Bubbles, Crashes & the Financial Cycle

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Outline of topics

- Agent-based Macroeconomics
- Leverage cycle – Geanakoplos
- Financial Instability Hypothesis – Minsky
- Basel III and the procyclicality of capital adequacy requirements
- Macro-prudential banking regulation
### The Business & Financial Cycle

#### The financial and business cycles in the United States

**Graph 1**

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1976-80</td>
<td>US real-estate boom</td>
</tr>
<tr>
<td>1980</td>
<td>DIMCA</td>
</tr>
<tr>
<td>1989</td>
<td>S&amp;L Crisis</td>
</tr>
<tr>
<td>2011</td>
<td>End of Regulation Q</td>
</tr>
</tbody>
</table>

**Source:** Drehmann et al (2012).

1. The line traces the financial cycle measured as the average of the medium-term cycle in the component series using frequency-based filters.
2. The line traces the GDP cycle identified by the traditional shorter-term frequency filter used to measure the business cycle.

1980: Depository Institutions Deregulation and Monetary Control Act: Deregulation of Savings and Loans institutions

2011: Regulation Q: prohibition of interest-bearing demand deposit accounts

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Financial Instability Hypothesis

- Equity/Asset-ratio: Measure for financial robustness
- Fragility synchronized with business cycle? (Fragile booms, deleveraging recovery)

![Graph showing Output and E/A ratio over time]

- 
- Output and E/A ratio
- Months
- F_EARatio
- Euroset output
Empirical Motivations

Features of macroeconomics with a financial cycle (Borio, 2012):

- the financial boom should not just precede the bust but cause it (à la Minsky).
- the presence of debt and capital stock overhangs (excess stocks, non-full utilization rates).

Findings:

- Recessions following a crisis after a fragile boom tend to have much larger declines in consumption, investment, output, and employment. (Shularick & Taylor, 2012)
- Balance sheet recessions: Recessions driven by deleveraging lead to a prolonged slump. (Koo, 2011)
# Balance sheets

<table>
<thead>
<tr>
<th>Firm Assets</th>
<th>Liabilities</th>
<th>Bank Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquidity</td>
<td>Loans from banks</td>
<td>CB reserves $(-0.1%)$</td>
<td>Deposits $+/-$ withdrawals</td>
</tr>
<tr>
<td>+ revenues</td>
<td>+ new loans</td>
<td>+ interest deposits</td>
<td>$+ new loans$</td>
</tr>
<tr>
<td>– wage bill</td>
<td>– bad debt</td>
<td>– taxes</td>
<td>$+ new loans$</td>
</tr>
<tr>
<td>– taxes</td>
<td></td>
<td>– dividends</td>
<td>$+/- CB reserves$</td>
</tr>
<tr>
<td>– dividends</td>
<td></td>
<td>+ interest on loans</td>
<td>$+/- CB reserves$</td>
</tr>
<tr>
<td>+ interest deposits</td>
<td></td>
<td>– taxes</td>
<td>$+/- interest$</td>
</tr>
<tr>
<td>– interest on loans</td>
<td></td>
<td>– dividends</td>
<td>$+/- interest$</td>
</tr>
<tr>
<td>+ new loans</td>
<td></td>
<td>+ new loans</td>
<td>$+/- CB reserves$</td>
</tr>
<tr>
<td>Inventory</td>
<td>Equity</td>
<td>CB debt $(+0.15%)$</td>
<td>Equity</td>
</tr>
<tr>
<td>+ output</td>
<td>+ profits</td>
<td>$+ profits$</td>
<td>$+ profits$</td>
</tr>
<tr>
<td>– sales</td>
<td>+ bad debt</td>
<td>– bad debt</td>
<td>– bad debt</td>
</tr>
<tr>
<td>Capital stock</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ investment</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sander van der Hoog

Bubbles, Crashes & the Financial Cycle
1. **The broad borrowers’ balance sheet channel:**
   (Bernanke & Blinder 1988)
   - Credit demand side
     - Focusses on external finance premium: probability of default
       External finance premium: inversely related to borrower's net worth.
     - Changes in the value of assets on the balance sheet of a **firm** affect the firm’s **ability to borrow**.

2. **The narrow bank lending channel:**
   (Bernanke & Gertler 1995)
   - Supply of bank loans determined by financial health of banks.
   - Changes in the value of assets on the balance sheet of a **bank** affects the bank’s **ability to lend**.
1. Firm’s default probability

\[ PD_t^f = \max\{0.03, 1 - e^{-\nu D_t^f / E_t^f}\}, \quad \nu = 0.1 \]

2. Interest rate offered by bank \( b \) to firm \( i \)

\[ r_t^{bf} = r_{ECB} \left( 1 + \lambda^B \cdot PD_t^f + \epsilon_t^b \right), \quad \epsilon_t^b \sim U[0, 1] \]

\( r_{ECB} = 0.01 \)

\( \lambda^B = 3 \): penalty rate for high-risk firm, uniform across banks

\( \epsilon_t^b \): bank’s ideosyncratic operating costs
Capital Adequacy Requirement

1. Risk-exposure of credit request (Expected Loss at Default):
   \[ x_t^f = PD_t^f \cdot L_t^f \]  
   (1)

2. Constraint: **Capital Adequacy Requirement** (CAR)
   \[ \sum_t x_t^f \equiv X_t^b \leq \alpha E_t^b, \quad \alpha \geq 0 \]  
   (2)

