The Credit Cycle and the Business Cycle: New Findings Using the Survey of Senior Loan Officers

Cara Lown and Donald P. Morgan[1]
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Abstract

VAR analysis on a measure of commercial lending standards collected by the Federal Reserve reveals that shocks to lending standards have a significant impact on both commercial loan volume and real output. Fluctuations in standards matter even when we add additional controls for credit quality and demand, suggesting that standards shocks can be identified with reductions in the supply of bank credit. Higher loan levels cause lending standards to tighten, suggesting a credit cycle with stop-and-go dynamics: positive loan shocks drive standards up, positive standards shocks drive loans down . . . ad infinitum. Fluctuations in standards matter far more (for loans and output) than do commercial loan rates, consistent with the role of informational frictions, quantity rationing, and credit availability effects in the transmission of economic shocks. Yet contrary to the hypothesis of a narrow bank lending channel, innovations in the federal funds rate ("monetary policy shocks") do *not* cause changes in credit standards; bankers simply adjust loan rates instead. Tightenings in credit standards, however, do cause easings in monetary policy. An examination of inventory behavior, the component of GDP most closely associated with bank business lending, indicates that lending standards are significant in structural inventory investment equations. The estimated impact of a moderate tightening of standards on inventory investment is of the same order of magnitude as the decline in inventory investment over the typical recession.

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I. Introduction

For most of the last 35 years, economists at the Federal Reserve have asked a sample of roughly 60 senior loan officers at major commercial banks around the U.S. the following question:

> Over the past three months, how have your bank's credit standards for approving loan applications for C&I loans or credit lines--excluding those to finance mergers and acquisitions--changed? 1) Tightened considerably 2) tightened somewhat 3) remained basically unchanged 4) eased somewhat 5) eased considerably.

Their responses over the various eras of the survey are pieced together in Chart 1; there is a break in the 1980s, when the Federal Reserve did not ask lenders about their standards. Note that all but one recession were preceded by a sharp spike in the net percent of loan officers reporting tightening standards and that the exception, in 1982, was preceded by a sharp shift upward, from easing toward tightening. Observe also that tighter standards are usually followed by slower commercial loan growth.

This paper investigates whether these gyrations in standards help predict-- and perhaps contribute to--the subsequent fluctuations in lending and output. Along the way, we investigate several long-standing macroeconomic questions. To what extent do commercial lenders allocate loans by changing non-price terms (like standards) as opposed to simply changing loan rates? Does the "availability" of credit affect economic activity and monetary policy, and vice-versa? These old fashioned questions are actually close cousins of modern research on the importance of financial frictions in the transmission of monetary and other disturbances throughout the economy. The same informational frictions that lead to a potential lending channel of monetary policy, or a broader financial accelerator, may also cause the credit rationing and availability effects emphasized in the earlier literature. Different language, but by and large, similar issues. In brief, this paper maintains that the

frictions central to both literatures are manifest in credit standards reported by commercial loan officers to the Federal Reserve over the last 35 years. Studying those standards should tell us something about the existence of such frictions, and their role in the business cycle.

While theory suggests an independent influence of standards on lending and output, the obvious econometric problem is identification. The changes in standards reported by lenders, which we would like to interpret as changes in credit supply, will almost certainly be correlated with disturbances to credit demand. A tightening in standards may merely signal some other disturbance that drives down loans and output. To minimize identification problems, we treat credit standards as an endogenous variable in a standard vector auto regression (VAR) that controls for recent macro, monetary, and credit conditions. Even with the most conservative ordering--standards last--we find that shocks to standards account for most of the variance decomposition in lending and a sizable share of the variance decomposition of output. Standards remain important even when the model is extend to include various proxies for commercial credit quality and demand (business failures and the loan rate) and forward looking variables (forecasted GDP and interest rate spreads).[2] Lastly, we include credit standards in structural equations for inventory investment, an especially volatile component of spending that is closely connected to the banking sector. We find that tightenings in standards are a significant drag on retail and wholesale inventory investment (though not manufacturing). Back-of-the-envelope calculations suggest that even a moderate tightening in standards--only about half as large as the typical pre-recession spike in Chart 1--slows the rate of inventory investment by the same order of magnitude as

[2] Instrumenting for standards is the obvious strategy to confront this identification problem, but the list of potential instruments is short.

the overall decline in spending during the typical recession.

II. The Loan Officers Opinion Survey

The series on commercial standards plotted in Chart 1 is from the Senior Loan Officer Opinion Survey on Bank Lending Practices, a quarterly survey of major banks around the country conducted by the Federal Reserve. The number of participating has varied over the years from between 120 and roughly 60 currently. Participating banks collectively account for about 60 percent of all bank loans made in the U.S. and roughly 70 percent of C&I loans. [3] Coverage is national, with participating banks from all 12 Federal Reserve Districts. Banks are asked to participate, primarily based on size and portfolio characteristics (e.g. an important share of C&I loans). The response rate is virtually 100 percent.

There have been several breaks in the series since its official inception in 1967.[4] Starting in 1978, lenders were asked to report separately for loans *at* the prime rate and for loans at "spreads above" prime. In 1984 the question on commercial credit standards was dropped from the survey altogether, under the (arguable) assumption that with the deregulation of deposit and other interest rates in the early 1980s, bankers would rely less on standards and more on interest rates in allocating loans. Concerns about a possible credit crunch led to the reinstatement of the question in 1990:2. Since then,

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[3] Banks are added or replaced as needed. "Megamergers" between very large U.S. banks in recent decades, for example, has necessitated frequent changes in the sample. The Senior Loan Officer Opinion Survey comprised a fixed set of 22 questions from its inception in 1964 until 1981. At that time, all but six of those questions were dropped from the survey to make room for more *ad hoc* questions on emerging developments. In 1984, five of the remaining six core questions were dropped, including the question above.

Recent survey results are at http://www.federalreserve.gov/boarddocs/SnLoanSurvey/.

[4] The survey was initiated in 1964 but only results after 1967 are officially available.

lenders are asked to report separately on standards for small firms (with annual sales under $50 million) versus large and middle-sized firms.

The changes in standards reported by loan officers are pieced together in the chart, along with GDP growth and recession indicators. From 1978-84, when the standards question distinguished between loans at prime, and loans above prime, we use the average of the responses to the two questions. For the 1990s, when the question distinguished by firm size, we use standards for loans to middle-sized and large firms on the theory that the former matter more in terms of aggregate lending conditions. The choice is largely immaterial however, as the correlation between the two series is 0.96.

Plotted in the chart is the *net* percent tightening: the number of loan officers reporting tightening standards less the number reporting easing divided by the total number reporting.[5] Loan officers almost *never* reported a net easing of standards over the 1967-77 period, a curiosity first noted by Schreft and Owens (1991).[6] The first reported easing was not until the 1980s. Credit standards were indeed tight in the early 1990s, after the question was reinstated, suggesting that concerns about a credit crunch may have been well founded. More recently, a substantial tightening in standards occurred after the Russian default in 1998 and the attendant financial deterioration in southeast Asia, and have been tightening again over the past year.

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[5] Weighting the responses over the 1990s by the extent of change (somewhat versus considerably) did not change the picture or the results, nor did using a diffusion index. Integrating the changes reported by lenders over time did not work as well as any of the other measures.

[6] This apparent bias toward reporting tightening in these early years could reflect that bankers were reporting standards relative to some long-term notion. Alternatively, bankers may not have reported easier standards for fear of scrutiny by regulators. Bankers need not have feared the regulator's club, however, since the responses of individual bankers are viewed as highly confidential and would not be shared with supervisory personnel except under extreme circumstances.

