The relation between bank losses & loan supply – an analysis using panel data

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Topic

- IMF Working Paper 232 (2008) by Erlend Nier and Lea Zicchino
- Title: *"Bank Losses, Monetary Policy, and Financial Stability – Evidence on the Interplay from Panel Data"*
- Research Questions:
  1. How severe is the effect of financial sector losses on credit supply?
  2. Is this effect related to initial capital strength?
  3. How much (monetary) loosening is required to counter the effect?

Background

- Shocks to the banking system can lead to a tightening of credit conditions, i.e. credit supply decreases
- Such a *credit crunch* affects spending of companies and households, i.e. has negative effects on real activity
- Thus, a financial crisis can amplify and even initiate an economic downturn (e.g. subprime crisis)
- Monetary policy may help to partially offset the adverse effects of a credit crunch on real activity
- For policy makers it is important to quantify the effect of shocks on the supply of credit (and subsequently on output)

Basic Specification

- The basic specification used by the authors is

$$\Delta \log(Loans)_{it} = \alpha Z_{it} + \beta GDPG_{jt} + \gamma Loss_{it} + \delta Loss_{it} \cdot CAP_{it-1} + u_{it} \quad (1)$$

- For their estimations they use data on more than 600 banks from 32 countries, observed over a period of 8 years
- The error term is given by $u_{it} = \mu_j + \lambda_t + \nu_{it}$, i.e. they use a two-way fixed effects model controlling for differences across countries and through time
- To ensure a reasonable degree of homogeneity across banks they restrict attention to banks listed at a stock exchange
- The estimator used allows for first-order autocorrelation within units and correlation and heteroskedasticity across units

Explanatory Variables

- Main variable of interest in (1) is *Loss*, measuring loan loss provisions by banks (apparently the best indicator for losses affecting bank capital)
- Reasons for focusing on bank losses
  - Losses prompt banks to act more cautiously in terms of lending
  - A reduction in capital due to losses reduces the amount of loans a bank can offer (regulatory requirements, e.g. Basel II)
  - The creditworthiness of a bank suffering losses decreases and thus it faces refinancing constraints

Explanatory Variables (cont.)

- The term $Loss_{it} \cdot CAP_{it-1}$ in (1) interacts bank losses with the equity ratio in the previous period
- This interaction accounts for initial capital buffers of banks (e.g. for banks with ample capital the effect of loan losses on credit supply is presumably lower than for banks with small buffers)
- The variable *GDPG* captures growth of nominal GDP in the country a bank is operating; it is included to account for loan demand
- Z is a vector of control variables including bank-specific characteristics (return on equity, equity ratio)
- Later the authors also use dummy-variables for monetary policy (e.g. $\Delta r^+ = 1$ if interest rates have gone up in a given year) and interactions of the latter with bank losses

Reason for Using Panel Data

- The authors claim that their results are much richer than those that could have been obtained by studying just one country
- They argue that this is in particular true with regard to the assessment of the relation between monetary policy, loan losses and loan supply
- Reason: assessing the effects of monetary policy in a single country with only one monetary path is complicated due to the lack of a counterfactual
- Using a panel, i.e. banks from different countries with potentially different monetary policies, introduces a counterfactual

Some Remarks

- It remains doubtful whether looking at listed banks only guarantees a reasonable degree of homogeneity among banks (e.g. investment vs. universal banks)
- Comparable studies typically use (available) quarterly data for the explanatory variables (yearly data are rather coarse)
- *"[. . .] theory suggests that the strength of credit crunch effects should depend on financing conditions at banking firms more generally [. . .]."*
- i.e. there are other potential explanatory variables which have probably been omitted (e.g. condition of money market, interbank market and international (private) equity markets)

Basic results on the first two hypotheses

Dependent variable: Loan growth	(1)	(2)
RoE	**0.25*** **	**0.23*** **
Capital	0.005	**-0.09** **
Provisions	**-1.84*** **	**-2.85*** **
GDP	**0.43*** **	**0.43*** **
Lagged Capital*Provisions		**6.23*** **
Year Dummies	Yes	Yes
Country Dummies	Yes	Yes
No. of obs.	3460	3453
Goodness of fit	0.25	0.25

H1 Negative shocks to capital appear to associated with a decrease in loan origination. Banks that are weakened by losses extend less credit than stronger ones.

