Capital Controls and Macroprudential Measures: What are They Good For?

Kristin Forbes—MIT (Sloan School)
Marcel Fratzscher —DIW (Berlin)
Roland Straub—ECB

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Motivation

- Increased interest in “capital-flow management” measures (CFMs) to address challenges related to large and volatile capital flows
  - International institutions & policymakers
  - Theoretical literature
- Empirical evidence mixed and inconclusive
- Two major empirical challenges:
  - Selection Bias
  - Endogeneity
- This paper: addresses econometric challenges using a propensity-score matching methodology
Key Results

• Key Results: Some CFMs work, not others
  – Main significant and robust results: macroprudential measures (and to lesser extent controls) effective in reducing several forms of financial fragility
  – Removing controls on capital outflows → small ER depreciation
  – No consistent effects of capital controls and macroprudential measures on other key goals (macroeconomic variables or financial volatilities)

• Comments today
  – New database
  – Propensity-score methodology

Results
New Database

• Large sample of 60 countries
  – All advanced economies, emerging markets and frontier economies
  – Exclude members of euro area, US, UK & Japan
  – Require information on capital flows in EPFR

• Weekly information on changes in capital controls & macroprudential measures
  – Primary source: AREARS, then supplemented
  – Code detailed information on type of CFM
    • Controls on inflows/outflows
    • Measures affect equity, bonds, FDI
    • Measures affect banks, foreign exchange
    • Measures viewed as “major”

• Final Database: 220 CFM events
  2/3 of countries in sample change a CFM from 2009-2011
# of Capital Flow Measures

<table>
<thead>
<tr>
<th>Controls on Inflows</th>
<th>Controls on Outflows</th>
<th>Macro-Prudential Measures</th>
<th>Related to Pressures From Capital:</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Outflows</td>
</tr>
<tr>
<td>29</td>
<td>21</td>
<td>42</td>
<td>85</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>49</td>
<td>135</td>
</tr>
<tr>
<td></td>
<td></td>
<td>72</td>
<td>220</td>
</tr>
</tbody>
</table>
Incidence of CFMs

Number of CFMs
Aimed at Reducing Capital Inflows

- Black line: Add control on inflows
- Green dashed line: Add prudential measure
- Red line: Remove control on outflows
Propensity-Score Methodology

- See paper for details on methodology
- “Treated” observations
  - Country-weeks when a country changes a CFM
  - Country-weeks with no change are “controls”
  - “Exclusion window” for 3 months before & after
- Estimate logit model to calculate propensity scores
  - Probability that each country changes its CFMs each period as a function of observable domestic & global variables:
    - Real effective ER & 6-month net portfolio inflows
    - Domestic credit/GDP & CPI inflation forecasts
    - Global risk (VIX) & TED spread
    - Commodity prices & interest rates differentials (vs. US)
    - Reserves/GDP, ER regime, capital account openness
    - Income level, size of financial sector, institutions
<table>
<thead>
<tr>
<th>LOGIT RESULTS</th>
<th>Increased Inflow Controls</th>
<th>Decreased Outflow Controls</th>
<th>Increased Macroprudential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real exchange rate (%ch)</td>
<td>11.222***</td>
<td>6.006**</td>
<td>1.317</td>
</tr>
<tr>
<td>Portfolio flows (6 mo, %ch)</td>
<td>0.001</td>
<td>0.004</td>
<td>0.000</td>
</tr>
<tr>
<td>Consensus CPI, 52-wk</td>
<td>0.207*</td>
<td>-0.148</td>
<td>0.337***</td>
</tr>
<tr>
<td>Private credit / GDP (%ch)</td>
<td>0.652</td>
<td>1.157</td>
<td>4.501**</td>
</tr>
<tr>
<td>VIX</td>
<td>0.052</td>
<td>-0.032</td>
<td>-0.045</td>
</tr>
<tr>
<td>TED Spread</td>
<td>-2.381</td>
<td>1.077</td>
<td>-0.646</td>
</tr>
<tr>
<td>Commodity prices (%ch)</td>
<td>-0.334</td>
<td>-2.536*</td>
<td>0.217</td>
</tr>
<tr>
<td>Interest rate vs. US (ch)</td>
<td>-0.037</td>
<td>-0.031</td>
<td>0.042</td>
</tr>
<tr>
<td>FX Reserves/GDP (% ch)</td>
<td>-0.663</td>
<td>-0.846</td>
<td>-0.817</td>
</tr>
<tr>
<td>Floating ER dummy</td>
<td>-0.349</td>
<td>0.488</td>
<td>1.615***</td>
</tr>
<tr>
<td>Capital account openness</td>
<td>-0.097</td>
<td>-1.008***</td>
<td>0.579***</td>
</tr>
<tr>
<td>Stock market cap. (% GDP)</td>
<td>-0.012*</td>
<td>0.006**</td>
<td>-0.000</td>
</tr>
<tr>
<td>Log GDP per capita</td>
<td>0.224</td>
<td>0.802**</td>
<td>0.052</td>
</tr>
<tr>
<td>Legal compliance</td>
<td>-17.397</td>
<td>105.058**</td>
<td>79.502***</td>
</tr>
<tr>
<td>Legal compliance2</td>
<td>3.100</td>
<td>-25.638**</td>
<td>-18.826***</td>
</tr>
<tr>
<td>Observations</td>
<td>4,953</td>
<td>4,708</td>
<td>4,394</td>
</tr>
<tr>
<td>Pseudo R²</td>
<td>0.192</td>
<td>0.222</td>
<td>0.155</td>
</tr>
</tbody>
</table>
Matching Algorithms