III. Why Study Standards?

Credit standards are worth studying only if their fluctuations are a potentially independent source of instability in the economy. In a classical world with perfectly symmetric information, the very notion of "standards" is meaningless. All positive valued projects would be funded, whether with loans, bonds, or equity, and the rate of spending on such projects would depend only on their availability.

When informational asymmetries are admitted in the model, the supply of bank credit can fluctuate independently of the "demand' (i.e., the availability of positive valued projects). In Bernanke and Gertler (1987), for example, savers cannot observe returns on banks' lending and so cannot share the risk of bad loan outcomes. Incentive compatibility requires bankers to hold capital and safe (non-loan) securities to buffer against even the worst case return on loans. An exogenous decline in bank capital forces banks to reduce lending, even if the quality of projects has not changed. In Rajan (1994), outsiders cannot observe the value of banks' loans directly, so they infer quality from banks' earning. Bankers manipulate their earnings by altering their "credit policies," (e.g,, their underwriting standards, provisioning, etc.). Banks may ease standards to cover up past mistakes, i.e, they try to outgrow the problem, or at least delay the day of reckoning until other bankers admit their similar mistakes. Proposition 2 in his paper is key to ours: adverse shocks to borrower credit quality are compounded by a contraction in bank credit policy (p. 410). Fluctuations in bank's credit policy, in other words, can amplify fluctuations in project quality, i.e., the availability of positive net present value projects.

While these papers differ in details, the overarching point (for us) is that credit policies are an independent source of variation in lending and spending. The credit cycle, and hence the business

cycle, are partly driven by fluctuations on the supply side. Exogenous shocks that reduce the demand for credit i.e., the availability of positive valued projects, may be amplified or accelerated through their effect on the supply of bank credit.

Credit Frictions and Monetary Transmission

With frictions in the right markets, monetary policy shocks may be transmitted in part though a *bank lending channel* (Bernanke and Blinder 1988). An exogenous loss of reserves may force banks to contract their lending (relative to non-reserve based lending). Apart from the general impact on spending of the higher federal funds rate associated with the lower supply of reserves (and hence deposit money), the accompanying reduction in bank loan supply will reduce spending by bank dependent borrowers.[7]

Credit Rationing and "Availability"

Credit rationing as a potential allocation mechanism became important in the 1950s (Blanchard and Fischer 1989). The large post-war budget deficits at that time made monetary policymakers hesitant to drive up interest rates. It was hoped that policymakers might still affect spending without necessarily driving up interest rates by reducing the *"availability"* of credit, as opposed to its price. Proponents of the doctrine seemed to lack a compelling story, however, about why banks would restrict credit availability other than by raising interest rates. Interest in rationing revived in the late 1970s as theorists introduced various informational asymmetries into models of credit markets and then showed that, in equilibrium, various forms of quantity rationing might emerge (Keeton (1979) and

[7] Some other friction must prevent bankers from perfectly offsetting the reserve loss with non-reservable liabilities.

Stiglitz and Weiss (1981)). Fuerst (1994) provides a modern treatment of the availability doctrine by combining a real side quantity rationing model with a monetary model with sluggish price adjustment.

The financial accelerator promulgated by Ben Bernanke, Mark Gertler, and Simon Gilchrist is a broader view of transmission *mechanisms.* Financial frictions generally (not just at the bank level) amplify and propagate shocks of all types, real *or* monetary. Credit rationing in their class of models is typically a special case of the frictions in the model, but the accelerator can operate strictly though interest rates (or spreads between rates).

Empirical Literature on Commercial Credit Standards

With one exception, academics have largely overlooked or neglected the information on standards in Chart 1. The exception is Harris (1973, 1974, 1975). His series of articles examines the correlation between the changes in loan rates, credit standards, and other non-price terms but he never goes on to investigate the link between the various lending terms and actual lending or output. Federal Reserve researchers are more aware of the series. Schreft and Owens (1991) provide an interpretive history of the Loan Officer Survey and note several dubious features in the data.[8] Keeton (1986) notes that standards appeared to fluctuate less after deposit rated deregulation, suggesting that non-price allocations mechanisms may have been supplanted by classical price allocation. Berger and Udell (1992) report reduced form correlations between Treasury bill rates and various terms of lending collected in the Survey of Terms of Bank Lending by the Federal Reserve. They found loan interest rates unresponsive to market rates, perhaps suggestive of non-rate rationing, but collateralization and

[8] Using the survey series on *consumer* credit standards, Duca and Garrett (1995) investigate the link between consumer spending and consumer credit standards.

commitment rates did not respond in the way expected under the quantity rationing hypothesis. [9]

Using mostly single equation analysis, Lown, Morgan, and Rohatgi (2000) find that the changes in standards reported in the Loan Officer Opinion Survey are highly negatively correlated with aggregate commercial loan growth and with various measures of economic and business activity. Notwithstanding potential biases in the survey, they conclude that lenders reports on standards are truthful and seemingly representative of lenders at large. LMR steer clear of identification issues for the most part by focussing on reduced form correlations. We take up where they left off with a more thorough VAR analysis.

IV. Vector Autoregression Results

Our core VAR includes four lags each of the following variables: log real GDP, log GDP deflator, log commodity prices, federal funds rate, log commercial loans at banks, and standards (the net fraction tightening). The first four variables comprise a more-or-less standard model economy, with output (real GDP), prices (GDP deflator), "supply" (commodity prices) and "demand" (interest rates), that has been used previously to analyze monetary policy shocks.[10] The difference here is the inclusion of the two credit market variables: commercial loans at banks and commercial credit standards.[11] Other researchers have included bank loans or broader credit aggregates in VARs, of course, but to no avail; given other variables in the system, loans or credit variables typically add little in

[9]In their view, the results made "it harder to argue" that credit rationing is macroeconomically important. The need for this footnote is a case in point.

[10]See, for example Christiano, Eichenbaum, and Evans (1996) and Bernanke and Mihov (1998).

[11] We add a loan interest rate later.

the way of explanatory power (Ramey 1993). The crucial difference here is the inclusion of credit standards as well. If standards are important in the allocation of commercial bank credit, and if the supply of bank credit matters for business activity, we should find a more important role for lending here. The VAR is estimated over the disjoint time period over which the commercial credit standards data are available: 1968:1 - 1984:1 and 1990:2-2000:2.

Exclusion Tests. Table 1 reports selected coefficient sums and p-values for several versions of the VAR. For the full model (middle panel), past values of standards are highly significant in predicting output, lending, and the federal funds rate, with the significance of the F-test at 0.000 for every variable (bottom row). Increases in standards--tightenings--are associated with lower future values of output and loans. The funds rate tends to fall after tightenings in standards, but the sum of coefficients on standards is insignificant in the funds rate equation. Standards themselves depend significantly and positively on lagged loans, but not on lags of output or the federal funds rate. In sum, standards "cause" output, loans, and the funds rate (in the statistical sense), while past values of loans cause standards.[12]

Excluding loans from the model alters the results in several interesting ways (right panel). Most importantly, the significance and sum of the coefficients on past standards falls considerably. This finding suggests a more causal effect of standards on output via loans, as excluding loans effectively shuts down the channel from standards to output through the loan market. Without loans in the model, past values of the funds rate and output are significant in predicting standards.

Excluding standards from the model (left panel) weakens the relationship between loans and

[12]Past commodity prices are significant in predicting standards, but not vice-versa.

output. The weak predictive power of loans is a common result; the new result here is that loans are significantly, positively correlated with output when we control for standards (middle panel).

