Vulnerability to Sudden Stops and Optimal Reserves as a Precautionary Tool

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I. Domestic Amplifiers of Systemic Financial Turmoil in Emerging Markets

II. Optimal Reserves: A Precautionary Tool Against Sudden Stops
OUTLINE

I. Domestic Amplifiers of Systemic Financial Turmoil in Emerging Markets

II. Optimal Reserves: A Precautionary Tool Against Sudden Stops
DOMESTIC AMPLIFIERS OF SYSTEMIC FINANCIAL TURMOIL IN EMERGING MARKETS

Focus

- External financial shocks may or may not trigger a Systemic Sudden Stop. This will depend on country-specific domestic variables.

- We estimate a Probit model to analyze the domestic determinants of the likelihood of Systemic Sudden Stops (as previously defined), with an emphasis on balance-sheet effects and financial integration.
Systemic Sudden Stops: The Sample

**Sample**
110 countries (21 developed)

**Period**
1992-2004

**Definition of Systemic Sudden Stop (3S)**
Periods characterized by systemic financial turbulence (as reflected in a significant rise in EMBI spreads, i.e. the cost of international financing for EMs) that results in a collapse in capital inflows for any given country.

Definition of Systemic Sudden Stop

More precisely, a 3S phase meets the following criteria:

- Aggregate spread window containing a spike in the EMBI spread exceeding two standard deviations from the mean.
- The phase starts when EMBI spreads rise one standard deviation above its sample mean.
- The Phase ends once the EMBI spreads fall one standard deviation below its sample mean.
- This phase of systemic financial turmoil coincides, for any given country in the sample, with a phase of Sudden Stop in capital flows defined along the same lines above (i.e., a fall that lies at least two standard deviations below its sample mean).
Systemic Sudden Stop Episodes

International Capital Market Conditions for EMs

Fed Fund Rate

EMBI Spreads

US Monetary Contraction
Tequila Crisis
Asia-Russian Crises

Effective Federal Funds Rate (%)

EMBI Sovereign Spread (Bps over US Treasuries)

Sudden Stop in Capital Flows: The Case of Chile
Systemic Sudden Stops: The Sample

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Definition of Systemic Sudden Stop (3S)
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Results
77 episodes of Systemic Sudden Stop, out of which only 6 take place in developed countries (however, this was before the 2009 global crisis!)

**Systemic Sudden Stops 1992-2004**

<table>
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<tr>
<th>Country</th>
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The list includes most of the paradigmatic cases of Systemic Sudden Stop

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Sudden Stops and Domestic Amplifiers in Emerging Markets: *Balance-Sheet Effects*  

**Balance-Sheet Effects**  

- Domestic Liability Dollarization (dollar-denominated domestic debt towards the domestic banking system).  

- Motivation: Banks are at the heart of the payments system, and their bankruptcy could represent a serious supply shock.  

- This supply shock will materialize when large RER depreciation occurs.  

- We show that when a Sudden Stop materializes, the current account deficit as a share of the absorption of tradable goods is key in explaining changes in the RER.
Sudden Stops and Domestic Amplifiers: Balance-Sheet Effect and Output Drops
Sudden Stops and Domestic Amplifiers in Emerging Markets

Basic Framework

Effect of shocks to the financing of the current account over the real exchange rate (RER):

• Demand function for nontradables:

\[ h_t = \alpha + \beta \, rer_t + \delta \, z_t \]  
(Eq. 1)

where \( h \) and \( z \) are (the log of) the demand for nontradables and tradables (RER=\( p^*/p \)).