H2 The impact of loan losses on loan growth is reduced for banks whose initial capital buffers are high and more pronounced for these which are poorly capitalized.

The Effect of Monetary Policy

- Analysis of changes in the short term interest rate in the country of origin of a bank
  - Δr^{+} – tight policy (rate goes up over the year)
  - Δr^{-} – loose policy (rate goes down over the year)
  - Δr^{0} – neutral policy (no change in the interest rate)
- Dummies instead of levels or changes, since the latter could be diverse in magnitude in a cross–country context
- Due to fixed effects approach – no use of levels

The Effect of Monetary Policy cont'd

Four consecutive specifications:

1. Check whether monetary policy affects loan growth
2. Check whether it modifies the effect of loan losses on loan growth – Interaction term
3. Interact monetary policy with the level of capital
4. Three–way interaction between monetary policy, loan losses and lagged capital

Dependent variable: Loan growth	(1)	(2)	(3)	(4)	(5)	(6)
RoE	**0.25*** **	**0.25*** **	**0.25*** **	**0.25*** **	**0.24*** **	**0.25*** **
Capital	0.006	0.006	0.005	0.006	0.009	0.004
Provisions	**-1.87*** **	**-1.89*** **	**-1.85*** **	**-1.36*** **	**-3.15*** **	**-1.91*** **
GDP	**0.45*** **	**0.45*** **	**0.45*** **	**0.42*** **	**0.43*** **	**0.46*** **
Δr^{+}	**-0.02*** **			-0.005		
Δr^{-}		**0.02*** **			0.01	
Δr^{0}			-0.03			**-0.04* **
Provisions*Δr^{+}				**-2.32*** **		
Provisions*Δr^{-}					**1.74*** **	
Provisions*Δr^{0}						0.94
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	3436	3436	3436	3436	3436	3436
Goodness of fit	0.25	0.25	0.25	0.26	0.26	0.26

Dependent variable: Loan growth	(1)	(2)	(3)
RoE	**0.25*** **	**0.25*** **	**0.25*** **
Capital	-0.07	**0.11** **	0.001
Provisions	**-1.83*** **	**-1.86*** **	**-1.86*** **
GDP	**0.43*** **	**0.46*** **	**0.46*** **
Δr^+	**-0.04*** **		
Δr^-		**0.04*** **	
Δr^0			-0.04
Capital*Δr^+	**0.19*** **		
Capital*Δr^-		**-0.19*** **	
Capital*Δr^0			0.07
Year Dummies	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes
No. of obs.	3436	3436	3436
Goodness of fit	0.25	0.26	0.25

Dependent variable: Loan growth	(1)	(2)	(3)	(4)	(5)	(6)
RoE	**0.22*** **	**0.23*** **	**0.23*** **	**0.22*** **	**0.23*** **	**0.22*** **
Capital	**-0.09** **	**-0.09** **	**-0.08** **	**-0.08** **	**-0.15** **	-0.02
Provisions	**-2.85*** **	**-2.87*** **	**-2.30*** **	**-3.93*** **	**-2.00*** **	**-4.58*** **
GDP	**0.45*** **	**0.45*** **	**0.42*** **	**0.43*** **	**0.41*** **	**0.43*** **
Lagged Capital*Provisions	**5.99*** **	**6.03*** **	**5.57*** **	**5.61*** **	**4.08*** **	**10.49*** **
Δr^{+}	**-0.02*** **		-0.006		-0.014	
Δr^{-}		**0.02*** **		**0.014* **		**0.02*** **
Provisions*Δr^{+}			**-2.15*** **		**-3.49*** **	
Provisions*Δr^{-}				**1.55*** **		**2.50*** **
Capital*Δr^{+}					0.12	
Capital*Δr^{-}						**-0.13* **
Lagged Capital*Provisions*Δr^{+}					**9.47*** **	
Lagged Capital*Provisions*Δr^{-}						**-6.31*** **
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	3429	3429	3429	3429	3296	3429
Goodness of fit	0.26	0.26	0.26	0.26	0.27	0.26