Impulse Responses. Chart 2 plots selected impulse responses for the core VAR (middle panel from Table 1). The net fraction of banks tightening their lending standards initially increases roughly 8 percent (lower left panel), considerably less than the 50 percent tightening during the alleged "crunch" in 1990. The degree of tightening falls in successive periods, but remains significantly above zero for about three quarters. After nearly nine months of tightening, lenders eventually begin to ease standards.[13] The tightenings seem more abrupt however; nearly two years pass before the net percent tightening is falls significantly below zero. Output, commercial loans, and the federal funds rate all fall significantly after the shock to standards, consistent with the earlier exclusions tests. Loans fall almost immediately and continue to contract until bankers begin to *ease* standards significantly. At the low point in lending, loan volume is about 3 percent lower than before the standards shock. Output declines significantly in the quarter immediately after the standards shock (upper left panel) and remains significantly below its initial rate for almost two years. At the trough, output is about 0.5 percent lower than before the shock.[14] The federal funds rate also tends to fall after the tightening in standards. The

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[13]This seesaw makes sense, as loan officers are reporting *changes* in standards; a change one way requires an equal and offsetting change in the other direction to return to the normal level of standards.

[14] Overall, the path of GDP roughly parallels the path of standards. The decline in GDP becomes insignificantly different from zero, for example, at about the same time that standards turn significantly negative (i.e. lenders start *easing*). The paths of GDP and loan volume are not as close, however. The trough in GDP, for example, clearly precedes the low point in loan volume. GDP includes non-business output, of course, and that activity should not necessarily parallel commercial lending.

decline becomes significant about three quarters after the shock, by which time the funds rate has been lowered about 50 basis points.

The response of standards to shocks in the other variables are largely sensible, but weak statistically. Positive output innovations cause some initially loosening in standards (albeit not significant) but later tightenings, suggesting a procyclical relation between standards and output in the short-run but a countercyclical relationship at longer horizons. Shocks to the federal funds rate do *not* affect standards; standards do tend upwards after a funds rate innovations, but the response is never significant.[15] Innovations in loans have a reasonably prompt, persistent, and significant impact on standards, a one standard deviation increase in the log of loans (about 1.0 percent) increases the net fraction tightening by approximately 4.0 percent two quarters later.

Variance Decompositions. Innovations in standards account for over a third of the variance decomposition of output at four quarters, more than any variable except output itself (Table 2). By comparison, innovations in the funds rate account for only 3 percent at four quarters, but then increase with the horizon. Innovations in standards explain an even larger share of the loan decomposition. At three quarters, 15 percent of the loan variance decomposition is attributable to standards shocks. By 12 quarters, over two-thirds of the variance decomposition of loans is due to shocks in standards. Innovations in standards account for 11 percent of the federal funds rate variance decomposition at four quarters and 16 percent by 12 quarters. The decomposition of the forecast error variance of standards is largely consistent with the earlier results. About 20 percent of the variance is attributable to loan

[15]We explore the link between funds rate shocks and standards more fully in Lown and Morgan (2001).

shocks, with another 10 percent accounted for by commodity shocks (not shown). Apart from that, the variance decomposition of standards is mostly attributable to innovations in the series itself. Innovations in the funds rate explain only a trivial share of the variance decomposition of standards.

Robustness. Our findings that commercial credit standards, or shocks therein, are highly significant in explaining commercial loan volume, output, and to a lesser extent, the federal funds rate are robust to a number of changes in the core VAR. Differencing GDP, the deflator, commodity prices, and loans did not alter the impulse results in a substantive way, nor did using 8 instead of 4 lags. Changes in the ordering of the financial variables also did not alter any of our results. Using industrial production rather than real GDP as the output measure actually strengthens the role of standards, somewhat, presumably because of the more direct link between commercial credit standards and production. We tested (crudely) for asymmetries in the relationship between standards and output (e.g. tightenings matter more than easing) but could not usually reject symmetry.

We did find one variation of the VAR that affected the link between standards and output in an interesting way. When loans are excluded from the VAR, the impact of standards shocks on output weakens substantially (consistent with Table 1, panel 3); the coefficients on lagged standards in the output equation sum to only -.012 ($p = 0.095$) versus -.047 ($p = 0.000$) in the VAR with loans. Innovations in standards account for only 7 percent of the variance decomposition of output in the VAR without loans, versus 35 percent in the VAR with loans. This finding suggest a more causal connection between standards and output, via the loan market, as opposed to a mere signaling role for standards. Recall also that there is feedback from loans *to* standards; positive loans shocks are associated with tightening standards (Chart 2). Tightenings that are merely in response to strong loan growth are not

necessarily contractionary so when we control for the feedback from loans to standards (by including loans in the VAR) we extract the deviations in standards that *are* contractionary i.e., the tightenings above and beyond what one would expect, given the recent path of loans.

Notwithstanding the result just noted, the crucial question remains whether positive shocks to credit standards can be interpreted as contractions in bank loan *supply*. The alternative interpretation is that standards shocks merely signal other disturbances that instead reduce credit demand or quality. Absent good instruments for standards, our identification strategy is to extend the core VAR with various proxies for credit demand and credit quality and to extract the deviations in standards not attributable to those proxies (and their innovations). Fluctuations in credit standards obviously reflect the reactions of lenders current and expected events. Lenders may also tighten standards beyond what one would predict from these events, however, which is what we are after here. These unexplained, or unaccounted for, tightenings in standards may affect lending and output independently from the original stimulus.

V. Extensions

Our list of extensions are summarized in Table 3. The list was motivated by a combination of theory, empirical findings by other researchers, and the reports of loan officers' themselves.[16] Expected output is an obvious, fundamental determinant of credit demand; lower expected output likely implies

[16] Since 1990, loan officers that report a change in their commercial credit standards are asked to rank five possible reasons for changing standards: economic outlook or uncertainty, expected capital position, more or less tolerance for risk, reduced or increased competition from other lenders, changes in specific sectors.

expected returns to investment, and hence, reduced demand for credit.[17] The business failure rate is also intended as a proxy for firms' credit quality and demand, with high failures indicating diminished investment prospects and reduced demand for credit.[18] The coverage ratio-- interest payments divided by cash flow--is intended to proxy for credit quality. Deviations in the *aggregate* coverage ratio across time may indicate deterioration in firms' financial conditions.[19] We include the spread between commercial paper and treasury bill as another forward looking variable. Increases in this spread are (usually) reliable indicators of future contractions in activity, although the cause of spikes in this spread are not necessarily obvious.[20] Banks' capital/asset ratio is included as a potential determinant of bank loan supply. In Bernanke and Gertler (1987), for example, capital is an essential determinant of banks' lending capacity. Adverse shocks to capital force banks to substitute safe securities for riskier loans in order to satisfy market imposed capital requirements. Capital is also rated

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[17] A diminished outlook may also reduce the supply of credit, however, if reduced fundamentals aggravate incentive problems between banks and borrowers; poorer investment prospects may lead project owners to shirk on current undertakings or shift effort and resources toward higher mean risk projects. Indeed, loan officers consistently rate "deterioration of increased uncertainty in the outlook" as the most important reason for tightenings in standards. We use the median (across forecasters) of the professional forecasts compiled by the Federal Reserve Bank of Philadelphia. The data are available on that bank's website.

[18]Increased failures may also cause lenders to tighten standards (rather than raising loan rates) to curb the increased risk of moral hazard by firms' on the brink of default.

[19] Across sectors and firms, coverage and credit quality might be positive since only high quality, stable borrowers can sustain high coverage ratios.

[20] Researchers have identified changes in the spreads with changes in monetary policy, increases in the extent of information problems, and simply increased risk or decreases risk tolerance.

high by loan officers as a reason for changes in standards.[21]

We add these extenders to the core VAR one at a time. The extra variables occupy the penultimate position in the ordering--before standards, but after all other variables. This conservative ordering tends to exaggerate the impact of the extenders on standards and diminish the (residual) impact of standards on output and loans.

