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The Credit Cycle and the Business Cycle: New Findings Using the Loan Officer Opinion Survey

VAR analysis on a measure of bank lending standards collected by the Federal Reserve reveals that shocks to lending standards are significantly correlated with innovations in commercial loans at banks and in real output. Credit standards strongly dominate loan rates in explaining variation in business loans and output. Standards remain significant when we include various proxies for loan demand, suggesting that part of the standards fluctuations can be identified with changes in loan supply. Standards are also significant in structural equations of some categories of inventory investment, a GDP component closely associated with bank lending. 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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FOR MOST OF the last 35 years, economists at the Federal Reserve have asked a sample of loan officers at large U.S. banks some version of 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.

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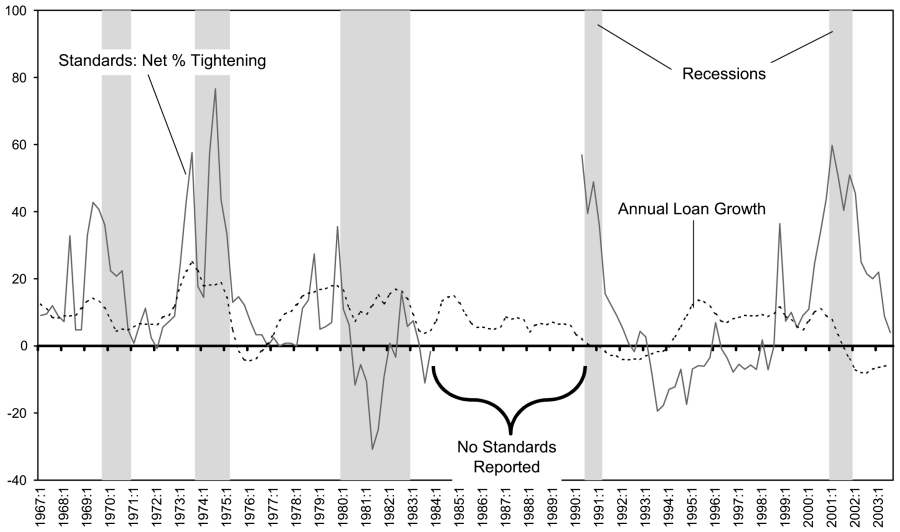

FIG. 1. Change in Commercial Credit Standards, C&I Loan Growth, and Recessions

Lenders' responses to the question on standards—the net percent reporting tightening standards—are plotted in Figure 1. Note the gap in the series between 1984 and 1990, when the question was not put to lenders. Observe that tighter standards are usually followed by slower commercial loan growth and that all but one recession were preceded by a sharp tightening in standards.

This paper investigates the correlation between these reported changes in standards and the subsequent fluctuations in lending and spending. Along the way, we investigate several long-standing macroeconomic questions. To what extent do bankers allocate business loans by changing standards as opposed to changing loan rates? How does economic activity depend on credit "availability," and vice-versa? These seemingly old-fashioned questions are actually close cousins of modern research on financial market frictions and their role in business fluctuations. The same sorts of informational frictions that give rise to bank lending or balance sheets effects stressed in the latest generation of literature can also cause the credit rationing and availability effects emphasized in the previous generation. The language and models have evolved, but the issues are fundamentally similar. 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.

We treat credit standards as an endogenous variable in a small vector auto regression (VAR) that controls for recent macro and monetary conditions. Even with standards ordered last in the VAR—the most conservative ordering—we find that shocks to standards account for most of the variance decomposition in business

lending, far more than are accounted for bank loan spreads. Innovations in standards also account for a sizable share of the variance decomposition of output. Standards are still significant when we add various proxies for commercial credit quality and demand (business failures) and forward looking variables (forecasted GDP and interest rate spreads). To get some sense of the economic magnitudes involved here, we add the standard series to a structural equation for inventory investment, an especially volatile spending component that is closely linked to bank lending. Tightenings in standards are a significant drag on retail and wholesale inventory investment (though not manufacturing). Estimates from the former equations imply that even a moderate tightening in standards—only about half as large as the typical pre-recession spike in Figure 1—slows the rate of inventory investment by the same order of magnitude as the overall decline in spending during the typical recession.

1. THE MEANING OF "STANDARDS"

We use "standards" to refer to any of the various non-price lending terms specified in the typical bank business loan or line of credit: collateral, covenants, loan limits, etc. One goal here is to show that the standards series in this paper makes a reasonable index for the full vector of non-price lending terms. Our concept of standards is closely tied to the informational frictions that occupy so much of the modern literature on credit markets. If lenders and borrowers have the same information about the credit risk in a transaction, the risk gets priced and allocated like any other good (or bad)—by price. With asymmetric information, credit gets elevated from a simple quantity-price commodity to a more complicated loan contract with detailed *non-price* terms.

The notion that the "price" of credit is a vector of terms (not just a simple scalar) goes back some ways in the literature:

> A recurrent theme in the literature and among market participants is that the interest alone does not adequately reflect the links between financial markets and the rest of the economy. Rather, it is argued, the availability credit and the quality of balance sheets are important determinants of the rate of investment (Blanchard and Fischer, 1989, p. 478)

Proponents of the "availability doctrine" in 1950s maintained that monetary policy operated more through changes in the "availability" of credit than through changes in rates (Roosa 1951), although they failed to explain why a lender would operate that way (except when constrained by interest rate ceilings). Keeton (1979) and Stiglitz and Weiss (1981) showed that "quantity rationing" can result endogenously in a variety of models where credit quality varies inversely with the level of interest rates (because of adverse selection or moral hazard among borrowers). Bernanke and Gertler (1989) argue that these frictions wax and wane over the course of

the business cycle; improved balance sheets during booms induce lenders to ease credit terms, and easier terms prolong the expansion.

Our paper is not strictly a test of any of these models. We invoke them here simply to establish the possibility that credit conditions warrant attention as a possible factor in business fluctuations. Credit conditions are not just passive reflections of fundamental economic conditions as in a classical model, but rather the credit cycle can influence the course of the business cycle.

