Credit Standards & Financial Institutions Leverage[1]

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[1] The views expressed in this paper are those of the authors and do not necessarily represent those of the European Central Bank, Banque de France, Bank of England or the Eurosystem.

Outline

The cyclicality of credit extension

- The importance of credit extension for the real economy has been highlighted in the literature (Bernanke (1983), Bernanke and Gertler (1989))
- Variations in credit can have an effect on the business cycle through a lending and a reinforcing balance sheet channel
- The Senior Loan Officer Opinion Survey on Bank Lending Practices carried out by the Federal Reserve provides a measure of cyclicality in credit as it reflects the criteria on which banks' lending decisions are based
- As shown e.g. by Lown and Morgan (2006), recessions have often been preceded by a tightening in lending standards

The role of agents' expectations

- While changes in banks' lending standards Granger-cause changes in output, loan volume and the federal runds rate, these macro-variables fail to explain variation in the lending standards (Lown and Morgan (2006))
- This paper takes a step back and attempts to identify variables that can act as leading indicators for the cyclicality in lending standards
- The intuition for the selection of the leading indicator is derived from Geanakoplos (2003) and Bhattacharya et al. (2011)
- Bhattacharya et al. (2011) show that periods of prosperity can invoke optimism about future economic conditions and result in financial institutions increasing their borrowing and shifting their portfolios towards riskier assets

Objective of the paper I

Identify a leading indicator for expected future credit conditions

- Changes in credit standards should only depend on realized shocks, but also on the past behaviour and risk-taking of financial institutions
- Test whether a measure, which captures risk-taking and leverage in the financial system, carries any additional information about the cyclicality in credit standards
- Compare quantity-based to price-based measure in their ability to act as leading indicators for lending standards

Objective of the paper II

Empirically test some of the predictions of leverage cycle theories

- These theories predict an asymmetric response by financial institutions in good and bad times
- In good times, FI are more optimistic about the future prospects of the economy, they increase their leverage and potentially their risk-taking
- On average, this should result in bigger losses should a bad shock occurs, a correction in expectations and a tightening in lending standards
- On the contrary, an increase in risk-taking and leverage in bad times should signal a recovery and an improvement of credit conditions

Guiding principles for econometric model

- On aggregate credit conditions can be characterized either as improving or deteriorating
- There is a need for a model which can distinguish between these to regimes
- Also, the change in credit conditions should depend on the level of past conditions and the specific point in the financial cylce
- Allow for time-varying transition probabilities between regimes dependent on our leading indicator

Modeling the cyclical behaviour of credit conditions I

- **Time-varying transition probability MS model (TVTP):** Filardo (1994) (see also Diebold et al. (1994), Filardo and Gordon (1998) and Layton and Smith (2007))
- State-dependent means and assuming normally distributed disturbances,

$$\begin{aligned} y_t &= \mu^0 + \Phi(L)(y_{t-1} - \mu^{S_{t-1}}) + \epsilon_t \text{ in state 0} \\ &= \mu^1 + \Phi(L)(y_{t-1} - \mu^{S_{t-1}}) + \epsilon_t \text{ in state 1} \end{aligned}$$

$\Phi(L) = \delta_1 + \delta_2 L + ... + \delta_d L^{d-1}$ is a lag polynomial, $\epsilon_t \backsim IIDN(0, \sigma^2)$, and $S_t \in \{0, 1\}$; thus the state-dependent mean $\mu^{S_t} = \mu^0 + \mu^1 S_t$

Modeling the cyclical behaviour of credit conditions II

- Credit conditions y_t have two regimes: $S_t = \begin{cases} 0 & \text{if } y_t < c \quad \text{(easing)} \\ 1 & \text{if } y_t > c \quad \text{(tightening)} \end{cases}$
- Move within and between the two regimes is governed by certain transition probabilities $P(S_t = s_t | S_{t-1} = s_{t-1}, z_t)$

$$= \begin{bmatrix} p(z_t) & 1 - p(z_t) \\ 1 - q(z_t) & q(z_t) \end{bmatrix}$$

with $p(z_t) = \frac{exp(\theta_{p0} + \sum_{m=1}^{M_1} \theta_{pm} h_{t-m})}{1 + exp(\theta_{p0} + \sum_{m=1}^{M_1} \theta_{pm} h_{t-m})}$ and $q(z_t) = \frac{exp(\theta_{q0} + \sum_{m=1}^{M_2} \theta_{qm} h_{t-m})}{1 + exp(\theta_{q0} + \sum_{m=1}^{M_2} \theta_{qm} h_{t-m})}$