Table 4 reports abbreviated sets of exclusion tests for each of the extended VARs. Even with the extra variables in the models, standards are highly significant in predicting loans and output. Past tightenings are associated with significantly lower levels of output and loans, as in the core VAR, and the sum of coefficients on standards in both the output and lending equations are of the same order of magnitude as before (Table 2). In short, none of the extender variables displace credit standards in predicting loans and output. Indeed, the other variables pale next to standards in terms of sheer predictive power (i.e., p-values).

Past values of the loan rate cannot be excluded (at 5 percent) from the loan equation. The negative sum of coefficients, though small and insignificant, suggests that higher loan rates are more closely associated with inward shifts in loan supply than with outward shifts in demand (which would imply a positive relationship between loan rates and loan quantities). The sum of coefficients on past loan rates is more than an order smaller than the sum on past standards, suggesting that the latter variable plays a more important role (than rates) in the allocation of bank loans.

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[21]We have also found that an increase in standards causes the ratio of bank loans to commercial paper to fall. This result is especially promising as this "mix" variable was introduced specifically to identify shifts in the (relative) supply of bank loans (Kashyap, et. al. 1993).

Weakening capital positions lead to some tightening in banks' credit standards, as expected, but the connection from capital to standards is not significant. This weak relationship might partly reflect the use here of book rather than market capital. Recall also that we are missing data for the 1984-1990 period, a time when banks were anticipating tightening regulatory constraints on their capital positions under the international Basle Accord.[22]

The business failure rate is the only variable that is significant in predicting standards. The sum of coefficients on past values of the failure rate is positive and highly significant, suggesting that lenders become more selective when facing increasingly distressed business borrowers. Given the recent failure rate, the current change in standards is related to its own past changes at only the 10 percent level, indicating that failures absorb some of the impact of lagged standards. Even controlling for the failure rate, however, standards are still highly significant in predicting loans and output, while the failure rate is not significant in either equation.

More on Business Failures. We investigate the VAR with the business failure rate in further detail, since that variable proved significant in explaining standards. The impulse responses from the model reveal that shocks to the failure rate are followed by a significant tightening in credit standards (Chart 3). Even after accounting for the effect of failures on standards, a standards shocks still cause output to slow significantly.[23]

Innovations in the failure rate account for about 10 percent of the variance decomposition of

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[22]Bernanke and Gertler (1987) show that lending is more influenced by capital when the level of capital is close to its regulatory minimum.

[23] The VAR ordering is standards last and failures second-to-last so the innovation in standards is orthogonal to the contemporaneous innovation in failures.

standards. The share of the variance decomposition of output attributable to innovations in standards is lower when the model includes business failures, but still sizable (Table 4). The share attributable to standards increases to about 15 percent at four quarters, and declines thereafter. Similarly, the importance of standards in explaining the variance decomposition of lending falls somewhat, but is still quite large: 18 percent at 4 quarters and 28 percent at 8 quarters.

More on Bank Capital. Although the predicted negative relationship between standards and capital ratios did not materialize in the exclusion tests, the strong theoretical priors for a role of capital motivated further investigation of that model. Examining the impulse response and variance decompositions may uncover indirect links between the variables via feedback among other variables in the VAR. In fact, positive shocks to the capital/asset ratio are somewhat expansionary in terms of lending standards. The response of standards is marginally significant (between 5 percent and 10 percent) four quarters after the initial shock and for several quarters thereafter. According to the variance decompositions (Table 5), however, shocks to the capital/asset ratio account for only 8 percent of the variance decomposition of standards at 8 quarters. Again, we view this mixed-to-weak result more as an indictment of our book value series of capital, than as evidence against capital constraints impacting bank lending.

VI. Standards in a Structural Inventory Investment Model

We estimate a structural equation for inventory investment and measure the quantitative effect of a tightening in standards on inventory investment. The structural part of the equation is intended to explicitly control for inventory investment *demand* so the coefficients on standards should measure the quantitative impact of a reduction in the supply of bank credit (via tighter standards) on investment.

Inventory spending makes the ideal laboratory for this because a) banks fund a substantial share of inventory investment, b) fluctuations in inventory investment figure disproportionately in GDP fluctuations, and c) inventory investment spending is curiously insensitive to interest rates (Blinder and Maccini, 1991). A finding that fluctuations in commercial credit standards affect inventory investment may help explain b) and c).

The inventory investment equation--a simple target adjustment ala Lovell (1961)--is similar to the version in Gertler and Gilchrist (1994):

$$\begin{aligned} \Delta I_t = {} & \alpha_0 + \alpha_1 (E_{t-1}S_t - I_{t-1}) + \alpha_2 r_{t-1} + \alpha_3 ST_{t-1} + \alpha_4 \Delta I_{t-1} + \alpha_5 \Delta S_{t-1} \\ & + \alpha_6 \Delta r_{t-1} + \alpha_7 \Delta ST_{t-1} + \varepsilon_t \end{aligned} \tag{1}$$

where *I*, *S*, and *ST* denote the logs of inventories, sales and loan standards, and *r* denotes the short-term real interest rate. The dependent variable is the inventory growth rate. According to the usual model, inventory investment each period depends on the gap between the lagged level of inventories and the target level of (expected) sales and on the short-term interest rate. Short-run dynamics are allowed via the lagged differences of all variables. The difference in our equation is the addition of commercial credit standards on the right hand side. Given inventory investment demand, we expect slower rates of investment when standards have been tight.

As is common, we use *actual* sales in lieu of expected sales on the right hand side. Since current sales are endogenous, we instrument using lagged values of sales and all the other variables,

including standards.[24] For the real interest rate, we use the prime loan rate less the one year inflation rate. We estimate (1) separately for each category of inventories: retail, wholesale, and manufacturing. For each category, we include the corresponding category of sales on the right hand side.

Table 5 presents the estimates of the inventory investment equations. Though insignificant in the equation for manufacturing, standards are highly significant in the equations for trade inventories.[25] We can reject that the standards coefficients are jointly zero in the wholesale inventory equation at the 6 percent level. The irrelevance of standards in the retail inventory equation can be rejected at 2 percent. Excluding standards from the retail inventory equation reduces the adjusted R^2 by about half, indicating that fluctuation in standards account for about half of the explanatory power of the retail inventory investment equation.

The impact of a change in standards on inventory investment in the trade sectors is large relative to normal behavior of those series. One standard deviation tightening in standards (about 19 percentage points) reduces retail inventory investment by 1.5 percentage points per year (compared to a mean rate of 3.9 per year; standard deviation of 6.2 percent) and wholesale inventory by 1.3 percentage points per year (compared to a mean of 5.2 percent, standard deviation of 5.6 percent). In absolute terms, this tightening would trim trade inventory investment on the order of $10 billion. That number is substantial relative to the $30 billion drop in real GDP during the typical recession. Bear in

[24]Including standards as an instrument eliminates the possible criticism that loan standards are significant in explaining inventories because they contain information about expected sales.

[25] We do not know why standards appear irrelevant for manufacturing inventories. The typical manufacturing firms may be larger (than the typical trade firm) and may be less bank-dependent for credit. Decomposing manufacturing inventories (by stage of fabrication) might reveal effects of standards on work-in-progress and raw material inventories.

mind also that the tightening in this experiment is gentle relative to the usual 40 percent net tightening before recessions (Chart 1).

VII. Conclusion

At a minimum, fluctuations in commercial credit standards are highly significant in predicting commercial bank loans, real GDP, and inventory investment in the trade sector. If standards are tightening more than usual (given macro and credit conditions), observers can expect lower levels of loans and slower rates of output with a high degree of confidence. Credit standards are more informative about future lending than are loan rates, consistent with the idea that informational frictions in credit markets force lenders to ration loans via changes in standards more than through changes in rates.