2. MEASURING STANDARDS

The Federal Reserve collects information on bank credit standards in its Senior Loan Officer Opinion Survey on Bank Lending Practices, a quarterly survey of major banks around the country. The number of participating banks has declined (along with the number of U.S. banking firms in the industry) from about 120 banks in the early years of the survey to roughly 60 today. Participants are typically the largest banks in their district and are expected to have a sizable share of business loans in their portfolio. In aggregate, participating banks account for about 60% of all loans by U.S. banks and about 70% of all U.S. bank business loans. Questionnaires are transmitted *via* fax or telephone to participating loan officers by Federal Reserve economists in each district, who check responses, follow up as necessary, then transmit completed surveys back to the Federal Reserve Board economists for tabulation. The response rate is virtually 100%.[1]

Minor diction changes in the question on standards (p. 1) over the years necessitated some splicing to come up with a single series. Starting in 1978, when the prime loan rate emerged as an important benchmark, loan officers were asked to report separately on standards for loans made *at* prime rate and for loans at *above* prime. For that period (1978–84), our series is the average of the responses to the two questions. The question was dropped from the survey in 1984. Bank interest rates were deregulated about the same time. With unfettered rates, Board decision makers may have reasoned that non-price terms, like standards, would matter less in the loan allocation process (Schreft 1991).[2] The question was reinstated in 1990:2 in response to concerns about a commercial lending crunch. Since then, lenders

1. Banks are added or replaced as needed, mostly because of mergers between participating banks. The Federal Reserve also conducts occasional *ad hoc* surveys when market events seem to warrant. We limit our study to data from the regular survey only. 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. Our spliced series on C&I standards can be found at http://www.ny.frb.org/rmaghome/economist/morgan/pubs.html (click on Standards). Recent survey results can be found at http://www.federalreserve.gov/boarddocs/SnLoanSurvey/.

2. Interest rate constraints may be sufficient to motivate non-price credit allocation, but are not necessary; incentive and informational constraints may also lead to such mechanisms. In fact, bank standards did become less volatile relative to loan rates after interest rate deregulated (Keeton 1986), suggesting that institutional constraints were part of why lenders resorted to non-price mechanisms.

have reported separately on standards for small and standards for larger firms; we use the latter, but the 0.96 correlation between the series makes that choice irrelevant.

The resulting series plotted in Figure 1 is a *net* percent tightening: the number of loan officers reporting tightening standards less the number reporting easing divided by the total number reporting.[3,4] Lown, Morgan, and Rohatgi (2000) find that the standards reported by loan officers are highly negatively correlated with aggregate commercial loan growth and with various measures of economic and business activity. The VAR analysis here takes up where the mostly single-equation methods in Lown et al. (2000) left off.

3. VAR RESULTS

The core of our VAR comprises just four variables: log real GDP, log GDP deflator, log commodity prices, and federal funds rate. These four variables represent a potentially complete macro economy with "supply" (commodity prices), "demand" (the federal funds rate), output, and prices. Versions of this model have been widely used in the macro and monetary literature (e.g., Christiano, Eichenbaum, and Evans, 1996, Bernanke and Mihov, 1998). We purposely chose an off-the-shelf model in order to keep attention on the data.

We model the commercial credit market with just two variables: the volume of commercial loans at banks and the net percent of loan officers reporting tightening commercial credit standards. We ordered the credit variables after the macro variables, with standards last, and loans second-to-last. The VARs include four lags each of every variable. All models were estimated over the disjoint time period for which we have standards data 1968:1–1984:1 and 1990:2–2000:2 (see Table 3 for summary statistics).[5]

Table 1 reports coefficient sums and significance levels for three VARs. The first model includes C&I loans, but not standards (left panel). Note that past values of output are significant in the loan equation, but loans are insignificant in the output equation. This confirms the familiar result that output "causes" loans (in the VAR sense), but not vice-versa (King 1986, Ramey 1993). Lagged output enters the

3. 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.

4. Schreft and Owens (1991) provide an interpretive history of the commercial standards series and note some dubious features of the data (e.g., the apparent aversion to reporting easings in early year). In a series of articles, Harris (1973, 1974a, 1974b, 1975) documents a significant, positive correlation between commercial credit standards, loan rates and other non-price terms. None of those articles investigates the relationship between standards, lending, and output, however. Duca and Garrett (1995) investigate a related series collected by the Federal Reserve on *consumer* credit standards. The consumer series is continuous, but its correlation with the commercial series is too low to use it to fill the gap in the commercial series.

5. The Senior Loan Officer Survey is conducted four times per year, but the surveys are not always three months apart. In those events, we matched the January survey with first quarter observations on the other variables, the May survey with second quarter data, etc. We use the average of the federal funds rate over the quarter.

TABLE 1

SUMS OF COEFFICIENTS AND *P*-VALUES IN ALTERNATIVE VECTOR AUTO REGRESSION MODELS

	Model 1				Model 2				Model 3			
	Dependent variable				Dependent variable				Dependent variable			
Independent variable	Real GDP	Fed. Funds	C&I Loans	Standards	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

NOTES: Sum of coefficients on lags of each independent variable is reported first (*P*-value in parentheses). Joint significance of each set of lags (i.e., *P*-value for *F*-test) reported second. All models comprise four lags each of log real GDP, log GDP deflator.

loan equation with a positive coefficient sum, implying a procyclical output-loan correlation. Note also that loans and the federal funds rate cause one another, although the relationship between the two is not necessarily intuitive.

The second VAR includes standards (middle panel). Past standards are highly significant in the equations for output and loans, with tightening standards associated with lower future levels of loans and output. Note the reverse causality from loans *to* standards; higher past loan levels are associated with tighter, future standards. Standards and past output are not directly related, but there is an indirect link *via* the positive correlation between past output and loans: higher output leads to higher loans, hence higher standards. Controlling for that indirect effect is important; otherwise, we confound the indirect, positive effect of past output on standards (via loans) with the direct *negative* effect of standards on future output. We show this by simply dropping loans from the VAR (right panel). Without loans, past output appears positively correlated with standards and the link from past standards and output is much less negative.[6]

Impulse Responses. Figure 2 plots impulse responses and standard error bands for the VAR model with loans and standards.[7] The typical standards shock amounts to an 8% increase in the net fraction tightening, which is significantly different from zero but substantially less than observed during the 1990 "crunch." The fraction tightening remains significantly above zero for about three quarters. After about nine quarters, lenders commence easing.[8] Loans, output, and the federal funds rate all decline significantly in response to the standards shock. Loans contract almost immediately and continue to decline until bankers start easing standards. At the trough, loan volume is about 3% lower than before the shock to standards. Output declines significantly in the quarter immediately after the standards shock and remains significantly below its initial rate for almost two years. At its trough, output is about 0.5% lower than before the shock.[9] The federal funds rate also tends to fall after the tightening in standards. The decline becomes significant about three quarters after the shock, by which time the funds rate has been lowered by about 50 basis points.

