



A theory of rollover risk, sudden stops, and foreign reserves[☆]



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ABSTRACT

Emerging economies have accumulated very large foreign reserve holdings since the turn of the century. We argue that this policy is an optimal response to an increase in foreign debt rollover risk. In our model, reserves play a key role in endogenously reducing debt rollover crises (“sudden stops”) by allowing governments to be solvent in more states of the world. Using a dynamic multi-country environment with learning, we find that a relatively small unanticipated increase in rollover risk jointly accounts for (i) the outburst of sudden stops in the late 1990s, (ii) the increase in foreign reserves holdings, and (iii) the subsequent reduction of sudden stops in emerging economies. We also show that a policy of pooling reserves may substantially reduce reserves because mutual insurance across countries dampens rollover risk.

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1. Introduction

Since the turn of the century, emerging economies have accumulated massive amounts of international reserves. Summers (2006) considered this dramatic rise in reserves to be “the most surprising development in the international financial system over the last half dozen years,” a buildup that was “was neither predictable nor

predicted ... far in excess of any previously enunciated criterion of reserve need for financial protection.” According to Bernanke (2005), this global “savings glut” has been the most important force behind the widening of the U.S. current account deficit. At the time of Bernanke’s “savings glut” speech, China’s foreign reserve holdings alone amounted to nearly one trillion U.S. dollars and represented approximately 45% of the (negative) net foreign asset position of the United States. While massive from an absolute perspective, China’s reserves as a percentage of GDP, which averaged 30% from 2002 to 2006, are comparable to those of other emerging economies, such as Korea (25%), Malaysia (45%), Thailand (30%), and Russia (21%).

This raises the question of why emerging economies have accumulated such large amounts of reserves. In the existing literature, reserves are typically held to prevent the adverse effects of a sudden stop in capital inflows (Alfaro and Kanczuk, 2009; Bianchi et al., 2012; Caballero and Panageas, 2005; Jeanne and Rancière, 2011). Motivated by the stylized fact that emerging economies have accumulated and maintained large foreign reserves while crises have been much less frequent since the outburst of crises in the late 1990s, our paper complements this literature by allowing reserve accumulation to endogenously reduce the probability of crisis. This endogenous channel is then used to explain the joint evolution of crises and reserves in the data. In a related paper, Gourinchas and Obstfeld (2012) also

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show that reserves are negatively associated with default crises, banking crises, and currency crises. In fact, reserves managers and central banks in emerging markets indicate that reserves are held mainly to stave off liquidity crises.¹

To explain the outburst of sudden stops in the late 1990s and the large accumulation of foreign reserves ever since, we develop a theory in which reserves endogenously prevent crises.² In particular, we focus on sudden stops (of external capital inflows) because they are a common symptom of financial crises such as currency crises, banking crises, and default crises in emerging economies.³ In this theory, sudden stops occur when foreign lenders choose not to roll over a country's external liabilities. We derive closed-form solutions for the optimal reserves and the induced probability of a sudden stop. The analytical expressions reveal how reserves are optimally set to balance the reduction in sudden stop probability, the induced fall in interest rates, and the reduction in final output due to lower investment.

Specifically, we consider the problem of a small open economy that borrows short-term from foreign lenders to finance long-term investments. This maturity mismatch gives rise to rollover risk: in the interim, a random fraction of creditors can choose to roll over while the other creditors cannot. Rollover risk in this environment is endogenous because the actual amount of debt that is rolled over depends on the debt arrangement. Faced with stochastic interim liquidity needs, the government may pay with the reserves it had set aside or liquidate its investment. For small liquidity shocks, interim payments are optimally paid with reserves, and no sudden stop occurs. For large shocks, the government cannot finance its debt obligations without liquidation, resulting in a sudden stop as all lenders refuse to roll over. Reserves therefore reduce the probability of sudden stops by inducing lenders to roll over in more states of the world. We also discuss the scope for reducing reserves holdings under mutual insurance across countries facing idiosyncratic and correlated rollover risk.

We extend the model to a dynamic multi-country setting in which countries learn from each other to form beliefs about the true rollover risk they face.⁴ Countries have incentives to learn about the true rollover risk, as it is a critical determinant of the allocation of reserves and the likelihood of sudden stops. In particular, a change in liquidity risk will affect the evolution of sudden stops and reserves. Indeed, using the *de jure* measure of financial openness introduced by Chinn and Ito (2006), we observe that capital openness suddenly entered a new phase around the mid-1990s (see Fig. 1 for an illustration of this surge). We use this evidence to posit a regime change in the liquidity risk faced by these countries.⁵ In our

