Challenges of Effective Monetary Policy in Emerging Economies

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1 Introduction

Modern monetary policy theory and practice have been heavily influenced by the experiences of developed countries, both large and small. A number of these ideas have also made their way into policymaking at central banks in emerging economies, mostly due to the absence of local intellectual alternatives. However, the realities of emerging economies are often at odds with the circumstances of developed economies that provide the backdrop for the intellectual underpinning of modern central banking. Specifically, the compulsions of unique institutional details as well as the thinness of financial markets in the context of increasing global integration often tends to render the monetary transmission mechanism in emerging economies both unstable and nonstandard.

The goal of this paper is to highlight the implications of specific institutional constraints and inherited practices that characterize emerging economies. We do so by focusing on India and fleshing out a number of confounding institutional and legacy issues that characterize the policy environment in the country. We then illustrate the consequences of these frictions for the monetary transmission mechanism by exam-

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ining two features of the policy environment in India: the statutory liquidity ratio (SLR) requirements imposed on banks and long-standing chronic fiscal deficits of the government. The SLR forces banks to hold a minimum fraction of their deposits in the form of government bonds.

We show that the SLR requirement can completely invert the monetary transmission mechanism: a reduction in the policy rate can end up raising lending spreads and thereby cause a contraction instead of an expansion in the economy. Effectively, a binding SLR requirement removes all substitutability between bank assets: banks are forced to keep loans to the private sector and to the government in fixed proportions. Consequently, the reduction in the deposit base that is induced by a fall in the interest rate then forces a reduction of loans to the private sector as well. We also show that in environments where the monetary authority is forced to monetize the fiscal deficit due to dominance of the fiscal authority, a binding SLR requirement renders both output and employment *independent* of the policy rate: monetary policy has no real effects.

These results are very stark due to the admittedly stylized nature of the model. However, they illustrate quite vividly the consequences of the policy-induced SLR friction in the financial system. In general, when the SLR is binding it is a form of financial repression. A lowering of the rate on government bonds in such an environment is tantamount to increasing the tax on banks since the rate on government bonds is lower than the lending rate to the private sector. Consequently, it can have the effect of causing a shrinking of bank balance sheets with the resultant contractionary effect on credit.

The more general message of our results is that the choice of policy goals cannot be divorced from the specifics of the monetary transmission mechanism as it operates in the country in question, both in terms of its theoretical and quantitative linkages. Country or region-specific factors that impact the transmission mechanism will have implications for which variables should or should not be targeted by policy in addition to dictating the quantitative magnitudes of the changes in the policy instrument that are required for attaining the policy target. The mapping between the policy instrument and the policy targets are susceptible to institutional design, market structure, and penetration of capital markets, international linkages, and global business cycle considerations. Our discussion of the challenges of monetary policy conduct in emerging economies like India will focus on a detailed breakdown of the specific issues surrounding the transmission mechanism from the policy instrument to each of the three stages and their subcomponents.

In the next section we describe and discuss in some detail some of the unique and confounding aspects of the institutional setting within which monetary policy is conducted in India. In Sect. 3 we formalize a standard model of an open economy with banks and formalize the impact of monetary policy in this benchmark economy. In Sect. 4 we illustrate the effect on the monetary transmission mechanism of imposing a statutory liquidity ratio requirement (SLR) on the banking sector in our model economy. In Sect. 5 we examine the effect of an exogenous fiscal spending constraint on this economy over and above the SLR requirement. We then examine the evidence on the behavior of banks in India with respect to their SLR holdings in Sect. 6. The last section contains concluding thoughts.

2 An Overview of the Issues

The conduct of monetary policy in emerging economies is problematic along (at least) three dimensions. First, the policy and institutional environment is characterized by an inordinate number of constraints as well as large and persistent shocks. Second, the scope and capacity for (first-best) implementation of policies is circumscribed by legacy structures, cross-cutting objectives, and a dearth of analytical and practical tools. Third, the reality of external financing for funding the current account deficit and investment needs, implies that foreign analysts' world view regarding conduct of monetary/macroeconomic policy cannot be wished away, i.e., it has to, willy-nilly, be internalized, or, taken as given. Bond investors typically look for an anchor to predict the interest rate path.

There are two interrelated sets of drivers for a reinforced focus on its central bank in respect of policy conduct and concomitant outcomes. It is apparent that between 2007 and 2013, inflation has come unhinged. In recent years India has emerged as an outlier compared to its own past (see Darbha and Patel (2012), for example); inflation as measured by consumers cost of living has averaged 9 % over the last six years. Even the much narrower wholesale price index inflation has, for an extended length of time since 2009, been well above the RBI's erstwhile "comfort level" of 5 %. India's performance along this metric stands in contrast to other comparable emerging economies which appear to have managed better the challenges associated with keeping inflation under check. This point has been forcefully made by the expert panel in RBI (2014) in its far reaching recommendations for changing the monetary policy framework in India. The concern with chronically high inflation should not be viewed solely as a concern of academics and policy hawks. Opinion polls around the May 2014 national elections confirmed and reinforced the Indian voters' traditional aversion to high inflation and priority on price stability (see Pew (2014)).

In January 2014 the central bank undertook a formal root and branch review of the monetary policy framework. Since the last such comprehensive review in 1985, the Indian economy has undergone a sea change. For one, it is unrecognizably more open to international trade and capital flows, a process set in motion since the early 1990s. Recent debates on inflation control in India have centered around a gamut of issues. For instance, whether it is even possible to manage/control inflation as measured by the CPI, or, whether a "core" measure without food and some other items should be considered, or, deploy the wholesale price index which has no services component despite the latter constituting over 60 % of the economy (perhaps retrograde?). Some have averred that India is *sui generis*, hence lower policy rates will bring about lower inflation, which is a monetary policy analogue of the Laffer curve argument. The same line of thinking has also advocated that a nominal anchor for the central bank is a luxury that the Indian economy cannot afford. In other words, the central bank can afford not to strive for price stability as a primary objective.

In light of the above, an important motivation for this Chapter is to understand the context for monetary policy conduct in EMEs generally, and India more specifically. This encompasses four themes, viz., theory, policy, institutions, and practical aspects. We would like our discussion in this Chapter to spur debate around two broad areas: (a) how important is it for the RBI to rebalance its reform agenda from high-profile subjects like a monetary policy framework to addressing relatively more mundane policy-induced impediments/distortions that undermine monetary policy efficacy/transmission; and (b) whether it would be better to possibly have a central bank that is tasked with a somewhat narrower remit that is more internally consistent given the institutional environment within which policy is conducted in India.

2.1 *The Elephant in the Room*

When we started writing this paper in early September of 2014, it coincided with the season of visits by rating agencies to India for their annual review of the economy. Some areas of usual concern in recent years like the current account deficit and declining growth have been reassessed, but observations on the fiscal side and inflation were cited by some as the main reasons standing in the way of a further rating upgrade.

At a conceptual level, the fiscal deficit is a concern for any economy on three dimensions: (i) solvency; (ii) crowding out; and (iii) spillover into unsustainable external imbalances. From the perspective of the RBI, two more can be added: (i) the entailed financial repression and associated repercussions for allocative efficiency on account of RBI's twin roles in this context, viz., as merchant banker to the government and in developing the government debt market; and (ii) the quantum of monetization.

