

Exploring Relationships between Real Activity and the Financial Stance

Tor Jacobson Jesper Lindé Kasper Roszbach

Research Division, Sveriges Riksbank

9 November 2005

Background

- Today, typical institutional set-up is an independent central bank assigned two tasks:
 - Price stability, financial stability
 - Analysis typically separated
- "Standard" models used in MP analysis usually contain no financial frictions
 - Representative agent approach
 - Aggregate data.
- Financial stability policy often lacks integrated model support or based on small ad-hoc models:
 - Models of contagion between banks or countries: Degryse & Ngyen [2004], Hartmann, Straetmans, De Vries [2003]
 - Portfolio credit risk models: Altman et al. [1968, 198x], Carling, Jacobson, Lindé, Roszbach [2004]
 - Market risk models: CreditRisk+, PortfolioView (commercial models)

Literature on impact of financial sector on real economy

- Policymakers: consensus that market imperfections and instability in the financial sector can have long-lasting effects on the real economy [LoweBoS01]
- Academics: role of financial sector and credit in macroeconomy source of frequent debate
 - Poole [FedNY93]: credit only plays a role of its own in periods of financial crises
 - Bernanke [FedNY93], Calomiris & Hubbard [QJE 89]: credit markets *generally* affect the macroeconomy through "credit channel"
- Bernanke and Gertler [JEP95]:
 - Credit channel \equiv "set of factors that amplify and propagate conventional interest rate effects" of MP, through endogenous changes in the external finance premium.

Credit channel

- Adherents of "credit view" identify two main links between actions of central banks and credit markets (the external finance premium):
 - (Borrowers') balance sheet channel: borrowers' BS and income statements important: changes in MP will have impact on variables such as net worth, cash flow and liquid assets
 - Bank lending channel: focuses on potential effect of MP on loan supply by financial institutions
 - Common premise: frictions interfere with the smooth functioning of financial markets, creating a wedge between cost of externally raised funds and the the opportunity cost of internal funds

Evidence of a credit channel

- Empirical evidence: supports existence of balance sheet channel
- Bank lending channel: evidence under debate
 - Bernanke [AER1983]: study of 1930's
 - * Financial crisis reduced quality of credit intermediation: disrupted normal flow of bank credit
 - * Defaults and bankruptcies \uparrow and erosion of borrowers' collateral relative to debt burdens \Rightarrow
 - * Cost of credit intermediation \uparrow
 - * Banks: stopped loans to lower-quality investors
 - Spread Baa - T-bill \uparrow : 2.5% (1929-30), 8% (1932)
 - * Resulting higher cost of credit reduced businesses' demand for current-period goods and services
 - Proxies for financial crisis (Δ deposits of failing banks, Δ liabilities of failing businesses) have substantial explanatory power for growth rate IP

How have shortcomings been addressed

- Recent research to meet criticism:
 - Early studies of CC failed to isolate supply from demand shocks
 - Avoid identification issues: test cross section implications of credit view
- Gertler and Gilchrist [SJE93] [QJE94]:
 - Larger firms: better access to credit, respond to unexpected adverse conditions by increasing short-term borrowing
 - Smaller firms: squeeze inventories and cut production
- Bernanke, Gertler and Gilchrist [ReStat96]: split up firms by degree of bank dependency i.s.o. size
 - Confirm GC 93-94 results

- Samolyk [JME94]:
 - Examine relationship banking conditions - economic performance at U.S. states level
 - Local bank BS conditions help to predict performance of regional economies in way consistent with existence of credit market imperfections

- Peek and Rosengren [AER00]:
 - Study effects of Japanese banking crisis on construction activity in U.S.
 - Retrenchment of Japanese lending had substantial impact on U.S. real estate activity ⇒
 - * At least some borrowers were not able to obtain alternative financing
 - * Credit markets were suffering from imperfections

Objective of this paper

- Integrate the analysis of financial stability and monetary policy into one model
 - use simple empirical models to analyze relationships between the real and financial sectors
 - average bankruptcy rate as measure of financial stance and link variable
 - macro and micro data
- Questions addressed
 - Can MP and FSP models be integrated?
 - Is there a feedback from MP on FSP and/or vice versa
 - Are effects state dependent?

How?

1. Use reduced form methods (VARs) to examine if various financial indicators affect the real economy.
2. Estimate a bankruptcy-risk model at the firm level:
 - Panel data, sample period 1990Q1 – 1999Q2.
 - All "active" Swedish "incorporated" firms \approx 8.000.000 observations
 - Use both firm specific and macro variables as regressors
3. Estimate a dynamic panel VAR for balance sheet ratios
 - Include macro variables to test the importance of aggregate shocks.
4. Once equipped with these empirical models, we perform some policy experiments.

What we find

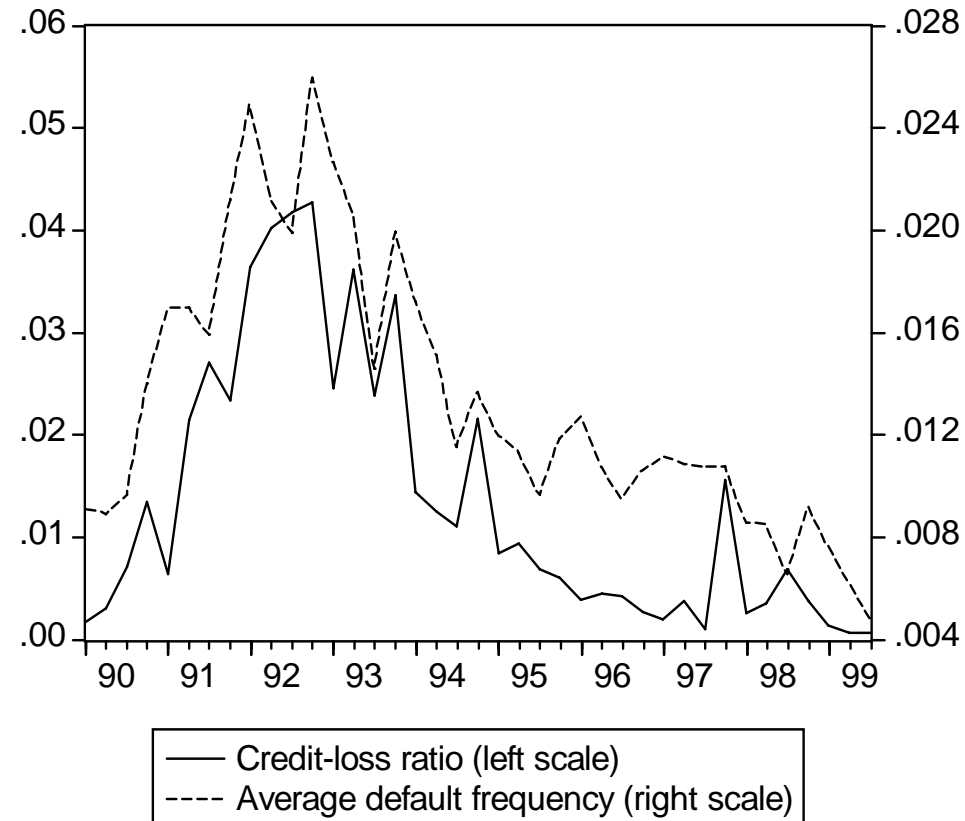
1. Real economy is not exogenous w.r.t. to the financial variable that we study. Statistically as well as quantitatively important effects.
 - (Average) balance sheet ratios do not seem to have predictive power for the real economy
 - Term-structure, stock prices, bank lending do not seem to influence real economy
2. Firm level bankruptcy-risk model can replicate the high/low bankruptcy risk in the beginning/end of the 1990s.
 - Firm-specific variables do a good job in ranking the firms, but cannot explain the absolute level of bankruptcy risk.
 - Macroeconomic variables are important for determining the absolute bankruptcy risk at the firm level.
 - Estimation of the bankruptcy risk model using aggregate data is not informative.
 - The “banking-crisis” in Sweden is not a unique event that cannot be explained by a model.

