Can Reserve Accumulation be Counterproductive?

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Overview

1 Motivation
   - Trend in Reserve Accumulation
   - Main Argument

2 Research Question

3 Basic Assumptions and Stylized Facts

4 Model

5 Next Steps
Central Banks intervene regularly on the foreign exchange market, typically through sterilized sale and purchase of international reserves.

There has been an unprecedented increase in accumulation of foreign exchange reserves in central banks around the world. This accumulation has also coincided with increased liberalization of the capital account around the world.

![Figure: Reserves as a Share of GDP (%)](source)

Source: Author's Calculations based data from World Bank World Development Indicators

Devika Dutt (UMass Amherst)  
Counterproductive Reserve Accumulation?  
January 6, 2019  
3 / 26
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**Figure**: Reserves as a Share of GDP (%)

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This paper entertains the theoretical possibility that the extent of reserve accumulation has unintended consequences that are costly.

I argue that higher reserve accumulation may make economies more attractive to foreign capital inflows in the context of the global financial cycle.

Therefore, it may be the case that higher reserve accumulation, intended as a safeguard against the effects of volatile capital flows creates the conditions it seeks to prevent through moral hazard.
Main Purpose: To theorize and identify potential indirect costs of foreign exchange intervention.

Research Question: Is it possible that higher reserve holdings encourage higher capital inflows and create instability and crisis, ceterus paribus?

- One of the best predictors of financial crises can be shown to be excessive credit growth. In particular, gross flows of capital can serve as a source of significant instability, even if net flows do not reflect an imbalance in the balance of payments.
- There has been significant build up of reserves in many developing countries which theoretically create moral hazard.
Basic Assumptions and Stylized Facts

- Global financial cycle in capital flows, asset prices, and credit growth that is correlated with monetary policy in the core countries, regardless of specific domestic macroeconomic conditions.
Heatmap of Correlation of Gross Inflows (Rey, 2013)

![Heatmap Image]

Source: Rey (2013)
Basic Assumptions

- Global financial cycle in capital flows, asset prices, and credit growth that is correlated with monetary policy in the core countries, regardless of specific domestic macroeconomic conditions.
- One of the best predictors of financial crises can be shown to be excessive credit growth.
- There has been an unprecedented increase in reserve accumulation, especially in developing countries.
- Moral hazard may be an unintended consequence of this reserve accumulation.
  - …no ex-ante announcement by policy makers can convince the public that ex-post (that in the midst of a generalized financial turmoil) the government would cross its arms and let the financial system proceed towards its debacle. (Corsetti et al., 1999)
Model Basics: Three regimes of Firm Finance a la Minsky

- Monetary policy of the center country plays an important role, instead of domestic monetary policy.
Model Basics: Three regimes of Firm Finance a la Minsky

- Monetary policy of the center country plays an important role, instead of domestic monetary policy.
- Incorporation of elements of moral hazard: higher reserve accumulation leading to more rapid transition from a hedge finance regime to a ponzi finance regime.
Cash Flows of a Firm: $R + D = I + V$

- $R$: Operating Revenues
- $D$: New Borrowing
- $I$: Investment
- $V$: Debt Service

Three possible financial states

- Hedged Firm: $R \geq V + I$ (Revenues covers debt service and investment)

Speculative Firm: $R \geq V$, but $R < V + I$, so that $D \geq 0$ but $D \neq I$ (firm covers debt service out of revenues, but is borrowing to finance part of its investment)

Ponzi Firm: $R < V$, so that $D > I$ (Firm is borrowing to at least partly service its debt)
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Three possible financial states
- Hedged Firm: \( R \geq V + I \) (Revenues covers debt service and investment)
- Speculative Firm: \( R \geq V \), but \( R < V + I \), so that \( D \geq 0 \) but \( D \not\equiv 1 \) (firm covers debt service out of revenues, but is borrowing to finance part of its investment)
- Ponzi Firm: \( R < V \), so that \( D > I \) (Firm is borrowing to at least partly service its debt)
• If the total debt of the firm is \( B \), then
\[
\dot{B} = D = D = I + V - R
\] (1)

• Writing this as a proportion of the firm’s assets and liabilities
\[
\dot{B} = (g - r)A + iB
\] (2)

Where, \( g = I/A \), \( r = R/A \), and \( i = V/B \)

• Solution of this differential equation is
\[
B(t) = (B_0 - \frac{g - r}{g - i}A_0)e^{it} + \frac{g - r}{g - i}A_0e^{gt}
\] (3)
Writing this in terms of $\phi = B/A$

$$
\phi(t) = \phi^* + (\phi_0 - \phi^*) e^{(i-g)t}
$$

(4)

where $\phi^* = \frac{g-r}{g-i}$

Firm solvency requires $\phi < 1$. The firm would be on the path of becoming bankrupt under the following conditions:

- If $i > g$, $\lim_{t \to \infty} \phi(t) = \pm \infty$ as $\phi_0 > \phi^*$
- If $g > i$, $\lim_{t \to \infty} \phi(t) = \phi^*$. This would be a path on which the firm would also become bankrupt in finite time if $\phi^* > 1$ or if $i > r$.