Shocks to both commodity prices and loans cause lenders to tighten standards. Innovations in loans have a prompt, persistent, and significant impact on standards: a

6. Past commodity prices are significant in predicting standards, but not vice-versa. Some of the relationships observed in the VAR without standards change when we add standards. Lagged output predicted loans in the model without standards, but not vice-versa. With standards, the causality goes both ways. Loans and the federal funds rates were *positively* related in the model without standards, not an entirely sensible result. With standards, loans and the funds are not significantly related.

7. The standard error bounds were generated using the Monte Carlo integration program provided in RATS V.5, 2000. See Users Guide (p. 300) and references therein.

8. This seesaw effect 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.

9. 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.

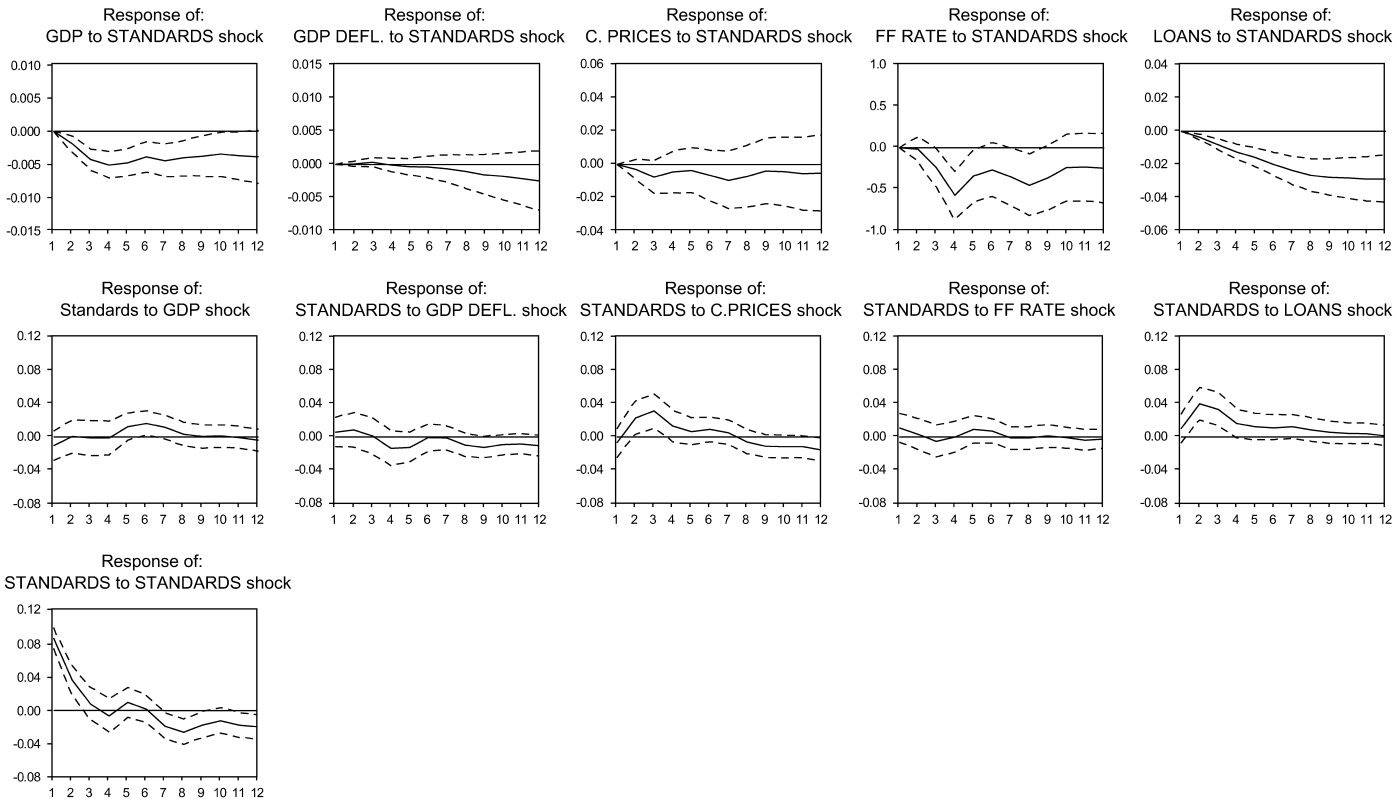

FIG. 2. Impulse Responses for Core VAR

one standard deviation increase in the log of loans (about 1.0%) increases the net fraction tightening by approximately 4.0% two quarters later. Shocks to the federal funds rate do not affect standards: standards tend upward after an innovation in the federal funds rate, but the response is never significant.[10]

Variance Decompositions. Innovations in standards account for nearly a third of the error variance in output at four quarters, even more than is attributable to innovations in the federal funds rate (Table 2). Standards shocks account for an even larger share of the errors in loans: 15% at three quarters, and nearly two-thirds at 12 quarters. The feedback from loans to standards, noted earlier, shows up here too: innovations in loans account for about 20% of the forecast errors in standards. Ignoring that feedback by omitting loans reduces the share of output shocks attributable to standards shocks to less than 10% (at most).[11] Shocks to standards account for 16% of federal funds innovations at the 12-quarter horizon. In sum, these decompositions largely confirm the earlier results: standards are important in accounting for loans, output, and the federal funds rate, but only loans matter (directly) in accounting for standards.

Robustness. Differencing GDP, the deflator, commodity prices, and loans did not alter the impulse results in a substantive way, nor did using eight instead of four 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, 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 reject symmetry.

4. EXTENDED VARs

The VAR results thus far indicate a strong statistical link between business lending standards, business loans, and economic activity, with tightenings in standards followed by contractions in loans and GDP. While it is tempting to identify the changes in standards with changes in bank loan *supply*, there is an obvious demand side interpretation as well. Tighter standards could signal some other negative disturbance to economic activity that reduces the demand for loans at the same time banks tighten standards. The cutting edge, however, that reduces loan quantities might be the reduction in borrower demand rather than any change in lending standards. Sorting out the correct structural interpretation of our VAR results will likely require a model. Short of that, we make some headway on the identification issue here by extending the VAR with additional variables that are (arguably) identified with either loan demand or supply.

10. We do not include a loan rate because once we control for standards, loan rates (or spreads) have no additional power for explaining loans or output. Lown and Morgan (2002) find no explanatory role for of standards in the monetary transmission more fully.