3. Impulse response functions to a given aggregate shock is highly state-dependent. Both the macroeconomic stance and the distribution of firms' balance sheet variables matter.
 - The non-linearity introduced by the bankruptcy risk model is quantitatively important.
4. In particular, the aggregate VAR model suggests a trade-off for monetary policy between stabilizing inflation and the bankruptcy frequency, whereas in the micro-macro model that trade-off is state-dependent, i.e. in “good” / “bad” times the trade-off appears to be low/high.
5. We can forecast inflation and bankruptcy rates quite well. Uncertainty in forecasts are found to be state-dependent.

Agenda

1. Measuring the financial stance of the economy
2. Testing for dependency of the macroeconomy on financial variables.
3. The bankruptcy-risk model
4. Dynamic Panel VAR modeling the balance sheet ratios
5. Putting it all together
6. The impulse response functions to an identified monetary policy shock
7. Forecasting inflation and bankruptcy
8. Summary
9. Future work

1. Measuring the financial stance of the economy



- Bankruptcy frequency and credit-loss ratio highly correlated
- In particular at the lower frequencies. No clear lead-lag relationship

2. Testing for dependency of the macroeconomy on financial variables

- Adopted the VAR estimated by Lindé (2002)

$$X_t = C + \delta_1 D_{923} + \delta_2 D_{931013} + \tau T_t + \sum_{i=0}^2 \Upsilon_i Z_{t-i} + \sum_{i=1}^2 \Gamma_i X_{t-i} + u_t^d$$

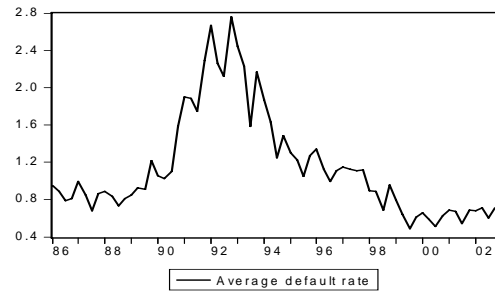
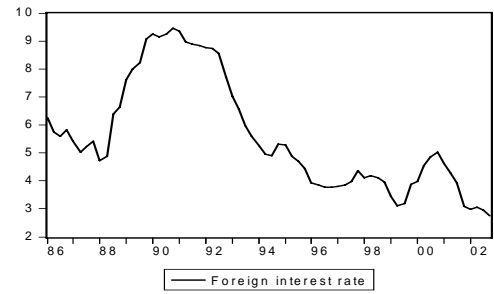
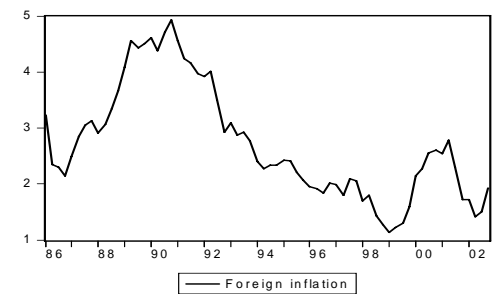
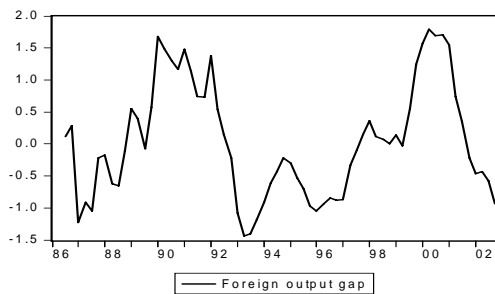
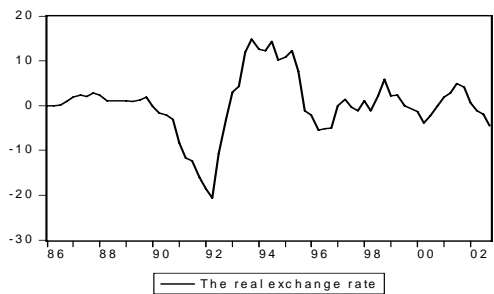
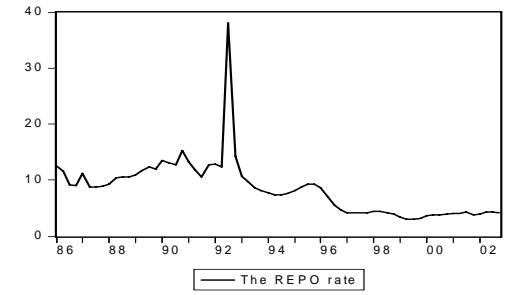
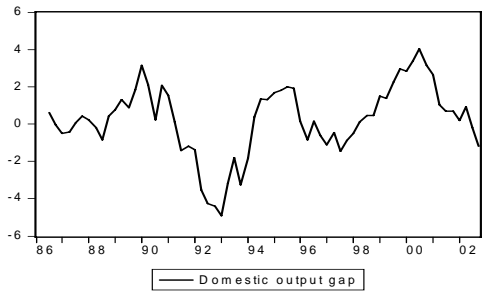
where