Data

- Identify two series of data
- One to proxy our dependent variable, i.e. the credit conditions
- Another to act as a leading indicator, which proxies for risk-taking behaviour and financial leverage
- We focus on the US financial system due to data availability and a longer time span
- The data on credit conditions comes from the Federal Reserve Senior Loan Officer Opinion Survey (1990Q2 to 2011Q3)
- The data on leverage of commercial banks and security broker-dealers is obtained from the Federal Reserve Flow of Funds Accounts

Credit conditions data

Three candidate variables as proxies for banks' credit conditions:

1. Net tightening (used e.g. by Loan and Morgan (2006)):
   - Computed as the number of loan officers reporting tightening standards less the number reporting easing divided by the total number reporting
   - Captures non-price lending terms, such as standards of creditworthiness, collateral, etc.
2. Non-performing loans:
   - Computed as the ratio of non-performing loans ($\geq$90 days past due) to total loans
   - Drawback: overall loan quality deteriorates when the economy is already in the bad state (Jimenez and Saurina (2006))
3. Charge-off rates:
   - Loans are first classified as "non-performing" and second, if they are unlikely to be fully repaid, they are charged off => signalling deteriorating economic conditions even later

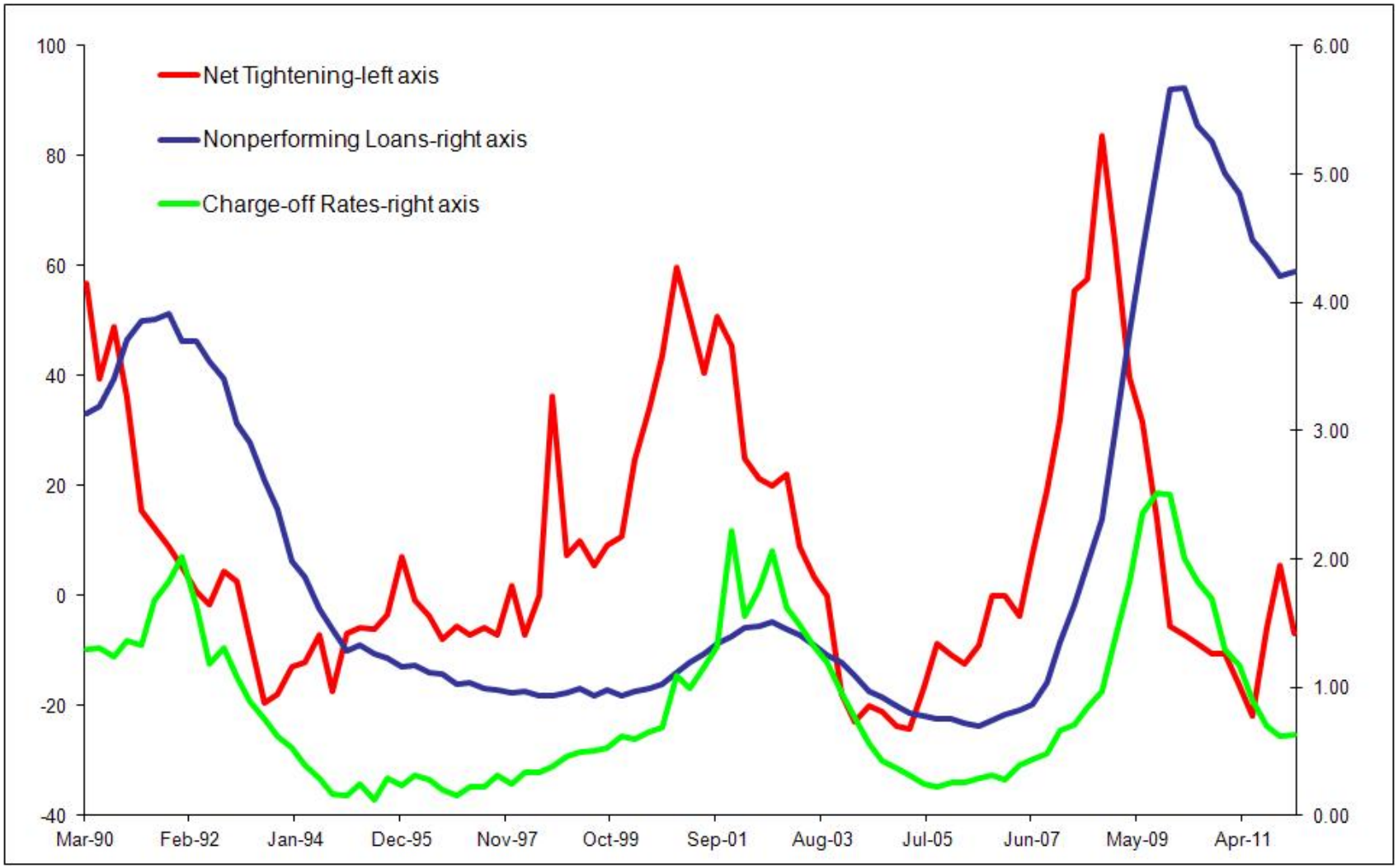
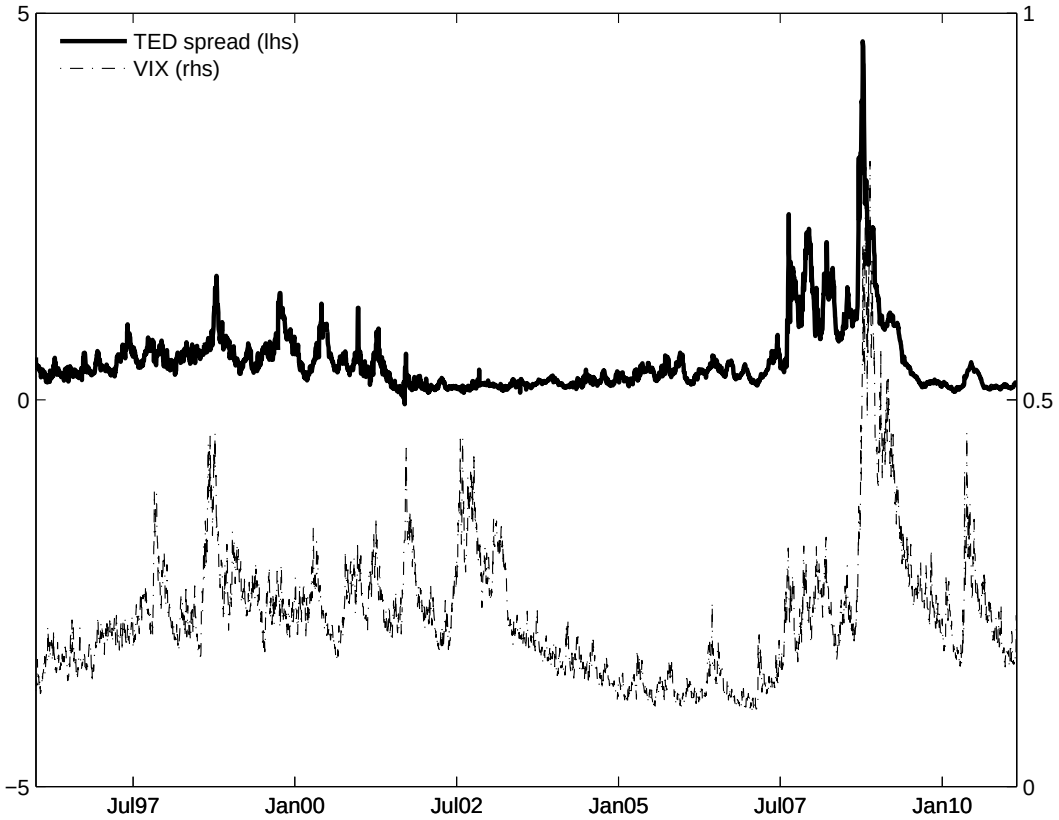