11. Ten percent of the innovations in standards is attributable to commodity price shocks (at most).

TABLE 2

VARIANCE DECOMPOSITIONS

Horizon quarters	Real GDP	Fed. Funds	C&I Loans	Standards
		Real GDP		
1	100 (0)	0 (0)	0 (0)	0 (0)
2	88 (5.4)	2 (2.0)	2 (2.5)	6 (3.1)
3	72 (7.7)	3 (1.8)	3 (3.5)	21 (6.0)
4	57 (9.2)	3 (3.1)	3 (3.8)	31 (7.5)
8	24 (9.3)	19 (8.5)	1 (3.6)	31 (8.8)
12	14 (7.8)	21 (9.7)	1 (3.4)	23 (9.3)
		C&I Loans		
1	5 (4.1)	14 (6.6)	73 (8.2)	0 (0)
2	4 (4.0)	8 (5.4)	66 (9.7)	5 (2.8)
3	6 (5.4)	5 (5.4)	55 (10.4)	15 (6.0)
4	9 (7.0)	5 (5.2)	43 (10.4)	25 (8.6)
8	17 (9.9)	3 (4.2)	16 (8.6)	52 (12.7)
12	14 (10.0)	2 (3.3)	9 (8.0)	66 (13.9)
		Standards		
1	1 (2.9)	1 (2.9)	1 (3.3)	95 (4.9)
2	1 (2.7)	1 (2.6)	15 (7.8)	77 (7.9)
3	1 (3.0)	1 (2.6)	20 (8.9)	66 (8.8)
4	1 (3.4)	1 (2.9)	21 (8.9)	63 (8.5)
8	3 (4.1)	2 (3.4)	20 (7.9)	60 (8.3)
12	5 (3.6)	2 (3.8)	18 (7.4)	58 (9.4)
		Federal Funds Rate		
1	6 (4.8)	90 (6.0)	0 (0)	0 (0)
2	15 (7.5)	66 (8.7)	0 (0.6)	0 (0.7)
3	25 (9.8)	47 (9.2)	0 (1.3)	2 (2.4)
4	26 (10.6)	36 (8.3)	0 (1.5)	11 (5.1)
8	25 (11.6)	25 (8.0)	0 (2.5)	14 (7.3)
12	23 (11.2)	21 (7.9)	1 (4.1)	16 (9.2)

NOTES: 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 enter last in the VAR. See Table 1 for VAR model description. Decompositions of commodity prices and deflator and their contributions are not reported. Standard errors in parentheses.

Our list of proxies, summarized in Table 3, is motivated by a mix of theory, findings elsewhere in the literature, and the reports of loan officers' themselves.[12] Expected output is an obvious fundamental determinant of credit demand; lower expected output likely implies lower expected returns on investment and hence, reduced demand for credit.[13] Business failures should also serve as reasonable proxy for demand; with high failures indicating diminished investment prospects and thus, reduced demand for credit. The coverage ratio—interest payments divided by cash flow—is intended to proxy for credit quality as well. The commercial paper-Treasury

12. 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.

13. 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 or 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.

TABLE 3

DATA DEFINITIONS, SUMMARY STATISTICS, AND SOURCES

Variable	Definition	Time Period	Summary Statistics					Source(s)
			Obs	Median	SD	Minimum	Maximum	
Loan Rate	C&I loan rate, annualized (mode at banks)	1967:1–1983:4	68	7.99	3.96	4.90	20.33	Federal Reserve Board Statistical Release H.8: Assets and Liabilities of Commercial Banks
		1990:2–2000:2	41	7.12	1.29	4.83	10.08	
Coverage Ratio (nonfinancial firms)	Net interest payments/(net interest payments + cash flow)	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	
Bank Capital/Asset Ratio	U.S. bank capital/U.S. bank assets	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	Liabilities of failed domestic firms/gross product of nonfinancial corporate firms	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	
Expected, Real GDP	Four-quarter ahead forecasted GDP (median forecast)	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	Six-month commercial paper rate (nonfinancial). T-bill rate (six-month until 1971; (three months after 1971)	1967:1–1983:4	68	0.73	0.62	0.03	3.51	Federal Reserve Board Statistical Release H.15: Selected Interest Rates
		1990:2–2000:2	41	0.43	0.16	0.18	0.91	

(*Continued*)

TABLE 3

CONTINUED

Variable	Definition	Time Period	Summary Statistics					Source(s)
			Obs	Median	SD	Minimum	Maximum	
Commodity Price Index	JOC-ECRI industrial price index, spot inflation rate smoothed, annualized (1996 = 100)	1967:1–1983:4	68	53.15	21.25	27.00	87.90	DLX, USECON
		1990:2–2000:2	41	88.70	7.93	79.50	106.50	
GDP	Billions of chained 2000 dollars, quarterly, SAAR	1967:1–1983:4	68	4364.20	630.24	3464.10	5590.50	DLX, USECON (GDPH)
		1990:2–2000:2	41	7988.00	859.27	7040.80	9847.90	
GDP Deflator	Implicity price deflator, quarterly, SA (2000 = 100)	1967:1–1983:4	68	37.96	13.40	23.61	66.01	DLX, USECON (DGDP)
		1990:2–2000:2	41	91.86	5.25	81.31	99.75	
Federal Funds Rate	Effective rate, p.a.%	1967:1–1983:4	68	7.55	3.65	3.55	17.79	DLX, USECON (FFED)
		1990:2–2000:2	41	5.31	1.30	2.99	8.24	
Standards	Net percentage of domestic respondents tightening standards for C&I loans (large and medium banks only)/100	1967:1–1983:4	68	0.07	0.19	−0.31	0.77	Senior Loan Officer Opinion Survey on Bank Lending Practices
		1990:2–2000:2	41	0.00	0.18	−0.19	0.57	
C&I Loans	Billions of dollars, monthly	1967:1–1983:4	68	184.72	99.68	80.53	415.43	Federal Reserve Board Statistical Release H.15: Selected Interest Rates
		1990:2–2000:2	41	694.63	142.16	590.53	1048.83	

TABLE 4

COEFFICIENTS SUMS AND P-VALUES IN EXTENDED VECTOR AUTO REGRESSION (VAR)