$$X_t = \left[y_t^d \quad \pi_t^d \quad R_t^d \quad q_t \right]'$$

and

$$Z_t = \left[y_t^f \quad \pi_t^f \quad R_t^f \right]'$$

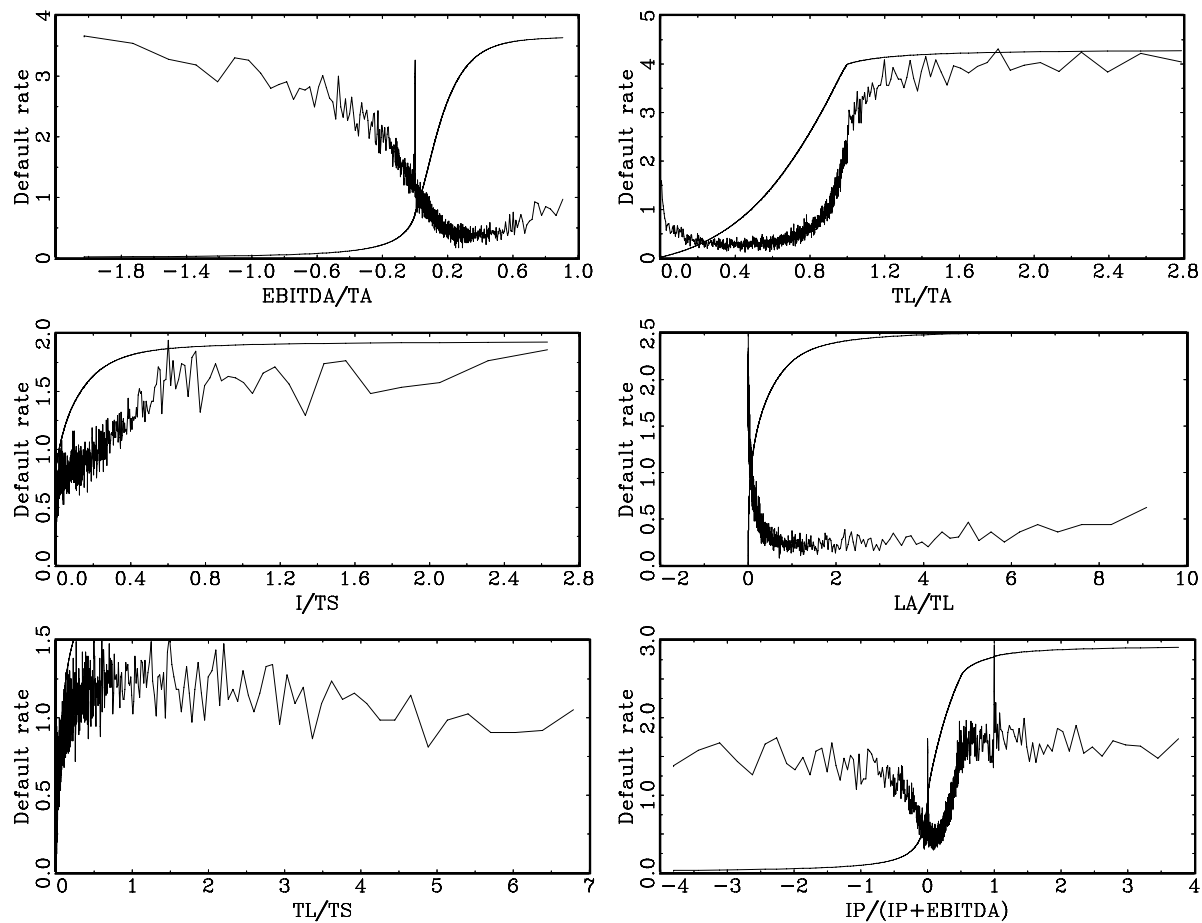
- Sample period: 1986Q3 – 2002Q4



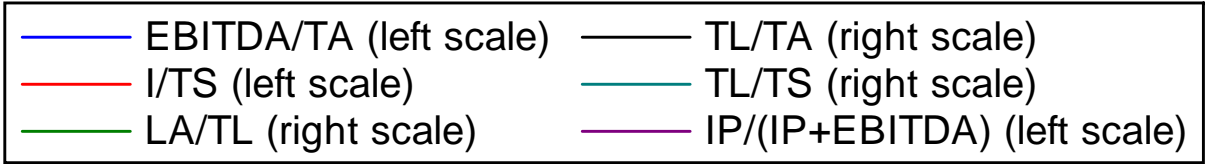
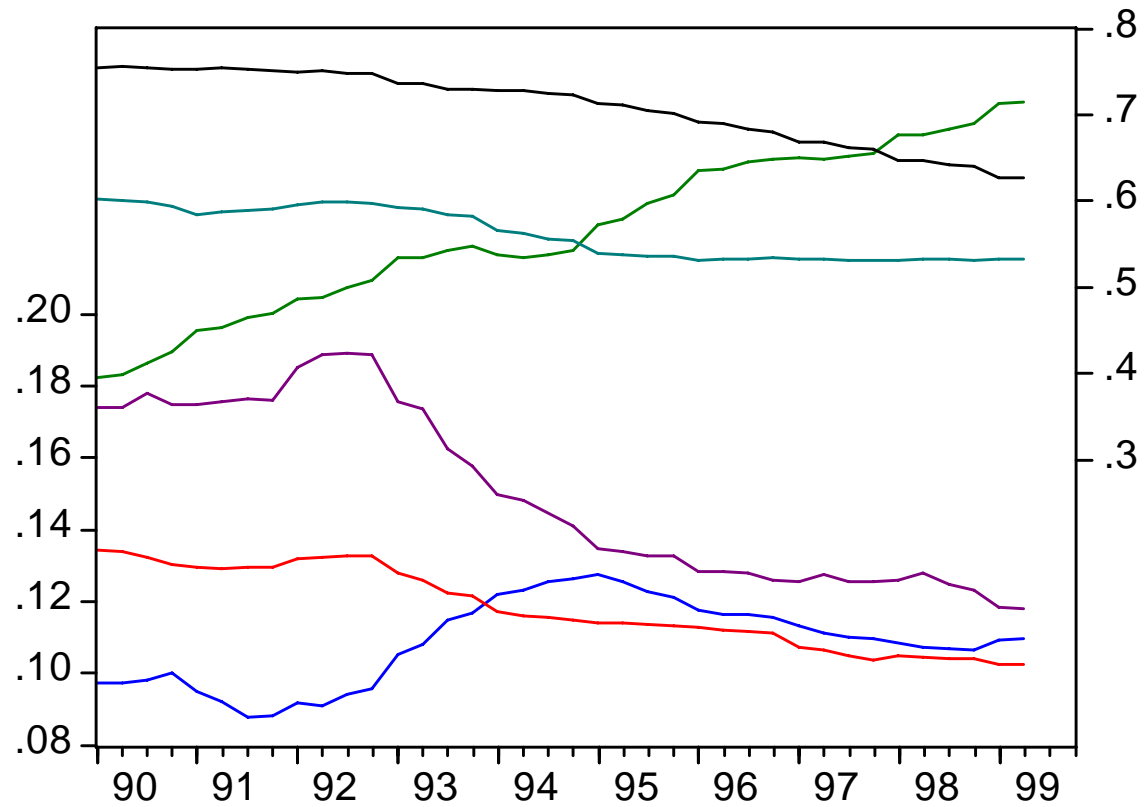
- Augment the VAR with lags of the bankruptcy frequency (df_t), use a block-exogeneity test (multivariate Granger causality test) to find that df_t enters significantly, p -value 0.001.
- Also quantitatively important: accounts for 20% of the fluctuations.
- Most other variables do not carry significant information for the macroeconomy, e.g. stock prices, bank-lending to Swedish public, term-structure ($r5m - r3m$). (But household prices do contain significant information.)
- Also, regressing the VAR residuals for the period 1990Q1 – 1999Q2 on the average balance sheets ratios, we find that they are insignificant.
- Conclusion: df_t seems to be an important link between the real and financial sector.

