



# External shocks, financial volatility and reserve requirements in an open economy <sup>☆</sup>

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## ABSTRACT

The performance of a simple, countercyclical reserve requirement rule is studied in a dynamic stochastic model of a small open economy with financial frictions, imperfect capital mobility, a managed float regime, and sterilized foreign exchange market intervention. Bank funding sources, domestic and foreign, are imperfect substitutes. The model is calibrated and used to study the effects of a temporary drop in the world risk-free interest rate. Consistent with stylized facts, the shock triggers an expansion in domestic credit and activity, asset price pressures, and a real appreciation. An optimal, credit-based reserve requirement rule, based on minimizing a composite loss function, helps to mitigate both macroeconomic and financial volatility—with the latter defined both in terms of a narrow measure based on the credit-to-output ratio, the ratio of capital flows to output, and interest rate spreads, and a broader measure that includes real asset prices as well. Greater reliance on sterilization implies a less aggressive optimal reserve requirements rule, implying that the two instruments are partial substitutes.

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## 1. Introduction

A key lesson of the global financial crisis is the importance of going beyond a microprudential approach, focused solely on the regulation of individual institutions, and adopt instead a macroprudential perspective for containing systemic risks and preserve financial and economic stability. At the same time, the greater focus on systemic risk has fostered a broad debate in academic and policy circles on how macroprudential regulation can prevent asset price pressures and unsustainable credit booms. Even though no consensus has yet emerged on what instruments are most appropriate and under which circumstances, some of them have already been made part of the Basel III regime for banking regulation (see [Basel Committee on Banking Supervision, 2011, 2013](#)).

Among these instruments figures reserve requirements, which are often thought of as a liquidity management tool. However, in recent years they have been used extensively in middle-income countries (MICs) for a broader set of purposes. Both

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Brazil and Turkey, for instance, lowered required reserve ratios in response to the collapse of Lehman Brothers in 2008 and increased them again in the period of large capital inflows that occurred between 2010 to mid-2011.<sup>1</sup> Other Latin American countries, such as Colombia and Peru, have also used this instrument aggressively (Vargas et al., 2010 and Tovar et al., 2012). More generally, there is evidence showing that central banks in a broad group of MICs have often raised reserve requirements in response to capital inflows (Hoffmann and Löffler, 2014) and rapid credit growth (Federico et al., 2014; Cerutti et al., 2017; Fendoglu, 2017).

This paper contributes to the debate on the role of reserve requirements on domestic-currency deposits in several ways. It extends the model in Agénor et al. (2014) to account for several important financial and policy features of MICs: a managed float; sterilized foreign exchange market intervention; and imperfect substitutability between deposits and central bank borrowing as sources of funding for commercial banks. The first two extensions are consistent with the evidence suggesting that many MICs operate a managed float regime, and the fact that sterilized intervention—rather than the policy interest rate—is the main instrument used by many emerging market and developing country central banks to affect the exchange rate. Indeed, as discussed by Chang (2008), Aizenman and Glick (2009), and Devereux and Yetman (2014), sterilization activity has played an important role in central bank policy responses to surges in capital inflows; its use has actually intensified in several countries since the global financial crisis. Even though the feasibility and effectiveness of sterilization remain a matter of debate (see Daude et al., 2016), this may well have been the consequence of a greater weight on mitigating exchange rate volatility. We also account for the possibility that changes in official reserves may be driven by other considerations, namely, self-insurance motives.

The model accounts as well for imperfect substitutability between deposits and central bank liquidity as sources of commercial bank funding. This is captured by assuming that the rate at which banks can borrow from the central bank incorporates a premium (above and beyond a base policy rate), which depends on the ratio of existing borrowing to deposits. Thus, because higher reserve requirements hamper the ability to attract deposits, they also lead (all else equal) to an increase in the cost of central bank liquidity, which in turn affects the cost at which private agents can borrow. As it turns out, this is the key channel through which changes in reserve requirements may operate in countercyclical fashion.

Our key findings (based on a parameterization that replicates the main stylized facts associated with episodes of large capital inflows driven by external shocks) are twofold. First, in response to a drop in the world risk-free rate an optimal, credit-based reserve requirement rule may help to mitigate both macroeconomic and financial volatility, with the latter defined either in terms of a narrow measure based on the credit-to-output ratio, the ratio of capital flows to output, and interest rate spreads, or in terms of a broader measure that includes also real asset prices. Second, if the quasi-fiscal costs of sterilization—which may be substantial in practice—are not accounted for in the central bank's loss function, it is optimal to fully sterilize, even when an optimal countercyclical reserve requirements rule is in place. In that sense, the two instruments are complements. Moreover, greater reliance on sterilization implies a less aggressive optimal reserve requirements rule, which implies that the two instruments are partial substitutes at the margin.

The remainder of the paper is organized as follows.<sup>2</sup> Section 2 gives a formal description of the model. As in Agénor et al. (2014), the model features imperfect capital mobility and a two-level financial intermediation system, which accounts for bank borrowing abroad—an important feature of cross-border capital flows in recent years.<sup>3</sup> In addition, as noted earlier, several novel elements are introduced: exchange rate smoothing, self insurance, sterilized foreign exchange market intervention, and imperfect substitutability between bank borrowing from the central bank and deposits. The equilibrium and some key features of the steady state are discussed in Section 3, and an illustrative parameterization is presented in Section 4. The results of our main experiment, a temporary drop in the world safe interest rate, are described in Section 5. The performance of the model with an arbitrary countercyclical reserve requirement rule is discussed in Section 6, whereas the optimal rule is discussed in Section 7. The concluding section discusses the policy implications of the analysis for middle-income countries.

## 2. The model

Consider a small open economy populated by seven categories of agents: a continuum of households with unit mass, a continuum of intermediate goods-producing (IG) firms, indexed by  $j \in (0, 1)$ , a representative final good (FG) producer, a continuum of capital good (CG) producers with unit mass, a continuum of commercial banks, indexed by  $i \in (0, 1)$ , the government, and the central bank. For simplicity, each household is matched to an IG producer, a CG producer, and a bank, and receives profits from all of them. The country produces a continuum of intermediate goods, which are imperfect substitutes to a continuum of imported intermediate goods. Both categories of goods are aggregated to produce a homogeneous final good. In turn, the final good is consumed by households and the government, used for investment by CG producers, or exported. Monopolistic competition prevails in the market for domestic intermediate goods and each intermediate good is produced or imported by a single firm. Banks are also monopolistically competitive.

<sup>1</sup> See Robitaille (2011), Glocker and Towbin (2015), and Barroso et al. (2017) for Brazil, and Mimir et al. (2013) for Turkey.

<sup>2</sup> The working paper version of this article provides a review of the literature on the use of reserve requirements and an intuitive discussion of their countercyclical role.

<sup>3</sup> See Hoggarth et al. (2010), Committee on International Economic Policy and Reform (2012), Herrmann and Mihaljek (2013), Reinhardt and Riddiough (2014) for a discussion of the importance of cross-border bank flows—especially changes in the external liabilities of resident banks—in international capital movements during the run up to, and the immediate aftermath of, the global financial crisis.

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