Figure : Net Tightening, Nonperforming Loans and Charge-off Rates

Risk-taking data I: Price-based measures

- **Price-based measures** include the expected default frequency (EDF) used by Altunbas et al. (2010), idiosyncratic bank volatility estimated through the approach proposed by Campbell et al. (2001), banks' credit default swap spreads (CDS) which have been shown by Andersson and Vanini (2010) to have underpriced credit risk before the crisis, the so-called Z-score used e.g. by Boyd et al. (2006) and Laeven and Levine (2009), banks' Value-at-Risk (VaR) which has certain drawbacks as stressed by Danielsson (2002)
- Most of these studies focus on the cross-sectional dimension of risk where these measures may be appropriate, but not in the time-series dimension (Borio et al. (2001))
- Price-based measures may fail to capture risk-taking as (procyclical) optimistic beliefs can bias them downwards (Adam and Marcet (2010))


TED spread (lhs)
VIX (rhs)
5
0
−5
1
0.5
0
Jul97
Jan00
Jul02
Jan05
Jul07
Jan10

Risk-taking data II: Quantity measures

- Borio (2003) argues that the credit gap can signal procyclicality
- We use a **quantity measure** as a measure of bank risk-taking in the US, namely the ratio of security broker-dealer liabilities to commercial banking liabilities for the following reasons:
  - Security broker-dealers played a central role in the ”securitized banking” of packaging and reselling loans (Gorton and Metrick (2009))
  - In contrast to commercial banks which targeted a fixed leverage ratio, security broker-dealers adjusted their leverage aggressively in response to changing economic conditions (Adrian and Shin (2010))
  - Less regulated financial institutions may face more competition than commercial banks and may thus seek more aggressively for higher yield in the margin (Hanson et al. (2010))

- We construct two series using the flow of funds data
- The first corresponds to the relative shift in riskiness (broker dealer's total liabilities over commercial banks' liabilities)
- The second signals the level of overall leverage in the financial system and is equal to the ratio of total assets to total equity of the two aforementioned types of financial institutions

Figure : Risk-taking behavior and leverage in the financial sector

Our indicator

- We argue that the combination of risk-taking behaviour and leverage in the financial system matters for future credit conditions
- Higher risk-taking should be less dangerous for the financial system and future credit conditions if it is accompanied by lower leverage
- An improvement in credit conditions during a recovery should stems from both a recovery in leverage and an improvement in the willingness to take risk