3. The bankruptcy-risk model

- Estimate a panel logit bankruptcy-risk model on firm level data, 1990Q1 – 1999Q2.
- Population: Incorporated firms (aktiebolag) that submitted a financial statement, plus defaulted firms.
- UC definition of bankruptcy. Firm could in theory default more than once if it recovers.
- Use both firm-specific and macro variables in the model.
- Around 200,000 firms in each of 38 quarters \Rightarrow 8,000,000 observations in the panel.
- Selection of balance sheet variables by graphing different balance sheet variables against default rates.
Default rates and variable values are calculated as averages over an interval of \pm 5000 observations.
- Use two additional firm specific variables; **payment remarks** and **no financial statement**.
- Truncate the balance sheet variables prior to estimation (upper and lower 0.5 percent of obs.).
- Replace missing values for BS variables for (non-)defaulting obs with mean for (non-)defaulting firms.
Results robust when using other methods (linear projection and bootstrapping).



Default rates and cumulative distribution functions for accounting data.



Quarterly average BS variables (lagged 1Y as in model)

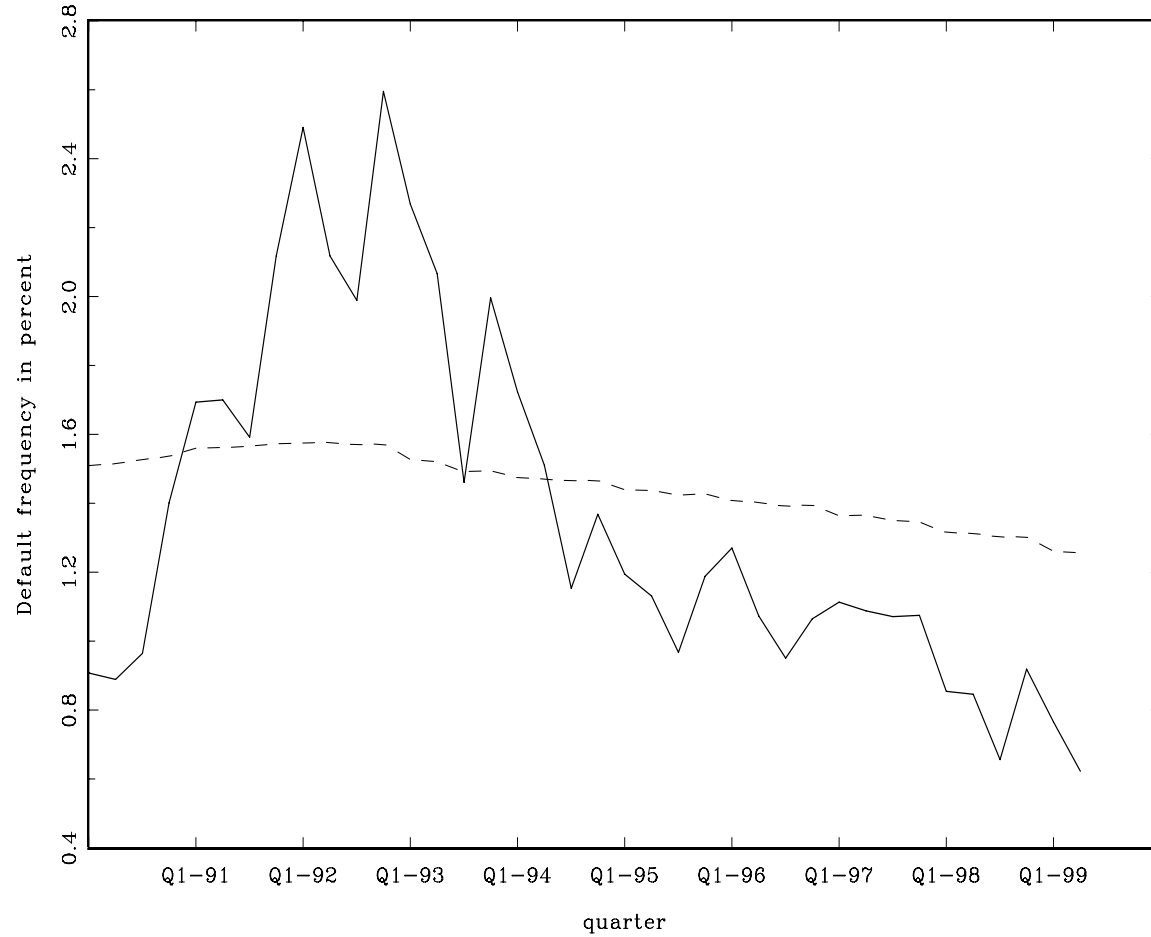
Table 2: Logit estimation results of the bankruptcy-risk model.