Only once in the last 40 years has the central government's fiscal deficit been as low as 3 % of GDP (2007/08). This is sobering given that several government consolidation plans since the early 1990s have had a terminal date target of this magnitude. It has been exceedingly uncommon for India's general government fiscal deficit to be lower than 6 % of GDP over the last four decades or so (see Fig. 1a). As a corollary, not surprisingly, in recent years the public sector's contribution to the country's savings rate has been modest, at best (see Fig. 1b). The extant challenge on the fiscal front has its antecedents in the post-2007/08 stimulus packages (see Buiter and Patel (2012) for a discussion of this); the general government fiscal deficit more than doubled during the course of one year from 4 % of GDP in 2007/08 to 8.3 % in 2008/09 and further to 9.3 % of GDP in 2009/10. While some adjustment was undertaken in subsequent years, it was only in late 2012 that a multiyear path for central government fiscal consolidation was put in place (see Kelkar (2012)). It is widely recognized that, at least in part, an important factor behind this was the possibility of a credit rating reassessment against the backdrop of a large and

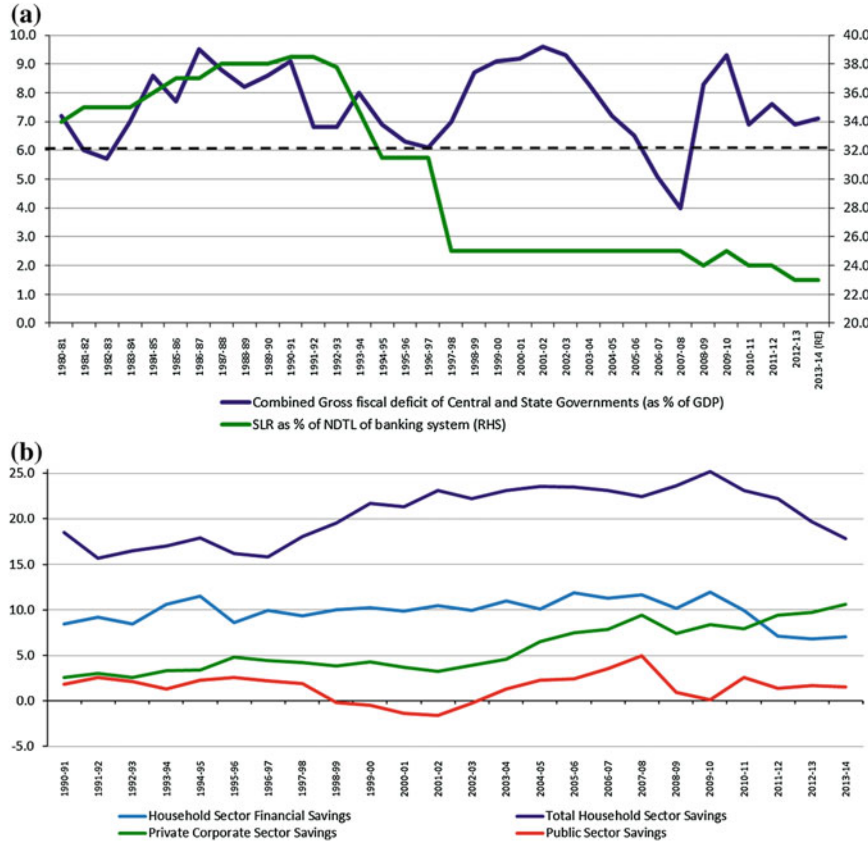

Fig. 1 Fiscal deficits, SLR requirements, and sectoral saving. **a** Fiscal deficit and SLR. **b** Saving rates, by sector. *Notes Panel a* of the figure shows the general government (Central and State Governments' consolidated) fiscal deficit (as % of GDP) on the left axis and the prescribed SLR of on the right axis. *Panel b* shows the sectoral saving rates in India (Saving–GDP ratio in percent)

widening current account deficit, which crossed 4 % of GDP in 2011/12. For the first time since the 1997 Asian crisis, questions were raised by some about India's external payments sustainability in light of tapering of the Fed's US$ 85 billion per month asset purchase program.

2.2 *Fiscal Dominance: Upshot of "Sophie's Choice" Confronted by the Central Bank?*

Sargent (1986) formally poses the aforementioned choice between a rock and a hard place as a game of Chicken. The question is who blinks between a monetary authority that is adhering to price stability while also being apprehensive about financial stability and the fiscal authority, who, while appreciating price and financial stability, is not keen to correct an unsustainable primary fiscal deficit through spending cuts or tax increases (including normal and ad hoc transfers from the central bank) and prefers to have the monetary authority directly monetise (accommodate) the public debt. If neither caves in, the deficit is financed by debt issuance and a confrontational outcome ensues. If the central bank does not monetise the fiscal deficit and the sovereign defaults, banks holding large amounts of sovereign debt may collapse, triggering a financial crisis with serious attendant spillovers to the rest of the economy. A monetary authority is unlikely to let this happen; the central bank will instead monetise the public debt and deficits. This is well known as Fiscal Dominance (see, e.g., Buiter (2010)). There are two reasons—one institutional, and the other practical—for this (almost) inevitable outcome. First, regardless of the extant legal position of the central bank, the sovereign has the political sway to compel the central bank to do its bidding. Second, the central bank when it assesses which "mess" is larger/more difficult to clean up, viz., the default of the sovereign, or, higher inflation, it may conclude that the latter is relatively easier to deal with in the larger scheme of things.[1] In contrast, monetary dominance occurs if the fiscal authority gives in and cuts public spending and/or raises taxes to stabilize or reduce the public debt to GDP ratio. In extreme situations, the central bank may be forced to "accommodate" up to the seigniorage-maximizing rate of inflation.

Even if the aforementioned extreme scenario is not reached, frictions associated with large fiscal deficits are felt strongly in the Indian context. Policy-induced frictions are primarily on account of the Statutory Liquidity Ratio (SLR), which earmarks a fraction of liabilities of banks for investment in central and state government securities. This has been a long-standing feature of the Indian economic landscape. As shown in Fig. 1, the SLR was consistently upwards of 30 % till the late 1990s. Despite a reduction in recent years it is still at a remarkably high 21.5 % currently. Given the nature of the SLR requirement, it is a far cry from the Liquidity Coverage Ratio (LCR) envisaged as a form of prudential regulation under Basel III—a potential liquidity fallback during times of stress.

The friction in credit allocation induced by the SLR requirement has come about on account of the importance accorded to the placement of government debt at the most economical interest rate possible. This compromises the financial viability of the banking sector as an apposite risk-aligned return/yield is not forthcoming on a large part of banks' balance sheets. It bears repetition that this is only one example of factors that undermine the banking sector, particularly public sector banks. The recent rise in the share of non-performing loans (NPLs) of public sector banks is yet another symptom of the role of frictions introduced by the complex institutional setting in which the banking sector operates in India. Moreover, since these frictions feed off each other operationally on a day-to-day basis they, almost inevitably, albeit through no fault of anyone, undermine the effectiveness of the central bank's policy instruments. Ultimately, the sanctity of the central bank's publicly announced policy

[1] In this context, it is pertinent to recall the observation of Ben Bernanke, the former Chairman of the Federal Reserve Board, that central banks cannot be in the business of brinkmanship.

goal posts may also start to be questioned by financial markets. In other words, the disjunction between number of instruments and targets becomes too hard to sustain.

Another adverse upshot of the government's long-standing fiscal stance is that provident & pension fund, as well as insurance company investment guidelines favor lending to government. Since long-term (usually 10-year) paper is favored, much of the long-term investment appetite of these entities is met through this. Asset-liability maturity mismatches, which are borne by commercial banks on long gestation highly cyclical projects (for example, most infrastructure projects) could be mitigated if financial institutions specializing in long-term savings products had more elbow-room to invest in these assets. Crowding out of funding has been a feature. At least in part, the increase in external commercial borrowing in the mid-2000s coincided with the escalation in the infrastructure investment-GDP ratio during that period.

2.3 Subsidized Agricultural Credit

Beyond the distortions implicit in SLR requirements, the dictates of priority sector lending have imparted an additional friction in the credit allocation process in the country. One example of this is agricultural credit allocation. The last 15 years has seen a policy driven sharp uptick in agriculture credit provision. In fact, in June 2004 the central government announced a "Comprehensive Credit Policy", which sought to double agriculture credit in a span of three years. Subsequent Union budgets established targets for credit to agriculture; since 2003/2004 flow of credit to agriculture has consistently exceeded the budgeted targets. In 2006/2007 the government implemented an Interest Subvention Scheme to make short-term crop loans of up to Rs. 3 lakhs to farmers at an interest rate of 7 %/year. Recent modifications to these subvention laws based on timely repayment of loans have reduced the effective cost of the loan for farmers to 4 %. Furthermore, state government subventions take the interest even lower. Combined with the loan waiver scheme in 2008/2009, the moral hazard that has been imparted into the agriculture credit subcategory (undermining incentives for both borrowers and bankers) is possibly unprecedented. Over the last decade and a half, agricultural credit grew by 21 %/annum compared to about 11 %/annum in the previous decade. Accordingly, the credit-GDP ratio in the agriculture sector witnessed a sharp increase; the ratio of outstanding agriculture loans to agriculture GDP increased from 9.8 % in the 1990s to 13 % in 2001/2002 to 38.7 % in 2012/2013 (see Fig. 2).

