that address the problem. Consider first the agency problem between loan officers and management. Management uses loan review as a key auditing system to assess the ability and effort of individual officers through costly monitoring of each officer's loan portfolio (Udell, 1989). While hard information in the loan files is relatively easy to monitor, it may be much more difficult to monitor soft information through loan review. To fully evaluate loan officer ability and effort in the presence of soft information, loan review relies heavily on drawing inferences about each officer from the ex post performance of that officer's loans. The process includes analyses of

(1) whether the ex ante structure of the loans helped reduce the occurrence of problem loans and mitigated losses when problems subsequently occurred,
(2) the frequency and severity of problem loans,
(3) whether problem loans were detected sufficiently early, and
(4) whether appropriate and timely intervention/renegotiation strategies were implemented.

In principle, loan review may also be used to identify which loan officers have succumbed to the institutional memory problem and suffered significant skills deterioration. For each individual officer with a memory problem, management could then decide the extent to which to accommodate the memory loss. However, the capacity of loan review to perform this function is likely to diminish as time passes since the bank's last bust because of the reduction in observed problem loans. As indicated, the ex post observation of problem loans is used to draw inferences about loan officer skills and effort. Thus, at the same time that loan officer skills are deteriorating, the agency problem between management and loan officers may worsen and potentially exacerbate the institutional memory problem.

Bank management could alternatively try to offset some of the decline in credit standards and reduce negative NPV lending by adjusting its loan policies and procedures in a more blunt fashion linked to hard information. For instance, management could reduce the amount of credit authority it delegates to its loan officers based on observable characteristics of the officers and loans. Similarly, management could impose incremental premiums on loan interest rates or more stringent collateral requirements on certain categories of

[4] The bank may further reduce the supply of credit during the bust as loan officer time is reallocated away from making new loans and toward dealing with problem loans.

[5] Consider the extreme case of a bank with a single loan officer that also manages and owns the institution. Cognizant of the deterioration in skills, the officer/manager/owner may maximize the value of the institution by easing standards and extending some negative NPV loans in the short run to avoid eliminating some positive NPV loans and destroying some positive NPV bank–borrower relationships, and then tighten standards in the next bust when the skills are restored.

loans to compensate for the unobserved low-quality credits that are likely to be included in these categories.

The impact of such blunt policy instruments is complicated by the fact that they may affect all loan officers, not just those that are contributing significantly to the institutional memory problem. Some of the credits that are reduced may be positive NPV projects or loans to valuable relationship customers, rather than negative NPV investments. Thus, it may be optimal for management to choose to accommodate the easing of credit standards as time passes since the last bust, rather than imposing these blunt instruments. Management may then wait until the next bust to tighten standards when it knows more about which individual loan officers suffered memory loss as well as which loans and relationships are positive and negative NPV.

The agency problems between management and external stakeholders may similarly worsen as time passes since the bank's last bust. Outside equity holders, subordinated debt holders, government regulators, and other external stakeholders generally have even less information about the bank's loan officers and portfolio than does bank management and may also need to observe loan performance problems to draw inferences about the bank and its management. However, these stakeholders face the same problem as bank management—too few observable problem loans on which to make inferences when time has passed since the bank's last bust. These external stakeholders may find that imposing discipline is more costly than accommodating an easing in credit standards because the costs in terms of the loss of positive NPV loans and relationships exceed the benefits of reducing negative NPV loans. As a result, these stakeholders may wait to take action until the next bust when they have more information.

The institutional memory hypothesis may apply more to either small or large banks because of different loan types and different governance structures. On the one hand, small banks tend to make proportionately more relationship loans to informationally opaque borrowers based on soft information. Large banks may be less inclined to make such loans because they are at organizational disadvantages at handling soft information that cannot be easily communicated to and verified by management (Berger and Udell, 2002; Stein, 2002). On the other hand, large banks usually have a greater separation of ownership and control and more layers of separation between management and loan officers than small banks, possibly increasing agency problems and exacerbating the institutional memory problem. In our empirical analysis, we distinguish where possible by bank size.

To the best of our knowledge, we are the first to articulate the institutional memory hypothesis laid out here—a deterioration in the ability of loan officers over a bank's lending cycle due to officer turnover and skills atrophy that may be exacerbated by worsening agency problems. However, there is some related literature on memory and cycles that focuses on the memory of management, rather than loan officers. One recent paper in the management literature is based on interviews of managers at three large Canadian banks. It finds that lessons from credit losses in certain sectors can be embedded as hard information in management policies and procedures and that adherence to these policies and procedures may decline over the lending cycle, although it does not directly analyze lending data over the cycle (Paul-Chowdhury, 1998).[6] The focus on hard information in management policies and procedures differs significantly from our focus on the deterioration of loan officer skills in processing soft information. Some related literature also suggests that senior management experience with a prior financial crisis may have helped the Australian banking system weather the 1930s depression (Butlin and Boyce, 1985; Fisher and Kent, 1999).[7]

3. The related literature on bank procyclicality

Much of the research on procyclicality has focused on credit crunches during business cycle downturns, particularly on the credit crunch in several nations in the early 1990s. A number of hypotheses for the decline in lending were tested and found to be consistent with the data to varying degrees. These include implementation of tougher capital standards—risk-based or leverage-based, explicit or implicit (e.g., Berger and Udell, 1994; Hancock et al., 1995); an increase in supervisory toughness, such as worse CAMELS ratings, higher classified assets, more formal actions for a given portfolio (e.g., Peek and Rosengren, 1995; Berger et al., 2001); bank retrenchment or reduced risk taking due to portfolio risks, losses, impaired capital, changed risk tolerance (e.g., Wagster, 1999; Furfine, 2001); or reduced loan demand (e.g., Bernanke and Lown, 1991).

One theory of procyclicality that focuses on the expansionary part of the business cycle is over-optimism, which may be consistent with recent research on behavioral finance and bounded rationality. During an expansion, banks may underestimate their risk exposure and ease their credit standards, which may increase the magnitude of losses in the next downturn.[8] Bank lending might be based on euphoric expectations associated with an investment boom driven by the business cycle (Minsky, 1977) or on "disaster myopia" where the subjective probability of a major shock decreases as time elapses since the last shock (Guttentag and Herring, 1984). The paucity of data available to bank managers across business cycles may also be a contributing factor, making it difficult for them to assess the systematic component of risk in their portfolios (e.g., Borio et al., 2001). Reduced supervisory toughness or lessened market discipline may also help explain an easing of credit standards during an expansion. Bank supervisors were found to reduce toughness during an expansion (Berger et al., 2001), and capital market participants were found to exercise

[6] Paul-Chowdhury (1998) is part of a larger management literature on learning and memory that analyzes how information may be acquired, stored, or lost, and may be used or misused by management (e.g., Walsh and Ungson, 1991).

[7] There is also evidence in the corporate finance literature that institutional memory may play a role in the nonfinancial sector. In particular, there is evidence that US companies with presidents that survived the Great Depression and continued to manage their companies were less likely to take on debt in the post-depression period (Graham and Narasimhan, 2003).

[8] Commercial real estate lending has been found to follow a "trend-chasing" pattern in which investment is at its highest when ex ante returns are at their lowest, consistent with over-optimism (Mei and Saunders, 1997). This behavior is also analogous to investors becoming over-optimistic about recent winners and over-pessimistic about recent losers (De Bondt and Thaler, 1985).

less discipline over subordinated debt issues during relatively good periods (Covitz et al., 2002).[9]

Bank managers might also ease credit standards simultaneously in a herding pattern during an expansion to mask emerging problems from outside owners, then tighten standards only when the condition of the borrowing sector has deteriorated considerably (e.g., Rajan, 1994). Herding may also occur because supervisory penalties may be perceived as lighter if banks are troubled simultaneously (Acharya, 2001) or because of contagion effects (Acharya and Yorulmazer, 2002).

Loan seasoning may help explain the second stylized fact—that observed loan performance problems are low during an expansion, then rise dramatically during the downturn. Observed performance problems generally materialize only with a lag after the loans are made. During an expansion, more new loans are issued, making the stock of loans relatively young and therefore less likely to have observed performance problems, and vice versa during downturns (e.g., Avery and Gordy, 1995).

Loan commitments might also induce procyclicality. If there is quantity credit rationing in the spot credit market during downturns, some firms may purchase loan commitments as insurance against such future rationing. For reasons of reputation, banks may lend excessively under commitments during booms (by not invoking the material adverse change clauses enough). As a result, commitment borrowers get excessive credit during booms, while spot borrowers get the right amount of credit, so the aggregate quantity of lending is excessive. During downturns, commitment borrowers get the right amount of credit and some spot borrowers are rationed, so the aggregate quantity of lending is deficient (Thakor, in press).

Under conditions of adverse selection, lending procyclicality may also be driven by changes over the cycle in the distribution of information about loan applicants. Banks might ease their credit standards during an expansion as the fraction of new applicants that have not been rejected by other banks increases. During a contraction, banks may then tighten their standards as the proportion of new applicants that not have been rejected elsewhere decreases (Dell'Ariccia and Marquez, 2004).

The institutional memory hypothesis does not rule out any of these other theories of procyclicality and may be complementary to them. Abstracting from the details, two main empirical implications tend to distinguish the institutional memory hypothesis from the other theories:

(1) the institutional memory hypothesis is based on the bank's own cycle of experience with loan performance problems as opposed to the aggregate business cycle, and

[9] Some have raised concerns that new Basel capital regulations could introduce more procyclicality in lending. For the banks that adopt the internal ratings-based (IRB) approach, the capital charges on loans depend on their assessed probability of default, which may be correlated with the business cycle. Higher capital charges during a downturn may reduce the supply of credit more than it would otherwise decline. This concern over capital requirements and procyclicality is consistent with evidence that capital buffers under the current Basel capital regulations are negatively related to the business cycle (Ayuso et al., 2004). It is not clear whether the new Basel capital requirements will alter this relationship. Recent work has analyzed potential solutions to the procyclicality problem under Basel II (Gordy and Howells, 2004). These solutions include counter-cyclical indexing and similar proposals (e.g., Ervin and Wilde, 2001; Kashyap and Stein, 2003).

(2) the institutional memory hypothesis likely applies with greater force to loans that are based more on soft information than to those based primarily on hard information as opposed to applying with relatively equal force to both soft- and hard-information-intensive loans.

Our empirical analysis examines both of these predictions.

4. Empirical model, variables, and data sets

In this section, we first briefly outline the empirical model employed to test the institutional memory hypothesis. We then describe the variables and data sets employed in the tests.