	Dependent variable:				Dependent variable:		
Independent variable:	Real GDP	C&I Loans	Standards	Independent variable:	Real GDP	C&I Loans	Standards
Standards	−0.045	−0.061	0.622	Standards	−0.038	−0.067	0.314
	(0.001)	(0.001)	(0.003)		(0.009)	(0.001)	(0.102)
	0.000	0.000	0.001		0.007	0.002	0.176
Loan Rate	0.001	−0.002	−0.044	Bus. Failure Rate	−0.011	0.005	0.556
	(0.791)	(0.520)	(0.228)		(0.295)	(0.743)	(0.000)
	0.609	0.022	0.403		0.878	0.907	0.006
Standards	−0.043	−0.057	0.680	Standards	−0.050	−0.065	0.746
	(0.000)	(0.001)	(0.000)		(0.000)	(0.000)	(0.000)
	0.000	0.000	0.000		0.000	0.000	0.000
Coverage Ratio	−0.001	0.000	0.015	Expected Real GDP	−0.010	−0.023	−0.134
	(0.037)	(0.920)	(0.111)		(0.522)	(0.310)	(0.567)
	0.076	0.792	0.295		0.952	0.679	0.906
Standards	−0.046	−0.063	0.702	Standards	−0.042	−0.054	0.787
	(0.000)	(0.000)	(0.000)		(0.000)	(0.001)	(0.000)
	0.000	0.000	0.000		0.002	0.001	0.000
Bank Capital/	0.012	−0.783	−5.609	Paper-Bill Spread	−0.003	−0.003	−0.024
	(0.964)	(0.031)	(0.161)		(0.452)	(0.642)	(0.736)
	0.282	0.127	0.323		0.258	0.068	0.590

Var models include the core variables described in Table 1, plus the variable indicated below. Reported 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.

bill spread is another forward looking variable, with spikes serving as a (usually) reliable signal of future contractions in activity.[14] We included capital/asset ratios at banks as a potential determinant of bank loan supply.[15] We also add a loan rate, or spread, to see which variable—standards or loan rates—seems most important in explaining loan levels. The extra variables are added one at a time to the VAR, and in the penultimate position (before standards, but after every other variable).

Table 4 reports abbreviated sets of exclusion tests for each of the extended VARs. Even with the extra variables in the models, standards remain highly significant in predicting loans and output, in fact, most of the extra other variables pale in comparison. Given standards, lagged loan rates are insignificant in predicting output. Lagged loan rates are significant (by the *F*-test) in predicting loan levels, but the sum of coefficients on the lagged loans rates is insignificant. Past values of the interest-coverage ratio are marginally significant in predicting real GDP, but less so than standards.

Of the extra variables, only the business failures rate is significant in explaining standards. A higher rate of failures is associated with tightening standards, as one

14. Researchers have identified changes in the spreads with changes in monetary policy, increases in the extent of information problems, and simply increased risk or decreased risk tolerance.

15. In Bernanke and Gertler (1987), for example, capital is an essential determinant of banks' lending capacity; adverse capital shocks force banks to substitute safe securities for riskier loans in order to satisfy market imposed capital requirements. Capital is also rated high by loan officers as a reason for changes in standards.

would expect. Given the failure rate, the current change in standards is related to its own past changes at only the 10% 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.[16]

We investigated the VAR with the business failure rate in further detail, since this 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 (Figure 3, lower right). Even after accounting for the effect of failures on standards, however, a standards shock still causes output to slow significantly.[17]

Innovations in the failure rate account for about 10% of the variance decomposition of 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 5). The share attributable to standards increases to about 15% 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% at four quarters and 28% at eight 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 this variable in the 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 (Figure 4, lower right). The response of standards is marginally significant (between 5% and 10%) 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% of the variance decomposition of standards at eight quarters. Again, we view this mixed-to-weak result more as a problem with using book-value capital series than as evidence against the notion that capital positions can sometimes constrain bank lending.[18]

In sum, the significance of the business failure rate in explaining credit standards provides some support for the idea that standards are altered in response to changes in firms' financial health. The marginal significance of bank capital suggests some role for bank balance sheet health as well. Yet even with the inclusion of these determinants of credit standards, the remaining unexplained or exogenous part of standards appears to play a significant role in accounting for movements in lending and output.

16. The insignificant relationship between bank capital ratios and standards might partly reflect our use of book capital rather than market capital. We are also missing data for 1984–90, when banks were anticipating tightening capital constraints under the Basle Accord.

17. The VAR ordering is standards last and failures second-to-last, so the innovation in standards is orthogonal to the contemporaneous innovation in failures.

18. We have also considered other bank variables such as the ratio of nonperforming loans to total loans and an index of bank stock prices. These variables were not significant in explaining standards, nor did they displace standards in explaining output or loans.