• **5 Matching Algorithms**
  1. **Nearest neighbor without replacement**
     - Brazil ↑ tax on inflows (wk 42, 2010) matches w/ Mexico (wk 20, 2010)
     - Indonesia ↑ macropru (2011, wk 4) matches w/ Turkey (2011, wk 31)
     - Korea ↑ macropru (2010, wk 1) matches w/ New Zealand (2010, wk 3)
  2. **5 nearest neighbors**
  3. **Radius** (with caliper = 0.005)
  4. **Kernel**
  5. **Local-linear**: Weighted average of all observations in control group
     - Non-parametric estimator with general weighting function to assign higher weight to controls closer to treated observation

• **Tests of methodology**
  – Preferred method (bias/efficiency tradeoff)
  – All treatments meet “common support condition”
  – Meets “independence” assumption/”balancing assumption”
<table>
<thead>
<tr>
<th>Matching Tests: Controls on Inflows</th>
<th>Mean: Treated Group ($\mu_T$)</th>
<th>Mean: Unmatched Control ($\mu_C$)</th>
<th>t-Statistics (H0: $\mu_T = \mu_C$)</th>
<th>Local-linear Mean Matched Control ($\mu_C$)</th>
<th>t-stat (H0: $\mu_T = \mu_C$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real ER</td>
<td>0.090</td>
<td>0.008</td>
<td><strong>4.21</strong>*</td>
<td>0.099</td>
<td>-0.33</td>
</tr>
<tr>
<td>Portfolio flows</td>
<td>0.401</td>
<td>-2.541</td>
<td>0.21</td>
<td>1.955</td>
<td>-0.58</td>
</tr>
<tr>
<td>Consensus CPI</td>
<td>7.156</td>
<td>4.158</td>
<td><strong>4.78</strong>*</td>
<td>6.115</td>
<td>1.03</td>
</tr>
<tr>
<td>Credit growth</td>
<td>0.044</td>
<td>0.026</td>
<td>0.99</td>
<td>0.012</td>
<td>1.12</td>
</tr>
<tr>
<td>VIX</td>
<td>25.752</td>
<td>26.482</td>
<td>-0.39</td>
<td>27.791</td>
<td>-0.82</td>
</tr>
<tr>
<td>TED</td>
<td>0.268</td>
<td>0.351</td>
<td>-1.39</td>
<td>0.271</td>
<td>-0.08</td>
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<tr>
<td>Commodities</td>
<td>0.068</td>
<td>-0.007</td>
<td>1.30</td>
<td>0.058</td>
<td>0.18</td>
</tr>
<tr>
<td>Interest rate - US</td>
<td>-0.523</td>
<td>-0.140</td>
<td>-0.56</td>
<td>-1.006</td>
<td>0.22</td>
</tr>
<tr>
<td>FX Reserves/GDP</td>
<td>0.080</td>
<td>0.084</td>
<td>-0.06</td>
<td>0.134</td>
<td>-0.73</td>
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<tr>
<td>Floating ER</td>
<td>0.667</td>
<td>0.744</td>
<td>-0.81</td>
<td>0.714</td>
<td>-0.33</td>
</tr>
<tr>
<td>CA openness</td>
<td>0.073</td>
<td>1.016</td>
<td><strong>-2.97</strong>*</td>
<td>0.234</td>
<td>-0.51</td>
</tr>
<tr>
<td>Stock mktcap.</td>
<td>43.231</td>
<td>84.666</td>
<td><strong>-1.98</strong></td>
<td>48.162</td>
<td>-0.40</td>
</tr>
<tr>
<td>GDP per capita</td>
<td>8.443</td>
<td>9.295</td>
<td><strong>-3.26</strong>*</td>
<td>8.535</td>
<td>-0.31</td>
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<tr>
<td>Legal compliance</td>
<td>2.046</td>
<td>2.229</td>
<td><strong>-3.82</strong>*</td>
<td>2.029</td>
<td>0.32</td>
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<tr>
<td>Legal comp. $^2$</td>
<td>4.216</td>
<td>5.018</td>
<td><strong>-3.76</strong>*</td>
<td>4.144</td>
<td>0.33</td>
</tr>
</tbody>
</table>
Impact of CFMs on Outcomes