4.1. Empirical model

The main testable prediction of the institutional memory hypothesis is that credit standards ease as time passes since the bank's last loan bust. The basic empirical model employed in the tests is given by:

$$\begin{aligned}&\text{Indicator of bank's credit standards}_{b,t}\\&\quad = f(\text{time since bank's last bust}_{b,t},\ \text{control variables}_{b,t-1}),\end{aligned} \tag{1}$$

where the dependent variable is an indicator of bank b's credit standards at time t, the key exogenous variable is the number of years since bank b's last bust, and the control variables account for other factors affecting the demand for and supply of bank b's credit. Equation (1) is a reduced form that takes both demand and supply factors into account, although we focus primarily on one supply factor—the time since the bank's last bust.

We test the institutional memory hypothesis using the bank's commercial loan growth as the main indicator of its credit standards. In our secondary tests, we also run Eq. (1) using the premiums over risk-free rates charged on its commercial loans, and its responses to the Senior Loan Officer Survey regarding its credit standards and spreads of its loan rates over its cost of funds. The key exogenous variable is measured as the number of years since the bank's loan portfolio was in its worst condition over an interval that includes the current year and the prior 10 years, i.e., the time since its worst condition over the interval $[t-10, t]$. The control variables are discussed below.

The model is estimated using data from individual US banks from 1980–2000—approximately two full business cycles (although the full period is not available for all tests). The data sets also include information back to 1970 to construct the "time since" exogenous variables, which are based on the last bust over the $[t-10, t]$ time interval. For an observation to be included in the data set, the bank must have a history of 10 consecutive prior years of performance to construct a sufficient "time since" history. For the discarded observations, it would be difficult to determine the time since their last bust and it is not clear how well the institutional memory hypothesis would apply (i.e., their loan officers have not had enough time to "forget").

We also run the model separately for several subsets of the data. We run the tests separately for the cycles of the 1980s (1980–1989) and 1990s (1990–2000) to examine how the results apply to these two cycles. There are reasons to believe that the 1990s are different—tougher capital standards, recovery from a significant credit crunch, technological change, etc. We also report the results for the 1986–2000 subsample because of a slight change in the definition of one of the variables (discussed below). Where possible, the tests are also run by bank size classes to investigate the extent to which the hypothesis applies to large versus small banks and by loan size class to determine the extent to which the hypothesis applies to loans to large versus small borrowers. We also run the regressions with only non-merging banks—i.e., deleting observations on banks that engaged in mergers over the $[t-10, t]$ time interval—to insure that our results are not due to mergers.

Descriptions and summary statistics for all of the variables employed in the analysis are shown in Table 1. Sample means are also shown for the three different data sets—the Call Report (CALL), Survey of Terms of Bank Lending (STBL), and Senior Loan Officer Survey (SLOS) data sets. Note that CALL and SLOS data are used in calculating some of the exogenous variables for all of the tests, but we divide up the tests and data sets by the dependent variables. All financial values are expressed in real 1994 dollars using the GDP deflator.

4.2. Dependent variables and their corresponding data sets

Our main indicators of credit standards are based on loan growth for each bank for each year taken from the CALL data set. We measure the annual proportional change in lending (i.e., $(L_{b,t} - L_{b,t-1})/L_{b,t-1}$) for commercial and industrial loans and commercial real estate loans, ΔLOANS-C&I and ΔLOANS-CRE. The loan officer skill atrophy from the institutional memory hypothesis may affect loan growth through both the screening of new customers and the monitoring of existing customers. The change in loan growth could occur through changes in the origination of new loans or the renewal of existing loans. The loan officer skills atrophy may also affect loan growth through covenant enforcement, renegotiation, or the calling or foreclosure of existing loans.

For both ΔLOANS-C&I and ΔLOANS-CRE, the loan growth is merger-adjusted, so that any change in lending due to the effects of adding two or more balance sheets together through mergers is removed. We also delete the top and bottom 1% of the observations of ΔLOANS-C&I and ΔLOANS-CRE. These extreme values—such as banks that increase their lending by several thousand percent in a single year or reduce lending to close to zero—likely reflect either data errors or idiosyncratic events that are unrelated to the institutional memory hypothesis or other hypotheses of procyclicality. As shown in Table 1, the sample mean annual growth rates for C&I and CRE loans (after trimming off the extreme values) are 6.52 and 11.00%, respectively. Although the institutional memory hypothesis may apply to any category of lending, the effects are likely to be strongest for these commercial loan categories, in which loan officer judgment is of primary importance. As discussed below, we also try robustness checks using other types of bank loans.

The loan growth data are annual, and are available for the full sample period from 1980–2000. The 21 years of data provide 203,243 bank-year observations that are employed in the loan growth regressions.[10] These regressions are run by OLS.

[10] The CALL frequency is quarterly, but we prefer to use the annual data because the December CALL is generally considered to be the most accurate and because it smooths out seasonal and other short-term fluctuations in lending.

Table 1
Variable definitions and summary statistics

Variables	Definitions	(1) CALL 1980–2000 ($n = 207{,}390$)	(2) STBL 1980–2000 ($n = 2{,}296{,}906$)	(3) SLOS 1990:Q3–2000:Q4 ($n = 2338$)
Dependent variables				
ΔLOANS-C&I	Annual proportional change in domestic C&I lending. Loan growth is merger adjusted, so that any change in lending due to the effects of adding two or more balance sheets is removed.	0.0652 (0.3354)		
ΔLOANS-CRE	Annual proportional change in domestic commercial real estate lending. Loan growth is merger adjusted, so that any change in lending due to the effects of adding two or more balance sheets together is removed.	0.1100 (0.3885)		
PREM	Bank premium over the Treasury rate of comparable duration. For fixed-rate loans, we use a Treasury security with duration equal to that of the loan. For floating-rate loans, we assume that the loans are expected to be repriced within 4 weeks and use the Treasury rate with duration equal to the minimum of the loans' durations and 4 weeks.		0.0389 (0.0180)	
STANDARDS	Quarterly trinomial variable based on the Senior Loan Officer Survey (SLOS): 1 indicates the bank reports that it eased its credit standards, 2 indicates the bank's credit standards remained basically unchanged, and 3 indicates the bank's credit standards tightened.			2.0453 (0.3865)
SPREADS	Quarterly trinomial variable based on the Senior Loan Officer Survey (SLOS): 1 indicates the bank reports that its spreads narrowed, 2 indicates the bank's spreads remained basically unchanged, and 3 indicates the bank's spreads widened.			1.9196 (0.6648)
Institutional memory and bank health variables				
ALLL	Allowance for loan and lease losses/total loans.	0.0147 (0.0106)	0.0182 (0.0109)	0.0223 (0.0128)
TIME-ALLL	Time since the bank's last bust as measured by years since ALLL was at its maximum over the prior 10 years. Definition changes slightly over time (see note in text).	4.9544 (3.6815)	4.9800 (3.6732)	4.5522 (3.0845)
ROE	Bank's return on equity.	0.0988 (0.2583)	0.1210 (0.2038)	0.1339 (0.1500)

(*continued on next page*)

Table 1 (*continued*)

Variables	Definitions	(1) CALL 1980–2000 ($n = 207{,}390$)	(2) STBL 1980–2000 ($n = 2{,}296{,}906$)	(3) SLOS 1990:Q3–2000:Q4 ($n = 2338$)
EQUITY/GTA	The bank's ratio of equity to gross total assets (GTA)	0.0888 (0.0287)	0.0672 (0.0205)	0.0703 (0.0166)
Bank size and market concentration variables				
LN(GTA)	Natural log of GTA (in thousands of real 1994 dollars).	11.0879 (1.2581)	16.0251 (1.6157)	16.6333 (1.1098)
HERFINDAHL	Weighted average of local market Herfindahl index.	0.2072 (0.1544)	0.1270 (0.0655)	0.1138 (0.0501)
Loan demand variables				
ST-GROW	Real state income growth.	0.0281 (0.0259)	0.0332 (0.0215)	0.0312 (0.0243)
GDP-GROW	Real GDP growth.	0.0292 (0.0202)	0.0314 (0.0182)	0.0339 (0.0188)
MOODY	Difference in yields between Moody's BAA and AAA rated long-term bonds (%).	1.1842 (0.4613)	1.0721 (0.4343)	0.7688 (0.1418)
RF3MO	Interest rate on three-month Treasury securities.	7.6299 (3.0346)	6.9841 (2.8016)	4.9385 (1.0767)
SLOS-Own Demand 1	Beginning in 1992, indicates that on average the bank faced weaker demand for C&I loans over the previous quarter (excluded from the regressions as the base case).			0.0971 (0.2961)
SLOS-Own Demand 2	Beginning in 1992, indicates that on average the bank faced basically unchanged demand for C&I loans over the previous quarter.			0.4530 (0.4979)
SLOS-Own Demand 3	Beginning in 1992, indicates that on average the bank faced stronger demand for C&I loans over the previous quarter.			0.1523 (0.3594)
SLOS-Missing Own Demand	Bank did not report demand conditions for the SLOS for the particular quarter.			0.2977 (0.4573)
SLOS-Aggregate Demand 1	Beginning in 1992, proportion of SLOS banks facing on average weaker demand for C&I loans over the previous year (excluded from the regressions as the base case).	0.0753 (0.1182)	0.1006 (0.1235)	0.1819 (0.1168)

(*continued on next page*)

Table 1 (*continued*)

Variables	Definitions	(1) CALL 1980–2000 ($n = 207{,}390$)	(2) STBL 1980–2000 ($n = 2{,}296{,}906$)	(3) SLOS 1990:Q3–2000:Q4 ($n = 2338$)
SLOS-Aggregate Demand 2	Beginning in 1992, proportion of SLOS banks facing on average basically unchanged demand C&I loans over the previous year.	0.1646 (0.2302)	0.2061 (0.2293)	0.3932 (0.1844)
SLOS-Aggregate Demand 3	Beginning in 1992, proportion of SLOS banks facing on average stronger demand for C&I loans over the previous year.	0.1159 (0.1810)	0.1673 (0.2022)	0.2889 (0.1808)
SLOS-Missing Agg. Demand	Dummy indicating the observation is prior to 1992, when the SLOS demand data became available.	0.6441 (0.4788)	0.5259 (0.4993)	0.1360 (0.3429)
Loan contract terms (STBL data set only)				
COLLATERAL	Proportion of bank loans that are collateralized.		0.6953 (0.4603)	
COMMITMENT	Proportion of bank loans for which the bank offered a commitment.		0.7395 (0.4389)	
DURATION	The weighted-average scheduled time until the principal and interest on the bank's average loan is repaid, discounted using the loan interest rate.		0.7345 (1.0954)	
FLOATING RATE	Proportion of bank loans with a floating rate of interest.		0.8185 (0.3854)	
TOTAL CREDIT SIZE	Natural log of the average size of bank loans (in thousands of real 1994 dollars), measured by the maximum value of the loan and the commitment level.		6.0560 (2.5111)	

The variables used in the loan growth regressions represent bank-year observations and appear in column (1). Summary statistics for ΔLOANS-C&I and ΔLOANS-CRE exclude observations in their respective 1st and 99th percentiles ($N = 203{,}243$), whereas sample statistics for all other variables in column (1) include all observations ($N = 207{,}390$). The variables used in the loan premium regressions represent individual loan observations and appear in column (2). The variables used in the loan standards and spread regressions are bank-quarter observations and appear in column (3). All financial variables are expressed in real 1994 dollars, using the GDP deflator.