It is unclear however whether this increase in credit allocation to agriculture has helped achieve the socioeconomic policy objectives of enhancing crop productivity and helping small and marginal farmers, especially given the indirect evidence of leakage. For one, the share of indirect credit in total agriculture credit has increased. Moreover, the share of large borrowers in both direct and indirect credit to agricultural has also risen. Given the scarcity of overall credit supply, the distortions implicit in the subsidized credit extension to agriculture would appear to have possibly compromised both the monetary policy and financial stability objectives of the Reserve Bank. The fact that there is scarce (if any) evidence on the productivity effects of

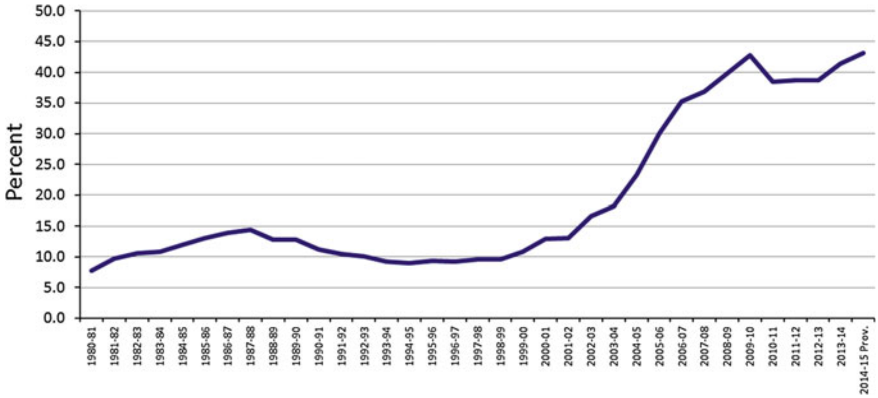

Fig. 2 Total bank credit to agriculture as ratio to agricultural GDP. *Note* The figure shows Scheduled Commercial Banks' (SCBs) total credit outstanding to agriculture and allied activities as ratio to GDP from agriculture and allied activities at current market prices

subsidized agricultural credit allocation through banks makes these policies even more problematic from a public policy standpoint.

2.4 Administered Interest Rates

We would be remiss if we did not mention an additional dimension, which is quasi-fiscal in nature, to the impediment of the monetary transmission mechanism, viz., the panoply of savings instruments whose interest rates are administered by the government (see Table 1). While yields on most of these instruments are broadly linked to government securities, the reset is annual and hence hinder the timely transmission of changes in policy rates to the liabilities' side of banks and financial institutions. It would seem that a quarterly or monthly reset based on, say, the average of market closing yields recorded over the last five days, would hasten and assist the transmission. Presently, banks are, to an extent, constrained on lowering deposit rates by the effective floor on rates that the system of administered rates on savings instruments imposes at the margin on the entire financial sector.

In the next few sections we shall outline the implications of a couple of these institutional distortions for the conduct of monetary policy. Specifically, we shall examine the consequences of a binding SLR requirement in banks in an environment of chronically high and exogenously given fiscal spending levels on the monetary transmission mechanism.

Table 1 Administered saving rates

Scheme	Formula		Announced rate	Tax deductions allowed
	Benchmark	Spread		
Post office savings deposits	No benchmark		4	No
1-year post office time deposits	364-day T-Bill cut-off	0.25	8.4	No
2-year post office time deposits	Linear Interpolation	0.25	8.4	No
3-year post office time deposits	Linear Interpolation	0.25	8.4	No
5-year post office time deposits	5 year G-sec yield	0.25	8.5	Yes
5-year recurring deposit	5 year G-sec yield	0.25	8.4	No
5-year senior citizens savings scheme	5 year G-sec yield	1	9.3	Yes
5-year monthly income scheme	5 year G-sec yield	0.25	8.4	No
5-year national savings certificate (NSC)	5 year G-sec yield	0.25	8.5	Yes
10-year NSC	10 year G-sec yield	0.5	8.8	Yes
Public provident fund—15 years	10 year G-sec yield	0.25	8.7	Yes
Kisan Vikas Patra—8 years 4 months	New scheme		8.7	No
Sukanya Samridhi account—21 years	New scheme		9.2	Yes

Notes 1. Interest rates applicable on small savings schemes are reset annually by the Government of India at the start of each financial year (FY)

2. G-sec yields are computed based on average of month-end yields (January to December)

3. PPF accumulation and withdrawal are also exempt under Sect. 10 of IT Act

4. Interpolated rate is the linear interpolation between 364-day T-Bill and 5-year G-sec rates

5. Post Office Savings Deposits interest income above Rs. 10,000 is taxable

6. Tax deductions if permitted are under Sec. 80C of the Income Tax Act

7. All interest rates are in percent per annum

3 Model

The goal of the model we develop here is to highlight two key aspects of monetary policy conduct and its transmission in India. The first is the effect of policy-induced institutional constraints on the transmission process. The specific constraint we shall use to illustrate the resulting complications is the Statutory Liquidity Ratio (SLR) provision which forces banks to hold a fraction of their deposits in the form of government bonds. The second is the role played by fiscal dominance on the transmission mechanism in small economies. The model we use is a variant of the structure formalized in Lahiri and Vegh (2007).

Consider a small open economy producing and consuming a single tradable good. Assume that the economy is perfectly integrated in goods markets so that $P_t = E_t P_t^*$ where P is the domestic currency price of the good, E is the nominal exchange rate (rupees/dollar) and P^* is the dollar price of the good. For convenience we set $P_t^* = 1$ for all t which is just a normalization. Time is continuous and there is no uncertainty. The economy consists of four actors: households, banks, firms, and a government (which is an integrated fiscal and monetary entity).

There is a continuum of identical households in the economy. We normalize the households to be of measure one. Private agents can access perfectly competitive international capital markets where they can buy and sell real bonds denominated in terms of the traded good at an constant world real interest rate r. Households own international bonds and also hold deposits in banks which pay interest i^d at every instant. Deposits can be used for carrying out domestic transactions. Transactions are costly and can be reduced using deposits.

3.1 Households

With no loss of generality we shall analyze the behavior of the representative household. The representative household maximizes lifetime utility

$$V = \int_{t=0}^{\infty} e^{-\rho t} u\left(c - \zeta x^{\nu}\right) dt \tag{3.1}$$

where ρ is the rate of time preference, c is consumption, and x is labor supply. Here we have suppressed time subscripts to economize on notation. In the following, we shall continue with this convention wherever there is no risk of confusion. The utility function $u(.)$ is twice-differentiable and concave in its argument.[2] The household's flow budget constraint in real terms is

$$\dot{b} = rb + wx + \tau - c - \dot{d} + \left(i^d - \pi\right) d - s(d) + \Omega^b + \Omega^f \tag{3.2}$$

where b denotes international bonds, d denotes demand deposits, w is the real wage, τ are lump-sum transfers received from the government, π is the rate of inflation (also the rate of depreciation in this one good model), Ω^b and Ω^f are dividends received

[2]Our utility specification, also known as GHH preferences due to their formalization in Greenwood et al. (1988), imply that labor supply only depends on the wage rate and is independent of any wealth effects. We employ these preferences here since they greatly enhance the analytical tractability of the model. We should add that this abstraction does not come at a great cost of realism since there is scant micro evidence that suggests the presence of significant wealth effects on labor supply.

from banks and firms which the households own. $s(d)$ is the transactions cost technology. We assume that $s' < 0$ and $s'' > 0$ implying that these costs are decreasing and convex in the household's holding of demand deposits. A dot over a variable indicates its time derivative. Defining $a \equiv b + d$ and $i = r + \pi$ (the nominal interest rate), we can rewrite this flow constraint as

$$\dot{a} = ra + wx + \tau - c + \left(i^d - i\right) d - s(d) + \Omega^b + \Omega^f$$

The household chooses perfect foresight paths for c, x, b and d to maximize lifetime welfare subject to its flow budget constraint taking as given the paths for $\tau, w, i^d, i, \Omega^b$ and Ω^f. The first-order conditions for household optimality are

$$u'(c - \zeta x^\nu) = \lambda \tag{3.3}$$

$$\nu \zeta x^{\nu-1} = w \tag{3.4}$$

$$-s'(d) = i - i^d \tag{3.5}$$

$$\dot{\lambda} = (\rho - r)\lambda \tag{3.6}$$

In the following we shall maintain the standard small open economy assumption $\rho = r$ to prevent secular trends in marginal utility. Hence, $\dot{\lambda}_t = 0$ for all t. These first-order conditions imply two key relations

$$d = S\left(I^d\right), \; S' < 0, \; I^d \equiv i - i^d \tag{3.7}$$

$$x = \left(\frac{w}{\nu\zeta}\right)^{\frac{1}{\nu-1}} \tag{3.8}$$

Equation (3.7) gives deposit demand as a decreasing function of the opportunity cost of holding deposits I^d while Eq. (3.8) gives labor supply as an increasing function of the wage rate. The wage elasticity of labor supply in this formulation is $\frac{1}{\nu-1}$. We shall maintain the assumption throughout the paper that $\nu > 1$.