Robustness Checks

- Concern that other influences on a bank's loan growth might have been omitted
- Replace country–fixed effects by bank–fixed effects to control for heterogeneity across banks
- Results remain robust
- Another concern: endogeneity of the bank–specific variables
- Dropping RoE from the regressions increases coefficient on the provisions ratio and capital variable turns significant
- Thus: retain RoE

Three–way panel estimation

- Data with three or more dimensions of variation – commonly described as multilevel or hierarchical data
- For such data structures, there is no algebraic transformation that sweeps away all the fixed effect error components and allows then to be recovered later
- A three–way error–components model:

$$y_{it} = \mathbf{x}_{it}\beta + \mathbf{w}_{j(i,t)t}\gamma + \mathbf{u}_i\eta + \mathbf{q}_{j(i,t)}\rho + \alpha_i + \phi_{j(i,t)} + \mu_t + \varepsilon_{it}$$

- With fixed–effect, time–invariant characterestics $[\eta, \rho]$ are not identified, thus define:

$$\theta_i \equiv \alpha_i + \mathbf{u}_i\eta$$

$$\psi_j \equiv \phi_j + \mathbf{q}_j\rho$$

- Giving:

$$y_{it} = \mathbf{x}_{it}\beta + \mathbf{w}_{j(i,t)t}\gamma + \theta_i + \psi_{j(i,t)} + \varepsilon_{it} \quad (2)$$

Spell fixed effects

- If we are not interested in the estimates of θ_i and $\psi_{j(i,t)}$ or in estimating parameters on the time–invariant variables, one can easily obtain consistent estimates for (2) by a transformation within each unique combination (or spell)
- Define $\lambda_s \equiv \theta_i + \psi_{j(i,t)}$ as spell–level heterogeneity, and subtracting averages at the spell level gives

$$y_{it} - \bar{y}_s = (\mathbf{x}_{it} - \bar{\mathbf{x}}_s)\beta + (\mathbf{w}_{j(i,t)t} - \bar{\mathbf{w}}_s)\gamma + (\varepsilon_{it} - \bar{\varepsilon}_s)$$

- Unless we want to analyze heterogeneity after estimation Stata's `xtreg, fe` is enough

Least–squares dummy variables

- Using dummy variables to directly estimate (2) usually infeasible – approx. $K + N + J$ parameters
- ABOWD, KRAMARZ and MARGOLIS 1999 suggest explicitly including dummy variables for j heterogeneity and sweep out i heterogeneity algebraically
- Define $F_{it}^{j} = 1\{j(i,t) = j\}$ and substitute $\psi_{j(i,t)} = \sum_{j=1}^{J} \psi_j F_{it}^{j}$ into (2)
- Gives:

$$y_{it} - \bar{y}_i = (\mathbf{x}_{it} - \bar{\mathbf{x}}_i)\beta + (\mathbf{w}_{j(i,t)t} - \bar{\mathbf{w}}_i)\gamma + \sum_{j=1}^{J}(\psi_j F_{it}^{j} - \bar{F}_i^{j}) + \varepsilon_{it}$$

- Problem: j effect not identified unless, i's can move between categories e.g. workers changing firms
- Could be done directly using `xtreg, fe` on appropriately clustered data

Computational problems and Stata application

- The FEiLSDVj method requires inverting a $(K + J) \times (K + J)$ cross-product matrix and storing J mean–deviated dummies
- Andrews, Schank and Upward 2006 propose a classical minimum distance estimator, that allows to circumvent part of the computational requirements
- Implemented in Stata `felsdvreg` package (by Cornelissen 2008)
- `a2reg` package – a bootstrapping method by Ouazad 2008 based on Abowd, Creecy, Kramarz 2002