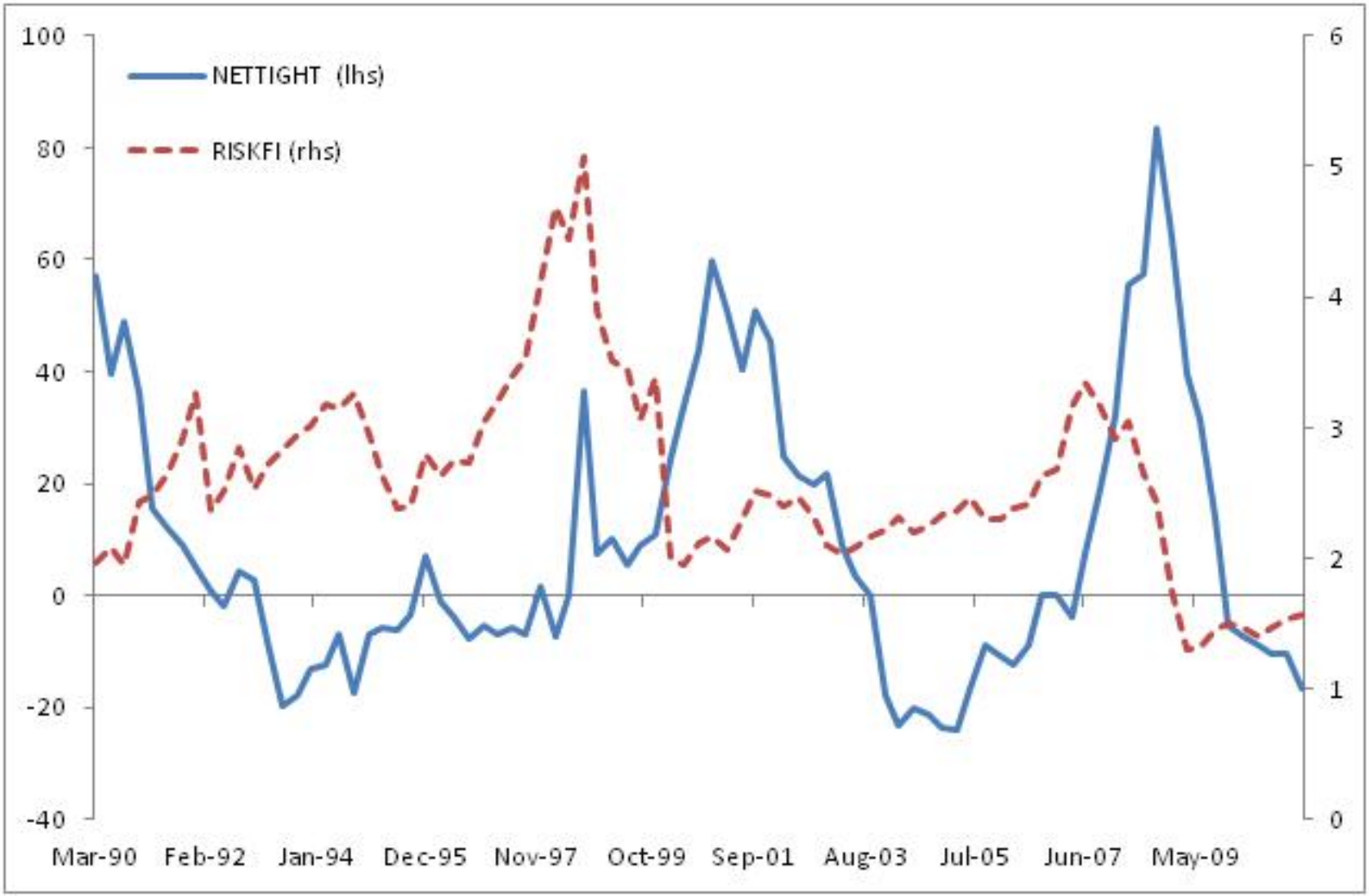


Figure : Net percentage tightening and our leading indicator

Our main results

Table : Estimation results - information variable RISKFI

Parameter	Value	t-statistic
Autoregressive component		
μ_0	-2.18**	(-2.34)
$\mu_0 + \mu_1$	21.14***	(9.40)
δ_1	0.77**	(34.87)
σ_ϵ	7.04***	(13.87)
Transition function component		
θ_{p0}	4.43***	(32.18)
θ_{p1}	-1.34***	(-17.07)
θ_{q0}	5.57***	(29.88)
θ_{q1}	-0.99***	(-16.75)