• Current account deficit (CAD):

\[ CAD_t = Z_t - Y_t + S_t \]  
(Eq. 2)

where \( Y \) is output of tradables and \( S \) are factor payments, remittances abroad, etc.
Sudden Stops and Domestic Amplifiers in Emerging Markets

Basic Framework

• When $CAD_t$ is driven down to zero, given $Y$ and $S$:

\[ \Delta CAD_t = \Delta Z_t \]  
(Eq. 3)

\[ CAD_{t-1} / Z_{t-1} = -\Delta Z_t / Z_{t-1} \]  
(Eq. 4)

• Then, from Eqs. 1 and 4, and assuming that the supply of nontradables is constant, in equilibrium we find:

\[ \Delta rer_t = (\delta / \beta) CAD_{t-1} / Z_{t-1} \]  
(Eq. 5)

• This is not the actual change in the RER but the part of the total change that the country finds difficult to prevent.
Balance Sheet Effect: Potential Changes in RER

- We know:
  \[ \Delta rer_t = (\delta / \beta) \, CAD_{t-1} / Z_{t-1} \]

- This can be rewritten as:
  \[ \Delta rer_t = (\delta / \beta) \, (1 - \omega_{t-1}) \]

  \[ \omega_t = (Y_t - S_t) / Z_t \] un-leveraged absorption of tradables

  where, \( Y_t = \) agricultural + industrial output

  \( Z_t = Y_t - \) exports + imports

- We use \((1 - \omega)\) in our estimations (leveraged absorption of tradables)
Sudden Stops and Domestic Amplifiers in Emerging Markets

Balance Sheet Effect: DLD Definition

- We construct a proxy for credit in foreign currency extended by the domestic banking system as a share of GDP (size of the burden matters, not share of total credit; difference with Arteta (2003), Edwards (2003))

- Benefits of this measure: It brings Asia closer to Latin America (a lower share of dollarization in total credit is compensated by large size of financial system) in terms of the size of DLD

- For developing countries, we add dollar deposits to bank borrowing in foreign currency, and assume currency matching of bank assets and liabilities due to regulatory measures
Sudden Stops and Domestic Amplifiers in Emerging Markets

Other Determinants of Sudden Stop

- Set of control variables:
  - FDI Integration
  - Portfolio Integration
  - TOT growth
  - Public sector balance / GDP
  - Public external debt/GDP
  - M2/R
  - Measures of exchange rate flexibility
  - EM dummy

- Variables are lagged one period to partially address endogeneity

- Given strong potential endogeneity between latent variable (capital flows) and $(1-\omega)$, we use Rivers-Voug method to account for this

- Given inclusion of random effects and residuals from a first-stage regression of $(1-\omega)$ using Rivers-Vuong, we use bootstrap methods to construct confidence intervals
### Panel Probit Results: Rivers-Vuong Non linear Integration Effects (All Countries)

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<td>$1-\omega_{t-1} (\Delta RER)$</td>
<td>9.418***</td>
<td>10.069***</td>
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<td>3.390***</td>
<td>3.847***</td>
<td>3.613***</td>
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<td>-1.118***</td>
<td>-0.881**</td>
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<td>(Portfolio Integration $t-1)^2$</td>
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<td>-129.510***</td>
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<td>-0.095**</td>
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<td>M2 over Reserves $t-1$</td>
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<td>843</td>
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All regressions include time dummies. Standard errors in parentheses.
How About Balance-Sheet Interactions?

Results suggest that the relationship between $\omega$ (un-leveraged absorption of tradables) and financial dollarization is highly non-linear, something that could be particularly harmful for EMs.
Probability of Sudden Stop and Financial Integration
(Probability of a Sudden Stop for Different Values of Portfolio Integration)

- At recent levels of financial integration, EMs hover around maximum values of SS probability
An Example: Estimated Sudden Stop Probabilities in Eastern Europe and Latin America
(Based on Calvo, Izquierdo and Mejia, 2007)

Notes: Simple country averages. LAC7 includes Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela. CAC5 includes Costa Rica, Guatemala, Honduras, Nicaragua and Dominican Republic. Eastern Europe includes Estonia, Hungary, Latvia, Lithuania, Poland, Romania, and Turkey.
DOMESTIC AMPLIFIERS OF SYSTEMIC FINANCIAL TURMOIL IN EMERGING MARKETS

Conclusions

- Systemic Sudden Stops are associated with large real exchange rate fluctuations.