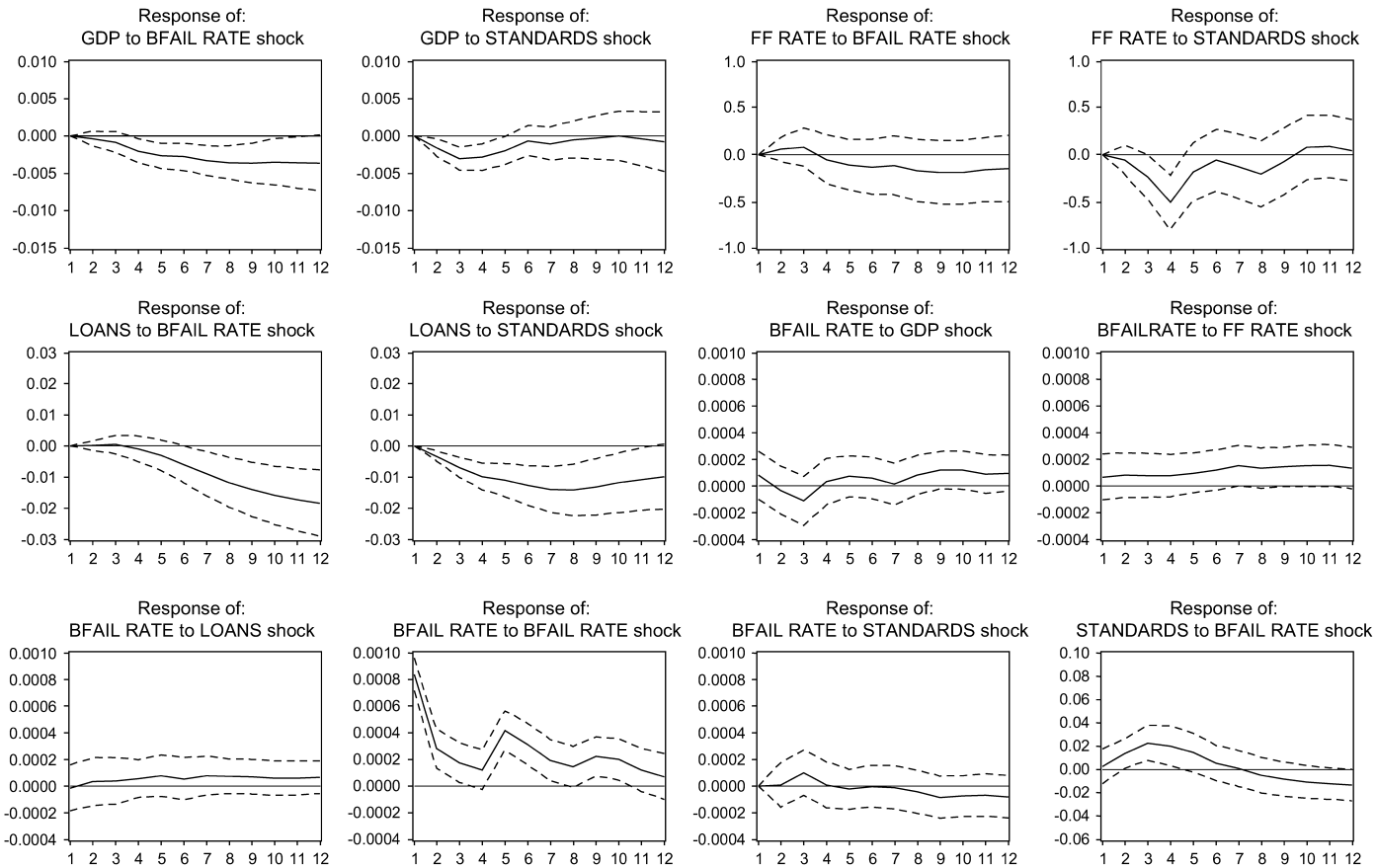

FIG. 3. Core VAR + Non-financial Business

TABLE 5

VARIANCE DECOMPOSITIONS FROM EXTENDED VARS

I. 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 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
2	88 (6.0)	3 (2.8)	3 (3.1)	0 (1.1)	4 (3.2)
3	76 (8.5)	3 (2.2)	3 (4.0)	1 (2.1)	12 (6.3)
4	61 (9.7)	3 (3.2)	3 (4.3)	4 (3.8)	15 (7.4)
8	25 (7.5)	23 (8.9)	2 (3.4)	12 (6.2)	7 (5.1)
12	17 (8.2)	24 (10.3)	1 (3.5)	11 (7.2)	3 (4.2)

B. Percentage of loan variance attributed to shocks to:

Horizon quarters	Real GDP	Fed. Funds	C&I Loans	Business Failures	Standards
1	6 (5.0)	14 (6.0)	70 (7.8)	0 (0.0)	0 (0.0)
2	5 (4.9)	8 (5.0)	64 (9.1)	0 (0.5)	4 (2.7)
3	6 (6.1)	7 (5.1)	55 (10.4)	0 (1.0)	12 (5.9)
4	7 (7.4)	7 (5.8)	45 (11.1)	0 (1.4)	18 (8.1)
8	13 (10.3)	7 (6.5)	19 (9.9)	9 (7.5)	28 (11.2)
12	9 (9.0)	4 (5.7)	12 (8.5)	25 (12.8)	25 (12.3)

C. Percentage of standards variance attributed to shocks to:

Horizon quarters	Real GDP	Fed. Funds	C&I Loans	Business Failures	Standards
1	0 (1.7)	1 (2.0)	1 (2.2)	0 (1.7)	98 (4.5)
2	1 (2.8)	0 (1.9)	23 (7.6)	2 (2.6)	65 (7.9)
3	1 (3.0)	1 (2.4)	25 (8.1)	6 (4.1)	50 (7.6)
4	1 (3.3)	1 (2.6)	24 (7.9)	9 (4.8)	47 (7.6)
8	6 (5.3)	3 (3.6)	21 (7.1)	8 (4.4)	44 (7.5)
12	6 (5.2)	3 (3.8)	18 (6.4)	10 (4.7)	39 (7.3)

II. 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 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
2	88 (5.7)	2 (2.7)	2 (2.4)	0 (1.0)	6 (3.4)
3	72 (8.2)	2 (1.9)	2 (3.3)	1 (2.3)	19 (6.7)
4	57 (9.5)	3 (2.7)	2 (3.6)	1 (2.4)	30 (8.6)
8	27 (7.8)	17 (8.7)	1 (3.3)	0 (3.6)	32 (10.2)
12	17 (7.1)	19 (10.0)	1 (3.9)	2 (5.4)	22 (10.5)

B. Percentage of loan variance attributed to shocks to:

Horizon quarters	Real GDP	Fed. Funds	C&I Loans	Capital/Asset Ratio	Standards
1	3 (4.2)	14 (5.9)	74 (7.6)	0 (0.0)	0 (0.0)
2	4 (4.4)	8 (4.7)	64 (8.6)	1 (1.2)	5 (2.8)
3	7 (6.0)	5 (4.4)	49 (9.6)	4 (3.5)	15 (5.9)
4	10 (7.6)	5 (4.8)	35 (9.3)	5 (4.8)	26 (8.2)
8	18 (10.4)	4 (5.1)	10 (6.3)	5 (6.6)	49 (12.3)
12	14 (10.2)	3 (4.9)	6 (6.1)	3 (6.7)	63 (14.4)

(*Continued*)

TABLE 5
CONTINUED

III. VAR With C&I Loan Rate

C. Percentage of standards variance attributed to shocks to:

Horizon quarters	Real GDP	Fed. Funds	C&I Loans	Capital/Asset Ratio	Standards
1	2 (3.3)	1 (2.1)	2 (2.5)	2 (2.7)	93 (5.5)
2	2 (2.7)	1 (2.0)	16 (7.1)	1 (2.3)	76 (7.8)
3	1 (2.9)	1 (2.5)	20 (8.0)	1 (2.4)	66 (8.2)
4	1 (3.3)	1 (2.6)	20 (7.8)	1 (3.0)	64 (7.9)
8	6 (4.3)	2 (2.9)	16 (6.6)	8 (5.7)	57 (7.3)
12	5 (4.1)	2 (3.1)	15 (5.9)	7 (5.4)	56 (7.9)