The institutional memory hypothesis predicts a greater flow of new lending as time passes since the bank's last bust, after controlling for other demand and supply factors. As time passes and the human capital of the loan officers deteriorates and credit standards decline, the loan officers may approve loans that they otherwise would have rejected earlier in the cycle and may raise the credit limits on other borrowers that would have received limited credit because the loan officers are less able to assess loan quality.

The loan growth tests using ΔLOANS-C&I and ΔLOANS-CRE are relatively straightforward tests of the institutional memory hypothesis, as an increase in lending corresponds quite closely with the concept of an easing of lending standards. A significant increase in lending is also a necessary condition for the institutional memory hypothesis to help explain the stylized fact that bank lending tends to increase significantly during a business cycle expansion and fall significantly during a downturn. However, we acknowledge that the change in the stock of loans is an imprecise measure of the flow of new loans, because the change in the stock also varies with loan maturity, prepayments, defaults, etc.

As secondary tests, we also examine the effects of the time since the bank's last bust on other indicators of credit standards. First, we use the premiums over risk-free rates charged on its loans taken from the Federal Reserve's Survey of Terms of Bank Lending (STBL) as an indicator of credit standards. The STBL covers approximately 300 US banks per quarter (although the respondent set is not constant over time), obtaining contract terms on all of their new domestic C&I loans during one or more days of the first week of the second month of the quarter. The survey covers almost all of the largest banks in terms of C&I lending plus a stratified random sample of smaller banks.

For each loan, we measure the loan rate premium over the risk-free rate of comparable duration, i.e., the appropriate US Treasury rate. For loan i made by bank b at time t with duration d, we measure $\mathrm{PREM}_{i,b,t,d} \equiv r_{i,b,t,d} - r_{\mathrm{US},t,d}$ as our dependent variable. The data are for individual loans from 1980–2000. The 21 years of data provide 2,296,906 observations on individual loan contracts. As shown in Table 1, the average loan premium is 3.89%—i.e., the average loan has a rate of 389 basis points above the risk-free rate. The PREM regressions are run by OLS.

We test whether loan premiums decline as time passes since the bank's last bust, controlling for other factors affecting demand and supply. The institutional memory hypothesis predicts that loan officers become less able to recognize potential loan problems and to differentiate lower-quality borrowers from higher-quality borrowers later in the bank's cycle. As a result, the bank may charge low premiums for some relatively risky loans. For example, as credit standards ease, loan officers may put some unobservable "prime + 3" borrowers into the "prime + 2" risk pool, reducing PREM.

Despite this prediction of the hypothesis, PREM may not decline even if the institutional memory hypothesis is true. Bank management may keep rates from falling or even impose higher rates as time passes since the bank's last bust as one of the blunt instruments for addressing the institutional memory problem. As discussed in Section 2, management could impose higher rates based on observable characteristics of loans or loan officers to compensate for the likely inclusion of unobservable low-quality credits in high-quality risk pools.[11]

Thus, the PREM tests are not direct tests of the institutional memory hypothesis, but they may be informative about its effects. If we find evidence in our main tests in favor of the hypothesis—i.e., that ΔLOANS-C&I and ΔLOANS-CRE increase as time passes since the bank's last bust—then the PREM tests may offer evidence on the net effects of the loan officers pooling some lower-quality borrowers with higher-quality borrowers versus the use of blunt premium increases by management to address the institutional memory problem. If our main tests using ΔLOANS-C&I and ΔLOANS-CRE do not support the institutional memory hypothesis, then the PREM tests are not informative.

Our third set of indicators of credit standards are taken from responses to the Federal Reserve's Senior Loan Officer Opinion Survey on Bank Lending Practices (SLOS). The SLOS has asked a consistent set of questions about the credit standards of about 60 large commercial banks from around the US since 1990:Q3. These large banks account for over half of all domestic C&I lending (e.g., the 61 SLOS banks in 2000 made 54.22% of all domestic C&I lending).

The SLOS asks senior management whether over the prior three months the bank's credit standards on commercial and industrial (C&I) loans and credit lines (other than those used to finance mergers and acquisitions)

(1) tightened considerably,
(2) tightened somewhat,
(3) remained basically unchanged,
(4) eased somewhat, or
(5) eased considerably (although no bank reported considerable easing).

As shown in Table 1, we combine the two tightening categories and reverse the order to obtain a quarterly trinomial variable for each bank, $\text{STANDARDS}_{b,t}$, which equals 1 if bank b reports that it eased its credit standards in quarter t, 2 if standards remained basically unchanged, and 3 if standards were tightened.[12]

In addition, the SLOS asks about the spreads charged on these C&I loans and lines over the bank's cost of funds. We again combine the categories and obtain a quarterly trinomial variable for each bank, $\text{SPREADS}_{b,t}$, which equals 1 if bank b reports that it narrowed its spreads (eased its pricing standards) in quarter t, 2 if spreads remained basically unchanged, and 3 if spreads were widened (standards were tightened).

The STANDARDS and SPREADS variables are available quarterly from 1990:Q3–2000:Q4, and cover approximately one business cycle, rather than the approximately two cycles of the CALL and STBL data sets. The 42 quarters of data provide 2338 bank-quarter

[11] The effect of the institutional memory hypothesis in reducing PREM may also be moderated by banks imposing "sticky" loan pricing policies in which loan rates do not vary much with aggregate interest rates or credit conditions (e.g., Stiglitz and Weiss, 1981; Berger and Udell, 1992; Berlin and Mester, 1999).

[12] The credit standards are collected separately for credits to large and middle-market firms (annual sales of $50 million or more) and small firms (sales of less than $50 million). Since the responses are almost always the same (about 98% of the time), we simply use the responses for the credits to the former group.

observations, or an average of 55.67 banks per quarter. The SLOS sample also represents only large banks. Of these observations, 1602 (68.52%) have assets over \$10 billion, 734 (31.39%) have assets between \$1 billion and \$10 billion, and only 2 (0.09%) have assets between \$100 million and \$1 billion.

The sample mean of STANDARDS is 2.0453, with banks having reported easing credit standards slightly less often (5.30% of the time) than they reported tightening (9.84%), although the majority of the time (84.86%) the banks reported no change in standards. The sample mean of SPREADS is 1.9196, with banks having reported easing or narrowing spreads slightly more often (26.43% of the time) than they reported easing or widening the spreads (18.39%), with no basic change in spreads most of the time (55.18%).

The institutional memory hypothesis predicts that individual loan officers ease their credit standards as time passes since the bank's last bust, but provides no direct prediction about intentional easing or tightening by the senior management of the bank to whom the questions are addressed. It may nonetheless be informative to learn whether senior management acknowledges the changes in credit standards by its loan officers if the hypothesis is true. As discussed above, senior management may attempt to offset part of the easing of loan officer standards by imposing blunt policy instruments like higher premiums, tighter credit limits, or increased collateral requirements on observed classes of loans to compensate for the unobserved low-quality credits that may be included in these classes. This tightening could influence the responses to the STANDARDS and SPREADS questions. Again, we view our main test using ΔLOANS-C&I and ΔLOANS-CRE as determining whether the data are consistent with the institutional memory hypothesis. If we find evidence in our main tests in favor of the hypothesis, then the STANDARDS and SPREADS results may give extra information about the attitude of management and whether they likely impose the blunt instruments to help offset the effects of the hypothesis.

4.3. The key exogenous variable—time since the bank's last bust

Our key exogenous variable—time since the bank's last bust—is defined as the number of years since the bank's portfolio was in its worst condition over the interval $[t-10, t]$, and may take values between 0 and 10, inclusive. This interval is longer than the longest aggregate expansion in the data set, giving enough time for most banks to have had at least one "learning experience." Experiences that occurred more than 10 years prior are less likely to be relevant to the current set of loan officers.

As our main measure, we use TIME-ALLL$_{b,t}$, years since the ratio of the allowance for loan and lease losses to total loans (ALLL) was at its maximum over the $[t-10, t]$ time interval. For the CALL and STBL data sets, which cover the full 1980–2000 time interval, TIME-ALLL$_{b,t}$ has sample means of 4.9544 and 4.9800 years, respectively. For the SLOS sample, which only covers large banks over 1990:Q3–2000:Q4, the mean is 4.5522 years. There is also considerable dispersion in this variable. For example, in the CALL data set, 17.80% of observations take the value 0 (i.e., this year is worse than any of the prior 10 years), 17.04% take the value 10 (i.e., this year and the prior 9 years are all better than 10 years ago), and nontrivial proportions take each value between 0 and 10 years (not shown in tables).[13]

ALLL is arguably the best indicator of the status of problems in the loan portfolio. It measures problem loans at any given time and takes into account the severity of the problems. The point in time at which ALLL is at its maximum over the period is likely to give the best opportunity for a "learning experience" in which loan officers can connect ex post outcomes with their ex ante decisions. Importantly, ALLL is monitored by supervisors to be sure that banks have enough reserves to cover expected losses from their existing loans. Examiners check the loan portfolio and require that banks raise their ALLL when it is not sufficient.[14] ALLL is superior in our view to the use of charge-offs, which typically occur relatively late in the problem loan process after loan officers may have most of their "learning experience" dealing with the problems. In effect, charge-offs occur after it is determined that the problems are not likely to be resolved. As shown below, our main results are robust to the use of charge-offs in place of ALLL. Because of reporting changes on the CALL, we measure TIME-ALLL with a slightly different definition over the years 1980–1985, although robustness checks shown below using only observations from 1986–2000 suggest that this is not a determining factor in our findings.[15]

A potential shortcoming of ALLL is that it captures only one dimension of a lending relationship's ex post outcome—expected future loan losses. Other dimensions of a problematic ex post outcome include the loss in profitability from other components of the bank-borrower relationship (e.g., fees on derivative products, cash management services, and capital market products) and the increased costs of loan officer and senior management time and other expenses related to the management of deteriorating credits (e.g., conducting on-site field examinations of borrower books and records), etc. To address this potential shortcoming, we use TIME-ROE$_{b,t}$—years since the bank's return on equity was at its minimum over the $[t-10, t]$ interval—as an alternative measure in a robustness check. ROE captures the earnings losses from other components of the bank-borrower relationship and the increased costs of managing distressed credits, as well as the current

[13] An ancillary regression (not shown in tables) of TIME-ALLL on all of bank and time fixed effects used in main analysis yields a relatively low R^2 of 0.1990, suggesting considerable variance remaining in this variable after absorbing the bank and time effects.