• Calculate **average treatment effect on the treated (ATT)** for each CFM on each outcome variable
  – Compare average values for treated observations with average for matched controls
  – Estimate cumulative ATT for each week over 6-months
  – Bootstrapped standard errors

• Test for impact on 4 cited goals (outcome variables):
  – **Exchange rate** (nominal & real) & **portfolio flows**
  – **Other macroeconomic variables** (interest rate differentials, equity markets, inflation)
  – **Financial market volatility** (exchange rate, portfolio flows, interest rates)
  – **Financial fragilities** (bank leverage, private credit growth, bank credit growth, inflation expectations, & exposure to short-term debt, portfolio liabilities & foreign-currency liabilities)
Impact on Nominal Exchange Rate
Increased Controls on Capital Inflows

Increased Controls on Capital Inflows
Local-Linear Matching

Weeks
1 6 11 16 21 26

NEER
-1.5 -1 -0.5 0

Insignificant
Significant at 10% level
Significant at 5% level
Fitted AT Line
Impact on Nominal Exchange Rate

**Increased controls on inflows**

*Increased Controls on Capital Inflows*
Local-Linear Matching

**Decreased controls on outflows**

*Decreased Controls on Capital Outflows*
Local-Linear Matching

**Increased prudential measures**

*Increased Prudential Measures*
Local-Linear Matching
Impact on Real Exchange Rate

Decreased Controls on Capital Outflows

Decreased Controls on Capital Outflows

Local-Linear Matching

Insignificant Significant at 10% level

Significant at 5% level Fitted AT Line
Increased Macroprudential Measures Impact on Financial Fragility

% Change in Bank Leverage

Change in Expected Inflation

Insignificant Significant at 10% level

Significant at 5% level Fitted AT Line

Increased Prudential Measures
Local-Linear Matching

Weeks

1 6 11 16 21 26

bkcred_d

Cons CPI

Weeks

1 6 11 16 21 26

-0.4 -0.3 -0.2 -0.1 0

-0.4 -0.3 -0.2 -0.1
Increased Macroprudential Measures Impact on Financial Fragility

% Change in Bank Credit

Change in Exposure to Portfolio Liabilities

Increased Prudential Measures
Local-Linear Matching

Insignificant
Significant at 10% level
Significant at 5% level
Fitted AT Line

Insignificant
Significant at 10% level
Significant at 5% level
Fitted AT Line
Increased Capital Inflow Controls Impact on Financial Fragility

% Change in Private Credit

Increased Controls on Capital Inflows
Local-Linear Matching

CPS, GDP

Weeks

Insignificant Significant at 10% level Significant at 5% level Fitted AT Line
Summary of Key Results

- Most effects in expected direction, but not significant and robust
- **Exchange rate** (real & nominal) and **portfolio flows**
  - Reduced controls on outflows → real ER depreciation (2.5% max)
  - Increasing controls on inflows and prudential measures do not have significant effects
  - (Controls on inflows reduce equity inflows, but not ER or net flows)
- **Other macroeconomic variables** (i differentials, equities, inflation)
  - No consistently significant effect of any CFMs
- **Financial market volatility** (ER, portfolio flows, interest rates)
  - No consistently significant effect of any CFMs
- **Financial vulnerabilities: many significant effects**
  - Increased prudential measures reduces bank leverage, inflation expectations, bank credit growth, exposure to portfolio liabilities
  - Increased controls on inflows reduces private credit growth (maybe bank leverage)
Extensions

Focus on “major” CFMs
- Only 39 of 135 events
- Controls on inflows and outflows reduce net inflows, but increase flow volatility
- Only significant effects on ER from removing controls on outflows

Differentiate capital control based on whether target equity or debt flows
- Equity flows significantly affected by capital controls, but no effect on net flows or exchange rate

Differentiate type of prudential regulation based on whether targets banks or forex
- Similar results
What are They Good For?

- Empirical literature needs to take endogeneity & selection bias seriously
- CFMs can be “good for” reducing forms of financial vulnerability (especially macropru)
- CFMs are generally NOT “good for” affecting exchange rates, portfolio flows, volatilities & other macro variables
  - Except removing controls on outflows may reduce ER appreciation
- Implications:
  - Why not focus more on changes in controls on outflows than inflows?
  - Justifies shift away from using CFMs to target macro variables (ER, flows) and instead toward reducing financial fragilities (Ostry et al., 2012)