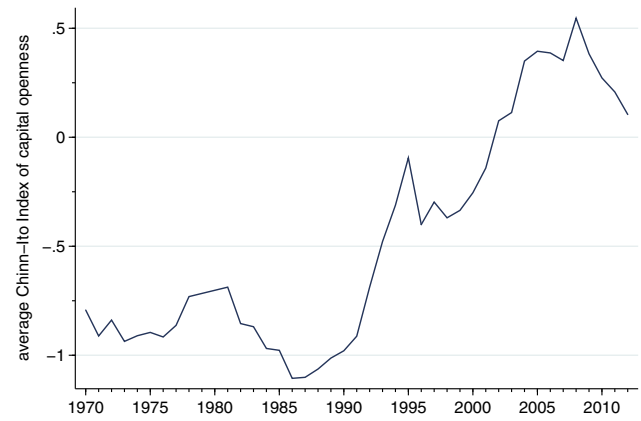


Fig. 1. Evolution of capital openness in emerging economies.

theory, an unexpected increase in rollover risk temporarily causes an underinvestment in reserve holdings, which increases the probability of a sudden stop. After observing the global increase in aggregate liquidity shocks and sudden stops, agents rationally update their common belief about the prevailing debt rollover risk. When agents have fully learned the new regime, reserves are permanently higher and sudden stops subside.

The model is then calibrated for two quantitative applications. First, we show that an unanticipated and permanent increase in rollover risk can account for both the short-lived outburst of sudden stops in the late 1990s and the large accumulation of foreign reserves ever since. A model in which reserves do not reduce the probability of a sudden stop cannot jointly match these facts: higher reserves and fewer crises cannot coexist. Introducing learning in the model is essential for explaining the short-lived outburst in sudden stops in the late 1990s: countries learned from one another and updated their beliefs after being caught off-guard. An empirical prediction of the model is that countries might hold large stocks of foreign reserves, even in the absence of sudden stops, which is consistent with the dynamics of reserves and sudden stops in the data. Quantitatively, an extension in which governments learn only from events in their own region fits the joint evolution of reserves and crises particularly well. Second, using the calibrated liquidity risk, we find that mutual insurance across emerging economies may reduce the reserves needed by as much as three-fifths: pooling or swapping reserves lowers the rollover risk when liquidity shocks are not perfectly correlated across countries.⁶ Finally, we use the model to discuss the experience of Baltic economies and the euro area periphery economies during the Global Financial Crisis.

This paper builds on a large body of literature on reserves, sudden stops, and debt crises. In particular, it relates to other papers on reserves (Aizenman and Lee, 2007; Calvo et al., 2012; Frenkel and Jovanovic, 1981; Heller, 1966; Obstfeld et al., 2010)⁷ and on sudden stops (Calvo et al., 2004; Durdu et al., 2009; Forbes and Warnock, 2012; Kehoe and Ruhl, 2009; Mendoza, 2010).⁸ Our work departs

¹ See International Monetary Fund (2011).

² While acknowledging other potential motives for holding reserves, such as foreign exchange management (see, for example, Dooley et al., 2004), we focus on the role of reserves as a buffer (and preventive measure) against crises. This is consistent with the view of policymakers. For example, Bernanke (2005) stated that “foreign reserves have been used as a buffer against potential capital outflows,” and a recent IMF survey of reserve managers found that building a “buffer for liquidity needs” was the foremost reason for building reserves (International Monetary Fund, 2011). In an excellent review, Chang (2007) highlights this liquidity motive across central banks in Latin America. For instance, the stated goal of Colombia's Banco de la Republica is to “maintain an adequate level of international reserves that reduce the vulnerability of the economy to foreign shocks.”

³ Sudden stops are defined as unusually large reversals of external capital inflows along with a severe contraction in economic activity. See also Gourinchas and Obstfeld (2012) for a discussion on how sudden stops can lead to currency crises and financial crises.

⁴ See Buera et al. (2011) who suggested that learning from peer countries is an important driver in the adoption of liberal and market-oriented policies over time and across countries.

⁵ Our view is that as emerging economies moved towards capital liberalization in the early 1990s and experimented with external borrowing, many countries may have underestimated the volatility of external capital flows. Increased volatility can, for example, be a result of the increasing ease with which investors can reallocate funds across countries.

⁶ This corresponds to an upper bound on the reduction of reserves, since there may be limits to mutual insurance such as moral hazard, private information, or aggregate uncertainty. We analytically characterize an extension of the model in which there is aggregate uncertainty arising from correlated shocks across countries.

⁷ See also Gourinchas and Jeanne (2013) for the literature on the capital allocation puzzle and reserves holdings.

⁸ Benigno and Fornaro (2012) provide an insightful model in which reserves stimulate trade through real exchange rate depreciation, which in turn generates growth externalities especially during recessions. In that sense, their model is also a model of endogenous reserves and crises. A vast related literature discusses the growth effects of private capital flows. See, for example, Alfaro et al. (2004, 2014), Benhima (2013), Buera and Shin (2009), Carroll and Jeanne (2009), Sandri (2014), Song et al. (2011).

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