[14] Banks are required to hold reserves equal to at least 1% to 2% for unclassified and special mention loans, 15% for substandard, 50% for doubtful, 100% for loss.

[15] The CALL variable RIAD3123, allowance for loan and lease losses, is available on a consistent basis from 1976 through 2000 (except that leases are excluded prior to 1984), so this definition is used in the numerator of the ALLL measures to compute TIME-ALLL for the years 1986–2000. This variable cannot be used for construction of TIME-ALLL for 1980–1985 because of the need for 10 prior years of consistent data to determine the bank's last bust over the $[t-10, t]$ time interval. For 1970–1975, the closest variable is RIAD3120, reserve for bad debt losses on loans, which includes the allowance for loan losses plus other items. We come as close as possible to a consistent series that matches RIAD3120 over 1976–1983 by summing RIAD3123 with RIAD2936 and RIAD2937 (the latter two items measure deferred income taxes which are included in RIAD3120 for 1970–1975). For 1984 and 1985, RIAD2936 and RIAD2937 are not available, so we use the 1983 values for the same bank. These data manipulations apply only to TIME-ALLL, which requires lagged variables prior to 1976, and do not affect the ALLL variable used in the regressions as a measure of bank health.

provisions to ALLL. A drawback of ROE is that it also includes earnings that are unrelated to the loan portfolio.

4.4. The control variables

The control variables include measures of bank health, bank size and market concentration, and loan demand. For some of the loan premium regressions, we also include controls for other loan contract terms. In all cases, we include fixed effects for the individual banks, which account for average differences across banks not captured by the other exogenous variables. The bank fixed effects reduce correlations across error terms as well.

We run the tests both with and without time fixed effects. As noted, time fixed effects make for quite stringent tests of the institutional memory hypothesis by in effect removing the part of the bank's lending cycle that is correlated with the aggregate business cycle. The time fixed effects also in effect control for the other hypotheses of procyclicality to the extent that these other hypotheses are driven by or correlated with the aggregate cycle or other overall economic conditions. The time fixed effects also reduce serial correlation in the error terms.

The $t-1$ subscript on the control variables in Eq. (1) denotes that these variables are measured as of the prior period to minimize any unintentional feedback from the endogenous variables, and to ensure that the credit standards being measured in the dependent variables did not occur prior to the exogenous control variables. One exception discussed below is that the loan contract terms that are sometimes included are for the same loan at the same time. Most of the control variables are taken from the CALL and matched to the dependent variables for the appropriate data set, although the STBL and SLOS also provide some controls.

The bank health variables include both $\text{ALLL}_{b,t-1}$ and $\text{ROE}_{b,t-1}$, the levels of allocations for loan and lease losses and return on equity, as well as $\text{EQUITY/GTA}_{b,t-1}$, the bank's ratio of equity to gross total assets (GTA). Bank health is included because prior research has demonstrated that banks in poor financial condition reduce credit supply due to pressure from regulators and supervisors and other external stakeholders, as well as internal pressure to rebuild capital and avoid financial distress.

For bank size, we include the log of gross total assets, $\text{LN(GTA)}_{b,t-1}$, because banks may compete in somewhat different loan markets with different conditions as they change in size. We also include the weighted average Herfindahl index of market concentration across all the markets in which the bank competes, $\text{HERFINDAHL}_{b,t-1}$, to account for potential differences in market power.

It is particularly important to control for loan demand, both in terms of loan applicants of a given risk class demanding more or less credit, and in terms of applicants becoming riskier or safer, since a riskier borrower will be granted less credit or pay a higher $\text{PREM}_{b,t-1}$ even if there is no change in loan supply. We include state and national income growth, $\text{ST-GROW}_{b,t-1}$ and $\text{GDP-GROW}_{b,t-1}$, as higher income growth is likely to be associated with improved investment opportunities and greater demand for credit for a given risk and with reduced risk. The spread between Moody's BAA and AAA long-term bonds, $\text{MOODY}_{b,t-1}$, is an indicator of aggregate risk. The three-month Treasury rate, $\text{RF3MO}_{b,t-1}$, affects the demand for credit in conventional terms, and also may affect borrower risk through moral hazard and adverse selection effects (e.g., Stiglitz and Weiss, 1981). When we include time fixed effects, we exclude the national demand variables GDP-GROW, MOODY, and RF3MO, since these are collinear with the time dummies. However, ST-GROW remains in the specification when we include time fixed effects because state economic conditions may differ from aggregate conditions.

For the SLOS data set, we also control for a measure of demand specific to the bank. Beginning in 1992:Q1, the SLOS asks whether the perceived demand for C&I loans over the prior three months was

(1) substantially stronger,
⋮
(5) substantially weaker.

We use the responses to form three control variables, SLOS-Own Demand $j_{b,t-1}$, where $j = 1, 2, 3$ correspond to weaker, unchanged, and stronger demand, respectively, over the prior quarter, with SLOS-Own Demand 1 excluded from the SLOS regressions as the base case. In some cases, the Own Demand variables are missing from the SLOS data set because the observation occurs during 1990:Q3–1991:Q4 (before the Own Demand series began) or because the bank answered about its STANDARDS and SPREADS but did not respond to the Own Demand question. We indicate these cases with the SLOS-Missing Own Demand dummy variable and set the other SLOS-Own Demand variables to zero.

For the CALL, STBL, and SLOS data sets we also form three control variables for aggregate loan demand changing from the prior year, SLOS-Aggregate Demand j_{t-1}, $j = 1, 2, 3$, in ascending order from weaker to stronger demand (again excluding the first variable for weak demand from the regressions as the base case). These variables represent the proportions of banks facing on average stronger, similar, or weaker demand over the four prior quarters, starting with the first quarter of the current year. These SLOS demand variables are set equal to zero for observations prior to 1992, when there was no information available on demand from the SLOS. To neutralize the average effect of these missing observations, we also include in all the regressions the SLOS-Missing Agg. Demand dummy, which equals 1 for all of the observations with no SLOS aggregate demand variables.[16] As above, when we include time fixed effects, we exclude all the SLOS aggregate demand variables as collinear with the time effects.

As additional control variables in the PREM regressions only, we include other loan contract terms for whether collateral is pledged, whether the loan is drawn under a commitment, the repayment duration of the loan, whether the rate is floating, and the total size of the credit (including the entire commitment, if any), COLLATERAL$_{i,b,t}$, COMMITMENT$_{i,b,t}$, DURATION$_{i,b,t}$, FLOATING RATE$_{i,b,t}$, and TOTAL CREDIT SIZE$_{i,b,t}$, respectively, for loan i issued by bank b at time t. These other terms help control for the risks, costs, borrower type, etc. However, to some extent, these terms are also

[16] Similar to the credit standards, the demand variables are collected separately for credits to large and middle-market firms and small firms, and we simply use the responses for the former group.

endogenous and may change with the credit standards of the bank, so we run the PREM regressions with and without these controls.

5. Empirical results

5.1. Loan growth test results

Table 2 displays the results of the main tests of the institutional memory hypothesis employing loan growth, ΔLOANS-C&I and ΔLOANS-CRE, to indicate bank credit standards using the CALL data set for the full sample from 1980–2000. The first two columns display the tests including both the bank and time fixed effects, and the last two columns show these tests with the bank fixed effects only. The control variables are identical except that the aggregate loan demand variables that do not vary in the cross section are excluded when the time fixed effects are included to avoid perfect collinearity.

The coefficients on the TIME-ALLL variable are positive and statistically significant at the 1% level in all four cases in Table 2, consistent with the implication of the institutional memory hypothesis that credit standards ease and more loans are issued as time passes since a bank's last bust. The coefficients in the ΔLOANS-C&I regressions of 0.0053 and 0.0058 are large in magnitude as well as statistically significant. For example, the coefficient of 0.0053 predicts that for an additional year since a bank's ALLL was at a maximum over the $[t-10, t]$ interval, its domestic C&I loan growth would be 0.53 percentage points higher. Thus, after 5 years of a sustained boom—approximately the sample average of TIME-ALLL—the expected annual loan growth would be 2.65 percentage points higher, which is substantial relative to the mean value for ΔLOANS-C&I of 6.52%. The coefficients in the ΔLOANS-CRE regressions of 0.0030 and 0.0024 are somewhat smaller, but still reasonably large and statistically significant. The smaller coefficients might reflect that commercial real estate loans may be more often based on hard information—such as loan-to-value ratios, utilization rates, and observed market values of apartment buildings, office buildings, retail stores, or other real estate that are similar to the commercial property used as collateral—than C&I loans, which may be more often based on soft information—such as the character and reliability of the business owners and managers that do not have sufficient real property to pledge as collateral. As discussed above, under the institutional memory hypothesis, the deterioration in loan officer ability would apply mostly to the accumulation and processing of soft nonquantitative information.

We argued above that ALLL is superior to charge-offs as an indicator of the status of the loan portfolio for use in our tests. Nonetheless, to check robustness, we replicate our main loan growth results in Table 3, substituting the ratio of charge-offs to total loans CHARGE-OFFS for ALLL and TIME-CHARGE-OFFS for TIME-ALLL. The results are qualitatively similar, although with slightly stronger findings for ΔLOANS-CRE.