Type of regressor	Model I		Model II		Model III	
	Coeff	s.e.	Coeff	s.e.	Coeff	s.e.
Constant	-4.649	0.012	-5.029	0.014	-5.839	0.027
Firm-specific^a						
EBITDA/TA	-0.6197	0.0160	-0.5564	0.0174	-0.5501	0.0176
TL/TA	0.5668	0.0092	0.4813	0.0103	0.4956	0.0105
LA/TL	-0.3421	0.0141	-0.5029	0.0170	-0.4710	0.0168
I/TS	0.1804	0.0094	0.1517	0.0109	0.1464	0.0110
REMARK (%)			3.3313	0.0267	3.5891	0.0275
TTLFS (%)			3.4259	0.0164	3.3921	0.0166
Macro^b						
Output gap					-0.0856	0.0042
Inflation rate					0.0075	0.0042
Nom. int. rate					0.0798	0.0033
Real FX					-0.0057	0.0008
Log-likelihood	-0.0686		-0.0558		-0.0550	
Aggregate R^2	0.06		0.11		0.91	
Pseudo R^2	0.11		0.24		0.28	
# observations	1, 836, 625		1, 836, 625		1, 836, 625	

Qualities of the model

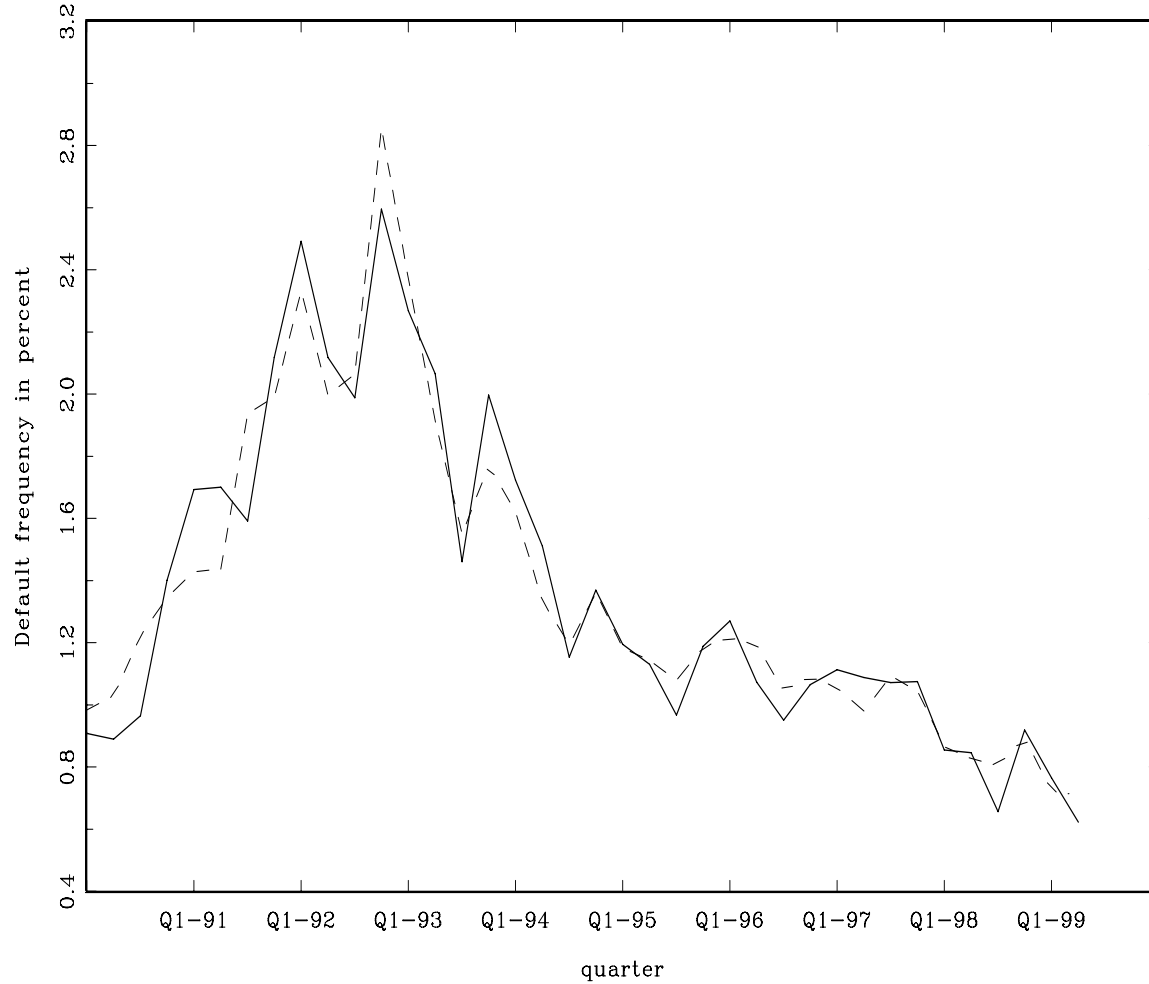
- Cross-section identifies accounting variables well, the time-dimension identifies the macro variables.
- OLS estimations on aggregate data produce very misleading estimates for accounting data (due to trends).
- Models able to reproduce aggregate bankruptcy rate when macro variables are included.

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Actual (solid line) and estimated (dotted line) bankruptcy rates at aggregate level: only firm specific information included (Model II)

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Actual (solid line) and estimated (dotted line) bankruptcy rates at aggregate level: firm-specific and macro-economic information included (Model III).

4. Dynamic panel VAR for balance sheet variables

- Let $Y_{i,t} = \left[\text{EBITDA}/\text{TA}_{i,t} \quad \text{TL}/\text{TA}_{i,t} \quad \text{I}/\text{TS}_{i,t} \quad \text{LA}/\text{TL}_{i,t} \right]'$ denote a 4×1 vector with the financial ratios for firm i .
- Let $Y_t = \left[Y_{1,t} \quad \dots \quad Y_{N_t,t} \right]'$ denote a $4 \times N_t$ matrix where N_t is the number of firms in the panel in quarter t .
- VAR model for the financial ratios

$$Y_t = \Theta_Y Y_{t-1} + \Theta_X X_{t-1} + u_t^y, \quad \text{var}(u_t^y) = \Sigma_Y$$

where X_t is defined as $\left[y_t^d \quad \pi_t^d \quad R_t^d \quad q_t \right]'$.

- Panel VAR is estimated using system GMM that allows for firm-specific effects (Arrelano & Bond RES91).
- Find 70 – 95% of the variation for the variables in Y_t are due to idiosyncratic shocks on average.