Firms will not be on the path to bankruptcy if $i < g$ and $r > i$. 
Regimes of Finance

Counterproductive Reserve Accumulation?

\[ i > r > g \]

\[ g > i > r \]

\[ r > i > g \]

\[ r > g > i \]

\[ g > r > i \]

\[ r = i \]

\[ r = g \]
Writing \( d = D/K, \ g = I/K, \) and \( r = \pi X/K, \)
- \( D \) is capital account surplus
- \( I \) is investment
- \( X \) is output
- \( K \) is capital stock
- \( \pi \) is share of profits out of output \( X \)
- We can analogously write
  \[
  d = g - sr
  \]
  \[
  \tag{5}
  \]
- We assume that capital account surplus \( d \) depends on the interest rate of the center country that determines global conditions of liquidity \( i \), and the profit rate \( r \):
  \[
  d = d_0 - \eta i - \psi sr
  \]
  \[
  \tag{6}
  \]
- We assume that growth rate of capital depends on profit rate \( r \), real interest rate \( i \), and a confidence factor \( \rho \)
  \[
  g = g_0 + h(r + \rho - i)
  \]
  \[
  \tag{7}
  \]
Laws of motion of state variables $\rho$ and $i$

- $\dot{\rho}$
  \[
  \dot{\rho} = \beta(g - \bar{g}) - \delta i
  \] (8)
  where $\beta > 0$ and $\delta > 0$

- $\dot{i}$
  \[
  \dot{i} = \gamma(i - \bar{i})
  \] (9)
  where $\gamma < 0$

- This allows us to get a dynamic equation for $\dot{g}$

\[
\dot{g} = \frac{hs(1 - \psi)\beta g}{s(1 - \psi) - h} - \frac{(hs(1 - \psi)(\delta + \gamma) - h\eta\gamma)i}{s(1 - \psi) - h} - \frac{hs(1 - \psi)\beta \bar{g} + h\gamma \bar{i}}{s(1 - \psi) - h}
\] (10)
Model Dynamics: Phase Diagram

Figure: Phase Diagram

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Model: Adding Reserves

- Reserve accumulation would be the excess of new borrowing $d$ over the current account deficit. Let us assume it depends on $g$ and $i$ in the following way

$$R = \lambda g - \alpha i \quad (11)$$

- Reserves positively affects the change in confidence factor

$$\dot{\rho} = \beta (g - \bar{g}) - \delta i + \lambda R$$
$$\dot{\rho} = \beta (g - \bar{g}) - \delta i + \lambda g - \alpha i \quad (12)$$

- $\dot{g}$ then becomes

$$\dot{g} = \frac{hs(1 - \psi)}{s(1 - \psi) - h} \dot{\rho} - \frac{h(s(1 - \psi) - \eta)}{s(1 - \psi) - h} i$$
$$\dot{g} = \frac{hs(1 - \psi)(\beta + \lambda)}{s(1 - \psi) - h} g + \frac{hs(1 - \psi)(\gamma \bar{i} - \beta \bar{g}) - h\eta\gamma \bar{i}}{s(1 - \psi) - h}$$
$$- \frac{hs(1 - \psi)(\delta + \alpha + \gamma) - \eta\gamma}{s(1 - \psi) - h} i \quad (13)$$
New Phase Diagram

Figure: Phase Diagram with Reserves
Conclusions

- There may be unintended consequences of the current model of self-insurance used by central banks in the current international monetary system, which may render it ineffective and expensive.
- This paper builds a theoretical model in the tradition of Minsky to show that theoretical possibility.
- In this model, reserves create more exuberance in the economy that pushes the economy into a more financially vulnerable state.
Empirical verification!!
Thank you for your attention!
Evidence: Reserve Accumulation and Crises?

Figure: Reserve Accumulation and Crises in Emerging Markets

Algeria

Argentina

Colombia

Costa Rica
Evidence: Reserve Accumulation and Crises?

**Figure:** Reserve Accumulation and Crises in Emerging Markets

- **Sri Lanka**
- **Turkey**
- **Uruguay**
- **Zimbabwe**

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Evidence: Reserve Accumulation and Crises?

Figure: Reserve Accumulation and Crises in Advanced Economies

Greece

Total reserves (% of GDP)


Year

Italy

Total reserves (% of GDP)


Year

New Zealand

Total reserves (% of GDP)


Year

Portugal

Total reserves (% of GDP)


Year
Figure: Trend in Capital Account Openness

Source: Author’s Calculations based on Chinn-Ito (2006)