As shown in Table 4, we rerun the main regressions for a number of different subsamples of the data. The table shows only the estimated coefficients and t-statistics for the key exogenous variable TIME-ALLL, but the same control variables are included. The test results are robust across all of the subsamples. As shown, the loan growth results are statistically significant and large in magnitude for the three time subsamples. The 1980–1989

Table 2
Loan growth tests, full sample, 1980–2000

Specification includes:	Bank and time fixed effects				Bank fixed effects only			
Dependent variable:	ΔLOANS-C&I		ΔLOANS-CRE		ΔLOANS-C&I		ΔLOANS-CRE	
Variable	Coefficient	*t*-stat.	Coefficient	*t*-stat.	Coefficient	*t*-stat.	Coefficient	*t*-stat.
Institutional memory and bank health								
TIME-ALLL	0.0053***	20.96	0.0030***	10.29	0.0058***	23.49	0.0024***	8.46
ALLL	−0.2893***	−2.75	−1.0521***	−8.71	−0.3785***	−3.64	−0.9008***	−7.54
ROE	0.0533***	15.99	0.0195***	5.11	0.0546***	16.37	0.0162***	4.26
EQUITY/GTA	0.7431***	15.69	0.4360***	8.05	0.7772***	16.55	0.5974***	11.10
Bank size and market concentration								
LN(GTA)	0.0296***	10.40	0.0432***	13.26	0.0284***	10.48	0.0622***	20.00
HERFINDAHL	0.0751***	4.12	0.0847***	4.02	0.1581***	9.04	0.0313	1.55
Loan demand variables								
ST-GROW	1.0036***	24.67	1.2623***	26.82	0.5194***	14.34	1.0234***	24.41
GDP-GROW					−0.2848***	−5.96	0.6374***	11.55
MOODY					0.0561***	18.86	0.1570***	45.78
RF3MO					−0.0006	−1.25	−0.0275***	−49.54
SLOS-Aggregate Demand 2					0.1604***	9.04	−0.0579***	−2.84
SLOS Aggregate Demand 3					0.2745***	22.24	−0.0568***	−4.01
SLOS-Missing Agg. Demand					0.1037***	8.92	−0.0114	−0.85
Adjusted R-squared	0.028		0.0300		0.0231		0.0225	
N	203,243		203,243		203,243		203,243	

OLS regressions for ΔLOANS-C&I, the annual proportional change in C&I lending from the previous year, and ΔLOANS-CRE, the annual proportional change in commercial real estate lending from the last year. Data are taken for 1980–2000. Variables represent bank-year observations. Number of observations is 203,243. Regressions include bank and time fixed effects as indicated (fixed effects not shown).

*** Significance at the 1% levels.

Table 3
Loan growth tests using charge-offs, full sample, 1980–2000

Specification includes:	Bank and time fixed effects				Bank fixed effects only			
Dependent variable:	ΔLOANS-C&I		ΔLOANS-CRE		ΔLOANS-C&I		ΔLOANS-CRE	
Variable	Coefficient	*t*-stat.	Coefficient	*t*-stat.	Coefficient	*t*-stat.	Coefficient	*t*-stat.
Institutional memory and bank health								
TIME-CHARGE-OFFS	0.0053***	16.49	0.0045***	12.15	0.0050***	15.79	0.0063***	17.27
CHARGE-OFFS	−3.5683***	−54.60	−2.0235***	−27.27	−3.6925***	−57.37	−1.6790***	−22.79
ROE	0.0353***	8.55	0.0187***	3.90	0.0409***	9.93	0.0153***	3.18
EQUITY/GTA	0.6508***	13.30	0.4193***	7.45	0.6712***	13.83	0.5607***	10.03
Bank size and market concentration								
LN(GTA)	0.0346***	11.92	0.0486***	14.51	0.0301***	10.86	0.0630***	19.68
HERFINDAHL	0.0319	1.63	0.0690***	3.06	0.0308	1.57	0.0627***	2.77
Loan demand variables								
ST-GROW	0.7725***	18.39	1.1319***	23.17	0.3231***	8.62	0.8872***	20.34
GDP-GROW					0.2341***	4.69	0.9773***	16.86
MOODY					0.0876***	28.50	0.1774***	49.76
RF3MO					0.0022***	4.79	−0.0255***	−47.17
SLOS-Aggregate Demand 2					0.1276***	6.98	−0.0864***	−4.09
SLOS Aggregate Demand 3					0.2526***	19.92	−0.0839***	−5.73
SLOS-Missing Agg. Demand					0.0851***	7.12	−0.0221	−1.60
Adjusted R-squared	0.0466		0.0352		0.0420		0.0277	
N	202,071		202,071		202,071		202,071	

OLS regressions for ΔLOANS-C&I, the annual proportional change in C&I lending from the previous year, and ΔLOANS-CRE, the annual proportional change in commercial real estate lending from the last year, using CHARGE-OFFS, the ratio of charge-offs to total loans, in place of ALLL and TIME-CHARGE-OFFS in place of TIME-ALLL. Data are taken for 1980–2000. Variables represent bank-year observations. Number of observations is 202,071. Regressions include bank and time fixed effects as indicated (fixed effects not shown).

*** Significance at the 1% level.

Table 4
Loan growth tests, various subsamples

Specification includes:	Bank and time fixed effects				Bank fixed effects only			
Dependent variable:	ΔLOANS-C&I		ΔLOANS-CRE		ΔLOANS-C&I		ΔLOANS-CRE	
	Coefficient	*t*-stat.	Coefficient	*t*-stat.	Coefficient	*t*-stat.	Coefficient	*t*-stat.
Time subsamples								
1980–1989 ($N = 111{,}216$)	0.0054***	14.76	0.0029***	6.44	0.0060***	16.99	0.0025***	5.73
1990–2000 ($N = 89{,}156$)	0.0039***	8.45	0.0045***	9.57	0.0037***	8.23	0.0046***	9.89
1986–2000 ($N = 134{,}278$)	0.0062***	18.54	0.0044***	11.49	0.0064***	19.29	0.0046***	12.27
Bank size subsamples								
Banks, GTA $\leqslant$ \$100M ($N = 141{,}529$)	0.0046***	14.10	0.0023***	6.04	0.0051***	15.84	0.0018***	4.92
Banks, \$100M < GTA $\leqslant$ \$1B ($N = 54{,}748$)	0.0059***	14.02	0.0046***	9.39	0.0065***	16.10	0.0038***	8.11
Banks, \$1B < GTA $\leqslant$ \$10B ($N = 5{,}914$)	0.0072***	7.00	0.0044***	3.25	0.0076***	7.73	0.0034***	2.65
Banks, \$10B < GTA ($N = 1052$)	0.0055***	2.90	0.0068**	2.16	0.0043**	2.39	0.0071**	2.42
Other subsamples								
Banks in the STBL ($N = 6339$)	0.0067***	6.33	0.0061***	4.39	0.0065***	6.37	0.0042***	3.17
Non-merging banks ($N = 181{,}222$)	0.0053***	19.17	0.0032***	10.05	0.0058***	21.49	0.0027***	8.63

This table reports coefficients and *t*-statistics for TIME-ALLL in OLS regressions for ΔLOANS-C&I, the annual proportional change in C&I lending from the previous year, and ΔLOANS-CRE, the annual proportional change in commercial real estate lending from the previous year. As in Table 1, the regressions control for bank health (ALLL, ROE, and EQUITY/GTA), bank size and concentration (LN(GTA) and HERFINDAHL), and loan demand (ST-GROW, GDP-GROW, MOODY, RF3M0, SLOS-Aggregate Demand 2, SLOS-Aggregate Demand 3, and SLOS-Missing Agg. Demand). The regressions also include bank and time fixed effects as indicated. Numbers of observations vary across regressions. Bank size subsamples are determined by GTA in real 1994 dollars. The non-merging banks subsample excludes banks that survived a merger during the previous ten years.

** Significance at the 5% level.

*** Idem., 1%.

and 1990–2000 subsamples roughly correspond to the two aggregate business cycles covered by our data set, and the 1986–2000 subperiod avoids the slight change in definition of TIME-ALLL due to reporting changes on the Call Report, as discussed above. These data suggest that the institutional memory hypothesis holds for both business cycles and that our test findings were not driven by the slight change in variable definition.

Table 4 also shows the test results when the model is rerun for each of four bank size classes separately, GTA $\leqslant$ \$100 million, \$100 million to \$1 billion, \$1 billion to \$10 billion, and > \$10 billion. As discussed above, the institutional memory hypothesis could apply with greater force to either small or large banks. As shown in Table 4, the test results are again robust—the coefficients of TIME-ALLL are statistically significant and large in magnitude for banks of all size classes for both C&I and commercial real estate loan growth.

We also try trimming the CALL data set down to only banks in the STBL data set. In addition, we try including only non-merging banks—banks that have not engaged in mergers over the entire $[t - 10, t]$ time interval. Neither of these sample selection issues appears to matter—the results are statistically significant and of substantial magnitude for these subsamples as well.

The loan growth results were also robust with respect to a number of other changes in specification not shown in the tables. As noted above, the institutional memory hypothesis may apply to any category of lending, so we also tried alternative dependent variables, replacing ΔLOANS-C&I and ΔLOANS-CRE with the growth of total loans, consumer loans, and other loans. Also noted above, we deleted the top and bottom 1% of the observations of our dependent variables, ΔLOANS-C&I and ΔLOANS-CRE. To ensure that the remaining extreme values did not drive the results, we also tried deleting the top and bottom 5% of these observations. As well, we tried using median regressions to reduce the importance of the extreme values. We also tried alternative specifications of the key exogenous variable, replacing TIME-ALLL with the time since ROE was at its minimum over the $[t - 10, t]$ interval and with the time since net loan loss provisions (the flow into ALLL) was at its maximum over the interval. We also tried several experiments with changing the amount of time since the last bust—replacing the 10 years with 5 or 8 years, or specifying a spline in which the first 5 years and second 5 years were allowed to have differential effects. In addition, we addressed the possibility that the value of knowledge learned during the last bust may not be sufficiently great if the last bust was not severe enough. To address this, we tried eliminating all observations when the allocation for loan and lease losses (ALLL) during the last bust was less than 1% of loans (about 10% of the observations). We also tried excluding the ST-GROW variable (real state income growth) to see if this proxy for demand conditions is driving the results. In all of these cases, the main results continued to hold and were statistically significant and large in magnitude.

For the most part, the control variables in the loan growth regressions shown in Table 2 have the expected signs and are statistically significant. As expected, healthier banks, larger banks, and banks in growing states tend to lend more, all else equal. Some of the aggregate demand variables have conflicting signs, but this may be due to putting in so many similar measures as well as including the bank fixed effects.

5.2. Loan rate premium test results

Table 5 shows the loan rate premium tests using the STBL data set for the full sample from 1980–2000. The regressions in the first two columns show the PREM tests including both the bank and time fixed effects, and the last two columns show the tests with the bank fixed effects only. The regressions are also run both with and without the other loan contract terms as control variables because of potential endogeneity.