We hesitate to interpret these correlations as evidence of a causal connection between bank loan supply and real activity as tightenings in standards may merely signal (as opposed to cause) an incipient slowdown. It is notable, however, that shocks to standards still affect lending and output in extended VAR models that control for recent macro conditions and credit quality. Standard are also significant in structural inventory investment equations, where the role of standards is (arguably) identified with changes in the supply of credit.

The feedback observed from loans *to* standards suggests a sort of credit "cycle." Higher levels of loans cause lenders to tighten standards, perhaps because they conclude (or are told by supervisors) that underwriting standards are too loose. Corrections occur. Continued corrections lead to lower levels of spending and loans. Standards are then lowered, again, loans accelerate . . . *ad infinitum*.

Some of the negative findings here are also interesting. Shocks to the federal funds rate do *not*

cause changes in standards, lenders simply raise loan rates more or less in step with the funds rate. While this finding seems counter to theories of a narrow bank lending channel of monetary policy, at least via changes in standards, further research using alternative monetary policy measures may yet uncover a standards channel.

We found a negative channel between bank's capital ratios and their lending via standards but the capital-standards correlation was statistically weak. We view this more as a problem with book capital measures than with theories of capital constraints on banks.

The federal funds rate falls in response to positive shocks in credit standards, suggesting that monetary policymakers follow a "lean-against-the-lenders" strategy. Lowering the funds rate does not affect standards directly but it stimulates spending through other channels.

What next? Disaggregation of the reported standards (by respondent) would be the obvious next step but that would violate the confidentiality understanding between participating loan officers and the Federal Reserve. It would be feasible, however, to investigate how the standards reported in the Loan Officer Opinion Survey (LOOS) line up with the more quantitative measures collected by the Federal Reserve in its Survey of Terms of Bank Lending (STBL). LOOS was introduced in the 1960s because policymakers felt that even qualitative information on standards might supplement the quantitative information they were already collecting in the STBL. The reinstatement of questions on *standards* in the 1990s suggests that, at least in the views of monetary policymakers, talking to loan officers about lending standards might be a useful supplement to the quantitative terms reported in the Survey of Terms of Bank Lending.

Our finding that standards are closely correlated with business failures might tie in with Peek,

Rosengren and Tootell (2000). They find that ratings of banks by their supervisors (CAMEL ratings) make an effective instrument for identifying loan supply shocks and their macroeconomic impact. General business failures will almost surely correlate with higher commercial loan losses at banks, which may lead to CAMEL downgrades and pressure from bank supervisors. Loan officers may respond by tightening their standards, which in turn leads to lower loan growth.[26]

[26]A natural test is whether the CAMEL ratings cause standards, but again, such a test, unless conducted with aggregated CAMEL ratings, would violate confidentiality requirements.

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Table 1: Sums of Coefficients and P-Values in Vector Auto Regression (VAR) Model

VARs comprise four lags each of the following (in order): log real GDP, log GDP deflator, log commodity prices, federal funds rate, and--if indicated--the log of commercial (C&I) loans at banks, and the change in commercial credit standards reported by senior loan officers at banks. All models estimated over the disjoint time period: 1967:1-1984:1 and 1990:2-2000:2. Reported below is the sum of coefficients on lags of each independent variable (p-value in parentheses). Also reported third is p-value for F-test of whether the coefficients are jointly zero. Standards are highly significant in predicting output, loans, and the federal funds rate. Omitting loans (panel 3) weakens the link between standards and output.

	Dependent variable:			*Dependent variable:*				*Dependent variable:*			
Independent variable:	Real GDP	Fed. Funds	C&I Loans	Real GDP	Fed. Funds	C&I Loans	Standards	Real GDP	Fed. Funds	C&I Loans	Standards
Real GDP	0.904	0.098	0.096	0.879	0.037	0.075	0.184	0.960	0.052		1.068
	(0.000)	(0.040)	(0.045)	(0.000)	(0.286)	(0.044)	(0.555)	(0.000)	(0.028)		(0.002)
	0.000	0.005	0.007	0.000	0.001	0.040	0.771	0.000	0.079		0.027
Fed. Funds	-0.237	1.075	0.229	-0.366	1.016	0.084	-0.299	-0.133	0.978		1.587
	(0.007)	(0.000)	(0.012)	(0.000)	(0.000)	(0.293)	(0.665)	(0.020)	(0.000)		(0.002)
	0.001	0.000	0.000	0.000	0.000	0.398	0.149	0.000	0.000		0.011
C&I Loans	0.026	-0.064	0.939	0.085	-0.070	1.010	0.298				
	(0.125)	(0.015)	(0.000)	(0.000)	(0.003)	(0.000)	(0.337)				
	0.478	0.005	0.000	0.000	0.000	0.000	0.000				
Standards				-0.047	0.016	-0.057	0.775	-0.012	-0.017		0.580
				(0.000)	(0.124)	(0.000)	(0.000)	(0.095)	(0.048)		(0.000)
				0.000	0.000	0.000	0.000	0.008	0.024		0.000

Table 2: Variance Decompositions

Each panel reports the decomposition of the variance of the forecast error of the series in the panel heading. Figures within panel are the share (%) of the variance at each horizon attributable to the variable in each column. Credit standards enters last in the VAR. See Table 1 for VAR model description. Decompositions of commodity prices and deflator and their contributions are not reported.

Real GDP

Horizon quarters	Real GDP	Fed. Funds	C&I Loans	Standards
1	100	0	0	0
2	88	2	2	6
3	72	3	3	21
4	57	3	3	31
8	24	19	1	31
12	14	21	1	23

C&I Loans

Horizon quarters	Real GDP	Fed. Funds	C&I Loans	Standards
1	5	14	73	0
2	4	8	66	5
3	6	5	55	15
4	9	5	43	25
8	17	3	16	52
12	14	2	9	66

Standards

Horizon quarters	Real GDP	Fed. Funds	C&I Loans	Standards
1	1	1	1	95
2	1	1	15	77
3	1	1	20	66
4	1	1	21	63
8	3	2	20	60
12	5	2	18	58

Federal funds rate

Horizon quarters	Real GDP	Fed. Funds	C&I Loans	Standards
1	6	90	0	0
2	15	66	0	0
3	25	47	0	2
4	26	36	0	11
8	25	25	0	14
12	23	21	1	16

Table 3: Extensions to VAR: Variable Descriptions

Variable	Definition	Time Period	Summary Statistics				Source(s)
			observations	median	SD	minimum	maximum	
Loan Rate	Interest rate on commercial and industrial loans, annualized.	1967:1 1983:4	68	7.99	3.96	4.90	20.33	Board
		1990:2 2000:2	41	7.12	1.29	4.83	10.08	
Coverage Ratio	Ratio of net interest payments to net interest payments plus cash flow of nonfinancial firms	1967:1 1983:4	68	12.63	3.02	7.11	18.98	Commerce Department
		1990:2 2000:2	41	11.51	3.44	9.97	20.83	
Aggregate Bank Capital/Asset Ratio	Ratio of bank capital to total bank assets of the U.S. banking system	1967:1 1983:4	68	0.05	0.01	0.02	0.07	Flow of Funds
		1990:2 2000:1	40	0.03	0.01	0.02	0.04	
Business Failure Rate	Ratio of liabilities of domestic business failures to gross product of nonfinancial corporate businesses.	1967:1 1983:4	68	0.08	0.05	0.04	0.28	Dun & Bradstreet
		1990:2 1998:3	34	0.21	0.28	0.08	1.15	
Median Log of Forecasted GDP	4-quarter ahead median forecasted GDP	1968:4 1983:4	61	7.17	0.31	6.60	7.39	Federal Reserve Bank of Philadelphia
		1990:2 2000:2	41	8.63	0.25	8.33	9.16	
Paper-bill Spread	Spread of the nonfinancial commercial paper rate over the secondary market T-bill rate.	1967:1 1983:4	68	0.73	0.62	0.03	3.51	Federal Reserve Board Statistical
	The spread was computed using 6-month rates until 1971 and 3-month rates during 1971-2000.	1990:2 2000:2	41	0.43	0.16	0.18	0.91	Release H.15: Selected Interest Rates

