Global Banks and International Business Cycles

Zeno Enders (Bonn), Robert Kollmann (ECARES), Gernot Müller (Bonn)

Advances in International Macroeconomics
- Lessons from the Crisis, Brussels, 23-24 July 2010
Output growth (deviation from average rates, yoy)
House prices

US: Case−Shiller US National Home price index
EA 16: Residential Property Price Index
The Question

Can country-specific shocks trigger simultaneous and global output collapse?

Standard international business cycle models notoriously predict little international co-movement

We explore role of global bank for international transmission

- Capital requirement/balance sheet constraint
- International spillovers of bank equity losses
Banks’ and overall stock market performance

Enders Kollmann Müller

Intro Model Calibration Model simulations Transmission Conclusion

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What we do

Model

• Frictionless two-country, one-good model
• Except for a global bank facing a balance sheet constraint
• Fluctuations due to productivity and loan default shocks

Results

• Bank balance sheet constraint matters little for (international) transmission of productivity shocks
• Loan losses due to default shocks matter little for business cycles in normal times
• An exceptionally large loan loss can trigger a large and simultaneously output decline in both countries
Related literature

Banks in closed-economy quantitative business cycle models

- Bank capital and interest rate spreads: Goodfriend/McCallum 07, Van den Heuvel 08, De Walque/Perrard/Rouabah 10
- Medium-scale DSGE: Meh and Moran 10, Roeger 09, Dib 10, Gerali/Neri/Sessa/Signoretti 10, Iacoviello 10

Financial factors in international business cycles

- Imperfectly competitively banks (without balance sheet constraint) raise co-movement somewhat: Olivero 10
- International implications of financial development and imperfectly enforceable debt contracts: Mendoza/Quadrini 10 and Perri/Quadrini 10
- Optimal portfolio holdings, leverage-constrained investors and international co-movement: Devereux/Yetman 10
Our contribution

Focus on bank balance sheet constraint for international transmission mechanism and neglect other (possibly relevant) frictions

Aggregate perspective on international banking sector and abstract from interbank market (see Kiyotaki/Gertler 10)

Take bank’s capital constraint as given

- Don’t take a stand on where it comes from
- Positive, rather than normative assessment
The Model

Two symmetric countries

- Workers provide labor effort, deposits savings with bank
- Entrepreneurs hire workers and maintain capital stock, take out loans from bank

Global bank

- Faces regulatory capital requirement: finance fraction of loans using own funds (equity)
- Interest rate spread: loan rate exceeds deposit rate
- Spread falls in excess capital

Homogenous good used for consumption and capital accumulation; all markets perfectly competitive
Worker

Life-time utility

\[ E_t \sum_{s=0}^{\infty} \beta^s [u(C_{t+s}) + \psi^D u(D_{t+1}) - \psi^N N_{t+s}] \]

Budget Constraint

\[ C_t + D_{t+1} = W_t N_t + D_t R^D_t \]

Instantaneous utility

\[ u(x) = \frac{x^{1-\sigma} - 1}{1 - \sigma} \]
Entrepreneur

Life-time utility

$$E_t \sum_{s=0}^{\infty} \beta^s \frac{d_{t+s}^{1-\sigma^E} - 1}{1 - \sigma^E}$$

Production function

$$Z_t = \theta_t K_t^\alpha N_t^{1-\alpha}$$

Capital accumulation

$$K_{t+1} = (1 - \delta)K_t + I_t[1 - .5\Xi(I_t/I - 1)^2]$$

Budget constraint

$$L_t R_t^L (1 - \delta_t^L) + W_t N_t + I_t + d_t^E = L_{t+1} + Z_t$$
Global bank

Global deposits and loans

\[ D_{t+1}^{W} \equiv D_{t+1} + D_{t+1}^{*} \quad \text{and} \quad L_{t+1}^{W} \equiv L_{t+1} + L_{t+1}^{*} \]

Capital requirement

Excess capital

\[ x_t \equiv (L_{t+1}^{W} - D_{t+1}^{W}) - \gamma L_{t+1}^{W} \]

Convex and decreasing cost function \( \phi(x_t) \)

\[ \phi(0) = 0 \quad \phi'(x_t) < 0 \quad \phi''(x_t) \geq 0 \]
Global bank cont’d

Objective

$$\max E_t \sum_{s=0}^{\infty} \beta^s u(d_{t+s}^B)$$

s.t.

$$L_{t+1}^W + D_t^W R_t^D + \phi(x_t) + d_t^B$$

$$= L_t R_t^L (1 - \delta_t^L) + L_t^* R_t^{L*} (1 - \delta_t^{L*}) + D_{t+1}^W$$