The coefficients on TIME-ALLL are negative and statistically significant in three cases and positive and statistically significant in the fourth case, but none of these coefficients are economically different from zero. The coefficients of between -0.00005 and 0.00003 predict that for an additional year since the bank's ALLL were at a maximum over the $[t-10, t]$ interval, PREM would be between about 0.005 percentage points ($1/2$ of 1 basis point) lower and 0.003 percentage points ($1/3$ of 1 basis point) higher. Thus, after 5 years of a sustained boom the expected PREM would be between 0.025 percentage points (2.5 basis points) lower and 0.015 percentage points (1.5 basis points) higher, which is fairly small relative to the mean value for PREM of 3.89% (389 basis points).[17]

However, this finding of no substantial effect of the time since the bank's last bust on PREM does *not* hold for all sizes of banks. Table 6 shows the PREM regressions for various subsamples. For the two smallest size classes (banks with GTA $\leqslant$ \$1 billion), all eight coefficients on TIME-ALLL are statistically significant and negative, and most of the magnitudes are much larger than for the main results and for most of the other subsamples. For example, the coefficients of -0.00048 and -0.00050 for the smallest bank size class using the bank-fixed-effects-only specification predict that for each additional year since the bank's ALLL were at a maximum over $[t-10, t]$, PREM would be about 0.050 percentage points (5 basis points) lower. After 5 years of a sustained boom, the expected PREM would be about 0.250 percentage points (25 basis points) lower, which is substantial in magnitude. Again, the results in the PREM tests are robust to replacing TIME-ALLL with the times since ROE was at its minimum and net loan loss provisions were at their maximum over the $[t-10, t]$ interval.

In contrast, the finding of essentially a zero effect of the time since the bank's last bust on commercial loan prices holds for the large bank size classes (GTA $>$ \$1 billion). This finding also holds for the time subsamples, holds for different credit size classes of loans ($\leqslant$ \$100,000, \$100,000 to \$1 million, $>$ \$1 million), and holds for non-merging banks. Presumably, the findings for the full sample and the findings for these other subsamples are due to the fact that the banks in the large size classes dominate the data sets. As shown in Table 6, more than two million of the observed loan premiums are from banks with $>$ \$1 billion in GTA, and less than 200,000 are from banks with $\leqslant$ \$1 billion in GTA. Consistent with this presumption, when the time subsamples, credit size classes, and non-merging bank subsamples are rerun using data only for banks with GTA $\leqslant$ \$1 billion, the measured effects are negative and larger in magnitude than for the full sample (not shown).

[17] We also tried running these regressions using a cluster method to construct the standard errors to account for correlations of error terms for loans made by the same bank in the same quarter, and the results remained materially unchanged.

Table 5
Loan premium tests, full sample, 1980–2000

Specification includes:	Bank and time fixed effects				Bank fixed effects only			
	Contract terms		No contract terms		Contract terms		No contract terms	
Variable	Coefficient	t-stat.	Coefficient	t-stat.	Coefficient	t-stat.	Coefficient	t-stat.
Institutional memory and bank health								
TIME-ALLL	−0.00005***	−11.49	−0.00003***	−6.42	−0.00003***	−7.26	0.00003***	7.66
ALLL	0.0098***	6.55	0.0328***	20.05	0.0130***	8.97	0.0271***	17.01
ROE	−0.0002***	−3.95	−0.0004***	−6.34	−0.0001*	−1.69	−0.0002***	−2.70
EQUITY/GTA	0.0055***	5.35	0.0181***	16.19	−0.0048***	−5.02	−0.0054***	−5.19
Bank size and market concentration								
LN(GTA)	−0.0002***	−7.70	0.0006***	16.32	−0.0006***	−21.07	−0.0005***	−17.29
HERFINDAHL	−0.0099***	−22.47	−0.0031***	−6.34	−0.0052***	−12.85	0.0051***	11.47
Loan demand variables								
ST-GROW	−0.0328***	−42.17	−0.0333***	−39.16	−0.0306***	−44.58	−0.0285***	−37.72
GDP-GROW					−0.0479***	−59.33	−0.0648***	−73.16
MOODY					−0.0066***	−133.92	−0.0071***	−131.22
RF3MO					0.0017***	215.36	0.0019***	221.62
SLOS-Aggregate Demand 2					0.0089***	35.01	0.0100***	36.04
SLOS Aggregate Demand 3					0.0116***	66.14	0.0096***	49.88
SLOS-Missing Agg. Demand					0.0060***	34.90	0.0077***	40.88
Loan contract terms								
COLLATERAL	0.00375***	161.67			0.00368***	155.09		
COMMITMENT	0.00377***	117.02			0.00386***	117.09		
DURATION	−0.00342***	−353.81			−0.00349***	−353.58		
FLOATING RATE	0.00422***	141.42			0.00416***	137.27		
TOTAL SIZE	−0.00272***	−488.91			−0.00286***	−507.93		
Adjusted R-squared	0.2441		0.0931		0.2089		0.0443	
N	2,296,906		2,296,906		2,296,906		2,296,906	

OLS regressions for PREM, the premium over the Treasury rate of comparable duration. Data are taken for 1980–2000. Variables represent individual loan observations. Number of observations is 2,296,906. Regressions include Q2, Q3, and Q4, which indicate the quarter in which the loan was made, in addition to bank and time fixed effects as indicated (fixed effects not shown).

* Significance at the 10% level.

*** Idem., 1%.

Table 6
Loan premium tests, various subsamples

Specification includes:	Bank and time fixed effects				Bank fixed effects only			
	Contract terms		No contract terms		Contract terms		No contract terms	
	Coefficient	t-stat.	Coefficient	t-stat.	Coefficient	t-stat.	Coefficient	t-stat.
Time subsamples								
1980–1989 ($N = 984,680$)	−0.00001*	−1.84	0.00001*	1.81	−0.00017***	−24.94	−0.00012***	−16.92
1990–2000 ($N = 1,312,226$)	−0.00007***	−11.31	−0.00004***	−6.29	−0.00014***	−24.97	−0.00014***	−21.30
1986–2000 ($N = 1,753,558$)	−0.00007***	−15.96	−0.00006***	−13.26	−0.00009***	−21.36	−0.00011***	−21.81
Bank size subsamples								
Banks, GTA $\leqslant$ \$100M ($N = 23,836$)	−0.00024***	−4.99	−0.00026***	−4.98	−0.00048***	−9.62	−0.00050***	−9.46
Banks, \$100M $<$ GTA $\leqslant$ \$1B ($N = 175,611$)	−0.00014***	−7.94	−0.00013***	−7.12	−0.00026***	−15.85	−0.00024***	−13.87
Banks, \$1B $<$ GTA $\leqslant$ \$10B ($N = 1,015,788$)	−0.00005***	−7.36	−0.00001	−1.08	−0.00004***	−6.84	0.00003***	3.93
Banks, \$10B $<$ GTA ($N = 1,081,671$)	0.00001*	1.90	−0.00002**	−2.21	0.00007***	11.25	0.00011***	14.89
Credit size subsamples								
Total credit size $\leqslant$ \$100K ($N = 724,211$)	0.00002*	1.85	0.00003***	2.71	−0.00006***	−7.14	−0.00003***	−3.77
\$100K $<$ Total credit size $\leqslant$ \$1M ($N = 612,585$)	−0.00005***	−7.76	−0.00007***	−9.85	0.00008***	11.50	0.00004***	5.20
\$1M $<$ Total credit size ($N = 960,110$)	−0.00006***	−11.42	−0.00009***	−15.46	−0.00004***	−8.74	−0.00008***	−14.75
Other subsamples								
Non-merging banks ($N = 634,005$)	0.00000	−0.23	0.00005***	4.24	−0.00009***	−9.54	0.00000	0.01

This table reports coefficients and t-statistics for TIME-ALLL in OLS regressions for PREM, the premium over the Treasury rate of comparable duration. As in Table 5, the regressions control for bank health (ALLL, ROE, and EQUITY/GTA), bank size and concentration (LN(GTA) and HERFINDAHL), loan demand (ST-GROW, GDP-GROW, MOODY, RF3M0, SLOS-Aggregate Demand 2, SLOS-Aggregate Demand 3, and SLOS-Missing Agg. Demand), and the quarter in which the loan was made (Q2, Q3, and Q4), in addition to bank and time fixed effects as indicated. Results are shown including and excluding loan contract terms. Number of observations vary across regressions. Bank size and loan size subsamples are determined by GTA and TOTAL CREDIT SIZE, respectively, in real 1994 dollars. The non-merging bank subsample excludes banks that survived a merger during the previous ten years.

* Significance at the 10% level.
** Idem., 5%.
*** Idem., 1%.

As discussed above, the PREM tests are not direct tests of the institutional memory hypothesis, but they may nonetheless be informative. For small banks ($\leqslant$ \$1 billion in GTA), the finding that PREM declines as time passes since the bank's last bust, given the earlier results that loan growth also increased, is consistent with the institutional memory hypothesis. For large banks ($>$ \$1 billion in GTA), the finding of no effect could reflect that the institutional memory hypothesis has no effect on loan pricing or could reflect that the pricing effects of the hypothesis are offset by management imposing higher rates on observable risk classes to compensate for likely inclusion of low-quality credits.

5.3. SLOS STANDARDS and SPREADS test results

Table 7 shows the results of the STANDARDS and SPREADS tests using the SLOS data set, which primarily covers large banks during 1990–2000. These equations are run as ordered trinomial logit estimations—eased, basically unchanged, or tightened for STANDARDS and narrowed, basically unchanged, and widened for SPREADS. The arrangement of the data is such that a negative coefficient on TIME-ALLL indicates easing standards or narrowing spreads as time passes since the bank's last bust. The first two columns show the STANDARDS test results with and without the time fixed effects, and the last two columns show corresponding tests for the SPREADS variable.

None of the four coefficients on TIME-ALLL in Table 7 suggest that the management of the large institutions responding to the SLOS intentionally eased standards as time passed since the bank's last bust. Three of the four coefficients are not statistically significantly different from zero and the one that is statistically significant—SLOS SPREADS with bank fixed effects only—is positive, rather than negative. As discussed above, the institutional memory hypothesis is about the behavior of the individual loan officers, rather than the intentions of senior management. Given our finding above of a significant increase in commercial lending, the finding of no reported easing of standards or narrowing of spreads by senior management may imply that the changes in standards are not intentional on the part of senior management or that the management is actively trying to offset the easing of standards, perhaps using one or more of the blunt policies described above.