5. Putting it all together

- VAR model for the foreign variables (exogenous w.r.t. to domestic variables)

$$Z_t = C_f + \tau_f T_t + \sum_{i=1}^2 B_i Z_{t-i} + u_t^f$$

- VAR model for domestic variables

$$X_t = C + \delta_1 D_{923} + \delta_2 D_{931013} + \tau T_t + \sum_{i=0}^2 \Upsilon_i Z_{t-i} + \sum_{i=1}^2 \Gamma_i X_{t-i} + \sum_{i=1}^2 \Lambda_i df_{t-i} + u_t^d$$

- Logit model: $df_{i,t} = \frac{1}{1 + \exp(\beta_0 + \beta_F F_{i,t} + \beta_Y Y_{i,t} + \beta_X X_t)}$

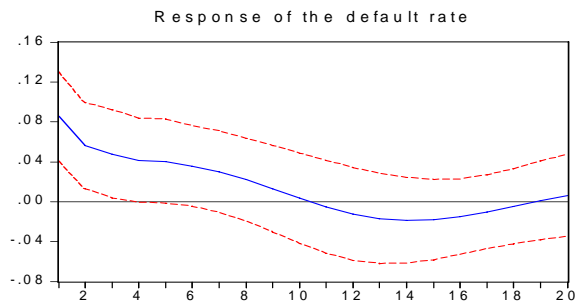
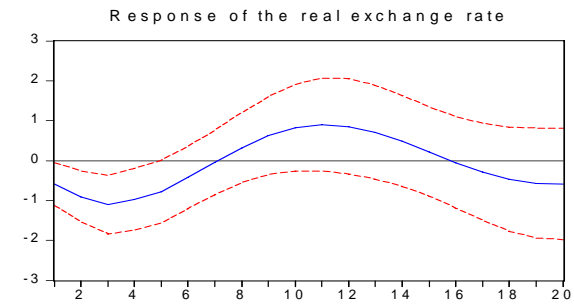
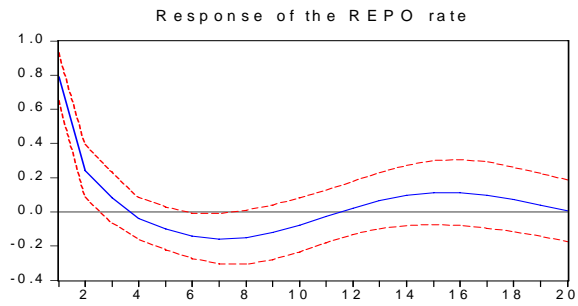
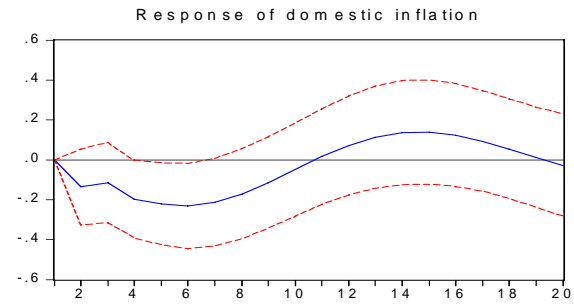
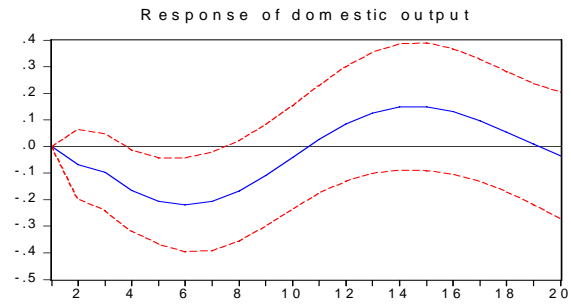
where $F_{i,t}$ fixed firm-specific information (remark and delayed financial report dummies).

- Panel VAR for accounting variables

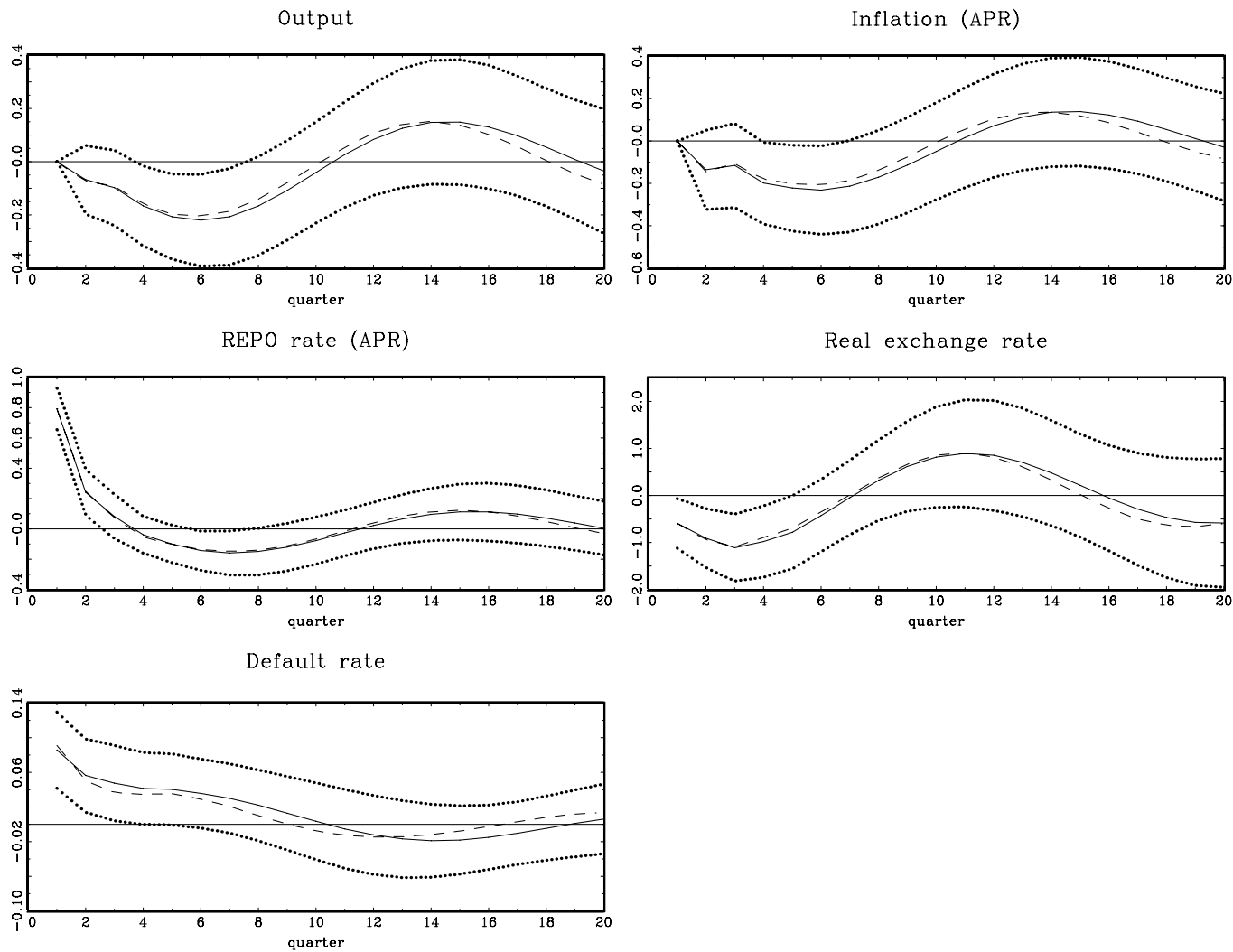
$$Y_t = \Theta_Y Y_{t-1} + \Theta_X X_{t-1} + u_t^y, \quad \text{var}(u_t^y) = \Sigma_Y$$

