The Macroprudential Role of International Reserves

By Olivier Jeanne*

There has been a lot of interest since the global financial crisis in the policies that emerging market countries can use to smooth the impact of the "global financial cycle" on their economies. Economists, including in the staff of the International Monetary Fund (IMF), have advocated a more active use of countercyclical capital controls,[1] and a theoretical literature has developed to justify the use of such controls.[2] However in the real world emerging markets governments have relied much more on international reserves than on capital controls as the main tool of capital flow management.

Figure 1 illustrates how reserves and capital controls have been used by Brazil.[3] I look at Brazil because it has been the main "poster boy" for the use of capital controls since the crisis. As shown by Figure 1 Brazil imposed a tax on capital inflows between October 2009 and May 2013. The figure also shows that Brazil has accumulated international reserves when it received gross capital flows and deccumulated reserves when there were gross outflows. No country has used countercyclical capital controls to the same extent as Brazil but many countries have relied on the same kind of reserves management, which some policy-makers have presented as a superior alternative to capital controls (de Gregorio, 2010). We need to better understand the role of international reserves in capital flow management and the interplay between reserves and capital controls.

This note discusses the role of reserves in capital flow management based on a simple welfare-based model of capital flows with banking frictions. The model features an emerging market economy (EM) and global banks. The banks are subject to a fire-sale risk and to a value-at risk constraint. The EM can mitigate the friction by accumulating reserves in good times and using them to stabilize the price of its liabilities in bad times. I show that the optimal management of reserves requires a government intervention as the private incentives to accumulate reserves are in general not aligned with the social benefits of reserves.[4] Capital controls have a role in this model, but it is limited to making agents internalize the social cost of accumulating reserves.

The model in this paper is interesting to compare with Jeanne and Korinek (2010). In both papers the financial friction is a pecuniary externality caused by a fire sale but the normative implications are quite different. In Jeanne and Korinek (2010) the financial friction was a collateral constraint in the EM economy and the most appropriate policy instrument was a countercyclical tax on capital inflows. By contrast in this paper the friction comes from a Value-at-Risk constraint in the global banking system and the most appropriate instrument is reserves management rather than capital controls.

I. Model

The model has two periods $t = 1, 2$ and one homogeneous good that is used for consumption. There are an emerging-markets

* Department of Economics, Johns Hopkins University, 3400 N.Charles Street, Baltimore MD 21212; email: ojeanne@jhu.edu. I thank Anton Korinek and Jonathan Ostry for their comments.

[1] See Jeanne, Subramanian and Williamson (2012), Rey (2015), Ostry et al. (2011) and IMF (2012).

[2] See for example Korinek (2011) and Farhi and Werning (2014).

[3] I thank Marcos Chamon and Màrcio Garcia for sharing their data on the Brazilian capital controls.

[4] The case for liquidity regulation is similar to Stein (2012). See Shleifer and Vishny (2011) for a review of the literature on fire sales in finance and macroeconomics. Aizenman (2011) uses a model of fire sales to analyze the optimal level of international reserves. Bruno and Shin (2015) emphasize the role of banking in the global financial cycle.

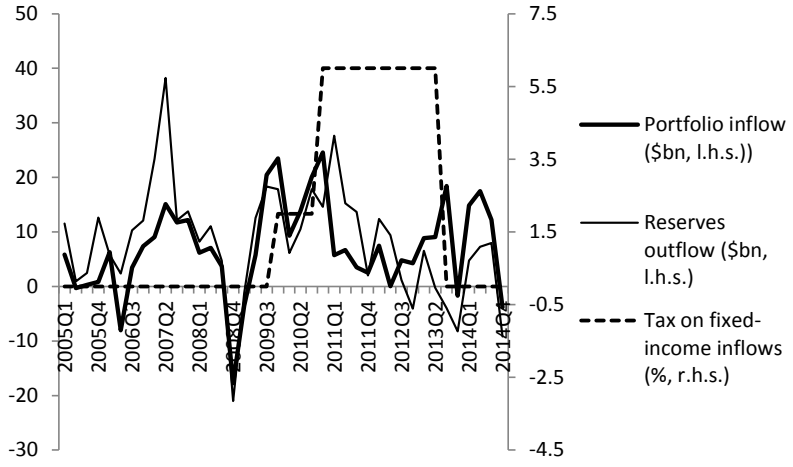

Figure 1. Capital flows, reserves and capital controls in Brazil (Source: IMF BOP Statistics)

economy and global banks. The emerging-market country is populated by a representative borrower with utility,

$$U = u(c_1) + E_1 c_2, \tag{1}$$

where $u(\cdot)$ satisfies the Inada conditions.

The EM borrower finances consumption and reserves by borrowing from global banks. His budget constraints are,

$$c_1 + m = b, \tag{2}$$

$$c_2 = y - (1+r)b + m, \tag{3}$$

where $b \geq 0$ and $m \geq 0$ respectively denote bank loans and international reserves, and r is the interest rate on bank loans.