- Potential real exchange rate adjustments coupled with Domestic Liability Dollarization (DLD) are key determinants of the probability of Sudden Stops.

- The relationship between potential changes in the real exchange rate and DLD is highly non-linear, i.e. their interaction could become a dangerous cocktail.

- A larger supply of tradable goods reduces leverage in the absorption of tradables, and therefore, the size of potential real exchange rate adjustments.

- Financial integration can increase the likelihood of a Sudden Stop at sufficiently low levels of integration. This should not be interpreted as evidence against integration, but rather, that financial integration should be accompanied by appropriate institutions that make integration safe.
Case Study: Balance-Sheet Effects in Argentina and Chile during the Russian/LTCM Crisis
Argentina and Chile during the Russian/LTCM Crisis: An Illustration

Sudden Stop and Economic Performance

**Sudden Stop**
(Capital flows, % of GDP)

**GDP**
(s.a. real indices, 1998.II=100)

**Investment**
(s.a. real indices, 1998.II=100)

Argentina and Chile during the Russian/LTCM Crisis: An Illustration

Sudden Stop and External Vulnerabilities

Current Account
(year ended in Jun-98, % of GDP)

-4.7%
-6.5%

Argentina
Chile

Openness
(share of tradables in GDP, avg 91-97)

24%
35%

Argentina
Chile

Required Change in the Equilibrium RXR
to eliminate the CA deficit
(scaled to Chile’s observed depreciation)

75%
48%

Argentina
Chile

Argentina and Chile during the Russian/LTCM Crisis: An Illustration

Financial Mismatches

**Dollarization of Private Debt**
(share of dollar denominated debt in total debt)

- **Argentina**: 80%
- **Chile**: 38%

**Financial Mismatch (55%)**

**Dollarization of Public Debt**
(share of dollar denominated debt in total debt)

- **Argentina**: 98%
- **Chile**: 44%

**Financial Mismatch (74%)**

Real Exchange Rate and Debt Valuation

Debt Valuation

Debt to GDP Ratio: 

\[ b = \frac{B + eB^*}{Y + eY^*} \]

Where: 

- \( b \) = Debt to GDP ratio 
- \( B \) = Debt payable in terms of non-tradables 
- \( B^* \) = Debt payable in terms of tradables 
- \( Y \) = Output of non-tradables 
- \( Y^* \) = Output of tradables 
- \( e \) = Real exchange rate

Impact of RXR Adjustments on Debt Valuation

Debt – Exchange Rate Elasticity: 

\[ \varepsilon_e^b = \frac{e(B^*Y - BY^*)}{(Y + eY^*)(B + eB^*)} \]

Special Cases

\[ \left\{ \begin{array}{l}
\circ \text{Complete mismatch (} B = Y^* = 0\text{): } \varepsilon_e^b = 1 \\
\circ \text{Perfect financial match (} \frac{B}{eB^*} = \frac{Y}{eY^*}\text{): } \varepsilon_e^b = 0 \\
\circ \text{Complete reverse mismatch (} B^* = Y = 0\text{): } \varepsilon_e^b = -1 \\
\end{array} \right. \]

Private Debt and the Real Exchange Rate

Dollarization of Private Debt
(share of dollar denominated debt in total debt)

Argentina
- Financial Mismatch (55%)
- Share of tradable goods in total production
- 80%

Chile
- Financial Mismatch (3%)
- 38%

Private Debt at the New Equilibrium RXR in Argentina
(% GDP)

- Initial Level: 32%
- Representative Firm: 43%
- Non Tradable Firm: 52%
Public Debt and the Real Exchange Rate

**Dollarization of Public Debt**

(share of dollar denominated debt in total debt)

Argentina

- 98% Financial Mismatch (74%)
- Share of tradable goods in total production

Chile

- 44% Financial Mismatch (9%)

**Public Debt at the New Equilibrium**

RXR in Argentina

(% GDP)