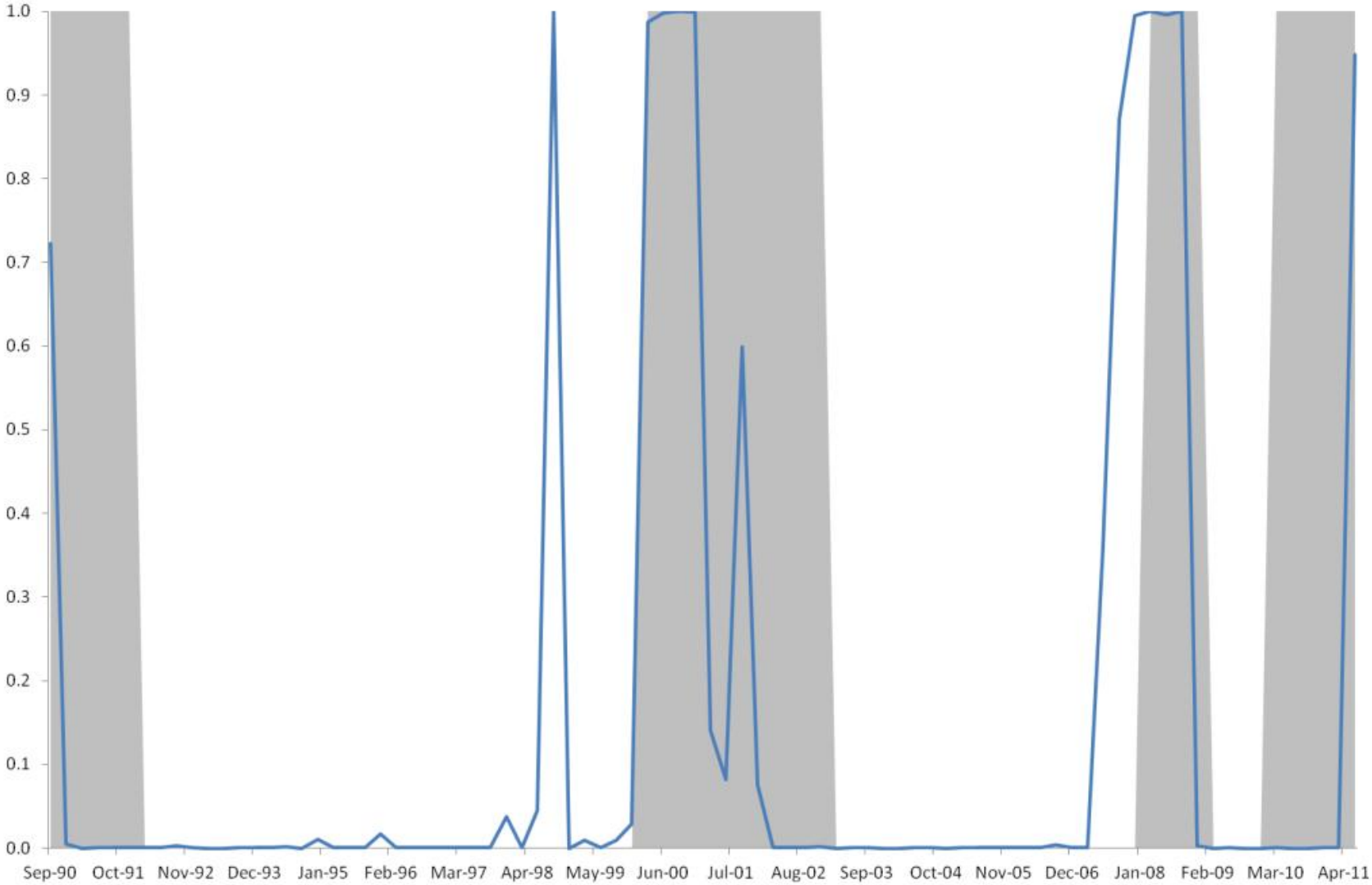


Figure : Inferred probability of a tightening regime given the available data

Table : Estimation results - information variables RISKSHIFT, LEVFI

	RISKSHIFT		LEVFI	
Parameter	Value	*t*-statistic	Value	*t*-statistic
		Autoregressive component		
μ_0	-2.03**	(-2.26)	-2.31**	(-2.58)
$\mu_0 + \mu_1$	21.21***	(8.66)	21.09***	(8.61)
δ_1	0.77***	(19.19)	0.77***	(20.34)
σ_ϵ	6.98***	(9.90)	6.87***	(12.28)
		Transition function component		
θ_{p0}	-4.00	(-1.18)	2.32	(1.52)
θ_{p1}	0.20	(1.35)	0.02	(0.26)
θ_{q0}	4.54	(1.83)	2.13**	(1.89)
θ_{q1}	-0.10	(-0.89)	-0.09	(-1.35)

Table : Estimation results - information variables VIX, TED, BAAMAAA

	VIX		TED		BAAMAAA	
Parameter	Value	*t*-statistic	Value	*t*-statistic	Value	*t*-statistic
			Autoregressive component			
μ_0	-2.16	(-2.59)	-2.36**	(-2.42)	-2.05**	(-2.27)
$\mu_0 + \mu_1$	21.45***	(10.37)	18.97***	(9.48)	21.58***	(8.57)
δ_1	0.76***	(25.36)	0.68***	(15.76)	0.76***	(20.10)
σ_ϵ	6.73***	(13.75)	7.53***	(14.64)	6.86***	(12.50)
			Transition function component			
θ_{p0}	1746.82	(0.16)	0.64	(0.66)	1.88	(1.02)
θ_{p1}	-67.03	(0.18)	0.68	(0.71)	-4.93	(-0.74)
θ_{q0}	3.03***	(381.34)	1203.14	(0.00)	-0.74	(-0.32)
θ_{q1}	-0.01***	(-23.08)	-1377.00	(0.00)	17.88	(1.39)

Conclusions

- Empirically test the theoretical argument that fluctuations in the leverage of financial institutions have consequences for future activity in the real economy
- Neither leverage nor (our) risk taking proxies provide useful information for the evolution of credit conditions by themselves
- Combined they can act as a leading indicator
- Asymmetric response depending on the regime
- Price-based measures fail to act as leading indicators for credit conditions