Table 4: Coefficients Sums and P-Values in Extended Vector Auto Regression (VAR) Models

VAR models below include the core variables described in Table 1, plus the variable indicated below. Reported below is the sum of coefficients on lags of each independent variable (p-value in parentheses). Also reported third is p-value for F-test of whether the coefficients are jointly zero. Past standards still

Independent variable:	*Dependent variable:* Real GDP	C&I Loans	Standards
Standards	-0.045	-0.061	0.622
	(0.001)	(0.001)	(0.003)
	0.000	0.000	0.001
Loan Rate	0.001	-0.002	-0.044
	(0.791)	(0.520)	(0.228)
	0.609	0.022	0.403
Standards	-0.043	-0.057	0.680
	(0.000)	(0.001)	(0.000)
	0.000	0.000	0.000
Coverage Ratio	-0.001	0.000	0.015
	(0.037)	(0.920)	(0.111)
	0.076	0.792	0.295
Standards	-0.046	-0.063	0.702
	(0.000)	(0.000)	(0.000)
	0.000	0.000	0.000
Bank Capital/ Asset	0.012	-0.783	-5.609
	(0.964)	(0.031)	(0.161)
	0.282	0.127	0.323

Independent variable:	*Dependent variable:* Real GDP	C&I Loans	Standards
Standards	-0.038	-0.067	0.314
	(0.009)	(0.001)	(0.102)
	0.007	0.002	0.176
Firm Failure Rate	-0.011	0.005	0.556
	(0.295)	(0.743)	(0.000)
	0.878	0.907	0.006
Standards	-0.050	-0.065	0.746
	(0.000)	(0.000)	(0.000)
	0.000	0.000	0.000
Expected Real GDP	-0.010	-0.023	-0.134
	(0.522)	(0.310)	(0.567)
	0.952	0.679	0.906
Standards	-0.042	-0.054	0.787
	(0.000)	(0.001)	(0.000)
	0.002	0.001	0.000
CP Spread	-0.003	-0.003	-0.024
	(0.452)	(0.642)	(0.736)
	0.258	0.068	0.590

Table 5: Variance Decompositions from Extended VARs

Reported in each panel is the decomposition of the variance of the forecast error of the series in the panel heading. Each cell within a panel reports the percentage of the variance at each horizon attributable to shocks in the variable in each column. Credit standards enters last in the VAR. See Table 1 for notes on the VAR model. The variance decompositions of commodity prices and deflator and their contributions to those of the other variables are not reported.

VAR with Business Failure Rate

A. Percentage of GDP variance attributed to shocks to:

Horizon quarters	Real GDP	Fed. Funds	C&I Loans	Business Failures	Standards
1	100	0	0	0	0
2	88	3	3	0	4
3	76	3	3	1	12
4	61	3	3	4	15
8	25	23	2	12	7
12	17	24	1	11	3

B. Percentage of loan variance attributed to shocks to:

Horizon quarters	Real GDP	Fed. Funds	C&I Loans	Business Failures	Standards
1	6	14	70	0	0
2	5	8	64	0	4
3	6	7	55	0	12
4	7	7	45	0	18
8	13	7	19	9	28
12	9	4	12	25	25

C. Percentage of standards variance attributed to shocks to:

Horizon quarters	Real GDP	Fed. Funds	C&I Loans	Business Failures	Standards
1	0	1	1	0	98
2	1	0	23	2	65
3	1	1	25	6	50
4	1	1	24	9	47
8	6	3	21	8	44
12	6	3	18	10	39

VAR With Bank Capital/Asset

A. Percentage of GDP variance attributed to shocks to:

Horizon quarters	Real GDP	Fed. Funds	C&I Loans	Capital/Asset Ratio	Standards
1	100	0	0	0	0
2	88	2	2	0	6
3	72	2	2	1	19
4	57	3	2	1	30
8	27	17	1	0	32
12	17	19	1	2	22

B. Percentage of loan variance attributed to shocks to:

Horizon quarters	Real GDP	Fed. Funds	C&I Loans	Capital/Asset Ratio	Standards
1	3	14	74	0	0
2	4	8	64	1	5
3	7	5	49	4	15
4	10	5	35	5	26
8	18	4	10	5	49
12	14	3	6	3	63

C. Percentage of standards variance attributed to shocks to:

Horizon quarters	Real GDP	Fed. Funds	C&I Loans	Capital/Asset Ratio	Standards
1	2	1	2	2	93
2	2	1	16	1	76
3	1	1	20	1	66
4	1	1	20	1	64
8	6	2	16	8	57
12	5	2	15	7	56

Table 6: Structural Inventory Investment Regression Equations with Credit Standards

Reported are regression coefficients (standard errors). Dependent variable is inventory investment of type indicated.

	Retail		Wholesale		Manufacturing	
C	-0.10	-0.09	-0.13	-0.11	-0.06*	-0.06*
	(0.06)	(0.07)	(0.07)	(0.07)	(0.03)	(0.03)
$S_t - I_{t-1}$	0.15*	0.14	0.20**	0.16*	0.10**	0.11**
	(0.07)	(0.07)	(0.08)	(0.07)	(0.04)	(0.04)
ΔI_{t-1}	0.01	0.06	0.04	0.06	0.45**	0.50**
	(0.09)	(0.08)	(0.09)	(0.08)	(0.08)	(0.07)
ΔS_{t-1}	0.33**	0.31**	0.12	0.15*	0.12**	0.11**
	(0.10)	(0.09)	(0.07)	(0.06)	(0.04)	(0.03)
r_{t-1}	-0.06	0.18	-0.04	0.11	-0.12	-0.12
	(0.25)	(0.24)	(0.24)	(0.23)	(0.10)	(0.08)
Δr_{t-1}	1.01	0.73	0.68	0.76	0.48	0.56*
	(0.55)	(0.56)	(0.52)	(0.48)	(0.27)	(0.26)
Standards $_{t-1}$	-0.08*	---	-0.07*	---	0.01	---
	(0.04)		(0.04)		(0.02)	
Δ Standards $_{t-1}$	-0.03	---	0.04	---	0.02	---
	(0.05)		(0.04)		(0.02)	
$\bar{R}^2$	0.24	0.12	0.20	0.16	0.58	0.57
P-value	---	0.02	---	0.06	---	0.16

The dependent variable is the growth rate of the respective inventory category. I and S denote the logarithm of the inventory and sales category respectively. Real is the level of the Prime Rate less the one-year inflation rate. Standards is the level of loan standards. The equations are estimated using instrumental variables with $(S_{t-1}\text{-}I_{t-l})$, $Real_{t-1}$, $Standards_{t-1}$, ΔI_{t-l}, ΔS_{t-1}, $\Delta Real_{t-1}$, and $\Delta Standards_{t-1}$ as instruments.

Standard Errors are in parentheses. *, ** indicate significance at the 5 and 1 percent levels, respectively.