Argentina

- Pre-depreciation: 54%
- Post RXR depreciation: 93%

Fiscal Sustainability in Argentina

In % of GDP: 2.1%
In % of Expenditures: 10%

* Required Adjustment to sustain public debt levels of 93% of GDP *
DOMESTIC AMPLIFIERS OF SYSTEMIC FINANCIAL TURMOIL IN EMS

References


OUTLINE

I. Domestic Amplifiers of Systemic Financial Turmoil in Emerging Markets

II. Optimal Reserves: A Precautionary Tool Against Sudden Stops
Optimal Reserves: Motivation

- Prior to the financial crisis, little was done to improve the resilience of EMs against Sudden Stops (SS), despite multiple official pronouncements about the need to find a new Financial Architecture.
- EM policymakers had strong incentives to self-insure by accumulating International Reserves (IRs).
- More recently, new instruments have been developed (FCLs, PLLs) but they are not widely used. As pointed out by Marino and Volz (2012):
  - Entry problem: Potential stigma of IMF involvement
  - Exit problem: graduation from precautionary agreements may signal country no longer qualifies and worsen financial conditions
Optimal Reserves: Motivation

- Following substantial increase in IRs in several EMs following SS episodes throughout the 1990s raises two questions:
  - Are EMs over accumulating IRs?
  - Is this accumulation consistent with a self-insurance motive?
Related Literature

- Concept of holding international reserves for precautionary reasons is not new.
  - Shocks to the trade balance
  - First to quantify optimal reserve levels for a large set of countries by weighting the adjustment costs resulting from external imbalances that cannot be met with reserves against the opportunity cost of holding reserves.
- Garcia and Soto (2004):
  - Larger amounts of IRs could imply that countries avoid costly liquidation of assets.
  - Reserves/ST liabilities affect probability of SS, however mechanism is not explicitly stated, indicators of external liabilities (factor that could be considered relevant in terms of providing a source of risk justifying the need to accumulate reserves) turn out not to be significant
  - Alternative assumptions about the costs of a crisis (from 5% to 15% of GDP)
Related Literature

- Jeanne and Ranciere (2006)
  - Model that incorporates the benefit of holding international reserves in sustaining domestic absorption in times of a SS
  - Expected costs of SS: Probability of SS exogenous to stock of reserves (probit model), cost of SS (sample average difference in the output growth rate in SS times relative to tranquil times).
  - Jeanne (2007) incorporates international reserves as a determinant of the probability of crises but finds no significant effect.

- Gonçalves (2007)
  - Include coverage of dollar deposit withdrawals during a SS as an additional element to consider at the time of choosing optimal reserves
  - does not incorporate a role for reserves either in affecting the probability of a Sudden Stop or the cost of a crisis.
Our Approach

• Builds on this precautionary approach literature and makes the following contributions:

  – Endogenize both the probability of a SS and the costs of a crisis through empirical models linked to balance-sheet effects.

  – Provides a rationale for the inclusion of IRs in the determination of the probability of a SS as well as output costs, as they constitute an instrument that offsets potential balance-sheet effects stemming from large Domestic Liability Dollarization (DLD).

  – Instead of selecting parameters to calibrate a first order condition to match data on reserves and costs of crisis, we estimate empirical models of the probability of a SS and of costs using country specific data on their determinants.

  – We then use FOC to put pieces together.

  – However, as it will become clear later, assumptions need to be made regarding the level of precaution of policy makers (i.e., picking most conservative scenario).
The Model

• Assumption: CBs conservatively choose the stock of reserves (R) by balancing the expected cost of a SS against the opportunity cost of holding reserves.