A. Percentage of GDP variance attributed to shocks to:

Horizon quarters	Real GDP	Fed. Funds	C&I Loans	Loan Rate	Standards
1	100 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
2	89 (5.7)	2 (2.0)	2 (2.5)	1 (1.9)	5 (3.4)
3	74 (8.5)	3 (2.0)	2 (3.1)	1 (2.4)	18 (6.9)
4	61 (10.2)	5 (3.5)	2 (3.5)	1 (2.2)	26 (8.5)
8	26 (8.6)	17 (7.0)	1 (4.0)	2 (4.3)	27 (9.7)
12	14 (7.0)	15 (7.3)	1 (4.5)	1 (4.2)	25 (11.2)

B. Percentage of loan variance attributed to shocks to:

Horizon quarters	Real GDP	Fed. Funds	C&I Loans	Loan Rate	Standards
1	3 (3.7)	7 (4.6)	81 (7.1)	0 (0.0)	0 (0.0)
2	3 (4.0)	4 (3.6)	67 (8.3)	3 (2.0)	5 (2.5)
3	5 (5.4)	2 (2.8)	56 (9.5)	3 (2.6)	15 (6.2)
4	9 (7.2)	2 (2.8)	44 (10.0)	2 (2.9)	24 (8.9)
8	20 (11.3)	1 (2.1)	17 (8.4)	1 (3.2)	45 (13.5)
12	19 (12.1)	1 (3.1)	9 (6.6)	2 (4.8)	56 (15.3)

C. Percentage of standards variance attributed to shocks to:

Horizon quarters	Real GDP	Fed. Funds	C&I Loans	Loan Rate	Standards
1	2 (3.0)	3 (3.2)	1 (2.3)	2 (2.7)	93 (5.6)
2	1 (2.9)	2 (2.8)	15 (7.0)	2 (2.5)	74 (8.1)
3	1 (2.9)	2 (2.8)	21 (8.3)	2 (2.9)	62 (8.9)
4	1 (3.2)	2 (2.8)	22 (8.2)	2 (3.0)	60 (8.6)
8	4 (4.3)	3 (2.8)	21 (7.3)	5 (4.5)	53 (8.4)
12	4 (4.3)	3 (2.9)	19 (6.7)	5 (4.3)	51 (8.6)

NOTES: 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.

The final panel in Table 5 reports the variance decomposition for a VAR including the C&I loan rate (in the penultimate position). Innovations in the loan rate account for only a trivial (and insignificant) share of innovations output, loans, and standards. Innovations in standards still account for sizable (and significant) shares of the innovations in output and C&I loans, even with the loan rate included in the VAR. Figure 5 plots selected impulse responses from the VAR that includes the loan rate.

