EVALUATING THE NET BENEFITS OF MACROPRUDENTIAL POLICIES: A COOKBOOK

Network models, stress testing and other tools for financial stability monitoring and macroprudential policy design and implementation
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Motivation

- Policies seek to address externalities (De Nicolo, Favara and Ratnovski, 2012)
  - Correlated risk taking of financial institutions during expansionary phase
  - Fire sales amplify the contractionary phase
  - Contagion propagates shocks through networks

- Externalities $\rightarrow$ Systemic Risk Indicators
- Indicators $\rightarrow$ Output forecast

- Measuring net benefits of policy: in terms of output forecast
Steps

- Framework for evaluating net benefits of policy
  - Benefits: lower probability and depth of crisis
  - Costs: lower intermediation and output from overestimating risks

- Measurements of ingredients
  - Probability of crisis: What are the warning signs?
  - Depth of output loss: What is the damage following a crisis?
  - Output loss if no crisis: What are the costs of policy?
  - How effective are policies?
    - Leakages
Policy Time Line

Steps Involved:
- Signal Issued
  - Determine whether:
    - Credit growth excessive
    - Credit boom identified
    - Liquidity risks are high

Policy Deployed
- Effects of policy...
  - Reserve Requirements
  - Capital Requirements
  - Provisioning
  - Loan-to-Value limits
  - Debt-to-Income limits

Intermediate Targets Affected
- ...on intermediate targets growth:
  - Real Credit
  - Real House Price
  - Loan-Deposit Ratio
  - Foreign Liabilities/
    - Foreign Assets

Costs
- Cost of tightening up on intermediation

Benefits
- Lower probability and depth of crisis

Effect on (forecast of) Output

Main References:
- IMF (2011b)
- Dell’Arriccia et al (2012)
- New staff estimates
- Lim et al (forthcoming)
- New staff estimates
- New staff estimates
- New staff estimates
- New staff estimates
- BCBS (2011a)
Net Benefits of Policy

Expected Y loss without policy: \(1 - pl\)

Expected Y loss with policy: \(1 - p*l^*\)

Cost of policy: Over-regulation and loss in intermediation and output, \(\alpha\)

\[
\frac{1 - p*l^*}{1 - pl} - \frac{1}{1 - \alpha} \geq 0
\]
Analytical Building Blocks

CORE Macrofinancial MODEL
Interactions between financial and real economic activity, $\alpha$

- Probability of crisis, $p$
- Loss given crisis, $l$
- Probability of crisis, $p^*$
- Effects of macroprudential policies
- Loss given crisis, $l^*$
“p”: Early Warning—Credit!

- Credit aggregates are key.
  - Low chance of missing a crisis: change in Credit/GDP >3-5 pp (IMF GFSR, 2011)
  - Low chance of overregulation
    - “gap” > 1.5 s.d. & growth > 10% (Dell’Ariccia et al, 2012)

- Range better than one threshold
  - Flag risks at the lower (GFSR) threshold and escalate concerns and implement policies by the Dell’Ariccia et al threshold

- All sources of credit, not just from banks
“p”: Early Warning—Combine!

- Panel Logit model (RE)
- 1970-2010, ADV & EM

Prob (crisis):
- Credit-GDP change (t-2)
- Real house price (RHP)_{(t-2)}\%
- (DUM if Credit-GDP change >3) * RHP_{(t-2)}\%
“I”: Loss Given Crisis

Model:
- Focus on GDP loss measures
- Measurement:
  - Take 5y window.
  - Compute % difference from potential output (based on 5y pre-crisis avg. growth rate).
  - When actual > potential, set at zero.
  - Cost of crisis = average difference over the window

Crisis Cost (% trend output)

Fall in GDP 1-5 years since financial crisis (in percent of the long-run forecast)
“I”: Loss related to risk-taking

- Higher pre-crisis credit growth related to higher depth of crisis
- Robust across different depth measures
- Policies that reduce credit growth reduces depth

### Depth of crisis

**Dependent variable: cost**

<table>
<thead>
<tr>
<th>Explanatory variable</th>
<th>OLS estimation</th>
<th>Tobit estimation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currency crisis dummy</td>
<td>3.004* 0.056</td>
<td>2.755* 0.079</td>
</tr>
<tr>
<td>Change in credit to GDP (-2)</td>
<td>0.578*** 0.000</td>
<td>0.575*** 0.000</td>
</tr>
</tbody>
</table>

**Number of observations**: 67

Note: The dependent variable is the cost of a financial crisis ("cost") as described in the text. The coefficients reported for each method are marginal effects, so are directly comparable. The p-values are shown under the estimated coefficients. ***, **, and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels of confidence based on robust standard errors, respectively.

### OLS and Tobit Marginal Effects
“α”: Cost of Policy

- Acknowledge asymmetric effects of credit on real economic activity
  - Positive boost in normal times (healthy or unhealthy)
  - Debt overhang (of which bank credit can be symptomatic) and adverse effects in times of financial distress

- Need to combine empirical models with structural models (endogenous risk interactions between financial and real sectors)
“α”: Cost of Policy (concl.)