Chart 1: Change in Commercial Credit Standards, C&I Loan Growth and Recessions

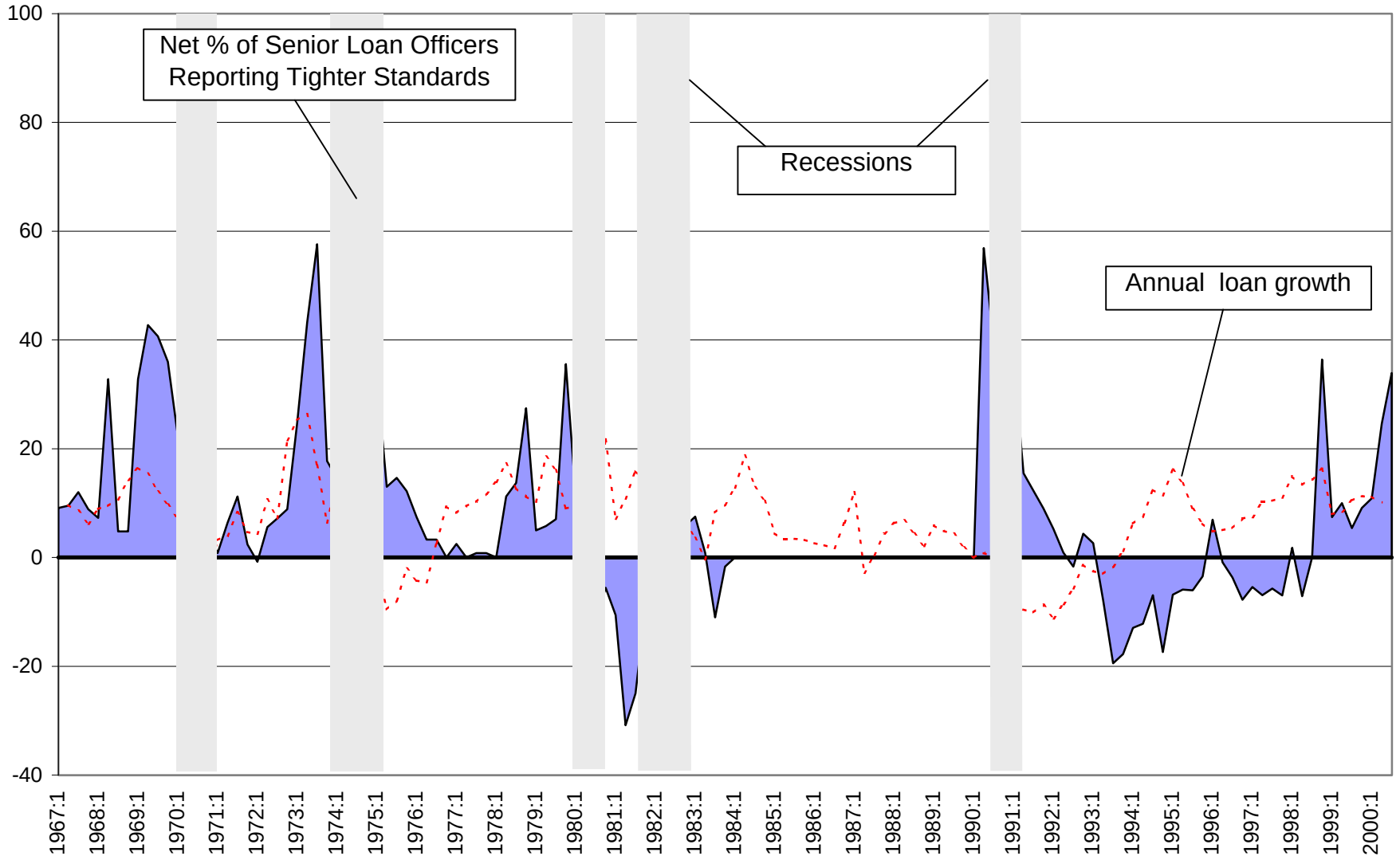
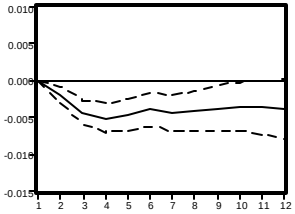
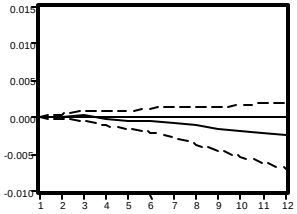


Chart 2:
Impulse Responses for Core VAR

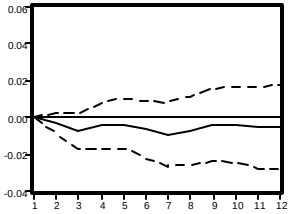
Response of:
GDP to STANDARDS shock



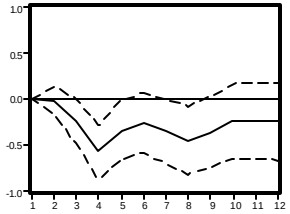
Response of:
GDP DEFL. to STANDARDS shock



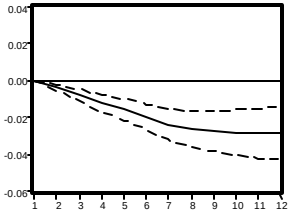
Response of:
C. PRICES to STANDARDS shock



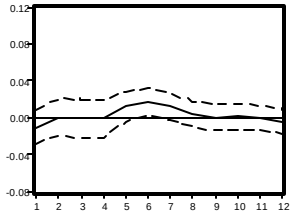
Response of:
FF RATE to STANDARDS shock



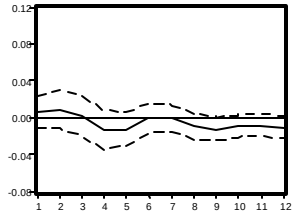
Response of:
LOANS to STANDARDS shock



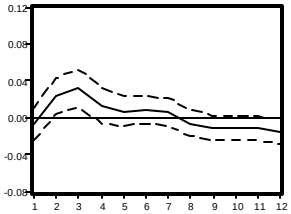
Response of:
Standards to GDP shock



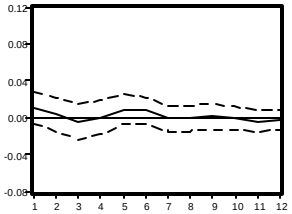
Response of:
STANDARDS to GDP DEFL. shock



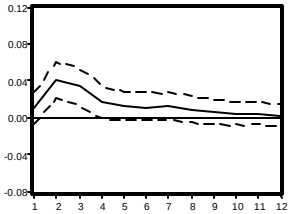
Response of:
STANDARDS to C.PRICES shock