3.2 Firms

Firms hire labor to produce output using the technology

$$y = Ax$$

where A is productivity. To introduce a productive role for credit, we assume that firms also face a credit-in-advance constraint to finance the wage bill

$$n = \phi w x$$

where ϕ is the fraction of wages that has to be paid before the realization of output. This fraction has to be financed through a working capital loan from banks. Firms maximize

$$\Omega^f = Ax - wx - \left(i^l - i\right) n$$

The first-order condition for the firm's problem is

$$A = \left(1 + \phi I^l\right) w \tag{3.9}$$

where $I^l \equiv i^l - i$ is the real lending spread.

3.3 Banks

Banks in this economy perform four functions: they accept deposits from households, they lend to firms, they hold as required reserves a fraction δ of deposits, and they buy government bonds. The key restriction we impose is that banks are not allowed to access international capital markets, i.e., this is a banking system that is closed to international capital flows. This restriction will allow us to break interest parity between international bonds and government bonds. More specifically, the assumption introduces a sheltered domestic market for government bonds in which these bonds can trade at a price different from the international interest rate on similar bonds.[3]

Let Z denote nominal government bonds held by the bank and M denote required reserves that the bank is mandatorily required to hold. Their real counterparts are given by $z = \frac{D}{P}$ and $m = \frac{M}{P}$. The closed banking system implies that the bank's balance sheet identity is

$$n + z + m = d$$

The bank's flow constraint (in real terms) is

$$\dot{n} + \dot{z} + \dot{m} - \dot{d} = \left(i^l - \pi\right) n + \left(i^g - \pi\right) z + \left(\pi - i^d\right) d - \pi m - \Omega^b$$

Adding and subtracting $r\left(n + z + m - d\right)$ from the right-hand side and using the bank's balance sheet identity, this reduces to

[3] In these small open economy environments, one has to break interest parity on government bonds in order to have an independent interest policy in the model. Our assumption that the banks hold government bonds and are also closed to international capital markets is an extreme way of achieving this. Less restrictive approaches to achieving this same goal would be to introduce costly banking along the lines of Diaz-Gimenez et al. (1992), Edwards and Vegh (1997) and Hnatkovska et al. (2013). Our approach here is analytically simpler.

$$\Omega^b = \left(i^l - i\right) n + (i^g - i) z + \left(i - i^d\right) d - i\delta d$$

where we have used the fact that $m = \delta d$. This is assuming that the reserve requirement constraint is always binding on the bank. Since reserves are noninterest bearing, this will hold as long as $i > 0$, i.e., the cost of holding reserves is positive.

$$\Omega^b = \left(i^l - i\right) n + (i^g - i) z + \left[i (1 - \delta) - i^d\right] \left(\frac{n + z}{1 - \delta}\right)$$

It is easy to check that bank optimality dictates that we must have

$$i^l = i^g \tag{3.10}$$

$$i^d = (1 - \delta)\, i^g \tag{3.11}$$

The intuition behind these conditions is straightforward. Since loans and government bonds are perfect substitutes for the bank, at an optimum they will demand the same returns from each, which gives Eq. (3.10). Moreover, for every dollar of deposits the bank receives, it can only lend out a fraction $1 - \delta$ which earns the going return on bank assets i^g. Under a competitive banking system, zero profits for banks then dictates that the deposit rate must equal the loan rate net of the reserve requirement ratio. Before proceeding, it is useful to note that any changes in i^g are transmitted fully to both the lending and deposit rates, i.e., the monetary transmission mechanism is seamless.

3.4 Government

The central bank in this economy prints money, holds international reserves, and issues government bonds. The fiscal authority makes transfers to households. The government's flow constraint is given by

$$\dot{R} = rR + \dot{m} + \pi m + \dot{z} - (i^g - \pi) z - \tau \tag{3.12}$$

The central bank's balance sheet identity is $R + q = m$ where q denotes real net domestic credit. Since we will be considering flexible exchange rate regimes, the central bank does not intervene in the foreign exchange market so that $\dot{R} = 0$. Without loss of generality we also assume that $R = 0$.

Given the flexible exchange rate regime, the government in this economy has potentially three policy instruments available to it—τ, $\dot{Q}/Q$ and i^g where Q is nominal domestic credit. Of these, only two can be freely chosen and the third will get determined from Eq. (3.12). We assume that the government sets i^g and $\dot{Q}/Q = \bar{\pi}$, while τ adjusts endogenously to make Eq. (3.12) hold. Notice that this assumption precludes any fiscal dominance. This is an issue that we shall return to below.

3.5 Equilibrium Relations

We now combine the optimality conditions of households, firms, and banks to derive the key macroeconomic equilibrium relationships. First, combining the household and firm conditions for optimal labor supply and demand, Eqs. (3.4) and (3.9) respectively, gives

$$x = \left[\frac{A}{\nu\zeta\left(1+\phi I^l\right)}\right]^{\frac{1}{\nu-1}} \equiv \tilde{x}\left(I^l\right) \tag{3.13}$$

$$n = \phi\nu\zeta\left[\frac{A}{\nu\zeta\left(1+\phi I^l\right)}\right]^{\frac{\nu}{\nu-1}} \equiv \tilde{n}\left(I^l\right) \tag{3.14}$$

where $I^l = i^l - i$ is the real lending spread. Note that the equilibrium condition $i^l = i^g$ also implies that $I^l = I^g$ where $I^g \equiv i^g - i$ is the real spread on government bonds.

Finally, combining the flow constraints of households, firms, banks and the consolidated government gives the evolution equation of net country assets

$$\dot{f} = rf + Ax - c - s(d) \tag{3.15}$$

where $f = b + R$ denotes net country assets. The right-hand side of Eq. (3.15) is also the current account equation for this economy.

It is straightforward to show that under flexible exchange rates with constant domestic credit growth $\bar{\mu}$ and interest rate i^g, this is a stationary economy that jumps to its steady state immediately at date 0. The steady state inflation rate is just the rate of growth of money which the economy attains immediately. Consequently, i jumps to its constant long run steady state level $\bar{\imath} = r + \bar{\mu}$ at date 0 itself.

3.6 Some Comparative Statics

What are the effects of monetary policy innovations in this economy? There are three independent instruments that the central bank can potentially use to affect the economy: i^g, μ and the reserve requirement ratio δ. The effects of changing the policy rate i^g are straightforward. A permanent, one time, unanticipated *reduction* in i^g reduces I^g and I^l, raises I^d while leaving the rate of inflation unchanged at $\bar{\mu}$. The fall in I^l causes loans, output and employment to rise while deposits decline due to the rise in the opportunity cost of holding them. Banks rebalance their portfolios by reducing their holdings of government bonds z to accommodate the rise in n in the face of a reduction in deposits. Clearly, a reduction in the policy rate is expansionary.

The second policy instrument available to the policymaker is the rate of money growth μ. A reduction in μ reduces inflation immediately. For a given and unchanging i^g, this causes both I^g and I^l to rise while the deposit spread I^d declines. Consequently, loans, employment, and output all fall while deposits and bank holdings of government bonds rise. Intuitively, the opportunity cost of loans rises due to the lower inflation rate which raises the cost of working capital for firms. As a result firms reduce their employment levels and output. Hence, a cut in the money growth rate in this economy is also contractionary.