Banks finance their loans by raising non-interest-bearing deposits. They charge the interest rate r because of linear cost of processing the loans. There is a small probability that a fraction s of banks will have to fire-sale their assets "between" period 1 and period 2 at a price q. The only agents on the buying side of a fire sale are the EM residents who buy back their liabilities with international reserves. Hence the fire-sale price of the asset satisfies

$$qsb = m.$$

I assume that the banks have no equity in period 1 and are subject to a value-at-risk constraint. They raise b in non-interest-bearing deposits and must be able to repay the deposits even if they fire-sale their assets. Hence q must be at least equal to 1 which is possible only if,

$$m \geq sb. \tag{4}$$

Reserves must amount to at least a fraction s of gross capital inflows so that the EM can buy back its liabilities at a price that ensures that banks satisfy their value-at-risk constraints. This is a necessary condition for the EM to receive any capital inflow at all.

Importantly, condition (4) is in general not satisfied if the decision to accumulate reserves is left to decentralized EM agents. To see this, assume that the probability of fire sales is vanishingly small so that ex-ante welfare is not affected by the risk of a fire sale. Then private EM residents maximize (1) subject to the budget constraints (2) and (3) and the non-negativity constraints $b \geq 0$ and $m \geq 0$. The solution is $u'(b) = 1 + r$ and $m = 0$. Private agents have no incentives to accumulate reserves that bear an opportunity cost r but bring a benefit with a vanishingly small probability.

In general private agents may accumulate reserves but this limit case illustrates that the private marginal gain from reserves, which is proportional to the *probability* of a fire sale, does not coincide with the so-

cial marginal gain from reserves, which depends on the fire-sale *price*. There is a true pecuniary externality coming from the fact that private agents do not internalize the impact of international reserves on the fire-sale price ex post, which determines their access to credit ex ante.

II. Policy

Let us consider the problem of a benevolent EM government who is subject to the liquidity constraint (4). The constrained-efficient allocation maximizes (1) subject to (2), (3) and (4). The solution satisfies the first-order condition,

$$u'(c_1) = 1 + \frac{r}{1-s}, \tag{5}$$

and the liquidity constraint $m \geq sb$ is binding. Observe that the social marginal cost of external borrowing is larger than r because of the need to accumulate a fraction of the capital inflow in non-interest-bearing reserves.

There are different ways that the EM government can implement the constrained-efficient allocation. The most simple way is for the government to impose the constraint $m \geq sb$ on individual borrowers through financial regulation. This is similar to Stein's (2012) case for macroprudential liquidity regulation. If this policy can be implemented there is no need for capital controls because individual agents take into account the opportunity cost of reserves in their borrowing decisions. It is not desirable to reduce the level of net capital inflows, which is already lower than the unconstrained first best.

However, this implementation of the constrained-efficient allocation may be difficult in practice. One problem with macroprudential policy is that it is part of banking regulation so that its reach is limited to a subset of agents in the financial sector. An alternative policy is for the government to engage in balance sheet operations in which it finances reserves accumulation by issuing debt.

Let us assume that in period 1 the government issues a quantity of debt b^g and uses the proceeds to buy reserves $m^g = b^g$. This operation can be interpreted as a sterilized foreign exchange intervention if one consolidates the central bank into the government sector. The government uses the reserves to buy back $s(b + b^g)$ at a unitary price if there is a fire sale (which again occurs with a vanishingly small probability). This requires a quantity of reserves,

$$m^g = \frac{s}{1-s} b,$$

where b still denotes the private sector's external borrowing. The government uses the reserves plus the proceeds of a lump-sum tax on EM residents to repay its debt in period 2. The private sector still accumulates no reserves in equilibrium.

If the EM government limited itself to accumulate reserves in this way it could increase domestic welfare but it would not achieve the constrained-efficient allocation because the private sector would overborrow. The private sector would borrow until the private marginal benefit is equal to the private marginal cost, $u'(c_1) = 1+r$, instead of equation (5). The source of the inefficiency is that private agents do not internalize the social cost of accumulating the reserves. In order to achieve the constrained first best the government must combine reserves management with a tax

$$\tau = \frac{sr}{1-s},$$

on capital inflows. Capital controls thus play a role along with reserves management in the optimal policy mix, but this role is mostly derivative—it is to make private agents internalize the social cost of accumulating reserves.

III. Discussion

I conclude by pointing to a few stylized facts about international capital flows that the model is consistent with. The first stylized fact is the "exorbitant privilege" (Gourinchas and Rey, 2007). EM economies finance low-yield assets by issuing high-yield liabilities, which means that advanced economies finance high-yield as-

sets with low-yield liabilities. The privilege is truly exorbitant in this model since EM economies must accumulate reserves because of the instability in the advanced-economy banking system, not because of any fundamental problem of their own.