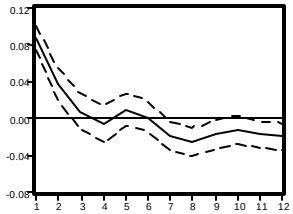
Response of:
STANDARDS to FF RATE shock



Response of:
STANDARDS to LOANS shock

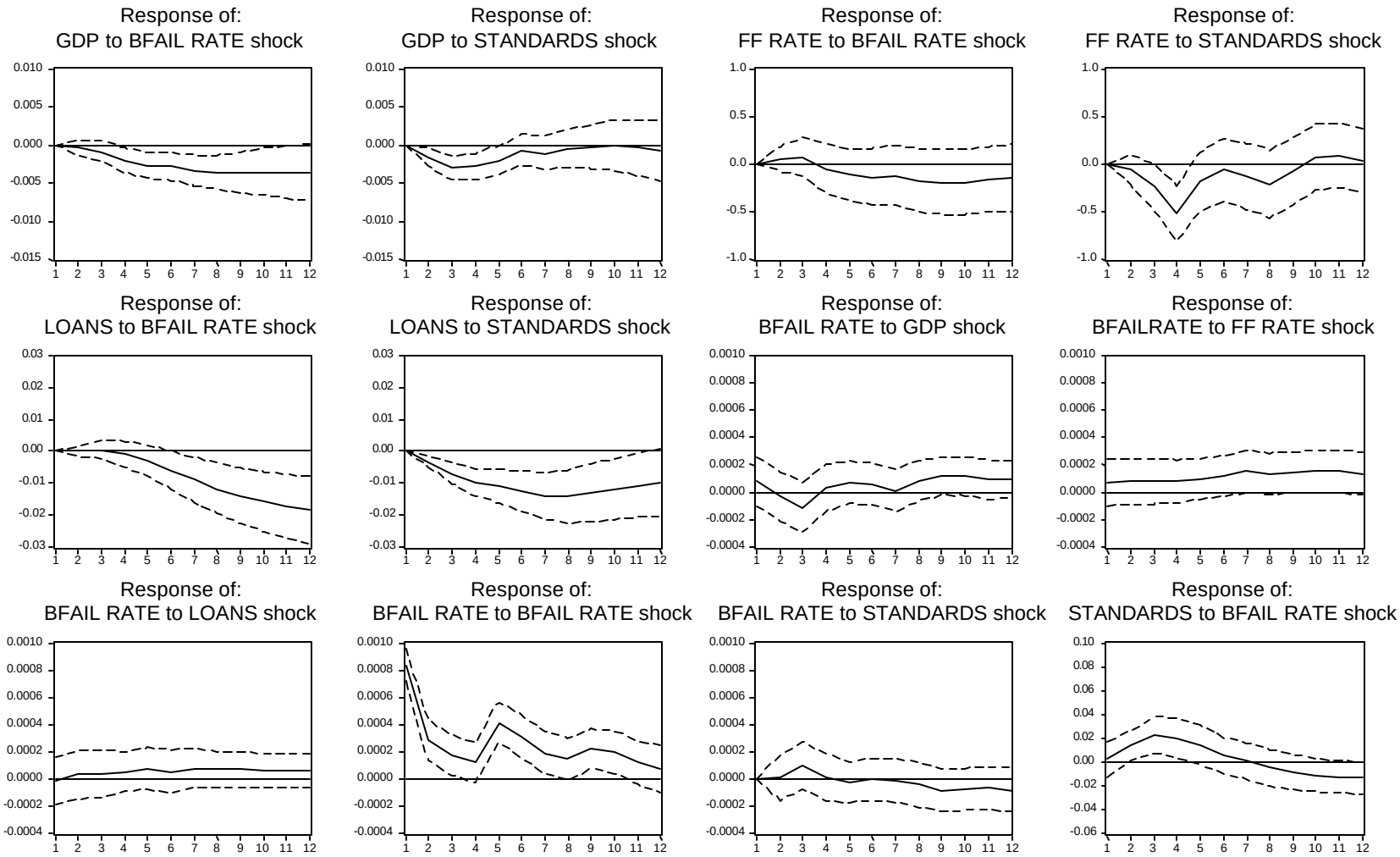


Response of:
STANDARDS to STANDARDS shock



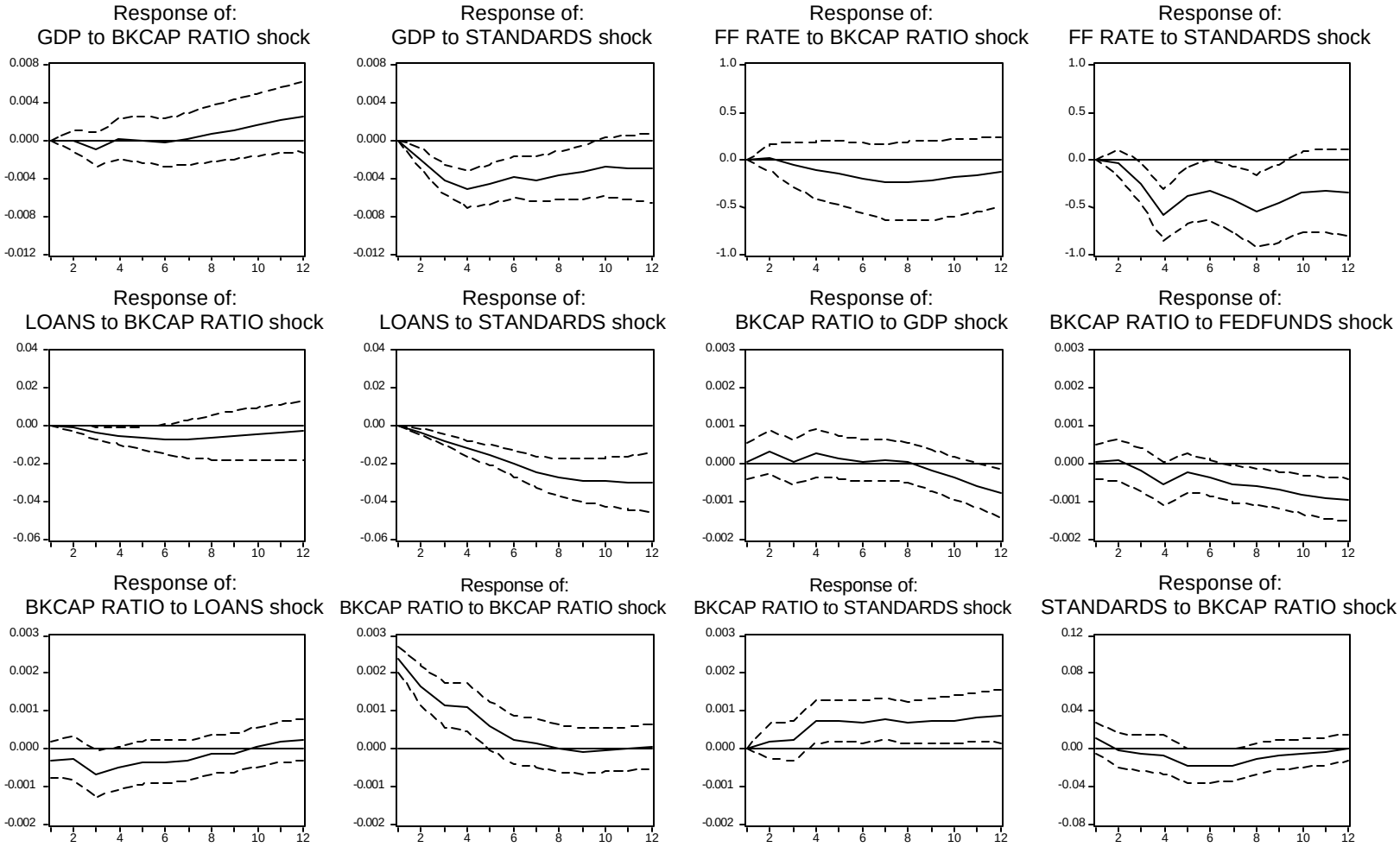
Notes: Core VAR includes (in order): log GDP, log GDP deflator, log commodity prices, federal funds rate, log C&I loans, standards (net % tightening); four lags of each variable. Estimation period: 1967:1-84:1 and 1990:2-2000:2.

Chart 3:
Core VAR + non-financial business failure rate



Notes: VAR includes (in order): log GDP, log GDP deflator, log commodity prices, federal funds rate, log C&I loans, non-financial business failure rate, standards (net % tightening); four lags of each variable. Estimation period: 1967:1-84:1 and 1990:2-2000:2.

Chart 4:
Core VAR + capital-asset ratio at banks



Notes: VAR includes (in order): log GDP, log GDP deflator, log commodity prices, federal funds rate, log C&I loans, bank capital-asset ratio, standards (net % tightening); four lags of each variable. Estimation period: 1967:1-84:1 and 1990:2-2000:2.