The third instrument that the central bank can use to affect the economy is the required reserve ratio δ. An unanticipated, permanent increase in δ reduces the deposit rate i^d. Since, μ is unchanged, the nominal interest rate i also remains unchanged. Hence, with unchanged i^g and μ, an increase in δ raises the deposit spread $I^d = i - i^d$ but leaves I^g and I^l unchanged. Deposits fall but loans, employment, and output stay unchanged. Banks respond to the lower level of deposits in the system by reducing their holdings of government bonds z.

4 Statutory Liquidity Ratio

We now consider a different environment relative to the one analyzed above. Suppose banks face an additional constraint wherein they have to hold at least a fraction β of their deposits in government bonds. In India this is known as the *Statutory Liquidity Ratio* (SLR). The constraint can be written as $z \geq \beta d = \frac{\beta}{1-\delta}(n+z)$ where the second equality follows from the bank balance sheet identity and the fact that $m = \delta d$. The SLR constraint can be rewritten as

$$z \geq \frac{\beta}{1-\beta-\delta} n \tag{4.16}$$

The representative bank's problem is to maximize

$$\Omega^b = \left(i^l - i\right) n + (i^g - i) z + \left[i(1-\delta) - i^d\right] \left(\frac{n+z}{1-\delta}\right)$$

subject to the inequality constraint given by Eq. (4.16). The optimality conditions for this problem are

$$i^l - \frac{i^d}{1-\delta} = \kappa \frac{\beta}{1-\beta-\delta} \tag{4.17}$$

$$i^g - \frac{i^d}{1-\delta} + \kappa = 0 \tag{4.18}$$

$$\kappa \left[z - \frac{\beta}{1-\beta-\delta} n\right] = 0 \tag{4.19}$$

where $\kappa \geq 0$ is the Kuhn–Tucker multiplier on Eq. (4.16). Note that $\kappa = 0$ when the constraint is not binding and $\kappa > 0$ when Eq. (4.16) binds.

When the constraint is binding, we can combine the two first-order conditions to eliminate κ and get

$$i^d = \beta i^g + (1 - \beta - \delta)\, i^l \tag{4.20}$$

Equation (4.20) must hold along all paths where the SLR requirement binds. The condition says that at an optimum banks will set the deposit rate equal to a weighted average of the returns from its two assets. In contrast to the case without any SLR requirement in which $i^d = (1 - \delta)\, i^g$, here the bank's return on its portfolio reflects the share of each component in the bank's portfolio. Out of every rupee of deposits, the bank has to put aside a fraction β in government bonds which earns the nominal rate i^g. A fraction $1 - \beta - \delta$ of every unit of deposits is available to be lent out to the private sector which earns the going nominal lending rate i^l. One can now immediately begin to see that changes in i^g may not be transmitted seamlessly to deposit rates in this environment.

Under a binding SLR requirement we have

$$z = \beta d \tag{4.21}$$

Further, since $z + n = (1 - \delta)\, d$, we also have

$$d = \frac{n}{1 - \beta - \delta} \tag{4.22}$$

For future reference, it is useful to rewrite Eq. (4.20) as

$$I^d = \delta i - \beta I^g - (1 - \beta - \delta)\, I^l \tag{4.23}$$

where, as before, $I^d = i - i^d$ and $I^l = i^l - i$.

Since we know that $z = \frac{\beta n}{1-\beta-\delta}$ and $d = \frac{n}{1-\beta-\delta}$ we can use the solution for loans given in Eq. 3.14 to get

$$z = \left(\frac{\beta}{1 - \beta - \delta}\right) \phi \nu \zeta \left[\frac{A}{\nu\zeta\left(1 + \phi I^l\right)}\right]^{\frac{\nu}{\nu-1}} \equiv D\left(I^l\right) \tag{4.24}$$

$$d = \left(\frac{\phi \nu \zeta}{1 - \beta - \delta}\right) \left[\frac{A}{\nu\zeta\left(1 + \phi I^l\right)}\right]^{\frac{\nu}{\nu-1}} \tag{4.25}$$

Recall from the household's optimal choice of demand deposits we also have the relation $d = S\left(I^d\right)$ which, when combined with Eq. (4.23), gives

$$d = S\left((\delta + \beta)i - \beta i^g - (1 - \beta - \delta)\, I^l\right) \equiv S\left(I^l; i^g, i\right) \tag{4.26}$$

We interpret Eq. (4.25), which is derived from the demand for loans by firms n, as the demand function for loanable funds $D\left(I^l\right)$. It is declining in the lending spread I^l. Conversely, Eq. (4.26) can be interpreted as the supply function of loanable funds $S\left(I^d\right)$ as it is derived directly from the supply of deposits by households. It is increasing in both I^l and i^g. We call it the supply function of loanable funds because an increased supply of deposits creates larger balance sheets of banks who look for opportunities to invest in loans. The equilibrium in the loan market will be at the intersection of the two functions.

Since i is determined by the rate of money growth, once I^l is known I^d is known as well. Hence, the individual interest rates in this economy (i^d, i^l, i^g and i) are known. All the other endogenous variables in the model are functions of these interest rates and/or productivity. Consequently, they are determined too. Solving for the equilibrium I^l as a function of parameters of the model and the policy variables i^g and μ thus solves the entire model.

The rest of the equilibrium relations remain unchanged relative to the no-SLR case as does the fact that the dynamics of the economy around the steady state are unstable implying that the only feasible perfect foresight equilibrium paths in this economy are those with a constant inflation rate π which equals the rate of money growth μ at all points in time. We can now analyze the effects of three shocks in this economy: (a) a decrease in the policy interest rate i^g; (b) an increase in the money growth rate μ; and (c) an increase in the SLR β.

4.1 Decrease in i^g

Suppose, starting from an initial steady state, the government permanently cuts the interest rate on government bonds. A decrease in i^g leaves the demand function for loans unaffected but reduces the supply of loans S. Consequently, the equilibrium I^l rises. Given that the nominal interest rate i is unchanged, this implies that the lending rate i^l must rise. As a result employment, output, deposits, loans, and holdings of government bonds all decline. This is a remarkable result since it shows that under a binding SLR constraint, a cut in the policy rate can be highly contractionary.

Intuitively, the cut in i^g causes the deposit spread I^d to rise (see Eq. (4.20)). This reduces the demand for deposits, or the supply of loanable funds available with the banking system. Under a binding SLR, loans and government bonds have to always be in a fixed proportion. Hence, they must both fall in order to accommodate the smaller deposit base of the bank. Consequently I^l has to rise since loan demand is a function of the lending spread.

To understand these results better, recall that in the environment without a binding SLR requirement, a cut in i^g simultaneously induced a fall in demand deposits and a rise in loans to firms. The expansion in loans by banks despite a fall in the deposit base was facilitated by a reduction of bank holdings of government bonds z. This was possible due to perfect substitutability between the two components of bank assets. Once the SLR constraint binds however, government bonds and loans to firms have to move in fixed proportions to each other, i.e., there is no substitutability between the two assets at all. Consequently, a fall in bank deposits has to be met with an accompanying decline in both components of bank assets, i.e., n and z both fall. An alternative way of making the point is to note that under a binding SLR constraint, reducing the interest rate on government bonds acts like a higher tax on banks. Consequently, they respond by reducing the size of their balance sheet.

4.2 An Increase in the Rate of Money Growth

Now consider an unanticipated and permanent increase in the rate of money growth μ. This shock raises the market nominal interest rate i which increases the deposit spread I^d. Consequently, the supply of loanable funds S to the market falls. The lower supply of loanable funds along with an unchanged demand for loans implies that the lending spread I^l has to rise in order to ration the lower supply of funds to the market. This is again a counterintuitive result in that an expansionary monetary shock causes deposits, loans, output, employment, and consumption to decline.

4.3 Rise in the SLR β

Suppose the government permanently raises the statutory liquidity ratio β. This unambiguously raises the demand for loanable funds (see Eq. (4.24)). The effect on the supply of loanable funds is however ambiguous and depends on parameters. If $i^l > i^g$ (which is the typical case in the data) then the supply of funds declines. In this case the lending spread unambiguously rises. However, the equilibrium effect on deposits is ambiguous.

The upshot of this though is that when the SLR constraint is binding the monetary transmission mechanism becomes so scrambled that it can end up inverting the effects of changes in the policy rate on the key interest rate spreads—raising the policy rate could reduce lending spreads while lowering rates could raise the lending spread. In such circumstances, changing the SLR level (β in our model) itself is more likely to yield conventional effects of monetary policy, i.e., a fall in β would act like a monetary expansion while an increase in β would be a monetary contraction.