• Reserves affect expected cost of a SS
  – Reduce the probability of a SS \( P(SS = 1|R) \)
  – Reduce the costs associated with SS \( K(R|SS = 1) \)

• Determinants of the probability of a crisis – including international reserves – are in and of themselves also determinants of the cost of a crisis.
The Model

• Formally, it is assumed the CBs seek to minimize a cost function of the form:

\[
L(R) = P(SS = 1|R)K(R|SS = 1) + \rho R
\]

Expected output cost of a SS

Opportunity cost of holding reserves

FOC: \( P'K + K'P + \rho = 0 \)
Empirical Implementation

*Probability of SS*

- Calvo, Izquierdo and Mejia (2008) identify as key factors: **DLD & Potential RER changes**
- We consider the potential offsetting impact that IR could have on hazard caused by DLD: \( NetDLD = DLD - R \)
- Probit Model:
  \[
P(SS_t = 1) = \Phi\left(\alpha_0 + \alpha_1 (1 - \omega_{t-1}) + \alpha_2 (NetDLD_{t-1}) + X\beta + \sum_i \eta_i \text{time}_{-\text{dum}}_i\right)
\]
  where:
  - SS is defined à la CIM (2008)
  - \((1-\omega)\): \(\Delta\text{RER}\) that results from a stop in financing of CAD, a function of \(\text{CAD/Z}\) (where \(Z\) is the absorption of tradable goods)
  - \(X\): set of control variables (financial integration, TOT, Fiscal Balance, etc.)
  - \(\text{time}_{-\text{dum}}\): yearly time dummies (capture changing external conditions)
- Sample: 110 countries (21 developed economies, and 89 developing countries) for the period 1992-2004.
## Empirical Implementation

### Probability of SS

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Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Time dummies included in all regressions.
Empirical Implementation

*Output Costs*

**Step 1: Definition of output costs ($K_{T,i}$)**

- For each country included in our Probit estimation, we compute the present discounted sum of any contiguous negative output gaps measured as the percentage difference between observed GDP and its corresponding HP trend.
  - Discount rate: 10%
  - HP Trend: 1980-2010

- For each episode, we denote $T$ as the period immediately prior to GDP falls below trend.

- Filter episodes in which a Systemic Sudden Stop occurs in a 3-year window centered at $T [K(R|SS = 1)]$
Output Costs of Sudden Stops

Note: Black bars indicate identified episodes in Developed countries.
Example: Peru’s Cost of a Sudden Stop after 1999

Cost of a Sudden Stop

Real GDP
HP trend

Step 2: Estimation of output cost functions

- No easy task: Policy responses affect output dynamics during crisis
  - Endogeneity issues.

- To the extent that investor predictions are right in the sense that the factors describing the vulnerability to a SS are valid, then these same factors could be a good predictor of the size of a crisis.
  - Ability of governments to respond to the crisis will depend on pre-existing vulnerabilities and the size of the shock.

- Note that *Net DLD* and Fiscal Balance proxy the ability to conduct counter-cyclical monetary and fiscal policies during crisis.
**Empirical Implementation**

*Output Costs*

**Step 2: Estimation of output cost functions**

• We estimate functions of the form:

\[
K_{T,i} = \phi_0 + \phi_1(1 - \omega_{i,T}) + \phi_2(NetDLD_{T,i}) + X_{T,i}\gamma + \sigma ShockSize + \varepsilon_{T,i}
\]

where *ShockSize* is change in the aggregate spreads before and after each Systemic Sudden Stop associated with a fall in output.

– *Aggregate* spreads to capture changes in international liquidity

– *EMs*: EMBI spread / *DMs*: Average European Sov. Spreads over German bonds.
## Empirical Implementation

### Output Costs

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<td>0.009*</td>
<td>0.008*</td>
<td>0.009*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.005)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.049**</td>
<td>0.007</td>
<td>0.006</td>
<td>0.009</td>
<td>0.020</td>
<td>0.015</td>
<td>0.031</td>
<td>0.020</td>
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<tr>
<td></td>
<td>(0.024)</td>
<td>(0.036)</td>
<td>(0.037)</td>
<td>(0.034)</td>
<td>(0.066)</td>
<td>(0.071)</td>
<td>(0.074)</td>
<td>(0.086)</td>
</tr>
<tr>
<td>Observations</td>
<td>37</td>
<td>35</td>
<td>35</td>
<td>34</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>31</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.41</td>
<td>0.46</td>
<td>0.46</td>
<td>0.47</td>
<td>0.46</td>
<td>0.47</td>
<td>0.47</td>
<td>0.52</td>
</tr>
</tbody>
</table>

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Empirical Implementation

Opportunity Cost of Holding Reserves

• Average of JP Morgan’s EMBI+ sovereign spread.