5.4. Loan growth test results using other types of loans

As discussed above, two main empirical implications tend to distinguish the institutional memory hypothesis from the other theories of procyclicality, although the institutional memory hypothesis does not rule out these other theories and may be complementary to them. First, the change in lending behavior under the institutional memory hypothesis is based on the bank's own cycle and experience, whereas the other theories of procyclicality are usually based primarily on the aggregate business cycle. As discussed above, our main findings for the effects of the time since the bank's last bust are robust to the inclusion of time fixed effects, so that our results do not appear to reflect the aggregate cycle or other factors that change systematically over time. These findings tend to support the institutional memory hypothesis as contributing to procyclical lending behavior independent of the other theories.

Table 7
Senior loan officer survey credit standards and spreads tests, 1990–2000

Dependent variable:	SLOS standards				SLOS spreads			
Specification includes:	Bank and time fixed effects		Bank fixed effects only		Bank and time fixed effects		Bank fixed effects only	
Variable	Coefficient	t-stat.	Coefficient	t-stat.	Coefficient	t-stat.	Coefficient	t-stat.
INTERCEPT1	−1.7942	−0.42	−14.0256***	−3.22	−2.2515	−0.74	−14.3818***	−4.56
INTERCEPT2	5.1225	1.20	−7.2762*	−1.67	1.3783	0.46	−10.8897***	−3.46
Institutional memory and bank health								
TIME-ALLL	−0.0369	−0.92	0.0249	0.65	0.0117	0.41	0.0905***	3.32
ALLL	−28.5907***	−2.80	−27.9593***	−2.76	4.7866	0.68	4.3013	0.62
ROE	−1.0534**	−2.18	−1.0785**	−2.24	−0.0181	−0.05	−0.0677	−0.17
EQUITY/GTA	−8.7794	−1.18	−0.3363	−0.05	−3.6970	−0.75	5.0979	1.07
Bank size and market concentration								
LN(GTA)	0.1374	0.55	0.7917***	3.72	0.1863	1.04	1.0407***	6.76
HERFINDAHL	1.5845	0.34	9.7400**	2.21	−12.4209	−3.61	−1.3305	−0.42
Loan demand variables								
ST-GROW	1.4454	0.22	−9.0446**	−2.32	6.2677	1.45	−1.4260	−0.58
GDP-GROW			−21.0482**	−2.26			−38.8949***	−6.21
MOODY			0.3287	0.24			2.3486**	2.56
RF3MO			0.7317***	6.30			0.3588***	4.42
SLOS-Own Demand 2	−0.0731	−0.30	−0.1625	−0.66	0.0090	0.05	−0.1226	−0.74
SLOS-Own Demand 3	−0.1835	−0.64	−0.3079	−1.08	−0.0740	−0.38	−0.2862	−1.49
SLOS-Missing Own Demand	−0.3119	−1.04	−0.5432*	−1.86	−0.2697	−1.38	−0.5289***	−2.76
SLOS-Aggregate Demand 2			−7.0091***	−3.29			−10.7427***	−7.44
SLOS Aggregate Demand 3			−7.1152***	−3.71			−7.0167***	−5.68
SLOS-Missing Agg. Demand			−4.9944***	−2.86			−7.1276***	−6.08
N	2338		2338		2338		2338	

Ordered logit regressions for STANDARDS, which equals 1 if the banks credit standards eased, 2 if the bank's credit standards remained basically unchanged, and 3 if the bank's credit standards tightened, and SPREADS, which equals 1 if the bank's lending terms eased, 2 if the bank's lending terms remained basically unchanged, and 3 if the bank's lending terms tightened. Data are taken for 1990:Q3–2000:Q4. Number of observations is 2,338. Regressions include Q2, Q3, and Q4, which indicate the quarter in which the loan was made, in addition to bank and time fixed effects (fixed effects not shown).

* Significance at the 10% level.
** Idem., 5%.
*** Idem., 1%.

The second main empirical implication that tends to distinguish our hypothesis from the other theories is that the effects of the institutional memory hypothesis on lending behavior likely apply with greater force to soft-information-intensive types of loans than to hard-information-intensive loan types. This is because loan officer skills in accumulating and processing soft information are likely to deteriorate more than those with hard information. In contrast, other theories seem to imply a more symmetric influence on soft- and hard-information-sensitive loans.

To investigate this further, Table 8 shows the results of replicating the main loan growth tests using the growth of credit card loans ΔLOANS-CCARDS and home mortgage loans ΔLOANS-HOMEMTG instead of ΔLOANS-C&I and ΔLOANS-CRE as the dependent variables. Credit card and home mortgage loans are generally based more on hard information, including consumer credit scores, and in the case of home mortgages, loan-to-value ratios and observed market values of similar homes. Note that even these types of loans may be based in part on soft information, particularly for small banks. Loan officers may use information from existing relationships with customers or knowledge of local economic conditions to encourage or discourage credit applications, to adjust the cutoffs for approval or credit limits based on credit scores or other hard information, or to apply manual overrides to preliminary decisions based on hard information. However, the use of this type of soft information in credit card and home mortgage lending may be less likely for the largest banks, so we also run the ΔLOANS-CCARDS and ΔLOANS-HOMEMTG regressions by bank size class in Table 9.

Before proceeding, note that we exclude observations from the ΔLOANS-CCARDS regressions when the bank reports that it has no credit card program or acts only as an agent for another bank. Although we lose more than half of the bank-year observations, this exclusion is important because the absence of loan growth for these observations (i.e., remaining at zero from year to year) primarily reflects business decisions unrelated to the institutional memory hypothesis or other theories of procyclicality. For both the ΔLOANS-CCARDS and ΔLOANS-HOMEMTG regressions, we also exclude observations of greater than 0.50 or less than −0.50 (i.e., more than 50% annual gain or loss), which likely reflect data errors or idiosyncrasies that are unrelated to the hypotheses of interest.[18,19]

The coefficients on the TIME-ALLL variable are all positive and statistically significant at the 1% level in Table 8. The coefficients in the ΔLOANS-CCARDS regressions of 0.0013 and 0.0014 are considerably smaller in magnitude than the coefficients on TIME-

[18] One idiosyncrasy of the credit card and home mortgage loan data is that they exclude the secondary-market sales of asset-backed securities in which the credit card receivables and home mortgage loans are the assets. Any purchases of asset-backed securities are reported elsewhere on the Call Report and not included in our variables. The exclusions of the secondary-market sales may remove from the growth rates some of the most hard-information-intensive of these credits.

[19] Recall that in our main tests, we delete the top and bottom 1% of the ΔLOANS-C&I and ΔLOANS-CRE observations. More stringent deletions are needed here because of a greater frequency of extreme values. Nonetheless, to be sure that the difference in deletion rules does not explain any difference in findings, we also reran the main tests of ΔLOANS-C&I and ΔLOANS-CRE excluding observations of greater than 0.50 or less than −0.50. The results (not shown) were robust to this change—the coefficients of TIME-ALLL remained statistically significant and reasonably close in magnitude to those reported in Table 2.

Table 8

Loan growth tests using credit card and mortgage loans, full sample, 1980–2000

Specification includes:	Bank and time fixed effects				Bank fixed effects only			
Dependent variable:	ΔLOANS-CCARDS		ΔLOANS-HOMEMTG		ΔLOANS-CCARDS		ΔLOANS-HOMEMTG	
Variable	Coefficient	*t*-stat.	Coefficient	*t*-stat.	Coefficient	*t*-stat.	Coefficient	*t*-stat.
Institutional memory and bank health								
TIME-ALLL	0.0013***	5.53	0.0030***	23.11	0.0014***	5.88	0.0025***	19.89
ALLL	−0.6111***	−5.22	−0.6920***	−12.38	−0.4793***	−4.10	−0.4166***	−7.48
ROE	0.0214***	5.37	0.0398***	17.83	0.0250***	6.24	0.0362***	16.10
EQUITY/GTA	0.0209	0.39	0.0126	0.51	0.0707	1.34	0.1575***	6.35
Bank size and market concentration								
LN(GTA)	0.0245***	9.27	0.0109***	7.40	0.0297***	12.12	0.0291***	20.54
HERFINDAHL	0.0042	0.20	0.0357***	3.68	0.0069	0.33	0.0369	3.76
Loan demand variables								
ST-GROW	0.3703***	9.22	0.6876***	32.76	0.1140***	3.21	0.4734***	25.08
GDP-GROW					0.2883***	6.13	0.1584***	6.35
MOODY					0.0402***	14.26	0.0472***	30.64
RF3MO					−0.0045***	−10.20	−0.0161***	−66.61
SLOS-Aggregate Demand 2					0.1909***	13.49	−0.0253***	−2.80
SLOS Aggregate Demand 3					0.0848***	8.48	−0.0246***	−3.91
SLOS-Missing Agg. Demand					0.1463***	15.58	0.0013	0.22
Adjusted R-squared	0.0282		0.0662		0.0137		0.0449	
N	73,876		189,860		73,876		189,860	

OLS regressions for ΔLOANS-CCARDS, the annual proportional change in lending on credit cards and related plans from the previous year, and ΔLOANS-HOMEMTG, the annual proportional change in home mortgage lending on 1–4 family residential properties from the last year. Data are taken for 1980–2000. Variables represent bank-year observations. Regressions include bank and time fixed effects as indicated (fixed effects not shown). The ΔLOANS-CCARDS regressions exclude observations in which the level is reported as "zero" or "none"—more than half of the observations. Banks are instructed to answer in this fashion if they have no credit card programs, or act only as agents for other banks and do not retain an interest in the receivables. The ΔLOANS-CCARDS and ΔLOANS-HOMEMTG regressions also exclude observations of greater than 0.50 or less than −0.50 (i.e., more than 50% annual gain or loss).