5 Fiscal Dominance

A recurrent issue that plagues monetary authorities everywhere is its relationship with the fiscal authority. The tendency of the fiscal authority moving unilaterally to set a path for the fiscal deficit and forcing the monetary authority to validate that path through an accommodative monetary stance has led to movements in many countries to institutionalize the independence of the central bank from the fiscal authority. This movement though still remains incomplete with central bank governors in many countries, including India, still reporting to the treasury/finance wing of the government. Effectively, this tends to create conflicting objectives for the central bank.

Fiscal dominance has three important consequences. First, if the government runs a fiscal deficit then it tends to get monetised by the central bank and consequently leads to inflation. Second, the existence of a fiscal deficit itself can induce inflationary expectations (independent of whether or not the fiscal authority actually expects the central bank to accommodate the deficit or not) and thereby put upward pressure on inflation immediately. Third, in the presence of fiscal dominance the monetary transmission mechanism tends to get scrambled. An example of this is the well known "unpleasant monetarist arithmetic" wherein a tightening of monetary policy could end up raising inflation rather than the intended goal of reducing it.

We illustrate the issues involved by introducing an exogenous fiscal constraint in the model above. Recall that the model thus far had fiscal spending τ adjusting endogenously to balance the government budget. Suppose instead that τ is exogenously given at the constant level $\bar{\tau}$. In effect we are now assuming that fiscal authority moves first and chooses fiscal spending $\bar{\tau}$. The monetary authority reacts by choosing monetary policy to balance the budget taking the fiscal stance as given.

The change in model specification leaves the optimization problem of households, firms, and banks unaffected and thereby leaving the optimality conditions derived above unchanged. The crucial change is in the government's problem. Recall that the consolidated government's flow budget constraint (in real terms) is given by

$$\dot{R} = rR + \dot{m} + \pi m + \dot{z} - (i^g - \pi) z - \bar{\tau}$$

The government's potential policy choices are the exchange rate regime, the money growth rate μ, the interest rate i^g and fiscal spending τ. Given the assumptions of perfect capital mobility and a flexible exchange rate regime we must have $\dot{R} = 0$. The remaining choices for the government are μ, i^g and τ. Previously, under an endogenous τ, the government could choose μ and i^g while τ would adjust to make the flow constraint hold at every date.

When $\tau_t = \bar{\tau}$ for all t, only one out of i^g and μ are exogenous. Indeed, without a domestic interest bearing bond, an exogenous τ would immediately imply an endogenous rate of money growth μ. However, here the central bank can choose one out of i^g and μ freely. In keeping with modern central banking practices, we shall assume that i^g is chosen independently by the central bank while μ adjusts endogenously to make the flow constraint hold at every point in time.

The central bank balance sheet identity implies that $\dot{R} + \dot{q} = \dot{m}$ where q denotes real domestic credit. Substituting this in to the consolidated government's flow constraint and rearranging the result gives

$$\delta\dot{d} = \bar{\tau} - rR - \pi\delta d - \dot{z} + (i^g - \pi) z$$

where we have used the fact that real money balances (or high-powered money) in this economy are just required reserves held by the banking system since there is no cash by assumption, i.e., $m = \delta d$. As before, we continue to assume, without loss of generality, that $R = 0$. Using this and the SLR requirement $z = \beta d$, the above reduces to

$$\dot{d} = \frac{\bar{\tau}}{\delta + \beta} + \left(\frac{\beta i^g}{\delta + \beta} - \pi \right) d$$

To determine the dynamic behavior of this economy, differentiate the first-order condition for optimal deposit demand to get $\dot{d} = \frac{\dot{I}^d}{-s''(d)}$. Substituting this in the above and rearranging the result yields

$$\dot{I}^d = -s''(d) \left[\frac{\bar{\tau}}{\delta + \beta} + \left(\frac{\beta i^g}{\delta + \beta} - \pi \right) S\left(I^d\right) \right]$$

where we have used the relation $d = S\left(I^d\right)$ from Eq. (3.7) above.

Recall that $I^d = (\delta + \beta)(r + \pi) - \beta i^g - (1 - \beta - \delta) I^l$ from the bank first-order condition given by Eq. (4.20).[4] Differentiating this expression with respect to time gives

$$\dot{I}^d = (\delta + \beta)\dot{\pi} - (1 - \delta - \beta)\dot{I}^l$$

where we have again retained the operating assumption that i^g is exogenously chosen by the government at a constant level. The lending spread I^l is also a function of I^d which can be seen from the fact that the bank balance sheet identity combined with a binding SLR constraint implies that $n = (1 - \delta - \beta) d$. Totally differentiating this expression and noting that the equilibrium levels of d and n are given by Eqs. (3.7) and (3.14), respectively, we can solve for I^l as an implicit function of I^d: $I^l = \Gamma\left(I^d\right)$ with

$$\Gamma'\left(I^d\right) = (1 - \delta - \beta)\frac{\tilde{d}'}{\tilde{n}'} > 0 \tag{5.27}$$

Using this in the expression for $\dot{I}^d$ above gives

$$\dot{I}^d = \left(\frac{\delta + \beta}{1 + (1 - \delta - \beta)^2 \frac{\tilde{d}'}{\tilde{n}'}} \right) \dot{\pi}$$

Further, we can use the function Γ in the expression $I^d = (\delta + \beta)(r + \pi) - \beta i^g - (1 - \beta - \delta) I^l$ to derive the implicit solution for I^d as a function of π and i^g: $I^d = p(\pi, i^g)$ with

[4] In deriving this we have also used the relation $I^g = i^g - i$ and the interest parity condition $i = r + \pi$.

$$p_\pi = \frac{\partial p}{\partial \pi} = \frac{\delta + \beta}{1 + (1 - \delta - \beta)\,\Gamma'} > 0; \;\; p_{i^g} = \frac{\partial p}{\partial i^g} = \frac{-\beta}{1 + (1 - \delta - \beta)\,\Gamma'} < 0 \quad (5.28)$$

We can now combine this with the differential equation for I^d derived above and rearrange the result to get

$$\dot{\pi} = \chi \left[\left(\pi - \frac{\beta i^g}{\delta + \beta} \right) S\left(p\left(\pi, i^g\right)\right) - \frac{\bar{\tau}}{\delta + \beta} \right] \quad (5.29)$$

where $\chi \equiv s''(d) \left(\frac{1+(1-\delta-\beta)\Gamma'}{\delta+\beta} \right) > 0$. Equation (5.29) is the equilibrium differential equation in π that describes the equilibrium dynamics of this economy. Note that i^g and $\bar{\tau}$ are both exogenous policy variables that are assumed to be constant over time. Setting $\dot{\pi} = 0$, It is easy to check that the steady state equilibrium level of inflation is defined implicitly by the expression:

$$\left(\hat{\pi} - \frac{\beta i^g}{\delta + \beta} \right) S\left(p\left(\hat{\pi}, i^g\right)\right) = \frac{\bar{\tau}}{\delta + \beta} \quad (5.30)$$

In this model, the key endogenous variable is π. Once the equilibrium path for π is determined, the equilibrium levels of all the other endogenous variables can be determined recursively. To see this more clearly, recall that employment, output, and deposit demand are functions I^l and I^d while consumption is determined from the country resource constraint which is obtained by combining the flow constraints for households, banks, firms, and the government

$$\dot{f} = rf + A\tilde{x}\left(I^l\right) - c - s\left(S\left(I^d\right)\right) \quad (5.31)$$

where $f = b + b^f + R$ denotes net country assets. Given that $I^l = \Gamma\left(I^d\right)$ and $I^d = p\left(\pi, i^g\right)$, given an exogenous level of i^g, determining π determines all the other endogenous variables of the system.