FOC

$$R_{t+1}^D \frac{\beta E_t u'(d_{t+1}^B)}{u'(d_{t}^B)} = 1 + \phi_t'$$

$$R_{t+1}^L E_t (1 - \delta_{t+1}^L) \frac{\beta E_t u'(d_{t+1}^B)}{u'(d_{t}^B)} = (1 + (1 - \gamma)\phi_t')$$

$$R_{t+1}^{L*} E_t (1 - \delta_{t+1}^{L*}) \frac{\beta E_t u'(d_{t+1}^B)}{u'(d_{t}^B)} = (1 + (1 - \gamma)\phi_t')$$
Market clearing and forcing processes

Net output

\[ Y_t = Z_t - \frac{1}{2} \phi(L_{t+1}^W(1 - \gamma) - D_{t+1}^W) \]

Market Clearing

\[ Y_t + Y_t^* = C_t + C_t^* + d^E_t + d^E_t^* + d^B_t + I_t + I_t^* \]

Productivity

\[ \ln \theta_t = \rho_\theta \ln \theta_{t-1} + \varepsilon_{\theta,t} \]

Defaults

\[ \ln \delta_t^L = \rho_\delta \ln \delta_{t-1}^L + \varepsilon_{\delta,t} \]
Mechanism

Balance sheet constraint dampens effect of unanticipated productivity shock

- Bank capital initially unaffected
- Workers savings and thus deposits increase
- Bank’s excess capital and loan supply reduced: spread increases

Unanticipated default shock

- Transfer of resources from bank to entrepreneurs
- Bank capital absorbs bulk of the loss, as banker smooths consumption
- Interest rate spread rises and depresses investment
Calibration

Required bank capital ratio $\gamma = 0.05$ ('well capitalized')

Effective loan rate

$$\tilde{R}_{t+1}^L \equiv R_{t+1}^L E_t(1 - \delta_{t+1}^L)$$

Effective interest rate spread up to first order

$$\tilde{R}_{t+1}^L - R_{t+1}^D \equiv \mu - \phi'' \gamma (L_{t+1}^W (1 - \gamma) - D_{t+1}^W)$$

Parameter $\phi''$ governs deleveraging

Pin down by targeting $\text{std}(\rho_t)/\text{std}(z_t) = 0.25$
Calibration cont’d

Mean default rate set to 0.95% (historical value)

Set $\beta, \phi'$ to match 1% deposit rate and actual spread of 2.5%

$\psi^N$ set to match $L/Y = 0.81$ (average US and EA)

Assume $\bar{x} = 0$ by setting $\psi^D$

Capital elasticity of output $\alpha = 0.3$

$\Xi$ set to match relative volatility of investment of 3.34 (average US and EA)

Worker and bank: log utility; entrepreneur: $\sigma^E = 0.01$ to match relative volatility of entrepreneurial consumption
Calibration cont’d

Productivity (Solow residuals)

- Autocorrelation: 0.95
- Volatility innovations: $E(\varepsilon_\theta,t)^2 = E(\varepsilon^*_\theta,t)^2 = (0.0053)^2$
- Cross-country correlation of innovations: 0.82

Default (default on bank loans)

- Autocorrelation: 0.97
- Volatility innovations: $E(\varepsilon_\delta,t)^2 = E(\varepsilon^*_\delta,t)^2 = (0.000282)^2$
- Cross-country correlation of innovations: 0.76

Correlation productivity and default innovations: $-0.63$
## Model performance

<table>
<thead>
<tr>
<th>Data 1995–2010</th>
<th>Standard deviation</th>
<th>Correlation with domestic GDP</th>
<th>Cross-country correlation</th>
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<tbody>
<tr>
<td>GDP</td>
<td>1.27</td>
<td>1.00</td>
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<tr>
<td>Aggregate consumption</td>
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<table>
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<tr>
<th>Baseline model</th>
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Limited effect of defaults for cyclical properties

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Limited effect of bank’s balance sheet constraint

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$\phi'' = 0$

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Effect of TFP shock: baseline (solid) vs $\phi'' = 0$ (dashed)
Bank capital had to absorb large loss during crisis

Estimates by GFSR (IMF, April 2010)

- Total losses due to loans and securities to be absorbed by banks 2007–2010: 2300 billions USD
- US banks’ losses due to loans: 588 billions (90 percent on domestic loans)
- EA banks’ losses due to loans: 440 billions (40 percent on domestic loans)

We assume default shock in Home equal to 5% of GDP

Pure transfer ⇒ balance sheet constraint crucial
Effect of default shock: baseline (solid) vs $\phi'' = 0$ (dashed)
Actual default builds up gradually
Gradual strain on bank capital

Transfer

Bank capital ratio

Spread

Investment

Output

Output*

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Conclusion

Exceptionally large loss of bank capital has sizeable effect on activity

- Pure transfer from global bank to entrepreneurs in one country
- Simultaneous output decline in both countries

Nevertheless, introduction of global bank in otherwise standard model

- Does not affect transmission of productivity shocks very much
- ‘Normal’ default shocks of little consequence for business cycles