*** Significance at the 1% level.

Table 9
Loan growth tests using credit card and mortgage loans, bank size subsamples, 1980–2000

Specification includes:	Bank and time fixed effects				Bank fixed effects only			
Dependent variable:	ΔLOANS-CCARDS		ΔLOANS-HOMEMTG		ΔLOANS-CCARDS		ΔLOANS-HOMEMTG	
Bank size subsamples	Coefficient	t-stat.	Coefficient	t-stat.	Coefficient	t-stat.	Coefficient	t-stat.
Banks, GTA < \$100M ($N = 35{,}708$ for CCARDS; $N = 132{,}295$ for HOMEMTG)	0.0014***	3.67	0.0030***	18.70	0.0013***	3.57	0.0027***	16.78
Banks, \$100M < GTA < \$1B ($N = 32{,}690$ for CCARDS; $N = 51{,}153$ for HOMEMTG)	0.0015***	4.48	0.0025***	10.10	0.0017***	5.15	0.0020***	8.47
Banks, \$1B < GTA < \$10B ($N = 4661$ for CCARDS; $N = 5450$ for HOMEMTG)	0.0010	1.06	0.0014	1.55	0.0016*	1.76	0.0000	0.03
Banks, \$10B < GTA ($N = 817$ for CCARDS; $N = 962$ for HOMEMTG)	−0.0021	−0.79	0.0020	0.79	0.0008	0.34	0.0021	0.91

Coefficients and t-statistics for TIME-ALLL in OLS regressions for bank size class subsamples for ΔLOANS-CCARDS, the annual proportional change in lending on credit cards and related plans from the previous year, and ΔLOANS-HOMEMTG, the annual proportional change in home mortgage lending on 1–4 family residential properties from the last year. Data are taken for 1980–2000. Variables represent bank-year observations. Regressions include bank and time fixed effects as indicated (fixed effects not shown). The ΔLOANS-CCARDS regressions exclude observations in which the level is reported as "zero" or "none"—more than half of the observations. Banks are instructed to answer in this fashion if they have no credit card programs, or act only as agents for other banks and do not retain an interest in the receivables. The ΔLOANS-CCARDS and ΔLOANS-HOMEMTG regressions also exclude observations of greater than 0.50 or less than −0.50 (i.e., more than 50% annual gain or loss). As in Table 8, the regressions control for bank health (ALLL, ROE, and EQUITY/GTA), bank size and concentration (LN(GTA) and HERFINDAHL), and loan demand (ST-GROW, GDP-GROW, MOODY, RF3M0, SLOS-Aggregate Demand 2, SLOS-Aggregate Demand 3, and SLOS-Missing Agg. Demand). Numbers of observations vary across regressions. Bank size subsamples are determined by GTA in real 1994 dollars.

* Significance at the 10% level.
*** Idem., 1%.

ALLL in the corresponding ΔLOANS-C&I and ΔLOANS-CRE regressions shown in Table 2, consistent with expectations of a smaller effect of the institutional memory hypothesis when the loans are more hard-information-intensive. The coefficients on TIME-ALLL in the ΔLOANS-HOMEMTG regressions of 0.0030 and 0.0025 are smaller than those in the corresponding ΔLOANS-C&I regressions, but about equal to those in the ΔLOANS-CRE regressions in Table 2, yielding a more mixed picture.

As noted above, credit card and home mortgage loans may involve some soft information. This may be particularly the case for small banks, whereas it is unlikely that large banks incorporate much soft information in their credit card and home mortgage loans. To better distinguish these bank size-driven information effects we run these regressions by bank size class.

Table 9 shows the results of running ΔLOANS-CCARDS and ΔLOANS-HOMEMTG regressions by size class subsamples. The format is comparable to Table 4 that showed some regressions by bank size class and other subsamples. We show only the estimated coefficients and t-statistics for the key exogenous variable TIME-ALLL, but the control variables are included in the regressions. For the two smallest bank size classes (GTA $\leqslant$ \$1 billion), all eight coefficients on TIME-ALLL remain statistically significant at the 1% level and of comparable magnitude to the full-sample findings in Table 8. However, the results are virtually dissipated for the two large bank size classes. For banks with GTA $>$ \$1 billion, seven of the eight coefficients are statistically insignificant and eighth is significant only at the 10% level. The magnitudes are also generally smaller and in some cases fall to zero or negative levels. By comparison, there was very little dissipation of the effects by size class subsamples in the ΔLOANS-C&I and ΔLOANS-CRE regressions shown in Table 4 (some coefficients fell to the 5% significant level, but the coefficient magnitudes often increased with bank size). The findings in Table 9 are consistent with the expectation that the institutional memory hypothesis applies with less force to the types of loans that are based more on hard information, given that credit card and home mortgage loans made by large banks are among the most hard-information-intensive loans made by commercial banks.

6. Conclusions

We test a new hypothesis that may help explain why bank lending behavior follows a strong procyclical pattern. The institutional memory hypothesis is driven by deterioration in the skills of loan officers over their bank's lending cycle. The deterioration in loan officer skills results in an easing of credit standards and lending to low-quality borrowers that would otherwise be rejected, as officers become less able to recognize potential loan problems and less able to differentiate low-quality borrowers from high-quality borrowers. The institutional memory problem and its effects on credit standards may be exacerbated by agency problems between loan officers and management and between management and external stakeholders (capital market participants, government regulators) that also worsen as time passes since the bank's last bust due to the lack of observed problem loans, although the hypothesis may hold in the absence of these agency problems. It may be optimal for management and external stakeholders to accommodate the easing of credit standards because the imposition of blunt instruments to ration credit to low-quality borrowers with negative NPV loans may also ration some positive NPV new loans and destroy some positive NPV bank-borrower relationships. Thus, it may be value-maximizing over the long run to wait until the next bust when they can sort out the good officers from the bad officers, even though it involves the extension of some negative NPV loans in the short run.

The institutional memory hypothesis does not rule out other theories of procyclicality and may be complementary to them. Nonetheless, the hypothesis has two main empirical implications that tend to distinguish it from the other theories. First, the institutional memory hypothesis is based on the bank's own cycle of experience with loan performance problems as opposed to the aggregate business cycle. Second, the institutional memory hypothesis likely applies with greater force to soft-information-intensive loans than to those based primarily on hard information, in contrast to the relatively symmetric influence on soft- and hard-information-intensive loans predicted by the other theories. Our empirical analysis tests both of these predictions.

To test the institutional memory hypothesis we use data from individual US banks over the interval 1980–2000, drawing data from several different sources. The main testable prediction of the hypothesis is that credit standards ease as time passes since the bank's last bust. Our main tests are for whether a bank's commercial and industrial lending and commercial real estate lending increase as time passes since the bank's last loan bust, controlling for other demand and supply factors. We find that the coefficient on this variable is positive, statistically significant, and large in magnitude for the growth of both types of commercial loans, consistent with the institutional memory hypothesis.

Running the tests for various subsamples of the data show that the main findings hold for the business cycles of both the 1980s and the 1990s, and also hold for all size classes of banks, ranging from less than \$100 million in assets to over \$10 billion in assets. Over both decades, and for institutions of all sizes, banks are found to increase their commercial loan growth as time passes since their last bust, controlling for other demand and supply factors. The findings are robust as well with respect to the exclusion of banks engaging in mergers, to the specification of additional loan categories, and to alternative specifications of the key exogenous variable.

Our main findings are also robust to the inclusion of both bank fixed effects and time fixed effects. The time fixed effects make the tests quite stringent because these effects control for the aggregate business cycle and other factors that change systematically over time. The time fixed effects also control for the effects of other hypotheses of procyclicality to the extent that these other hypotheses are driven by, or are correlated with, the aggregate cycle or other systematic factors. Thus, the findings tend to support the institutional memory hypothesis as having explanatory power independent of the other theories of procyclicality.

The findings with regard to loan pricing, however, differ by size of bank. We find evidence that small banks (assets $\leqslant$ \$1 billion) reduce their loan interest rate premiums by a substantial magnitude as time passes since their last bust. Although this is not a direct test of the institutional memory hypothesis, it is nonetheless consistent with the hypothesis. The finding that premiums decline as loan growth increases for small banks is consistent with the implication of the hypothesis that the loan officers in these banks may be less able to recognize potential loan problems and place some low-quality borrowers in high-quality risk pools with lower premiums as time passes since their last bust.

Large banks, in contrast, exhibit essentially no change in loan premiums as time passes since their last bust. This finding could reflect that the institutional memory hypothesis does not significantly affect loan pricing for large banks or that the management of these banks may implement pricing policies to compensate for some of the pooling of unobserved low-quality credits with high-quality credits due to the institutional memory problem. Consistent with this interpretation, we also find that large banks that responded to the Federal Reserve's Senior Loan Officer Opinion Survey showed no evidence that the senior management of these institutions intentionally eased standards or narrowed loan spreads as time passed since the bank's last bust. The difference in loan pricing results between large and small banks may also be due to the different types of credit issued by these banks, to the different organizational structures of these banks, or to other factors.

Thus, the evidence suggests that the loan officers of banks of all size classes ease their credit standards over their bank's lending cycle in terms of increased commercial loan growth in accordance with the institutional memory hypothesis. However, the senior management of large institutions may recognize this dynamic and compensate to some degree by imposing higher rates or putting other restrictions on observed risk classes of loans.

To test the second main distinguishing empirical implication of the institutional memory hypothesis, we compare the effects on bank lending behavior by types of loans that tend to be based more on soft versus hard information. We find that our results are stronger for C&I loans than for commercial real estate, credit card, and home mortgage loans. This is consistent with the predictions of the hypothesis, given that C&I loans tend to be the most soft-information-intensive. Also consistent with the predictions, we find that the effects of the time since the bank's last bust are virtually dissipated for credit card and home mortgage loans extended by large banks. Arguably, these are among the most hard-information-intensive types of loans made by commercial banks.

Overall, our findings suggest that the institutional memory problem may significantly affect bank credit standards and their supply of commercial credit. These findings have several potential policy implications. They suggest the possibility that regulatory capital requirements and supervisory scrutiny might be made more countercyclical than they otherwise would be to compensate for the unobserved changes in problem loans driven by the loss of institutional memory, particularly in nations experiencing long expansions. Other theories of procyclicality that may operate concomitantly with the institutional memory hypothesis—over-optimism, loan seasoning, herding, commitments, adverse selection, and the credit crunch hypotheses—also emphasize the potential benefits from countercyclical regulatory and supervisory responses. Our findings suggest in addition that supervisors might act to counter an individual bank's lending cycle by becoming tougher when significant time has passed since the bank experienced its own last bout of performance problems.

Our findings may also suggest how bank managers and government supervisors might consider adjusting the way they monitor bank loan portfolios. For example, banks might groom junior officers by exposing them to more loan work-outs early in their careers than they otherwise would to improve their learning experiences. Another possibility is for banks to allocate more seasoned officers than they otherwise would to loans that have not shown problems for a sustained period to look for more subtle indicators of future difficulties. Similarly, supervisors might expose junior examiners to banks with problem loans more than they otherwise would and assign more seasoned examiners than they otherwise would to banks that have not shown problems for a sustained period.

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