• Rationale: government can choose between paying back debt (in which case it foregoes interest payments at the ongoing public bond rate), or holding reserves (in which case it earns the risk free rate).
Optimal Reserves

- With empirical estimates of $P(SS = 1|R)$, $K(R|SS = 1)$ and $\rho$, FOC condition becomes:

$$
\frac{\alpha_2}{\sqrt{2\pi}} e^{-A^2/2} B + \phi_2 \int_{-\infty}^{A} \frac{1}{\sqrt{2\pi}} e^{-t^2/2} dt + \rho = 0
$$

with:

$$
A = \alpha_0 + \alpha_1 (1 - \omega) + \alpha_2 (NetDLD) + X\beta + \bar{\eta}
$$

$$
B = \phi_0 + \phi_1 (1 - \omega_{T,i}) + \phi_2 NetDLD_{T,i} + X_{T,i}\gamma + \sigma ShockSize
$$

$$
NetDLD = DLD - R^* 
$$

where:

- $\bar{\eta}$ is the estimated coefficient of the time dummy that the policymaker believes reflects global financial conditions
- $R^*$ is the optimal level of reserves
Optimal Reserves

• Although country-specific variables used in both Probit and output costs estimations can be chosen for each point in time, a decision that remains to be made relates to the size of the shock for which countries will insure when deciding on their optimal reserve level.

• Policymakers may face uncertainty in choosing amongst different specifications of the probability of a SS and the SS cost function.

• To tackle both issues, we follow Hansen and Sargent (1998), and assume that the policymaker implements a robust policy by minimizing the objective function for the most conservative model.
Optimal Reserves

• Model uncertainty: each model is defined as a triplet of a Probit equation, a cost function and a particular size of the external shock.

• We calculate optimal reserves for each combination of Probit estimations and estimated cost functions, assuming the maximum size of the external shock in both cases.

• For Probit, we take the maximum estimated coefficient of the set of time dummies (1999). For cost equations, we use the maximum shock size observed in the sample (1999).
  
  – Specifications with non-significant controls are excluded.

• Most parsimonious turns out to yield the larger optimal reserve level.
  
  – Probability of SS: NetDLD, 1- \( \omega \)
  
  – Output costs of SS: NetDLD and the fiscal balance
Sample of Countries

- We calculate the optimal level of international reserves as of 2007 for a set of 27 Emerging Economies.
  - Focus on economies that belong to JP Morgan’s EM Bond Index.
  - Assessing how well prepared they were to withstand the 2008/2009 global financial crisis.

<table>
<thead>
<tr>
<th>Emerging Asia (6)</th>
<th>Latin America (9)</th>
<th>Emerging Europe (9)</th>
<th>Other Emerging (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>Argentina</td>
<td>Bulgaria</td>
<td>Egypt</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Brazil</td>
<td>Czech Republic</td>
<td>Nigeria</td>
</tr>
<tr>
<td>Korea</td>
<td>Chile</td>
<td>Hungary</td>
<td>South Africa</td>
</tr>
<tr>
<td>Malaysia</td>
<td>Colombia</td>
<td>Poland</td>
<td></td>
</tr>
<tr>
<td>Philippines</td>
<td>Dominican Rep.</td>
<td>Romania</td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>Mexico</td>
<td>Russia</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Peru</td>
<td>Slovakia</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Uruguay</td>
<td>Turkey</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Venezuela</td>
<td>Ukraine</td>
<td></td>
</tr>
</tbody>
</table>
Optimal vs. Observed Reserves
(as of 2007, % of GDP)

Out of 27, only 10 display higher-than-optimal reserves.
Overall, these results suggest that, on average, LAC and Asian countries were better positioned in 2007 to weather Sudden Stops relative to Eastern European economies.