6. The impulse response functions to an identified monetary policy shock

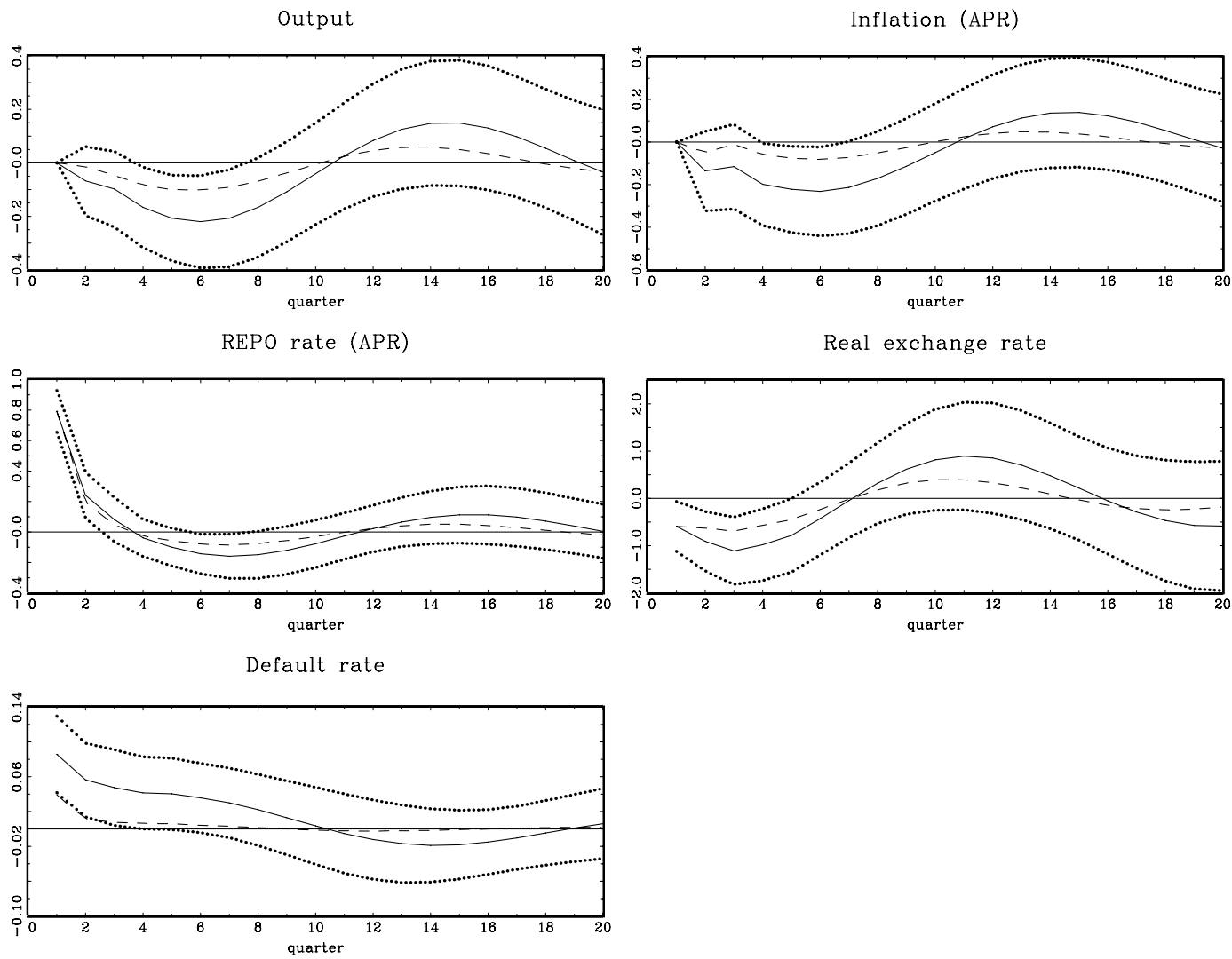
- Study the trade-off between for policy makers to stabilize inflation and the bankruptcy frequency.
- Adopt the following assumption; first goods markets clear, then interest rate is set, finally financial markets clear.
- First figure below reports the impulse response functions in the micro-macro model using the macroeconomic stance and firm portfolio 1991Q1. Also report impulse response functions in the aggregate VAR where the aggregate bankruptcy frequency is endogenous.
- Last figure below reports same thing but using the macroeconomic conditions and firm portfolio 1998Q1 instead. Results very different, both for real variables and the bankruptcy frequency.



Impulse response functions to an identified MP shock in the estimated VAR model where the bankruptcy rate is endogenous. Solid lines: point estimates, dotted lines: 95% confidence interval.