3. Risk-exposure "budget" of the bank:
   \[ V_t^b \equiv \alpha E_t^b - X_t^b \]  
   (3)

4. Loan granted:
   \[ \ell_t^f = \begin{cases} L_t^f & \text{if } x_t^f \leq V_t^b \\
   \theta \cdot L_t^f = V_t^b / PD_t^f & \text{if } 0 \leq V_t^b \leq x_t^f \\
   0 & \text{if } V_t^b \leq 0 \end{cases} \]
   \[ \text{No rationing} \quad \text{Partial rationing} \quad \text{Full rationing} \]  
   (4)

Possibility of **credit rationing**: \{\theta : V_t^b - PD_t^f \cdot \ell_t^f = 0\} \rightarrow \theta L_t^f = V_t^b / PD_t^f
Constraint: **Reserve Requirement**

\[ M_t^b \geq \beta \cdot Dep_t^b \]  \hspace{1cm} (5)

Excess liquidity "budget" of the bank:

\[ W_t^b \equiv M_t^b - \beta \cdot Dep_t^b \]  \hspace{1cm} (6)

Loan granted:

\[ \ell_{t}^{bf} = \begin{cases} L_t^f & \text{if } W_t^b \geq L_t^f \text{ No rationing} \\ \phi \cdot L_t^f = W_t^b & \text{if } 0 \leq W_t^b \leq L_t^f \text{ Partial rationing} \\ 0 & \text{if } W_t^b < 0 \text{ Full rationing} \end{cases} \]  \hspace{1cm} (7)

Possibility of credit rationing:

\[ \{ \phi : W_t^b - \phi \cdot L_t^f = 0 \} \rightarrow \phi = W_t^b / L_t^f \]

- Illiquid banks stop lending to all firms (bank lending channel)
- Risky firms cannot get loans (borrower’s balance sheet channel)
Parameter sensitivity analysis

- Default: \(\alpha = 32\) (3%)
- Lower: amplitude of recessions increases

\(\beta\)-sensitivity: Reserve Req.
- Default: \(\beta = 0.05\) (5%)
- Higher: amplitude of recessions decreases
Parameter sensitivity analysis

- **α-sensitivity: Cap. Adq. Req.**
  - Default: $\alpha = 32$ (3%)
  - Lower: amplitude of recessions increases

- **β-sensitivity: Reserve Req.**
  - Default: $\beta = 0.05$ (5%)
  - Higher: amplitude of recessions decreases
Firm activity

Number of illiquid firms

No constraint

Capital constraint ($\alpha = 2$)

Liquidity constraint ($\beta = 0.50$)
Bank activity

Number of active banks (unconstrained + constrained by equity/liquidity constraint)

No constraint

Capital constraint ($\alpha = 2$)

Liquidity constraint ($\beta = 0.5$)
## Summary

### Capital Adequacy Requirement ($\alpha$)

1. More limits on **excessive risk-taking**
2. Amplitude recessions increases
3. More banks fail
4. More firms go illiquid
   - constraint does not discriminate
   - constraint self-reinforcing
5. Steep, sudden deleveraging
6. Concentration in banking sector

### Reserve Requirement ($\beta$)

1. More limits on **liquidity supply**
2. Amplitude recessions decreases
3. Banks stay alive
4. Large firms go illiquid
   - large firms largest credit demand
   - liq. constraint helps small firms
5. Gradual deleveraging in waves
6. Bank equity can recover
Outlook

- Macroprudential regulation
  - Systemic risk
  - Bank-firm networks
- Empirically-grounded bank behavior
  - Credit quotas
  - Credit rationing of SMEs
Thank you for your attention!

Model documentation:

www.wiwi.uni-bielefeld.de/vpl1/research/eurace-unibi.html

Papers:

▶ **H Dawid, S Gemkow, P Harting, S van der Hoog & M Neugart (2014):**

▶ **H Dawid, S Gemkow, P Harting, S van der Hoog & M Neugart (2012):**
The Eurace@Unibi Model: An Agent-Based Macroeconomic Model for Economic Policy Analysis. Working Paper University Bielefeld.

▶ **H Dawid, S Gemkow, P Harting, S van der Hoog & M Neugart (2011):**
Eurace@Unibi Model v1.0 User Manual. Working Paper Bielefeld University.

▶ **H Dawid & P Harting (2012):**

▶ **H Dawid & M Neugart (2011):**
The ETACE Virtual Appliance

by Gregor Böhl, Sander van der Hoog, Philipp Harting, Simon Gemkow and Herbert Dawid

Installation Guide

Download:

Why is it?

The intention behind the software package is to make every step related to the initialization, execution and analysis of the Eurace@Unibi model as easy as possible. The following versions of the Eurace@Unibi model are included:

- Dawid, Gemkow, Harting, van der Hoog & Neugart (2012): Eurace@Unibi
Scenario: Capital Adequacy Requirement

Output

Bank activity

Firm activity

Bank equity

Firm fragility

Mean interest
Scenario: Minimum Reserve Requirement

Output

Bank activity

Firm activity

Bank equity

Firm fragility

Mean interest
Scenarios: Firm Fragility

Firm E/A-ratio

Capital constraint

Liquidity constraint

Liquidity constraint
Literature

- Delli Gatti, Desiderio, Gaffeo, Cirillo & Gallegati, 2010: Macroeconomics from the Bottom-Up
- Dosi, Fagiolo, Napoletano & Roventini, 2012: Income distribution, credit and fiscal policies in an agent-based keynesian model. LEM Papers Series 2012/03,
- Ashraf, Gershman & Howitt, 2011: Banks, Market Organization, and Macroeconomic Performance: An Agent-Based Computational Analysis
- Claessens, Kose & Terrones, 2011: How do business and financial cycles interact?