To determine the equilibrium dynamics, we differentiate Eq. (5.29) with respect to π. Evaluating it around the steady state inflation rate $\hat{\pi}$ gives

$$\left.\frac{\partial \dot{\pi}}{\partial \pi}\right|_{\pi=\hat{\pi}} = \chi \left[1 - \left\{ \frac{\hat{\pi} - \frac{\beta}{\delta+\beta} i^g}{p\left(\hat{\pi}, i^g\right)} \right\} \eta_d p_\pi \right] S\left(p\left(\hat{\pi}, i^g\right)\right) \quad (5.32)$$

where $\eta_d \equiv -\frac{S'(I^d)}{d} I^d$ denotes the elasticity of deposit demand with respect I^d (which is opportunity cost of holding deposits). The dynamic behavior of π depends on the sign of $\left.\frac{\partial \dot{\pi}}{\partial \pi}\right|_{\pi=\hat{\pi}}$. If this derivative is positive, then Eq. (5.29) defines an unstable differential equation associated with explosive dynamics. As is standard in monetary models of this type, we shall impose the condition

$$1 > \left\{ \frac{\hat{\pi} - \frac{\beta}{\delta+\beta} i^g}{p\left(\hat{\pi}, i^g\right)} \right\} \eta_d p_\pi \tag{5.33}$$

throughout, which will guarantee that Eq. (5.29) is unstable. Hence, all perfect foresight equilibrium paths must have a constant π, i.e., the inflation rate must jump to its long run steady state level at $t = 0$. If this condition fails to hold then the model will permit indeterminacy of equilibrium all of which converge to the same steady state.

5.1 *Effect of Raising the Interest Rate*

The key question that we would like to address is about the effect of the policy rate i^g on this economy. As before, our focus of attention is on the effect of monetary policy on output and employment. However, in contrast to the economy with an endogenous fiscal spending level, here $\bar{\tau}$ is exogenous and consequently, the rate of inflation is also endogenous. Hence, we are also interested in the effect of changes in the policy rate on inflation along with its effects on loans, employment, and output. Proposition 5.1 illustrates the key result[5]

Proposition 5.1 *Under a binding SLR constraint and exogenous fiscal spending $\bar{\tau}$, deposits and loans to firms are both independent of the policy rate i^g. Consequently, employment and output are unaffected by changes in the policy rate. The inflation rate is strictly increasing in the policy rate.*

Proof The government flow constraint is, as before, $\bar{\tau} = \pi m - (i^g - \pi) z$. Since $m = \delta d$ and $z = \beta d$, this can be rewritten as $\bar{\tau} = [(\delta + \beta)\pi - \beta i^g] d$. The bank optimality condition (Eq. 4.20) can be rewritten as $I^d + (1 - \beta - \delta) I^l - (\delta + \beta) r = (\delta + \beta)\pi - \beta i^g$. Using the expression for $\bar{\tau}$ derived above this reduces to $\left[I^d + (1 - \beta - \delta) I^l - (\delta + \beta) r\right] d = \bar{\tau}$. From Eqs. 3.7 and 3.14 we know that $d = S\left(I^d\right)$ and $n = \tilde{n}\left(I^l\right)$. The SLR constraint is $n = \beta d$. These three relationships jointly imply $I^l = \Gamma\left(I^d\right)$. Consequently, we have $\left[I^d + (1 - \beta - \delta)\,\Gamma\left(I^d\right) - (\delta + \beta) r\right] S\left(I^d\right) = \bar{\tau}$. The left hand side of this equation only depends on I^d. Hence, the equilibrium deposit spread I^d only depends on $\bar{\tau}$ and the other parameters. Consequently, both I^d and I^l are independent of i^g. Lastly, differentiating both sides of $I^d + (1 - \beta - \delta) I^l - (\delta + \beta) r = (\delta + \beta)\pi - \beta i^g$ with respect to i^g gives $\frac{d\pi}{di^g} = \frac{\beta}{\delta+\beta} > 0$ where we have used the independence of I^d and I^l from i^g. Since $\frac{d(i - i^d)}{di^g} = 0$ it follows that $\frac{di^d}{di^g} = \frac{d\pi}{di^g} = \frac{\beta}{\delta+\beta}$. ■

The proposition is stark along two margins. First, in the joint presence of an exogenous fiscal constraint and a binding SLR, interest rate policy has no effect on

[5] We are indebted to Rajesh Singh for pointing out and proving the results in this proposition.

employment and output since the lending spread is independent of i^g. Intuitively, the government budget dictates a unique deposit spread in order to finance the fiscal spending which, through the SLR constraint, renders the lending spread invariant to changes in the policy rate as well. Effectively, the imposition of an exogenous fiscal spending on top of the binding SLR constraint removes all degrees of freedom from the banking sector.

To understand this result better, note that $\frac{d(i^l - i)}{di^g} = 0$ implies that $\frac{d(i^l - i^g)}{di^g} = \frac{-\delta}{\delta+\beta}$ where we have used the fact that $\frac{di}{di^g} = \frac{d\pi}{di^g} = \frac{\beta}{\delta+\beta}$. Clearly the wedge between the lending rate to firms and the rate on government bonds declines as i^g rises. Moreover, recall that the bank optimality conditions in this case are $i^l - \frac{i^d}{1-\delta} = \kappa \frac{\beta}{1-\beta-\delta}$ and $i^g - \frac{i^d}{1-\delta} + \kappa = 0$ which imply that $i^l - i^g = \left(\frac{1-\delta}{1-\beta-\delta}\right)\kappa$. Differentiating these with respect to i^g gives $\frac{d(i^l - i^g)}{di^g} = \left(\frac{1-\delta}{1-\beta-\delta}\right)\frac{d\kappa}{di^g}$. Combining these two expressions for $\frac{d(i^l - i^g)}{di^g}$ implies that the Kuhn–Tucker multiplier κ declines secularly as i^g rises since $\frac{d\kappa}{di^g} = -\left(\frac{\delta}{1-\delta}\right)\left(\frac{1-\delta-\beta}{\delta+\beta}\right) < 0$. Hence, there exists a threshold upper level of i^g beyond which the SLR constraint ceases to bind. Intuitively, the return on government bonds becomes so high that banks voluntarily choose to hold excess SLRs.

Second, in this environment raising the policy rate i^g unambiguously *raises* the inflation rate. This again runs contrary to the accepted wisdom regarding monetary transmission wherein a rise in the policy rate depresses aggregate demand and consequently reduces the domestic inflation rate. This is a type of unpleasant monetary arithmetic result that has been made by many authors before (see, amongst others, Sargent and Wallace (1981) and Hnatkovska et al. (2013)).

In summary, our results indicate that in the presence of a binding SLR, the transmission of monetary policy in general becomes scrambled with cuts in policy rates generating inducing hikes in lending rates and contractions in real activity. When a binding SLR requirement is combined with a situation of fiscal dominance by the fiscal authority, the transmission of monetary policy to the economy becomes even more scrambled with inflation also potentially responding to changes in the policy rate in nonstandard ways.

6 Some Confounding Evidence

The analysis in the model above was conducted based on a binding SLR requirement. It is instructive to note that in contrast with the case of no SLR constraint analyzed in Sect. 3 (or equivalently, the case where the SLR constraint does not bind), under a binding SLR constraint when $\kappa > 0$, Eqs. (4.17) and (4.18) in Sect. 4 imply that $i^l > \frac{i^d}{1-\delta} > i^g$. This contrasts with the case where the constraint does not bind when $i^l = i^g$. The upshot of this is that in environments where the SLR constraint is binding

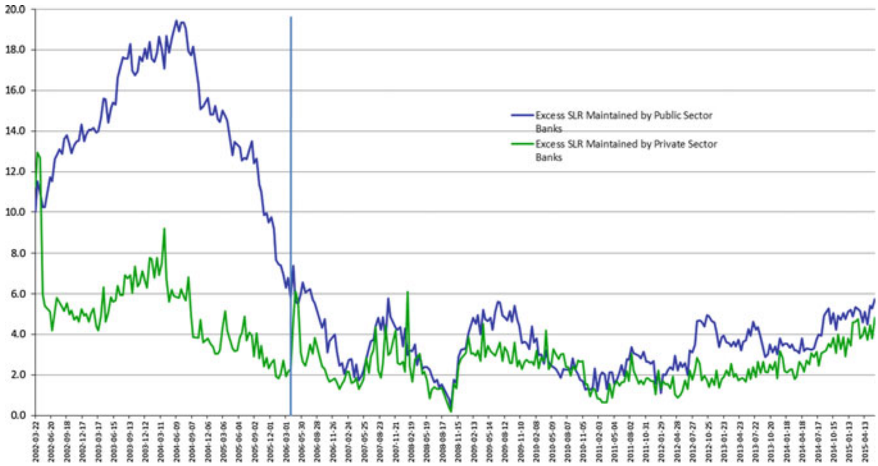

Fig. 3 Excess SLR held by scheduled commercial banks

the lending rate should be strictly greater than the rate on government bonds while in situations where the constraint is not binding the two rates should be equated.