Effect of 1 pct Increase in Credit on GDP

Positive about 0.2 % when no distress

Negative about -1 % when high distress

Bank Distress Index
Externality 1: Financial institutions take correlated risks during the boom phase

Externality 2: The risk of fire sales, that causes a decline in asset prices amplifying the contractionary phase of the financial cycle.
Policy Effectiveness: On Average

- **Credit growth and house prices** (intermediate targets related to correlated-risk taking externality): LTV/DTI limits, reserve requirements and risk weights effective

- **Loan/Deposit and Net open position** (intermediate targets related to fire sales externality)
  - tighter RRs and DTIs seem to work towards lowering the asset-liability funding mismatches.
  - LTV/DTI limits and higher risk weights slow capital inflows
“p*”, “l*”: Lower Probability and Depth, from Policy

- Policies affect indicators
- Indicators affect probability of crisis, $p \rightarrow p^*$
- Indicators affect depth of crisis, $l \rightarrow l^*$
Net Benefits of Policies

<table>
<thead>
<tr>
<th>Reserve Requirements (RR)</th>
<th>Capital Risk Weights</th>
<th>Loan-to-Value (LTV) limits</th>
<th>Debt-to-Income (DTI) limits</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>0.045</td>
<td>0.038</td>
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<tr>
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<td>0.0049</td>
<td>0.0101</td>
<td>0.0044</td>
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</table>

Average Effects of Tightening

- Credit Growth changes in two-years by (in percentage points)  
  \(-2.45\) - \(-5.04\) - \(-2.18\) - \(-2.63\)

- House price growth changes in two-years by (in percentage points)  
  \(-5.36\) - \(-5.79\) - \(-3.70\) - \(-1.98\)

- Loss given crisis, \(l^*\):  
  \(0.065\)

- Cost on output forecast, \(\alpha\):  
  \(0.0049\)

\[ (1 - p^{*}/l^*)(1/1-p) \geq 0 \]

1 See Figure 5 and Annex 5 for estimates of \(p\) and \(p^*\), given credit growth and house price growth. See Annex 4 and Figure 8 for \(l\). 2 See Annex 6 Table 1 for the results on changes in the credit-GDP ratio. See the note under Figure 9 for the calculation of the two-year effects. 3 See Annex 6 Table 2 for the results on real house price growth. See the note under Figure 9 for the calculation of the two-year effects. 4 See Annex 4 and Figure 8: Average loss given crisis is 0.08. With slowing credit growth, loss is lowered. 5 For the United States, one percentage point lower credit growth reduces the output forecast by 0.2 percent. See Annex 3. 6 See expression 3.1 in the text for the expression on net benefits.
Policy Leakages

- Cross-border lending (Central and Eastern Europe)
  - RRs (and provisioning requirements) leak
  - Combine capital tools and LTV (Ext 1) and DTI (Ext 2)

- Foreign bank branches (UK)
  - Capital tools may not work fully (Aiyar et al)
  - Combine LTV and DTI
  - RR?

- Nonbank financial institutions (US)
  - LTV and DTI
  - Coordinate with other nonbank supervisors
  - Capital and RRs difficult to implement
Conclusions

- Early Warning model performance most important
- Role of credit key, but must combine with other indicators
- All sources of credit
- Net benefits higher with
  - Greater policy effectiveness
  - Sensitive to macro-financial linkages: credit-output sensitivities
Conclusions

- Most effective policies:
  - RRs, Risk weights (capital), LTV
- Policies have prolonged impacts
- Beware of policy leakages
  - Tailor tools to financial structure of country
- Basic recipe proposed in this paper: Country-specific flavors and garnishes encouraged!
- Improvements: More evidence on effectiveness; confidence intervals
Thank you

Comments and suggestions?

<table>
<thead>
<tr>
<th>Dependent variable: Credit/GDP y/y growth</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
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<tbody>
<tr>
<td>Credit/GDP growth_{t-1}</td>
<td>0.83 ***</td>
<td>0.89 ***</td>
<td>0.88 ***</td>
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<td>DTI</td>
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Number of observations: 638, 631, 542, 705, 374
Number of countries: 15, 15, 13, 17, 9
**Evidence: Regression Results (2)**

Table A6.2. Effects of Macroprudential Measures on Real House Price Growth: Panel GMM Estimation (2000-2011)

<table>
<thead>
<tr>
<th>Dependent variable: Real House prices y/y growth</th>
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<th>II</th>
<th>III</th>
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<tbody>
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<td>Real house price</td>
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<td>GDP Growth</td>
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<td>0.05</td>
<td>0.07</td>
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<tr>
<td>Lending rates</td>
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<td>-0.13 ***</td>
<td>-0.05 **</td>
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<tr>
<td>Risk weights</td>
<td>-1.24 ***</td>
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<td>DTI</td>
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<td>-0.52 **</td>
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Number of observations: 433, 431, 428, 593, 307
Number of countries: 11, 12, 11, 15, 8
Other Evidence on Effectiveness

Kuttner and Shim (2013)

Korea: Impact of Lowering LTV and DTI Limits

<table>
<thead>
<tr>
<th>Long run effect on: (in percent)</th>
<th>Ten percentage point lower LTV limit</th>
<th>Ten percentage point lower DTI limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortgage loans</td>
<td>-2.2</td>
<td>-2.0</td>
</tr>
<tr>
<td>House prices</td>
<td>-2.8</td>
<td>-1.1</td>
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<tr>
<td>Nominal GDP</td>
<td>-0.8</td>
<td>-0.3</td>
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Jacome and Mitra (2015)