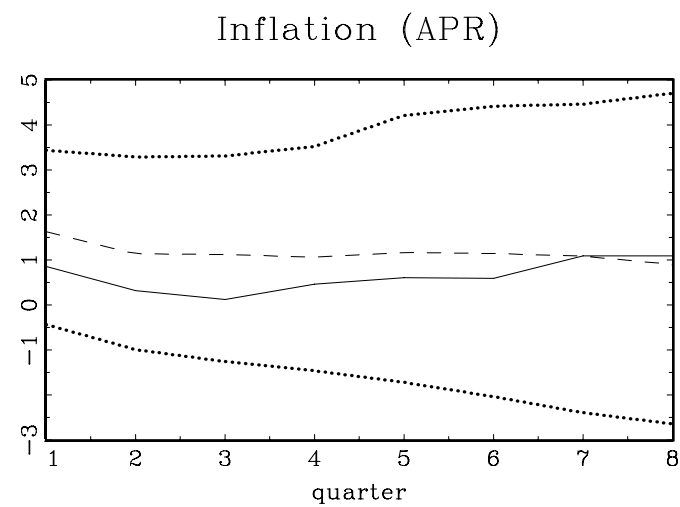
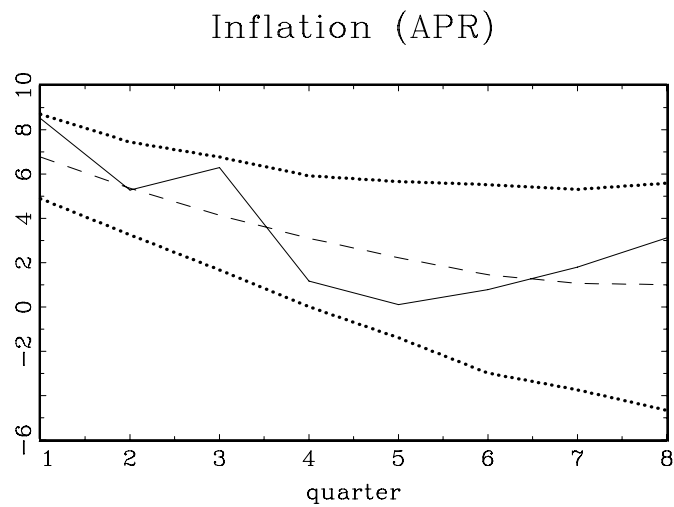
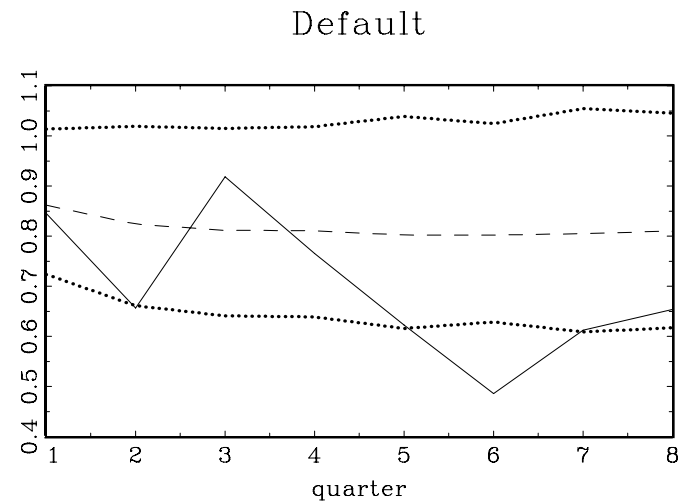
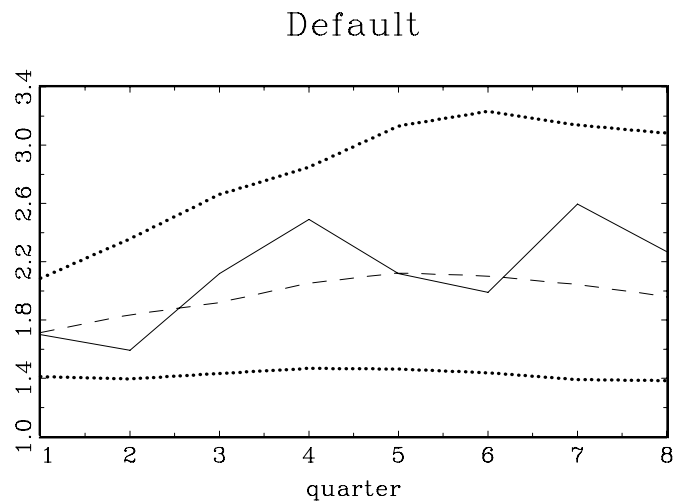
Impulse response functions in the VAR model with the bankruptcy rate endogenous (point estimates: solid line, 95% confidence interval: dotted lines). Empirical micro-macro model for 1991Q1 (dashed line).



Impulse response functions in estimated VAR model with the bankruptcy rate endogenous (solid line: point estimates, dotted lines: 95% confidence interval). Empirical micro-macro model for 1998Q1 (dashed line).

7. Joint forecasts of bankruptcy and inflation.

- Same initial conditions as in the previous section.
- Starting point in two quarters, 1991Q1 and 1998Q1, i.e. the beginning of a recession and the beginning of a "boom in the economy.
- 1,000 simulations with the estimated model 8 quarters into the future resulting in 1,000 projections in periods $t + 1, \dots, t + 8$ for the bankruptcy rate and inflation.



Joint forecasts of the default frequency 8 quarters ahead starting 1991Q1 (left panel) and 1998Q1 (right panel). Dashed line: median forecast, dotted lines: 95% confidence interval, solid line: actual outcome.

8. Summary and conclusions

1. Real economy not exogenous with respect to financial sector!

- Statistically as well as quantitatively important effects
- Average bankruptcy rate as measure of financial stance
- No predictive power of other (average) balance sheet ratios, term-structure, stock prices, bank lending for real economy.

2. Firm level bankruptcy-risk model can replicate high/low bankruptcy risk in beginning/end of the 1990s.

- Firm-specific variables rank firms, macro variables determine absolute level of bankruptcy risk at firm level
- Estimating bankruptcy risk model with aggregate data not informative.
- “Banking-crisis” not a unique event that cannot be explained by a model.

3. Impulse response functions to a given aggregate shock highly state-dependent.
 - Both macroeconomic stance and distribution of firms' balance sheet variables matter.
 - Non-linearity from bankruptcy risk model quantitatively important.
4. Model forecasts inflation and bankruptcy rates quite well. Uncertainty in forecasts state-dependent.
5. Aggregate VAR model suggests a trade-off for MP between stabilizing inflation and bankruptcy frequency
 - Micro-macro model indicates trade-off is state-dependent, i.e. in "good" / "bad" times the trade-off appears to be low/high.
6. Disappointing? Try to explain more of variation in bankruptcy frequency with accounting variables.
7. Extension: estimate different models for different industries/firm sizes.
 - Different industries may display different degree of cyclical bankruptcy risk variation.
 - Firm size may be important.