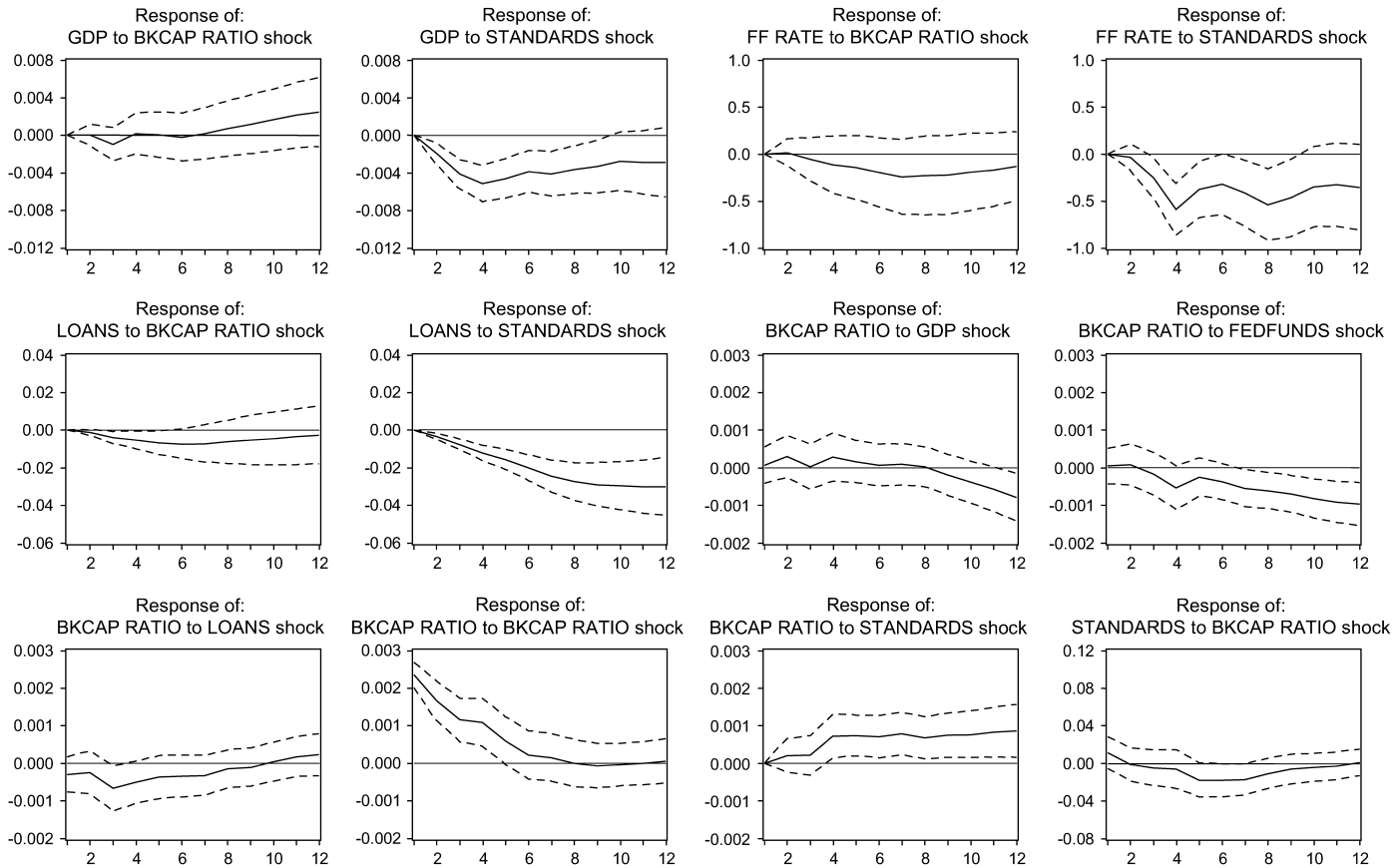

FIG. 4. Core VAR + Capital-asset Ratio at Banks

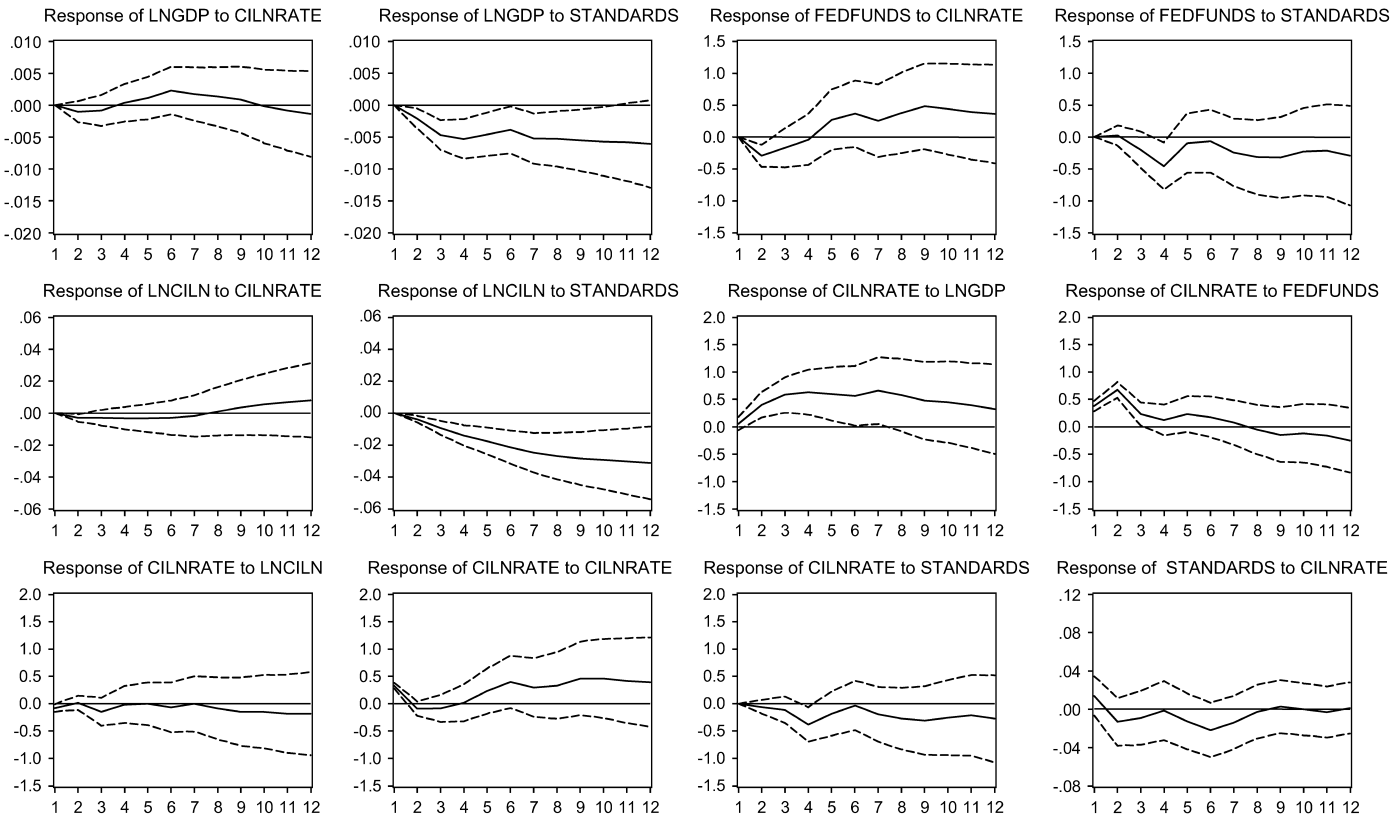

FIG. 5. Core VAR + C&I Loan Rate

The loan rate responds strongly and positively to innovations in output. Shocks to the loan rate cause loans to contract slightly, but the loan response is very brief, especially by comparison with the response of loans to a shock in standards.

5. 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. A similar strategy was used in the exploration of the "mix" variable by Kashyap, Stein, and Wilcox (1993). Inventory spending makes the ideal laboratory for this examination because (1) banks fund a substantial share of inventory investment, (2) fluctuations in inventory investment figure disproportionately in GDP fluctuations, and (3) 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 (2) and (3).

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

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

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 of 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 use lagged values of sales and all the other variables (including standards) as instruments for current sales.[19] For the real interest rate, we use the prime loan rate less the one-year inflation rate. We estimate Equation (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.

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

TABLE 6

STRUCTURAL INVENTORY INVESTMENT REGRESSION EQUATIONS WITH CREDIT STANDARDS

	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)	
$\Delta\text{Standards}_{t-1}$	−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

Reported are regression coefficients (standard errors). Dependent variable is inventory investment of type indicated. 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}–I_{t-1}), Real_{t-1}, Standards_{t-1}, ΔI_{t-1}, ΔS_{t-1}, ΔReal_{t-1}, $\Delta\text{Standards}_{t-1}$ as instruments. Standard errors are in parentheses. * and ** indicate significance at the 5% and 1% levels, respectively.

Table 6 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.[20] We can reject that the standards coefficients are jointly zero in the wholesale inventory equation at the 6% level. The irrelevance of standards in the retail inventory equation can be rejected at 2%. 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 the 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%) and wholesale inventory by 1.3 percentage points per year (compared to a mean of 5.2%, standard deviation of 5.6%). 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 mind also that the tightening in this experiment is gentle relative to the usual 40% net tightening before recessions (Figure 1).

20. 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.

6. CONCLUSIONS

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), lower levels of loans and slower rates of output can be expected with a high degree of confidence. Credit standards are far more informative about future lending than are loan rates, which is consistent with the idea that some sort of friction in lending markets leads 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 macroeconomic conditions and firm and bank financial health. Standards are also significant in structural inventory investment equations, where the role of standards is (arguably) identified with changes in the supply of credit.

We found feedback from loans *to* standards, suggesting a sort of credit cycle. Higher loan levels cause tightening standards, perhaps because lenders conclude (or are told by supervisors) that standards are too loose. Tighter standards are followed by lower spending and loan levels, which eventually cause *easing* standards and higher spending and loan levels . . . *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 to counter 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 relationship between banks' capital ratios and their lending via standards but that link between bank capital and lending standards 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.

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