What does data pertaining to the Indian experience with SLR requirements reveal about the trade-offs identified by the model? Fig. 3 shows the excess SLR held by public sector and private sector banks separately since March 2002. The excess SLR is computed as difference between the ratio of the actual SLR held by the bank to its net demand and time liabilities (NDTL) and the ratio required by policy. Three key features of the data are worth pointing out: (a) the amount of the excess SLR held by the banking system overall declined between 2002 and 2010 but started rising from 2011 onwards; (b) the amount of excess SLR held by public sector banks (around 6.8 % on average) has consistently exceeded that of private sector banks (around 3.3 % on average) throughout this period; and (c) the difference between public and private sector banks in their holdings of excess SLRs had almost disappeared between 2007 and 2010 but the period since 2010 has witnessed a faster increase in the excess SLR holdings of the public sector banks. Thus, the average excess SLR holdings of public sector banks has averaged 3.5 % since 2010 while private banks have held only 2.4 % excess SLRs during this period.

We should point out that since scheduled commercial banks can borrow from the Marginal Standing Facility (at a 100 basis points premium over the repo rate) against its excess SLR over and above what they can borrow from the repo market, there is a well-defined precautionary liquidity management reason for banks to hold some excess SLRs. This can possibly explain the 1–2 % excess SLRs that have been typically held by private banks. The puzzle though is the rather high excess SLRs holdings of public sector banks (which have now reached 5.5 %). It is worth pointing out that given the approximately 4 % point spread between the average lending rate of public sector banks, and 10-year government securities, the back-of-the-envelope (risk unadjusted) losses implicit in these excess SLR holding of public sector banks in the fiscal year 2014–2015 amounted to around $17 billion (Rs. 102 billion). To put this number in perspective, the combined profits of public sector banks in 2013–2014 was about $6 billion.

One explanation for these excess SLR holdings could be that the return on bank loans to the private sector are sufficiently close to those on government securities so that banks choose to hold their assets in relatively safer government bonds. However, this is not borne out in the data. The weighted average lending rates of public sector banks in 2014–2015 have been in the range 12.01–12.13 % while the return on ten-year government securities has been in the range 7.68–9.15 %. For comparison purposes, the average lending rates of private sector banks this year have been in the range 12.25–12.56 %. Clearly, lending rates are greater than the rates on government securities for both groups, and by around the same amount. The data suggests some degree of nonoptimizing behavior on the part of public sector banks.

A potential rationalization for the hesitance of the public sector banks to extend credit to nongovernment entities is the quality of its existing asset portfolio. Figure 4 shows the non-performing assets (NPA) of public and private sector banks as a proportion of their assets. The striking feature of the figure is the sharp increase in the share of non-performing loans of public sector banks since 2009 while the corresponding NPAs of private sector banks have stayed relatively unchanged. This is precisely the period when the excess SLR holdings of public sector banks have also increased sharply. A working hypothesis then is that public sector banks have chosen to increase their SLR holdings at lower interest rates instead of lending on account

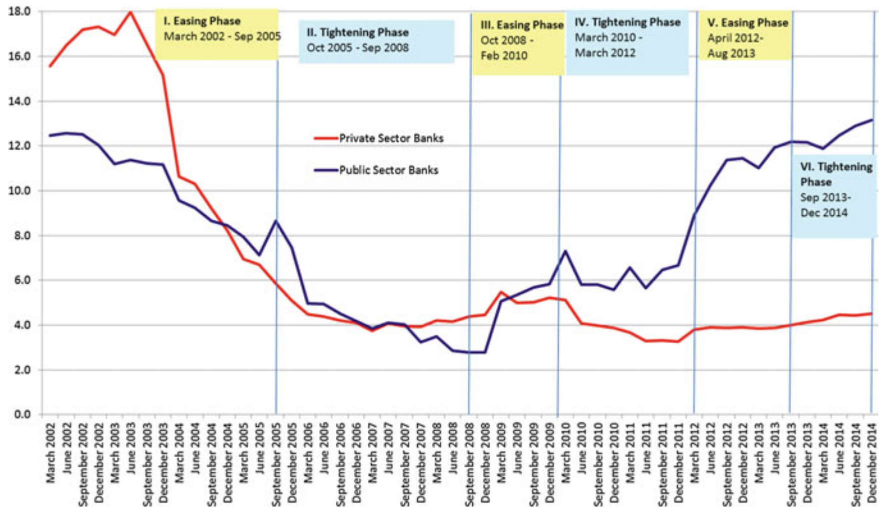

Fig. 4 Non-performing assets of scheduled commercial banks. *Note* The figure shows the gross non-performing assets and restructured advances of PSBs and private sector banks as percent of gross advances

of the overhang of NPAs on their balance sheets. This, of course, is costly to the tax payer as the banks are potentially losing profits that they could make while they are also contributing to a liquidity squeeze in the economy. A third deleterious effect of this banking strategy is that the lower return on bank assets tends to get passed on to bank depositors as lower deposit rates and consequently tends to lower saving rates as well. In a developing economy that is starved for investable funds, this is very damaging.

7 Conclusion

The primary motivation for the paper was to highlight the effects of policy-induced frictions, particularly those that are likely to impact open emerging economies like India, in the transmission of monetary policy, with consequent implications for the efficacy of policy action. These include, inter alia, interest rate subventions/subsidies, slow adjusting administered floors on diverse savings instruments, intermittent loan waivers to specific sectors and allocative guidelines to banks (the distortions are multidimensional and affect both the assets and liabilities side of bank balance sheets). In the last category, the paper sought to formally explore, specifically, the implications of "regulatory" instruments that are designed to facilitate government borrowing. The statutory liquidity ratio (SLR) is particularly insidious given its size, viz., 21.5 % of an individual bank's net demand and time liabilities have to be earmarked for buying government securities. Back-of-the-envelope cost to banks of the SLR presented in the paper is not insignificant.

The theoretical model that has been sketched in the paper allows us to make several formal inferences

- The possibility of inverted monetary policy outcomes in the presence of a binding SLR. For example, a cut in the policy rate (government bond yield) reduces the demand for deposits (by the same token, the supply function of loans shifts to the left). A binding SLR implies that banks cannot reallocate the scarce deposits between higher return private loans and government bonds. The constraint implies that assets have to be held in fixed proportions (like a Leontief technology) which causes both components of bank assets to fall. The fall in loans implies output and aggregate demand gets depressed in response to the interest rate reduction. A lower interest rate on government bonds effectively acts like a higher tax on the banking sector in the presence of a binding SLR constraint. Consequently, their balance sheets contract.
- An exogenous fiscal constraint and a binding SLR may result, under some conditions, to inflation rising in response to an increase in the policy rate. However, the additional constraint of an exogenous fiscal spending also implies that interest rate changes have no real effects whatsoever as the both the deposit spread and the lending spread remain invariant. This is an even starker illustration of the scrambling effects of SLR requirements on monetary policy transmission.

- When the SLR is binding, a conventional outcome is more likely to emerge by changing the SLR rather than tweaking the policy rate.

The scrambled outcomes that are shown to be possible underscore the importance of formally modeling and understanding the succession choices made by various stakeholders, including banks optimizing in the midst of profound regulations.

Among other extensions that may be helpful in understanding the process better, introduction of policy driven interest caps/floors on financial intermediation, asymmetry between the objectives of public sector banks ("blunter" top-line driven orientation) and those of private sector banks ("sharper" bottom-line driven orientation), and the role of benchmarks formula that links the policy rate with lending rates. In exploring the chain that constitutes monetary policy transmission, it is not inconceivable that (a sort of) general equilibrium approach that is rich in regulatory details, in combination with distortions and skewed incentives may throw up more surprises. Further, against the background of large fiscal deficits the "optimum" choice between taxing banks versus recourse to the printing presses of the central bank is an interesting subject for closer scrutiny.

For the central bank, the tasks ahead are twofold. First, perhaps rebalance the reform agenda from high-profile subjects such as legislative amendments, like a monetary policy framework and associated institutional changes, to addressing policy-induced distortions that undermine monetary policy efficacy and transmission. Second, address the challenge of multiple roles/objectives and limited instruments.

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