Results are consistent with the relative performance of these economies in the aftermath of the 2008 US financial crisis, after which LAC and East Asia came out relatively unscathed, while Eastern Europe fell into deep recession.
Explaining Deviations from Optimal

- Low self-insurance levels in Eastern European Countries
  - Presence of the European Union (EU) as a de-facto lender of last resort could have mitigated the perceived need for self-insurance.

- Oil exporters (Nigeria and Russia) display higher than optimal reserves
  - Reserve accumulation as mechanism to save proceeds of oil for inter-temporal smoothing of consumption of oil resources across generations.

- To analyze whether deviations of observed reserves from precautionary-motive optimal reserves are in any way associated with alternative motives, we run regressions of reserve deviations (observed minus optimal reserves) against measures of:

| Perceived lender of last resort comfort | - % of EU foreign bank lending in domestic credit to the private sector  
|                                          | - No access to IMF financing (ARG, VEN) |
| Relevance of oil production             | Oil trade balance as a share of GDP  |
| Mercantilist approach                  | Deviations of the REER from its 5-year MA |
### Explaining Deviations from Optimal

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Balance/GDP</td>
<td>0.696***</td>
<td>0.674***</td>
<td>0.738***</td>
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<tr>
<td></td>
<td>(0.226)</td>
<td>(0.269)</td>
<td>(0.239)</td>
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<tr>
<td>EU Foreign Bank Lending</td>
<td>-0.175**</td>
<td>-0.184**</td>
<td>-0.174**</td>
</tr>
<tr>
<td></td>
<td>(0.068)</td>
<td>(0.071)</td>
<td>(0.069)</td>
</tr>
<tr>
<td>REER Gap</td>
<td></td>
<td>0.252</td>
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<td></td>
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<td>(0.331)</td>
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<td>No Access to ILOR</td>
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<td>-0.0402</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>(0.066)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.0215</td>
<td>0.0741</td>
<td>0.0241</td>
</tr>
<tr>
<td></td>
<td>(0.053)</td>
<td>(0.066)</td>
<td>(0.056)</td>
</tr>
<tr>
<td>Observations</td>
<td>27</td>
<td>23</td>
<td>27</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.312</td>
<td>0.322</td>
<td>0.314</td>
</tr>
</tbody>
</table>

- Users of EU foreign lending are prone to holding lower amounts of reserves relative to optimal levels
- Oil producers tend to hoard more reserves than those deemed optimal from a precautionary standpoint
- No evidence for mercantilist motive
Optimal Reserves: where do we stand?

- How about more recent estimates of optimal reserves?

- Extend the assessment of international reserves adequacy to 2010 for same set of countries
  - China and Slovakia are not included in this exercise due to lack of data
Optimal vs. Observed Reserves
(2007 vs. 2010, % of GDP)
Optimal vs. Observed Reserves
(as of 2010, % of GDP)
Optimal Reserves: where do we stand?

• Unlike results for 2007, we find that with the exception of Korea, Malaysia and Thailand, all other countries in our sample display lower-than-optimal reserves.

• While observed reserves remain relatively constant on average, the stock of optimal reserves has increased.
  – Change in risk factors (1-\(\omega\), Gross DLD and the government budget balance).
• LAC and Asia: All risk factors have increased.
• LAC: CAB has changed from positive to negative, while the average Gov. Balance has deteriorated
• Europe: observed reduction in the CAD relative to the absorption of tradable goods (or $1 - \omega$ in our model) is more than compensated by the deterioration of the Gov. Balance and the increase in Gross DLD.
### Optimal Reserves: where do we stand?