Second, the model also speaks to the behavior of gross capital flows and international reserves in the global financial cycle. Forbes and Warnock (2012) and Broner et al. (2013) have documented how gross capital inflows and outflows tend to move together. This was especially true in the global financial crisis, which saw an unprecedented coincidence of stops in capital inflows and retrenchment in capital outflows as investors around the world liquidated foreign investment positions and brought money home. As a result gross capital flows are much more volatile than net flows. Figure 1 shows the importance of international reserves in this phenomenon in the case of Brazil. There is also evidence that capital flow episodes are driven primarily by global factors rather than domestic fundamentals.

As simple as it is the model is consistent with several of these facts. The coincidence of a stop and a retrenchment could come from a fire sale in which EM economies buy back their own liabilities with reserves. One can also think of the global financial cycle as originating from fluctuations in the interest rate r.[5] In good phases of the cycle, when r is low, there is an expansion in both gross capital inflows to, and outflows from, EM economies. In bad phases of the cycle, when r is high, there is a contraction in the balance sheet of EM economies.

Although there is no exchange rate in the very simple model presented here, it would be easy to introduce one by assuming that the consumer has a taste for a nontradable endowment. The EM government would then stabilize the real exchange rate through reserves management: The accumulation or deccumulation of reserves in response to changes in r would mitigate the appreciation or depreciation of the real exchange rate. However the exchange rate would not be a target. A different kind of models is required to capture the view that reserves are used to target the exchange rate. For example, Blanchard et al.'s 2015 analysis assume that reserves are used to achieve an exchange rate target that is separate from macroprudential concerns.

[5] Another source of fluctuation could be in bank equity, which here has been set to zero.

REFERENCES

Aizenman, Joshua. 2011. "Hoarding International Reserves versus a Pigovian Tax-cum-Subsidy Scheme: Reflections on the Deleveraging Crisis of 2008–2009, and a Cost Benefit Analysis." *Journal of Economic Dynamics and Control*, 35(9): 1502–1513.

Blanchard, Olivier, Jonathan D Ostry, Atish R Ghosh, and Marcos Chamon. 2015. "Are Capital Inflows Expansionary or Contractionary? Theory, Policy Implications, and Some Evidence." *National Bureau of Economic Research Working Paper 21619*.

Broner, Fernando, Tatiana Didier, Aitor Erce, and Sergio L Schmukler. 2013. "Gross capital flows: Dynamics and crises." *Journal of Monetary Economics*, 60(1): 113–133.

Bruno, Valentina, and Huyn Song Shin. 2015. "Cross-Border Banking and Global Liquidity." *Review of Economic Studies*, 82(2): 535–564.

de Gregorio, Jose. 2010. "Tackling the capital inflow challenge." *Central Bank of Chile Economic Policy Paper No.35*.

Farhi, Emmanuel, and Ivan Werning. 2014. "Dilemma Not Trilemma: Capital Controls and Exchange Rates with Volatile Capital Flows." *IMF Economic Review*, 62(4): 569–605.

Forbes, Kristin J, and Francis E Warnock. 2012. "Capital Flow Waves: Surges, Stops, Flight, and Retrenchment." *Journal of International Economics*, 88(2): 235–251.

Gourinchas, Pierre-Olivier, and Hélène Rey. 2007. "From World Banker to World Venture Capitalist : US External Adjustment and the Exorbitant Privilege." In *G7 Current Account Imbalances : Sustainability and Adjustment.* , ed. R. Clarida. University of Chicago Press.

IMF. 2012. "The Liberalization and Management of Capital Flows: an Institutional View." *http://www.imf.org/external/np/pp/eng/2012/111412.pdf.*

Jeanne, O., A. Subramanian, and J. Williamson. 2012. *Who Needs to Open the Capital Account?* Peterson Institute for International Economics.

Jeanne, Olivier, and Anton Korinek. 2010. "Excessive Volatility in Capital Flows: A Pigouvian Taxation Approach." *American Economic Review Papers and Proceedings*, 100(2): 403–7.

Korinek, Anton. 2011. "The New Economics of Prudential Capital Controls: A Research Agenda." *IMF Economic Review*, 59: 523–561.

Ostry, Jonathan D, Atish R Ghosh, Marcos Chamon, and Mahvash S Qureshi. 2011. "Capital Controls: When and Why?" *IMF Economic Review*, 59(3): 562–580.

Rey, Hélène. 2015. "Dilemma not trilemma: the global financial cycle and monetary policy independence." National Bureau of Economic Research Working Paper 21162.

Shleifer, Andrei, and Robert Vishny. 2011. "Fire Sales in Finance and Macroeconomics." *Journal of Economic Perspectives*, 25(1): 29–48.

Stein, Jeremy C. 2012. "Monetary policy as financial stability regulation." *The Quarterly Journal of Economics*, 127(1): 57–95.