#### LAC 7 and LAC 5: Initial Conditions

<table>
<thead>
<tr>
<th>Country</th>
<th>DLD (% of GDP)</th>
<th>CAD/Z</th>
<th>Fiscal Balance (% of GDP)</th>
<th>DLD (% of GDP)</th>
<th>CAD/Z</th>
<th>Fiscal Balance (% of GDP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>4.8%</td>
<td>-10.3%</td>
<td>-2.1%</td>
<td>1.9%</td>
<td>2.5%</td>
<td>-4.5%</td>
</tr>
<tr>
<td>Brazil</td>
<td>6.2%</td>
<td>-0.4%</td>
<td>-2.7%</td>
<td>9.2%</td>
<td>12.4%</td>
<td>-3.9%</td>
</tr>
<tr>
<td>Chile</td>
<td>10.1%</td>
<td>-19.5%</td>
<td>7.9%</td>
<td>15.4%</td>
<td>5.5%</td>
<td>-1.8%</td>
</tr>
<tr>
<td>Colombia</td>
<td>1.9%</td>
<td>7.5%</td>
<td>-0.8%</td>
<td>3.8%</td>
<td>11.0%</td>
<td>-1.5%</td>
</tr>
<tr>
<td>Mexico</td>
<td>3.5%</td>
<td>3.8%</td>
<td>-1.2%</td>
<td>8.8%</td>
<td>5.2%</td>
<td>-4.2%</td>
</tr>
<tr>
<td>Peru</td>
<td>19.0%</td>
<td>-4.4%</td>
<td>3.2%</td>
<td>24.3%</td>
<td>12.5%</td>
<td>-0.1%</td>
</tr>
<tr>
<td>Venezuela</td>
<td>0.4%</td>
<td>-19.0%</td>
<td>-2.8%</td>
<td>0.3%</td>
<td>-13.9%</td>
<td>-14.2%</td>
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<tr>
<td>Average-LAC7</td>
<td>6.6%</td>
<td>-6.0%</td>
<td>0.2%</td>
<td>9.1%</td>
<td>5.0%</td>
<td>-4.3%</td>
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<tr>
<td>Average-LAC5</td>
<td>8.1%</td>
<td>-2.6%</td>
<td>1.3%</td>
<td>12.3%</td>
<td>9.3%</td>
<td>-2.3%</td>
</tr>
</tbody>
</table>

LAC 5 excludes Argentina and Venezuela. 2014*: Preliminary data.

Source: Calvo et al. (2013)
Optimal Reserves: where do we stand?

- Effects of the global financial crisis have not yet dissipated completely.

- Most countries implemented significant countercyclical fiscal policies that, in most cases, have not been fully reverted.

- Lower post-crisis growth in developed economies—particularly in Europe, but also in China— and the consequent weaker external demand has contributed to a deterioration of current accounts in EMs.

- If this global setting were to remain in the medium term:
  - need to improve fiscal positions
  - increase access to liquidity (either through reserve accumulation and/or by securing access to international resources)
Conclusions

- Under robust policy choices, average observed reserves holdings on the eve of the financial crisis were not distant from optimal reserve holdings prescribed by the model (w/o calibration).

  - Reserve over-accumulation in EMs was not obvious

  - Currency mismatches, current account deficits, fiscal balance are taken into account by policymakers in determining the level of International Reserves
Conclusions

- Discrepancies from the standpoint of individual economies point to:
  - Need to adjust stock of reserves by access to alternative sources of liquidity (FCLs, private credit lines to the banking system, etc).
  - Particularly important after 2008. Multilateral institutions, particularly the IMF, have taken a more active role as Lenders of Last Resort via provision of Flexible Credit Lines (FCL), which should be added to a country’s stock of international reserves.
  - In financial centers (like Uruguay), foreign banks may hold large levels of reserves to meet potential dollar deposit withdrawals, which could be included in measures of total foreign currency reserves.
  - Existence of other motives for reserve accumulation.
Vulnerability to Sudden Stops and Optimal Reserves as a Precautionary Tool

Alejandro Izquierdo
Research Department
IDB

Guillermo Calvo
Columbia University

February 12, 2015