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The Theoretical Superiority of the Compensation view in Explaining Monetary Policy Autonomy

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The Theoretical Superiority of the Compensation view in Explaining Monetary Policy Autonomy

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Abstract: This paper compares three theoretical frameworks that attempt to explain the phenomenon of weak relationship between foreign and domestic interest rate under fixed or manage-float exchange rate regimes - the Mundell-Fleming (MF) model without sterilization and the Mundell-Fleming model with sterilization (MFS) and the Compensation view. It argues for the theoretical superiority of the Compensation view as it can explain monetary policy autonomy under less restrictive assumptions. The paper outlines the underlying models of these frameworks and highlights the centrality of commercial bank loans in the Compensation view. I discuss the trend in India's interest rates which is consistent with the Compensation view.

Keywords: Monetary Policy, Endogenous money, Mundell-Fleming, Compensation view, Sterilization

JEL classification: E43, E51, E52, E58

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1. Introduction

The central banks of large number of countries have explicitly set the policy rates in the recent period to influence short term interest rates, while continuing with fixed or managed-float exchange rate regimes. Despite large cross-border financial flows, monetary policy in these countries registered considerable autonomy as reflected by a weak relationship between foreign and domestic interest rate and a strong relationship between policy rate and domestic interest rate.

Such phenomena of monetary policy autonomy under fixed and managed-float exchange rate regimes have been conventionally explained within two variants of the Mundell-Fleming framework. The first variant involves the standard Mundell-Fleming model (henceforth, MF), where the proposition of impossible trinity holds and the autonomy of monetary policy is explained by partial or complete capital controls (Obstfeld et.al, 2005). The second approach involves sterilization operation within an otherwise Mundell-Fleming model (henceforth, MFS), where impossible trinity ceases to hold and monetary policy attains autonomy due to interest rate targeting policies of central banks (Obstfeld and Rogoff,1995; McCallum,1996 and Obstfeld, 2015). There are two common features in these approaches. Both these approaches assume the flexible exchange rate regime as a sufficient condition for monetary policy autonomy. None of these approaches acknowledge the causal relationship from commercial bank loans to deposits and reserves.

The first feature of Mundell-Fleming framework has been contended in the recent period as the autonomy of monetary policy was shown to be constrained even under flexible exchange rate regime due to the presence of global financial cycles and its effect on policy rate (see Rey, 2015). The Mundell-Fleming framework was argued to be *insufficient* for addressing issues of monetary policy autonomy. The policy choice was argued to be characterized by an impossible dilemma where capital control acts as a necessary and sufficient condition for attaining monetary policy autonomy.

This paper provides a critique of the Mundell-Fleming framework based on its second feature and highlights the centrality of bank loans in money supply process. I argue that neither MF

nor the MFS approach are *necessary* to explain an observed phenomenon of monetary policy autonomy as the same can be explained under Compensation view as outlined in Lavoie (2001 and 2022). But as compared to the MF and MFS approaches, I argue for the superiority of the Compensation view as it can explain the trends in interest rates under less restrictive conditions. I draw the distinction among the three frameworks by outlining the underlying models that inform the Compensation view, the MF and the MFS framework under fixed exchange rate regimes and perfect capital mobility. While MF model requires capital control as a pre-condition, this paper argues that the MFS approach requires an additional condition of a negative relation between policy rate and foreign interest rate for explaining a weak relationship between foreign and domestic interest rate. The Compensation view can explain an observed phenomenon of monetary policy autonomy without these two conditions. This paper briefly discusses the trends in the short-term interest rates of India which lends support to the Compensation view.

The central argument of the paper is based on the nature of relationships among different short-term interest rates that emerge out of these alternative approaches. Due to different routes of money endogeneity, I argue that a key empirical distinction among the three approaches would turn out to be the way equilibrium domestic interest rate responds to the policy rate and the foreign interest rate. The domestic interest rate under MF model would be a positive function of foreign interest rate. Under MFS model, the domestic interest rate would turn out to be a positive function of both foreign interest rate and the policy rate. Under the Compensation view, domestic interest rate would be a positive function of the policy rate. The way monetary policy autonomy would be explained under alternative approaches would be based on these relationships. The rest of the paper is organized as follows.

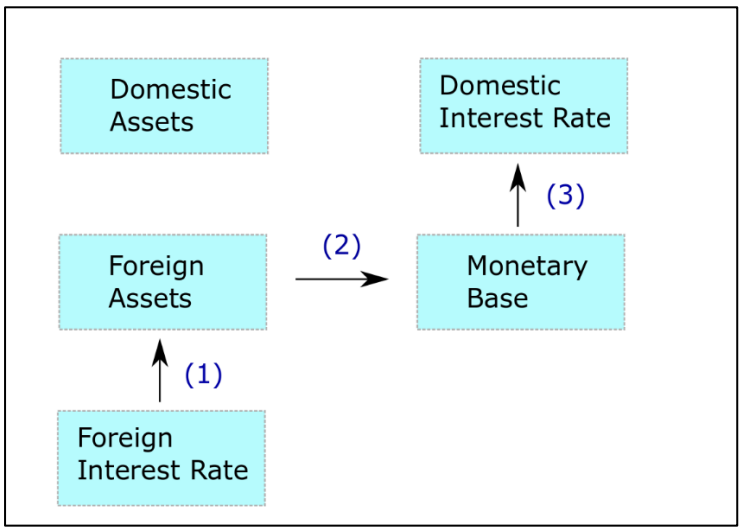
Section 2 outlines the alternative ways in which monetary base and money supply is endogenized under the three approaches. Section 3 describes the underlying models and highlights the empirical implications of alternative closures. Section 4 discusses the experience of monetary policy in India by outlining the broad trends of short-term interest rate, policy rate and their relationship with the US Fed rate. Section 5 provides some concluding remarks about the implication of this analysis.

2. Money Endogeneity in Fixed Exchange Rate Regimes

Depending on the role assigned to the commercial bank loans, money supply process has been explained broadly under two alternative approaches, what Palley (2013) termed as the Mainstream and the Post-Keynesian frameworks. Bank loans play no role in explaining the money supply process under the Mainstream approach, which includes both the Monetarist as well as the neo-Keynesian IS-LM theories. While money supply is exogenous under monetarism, it is endogenized under neo-Keynesian ISLM models due to endogeneity in money multiplier or central bank's interest targeting policies (ibid). In contrast to the Mainstream approach, bank loans play a key role under post-Keynesian framework in the endogenization of money supply and monetary base.

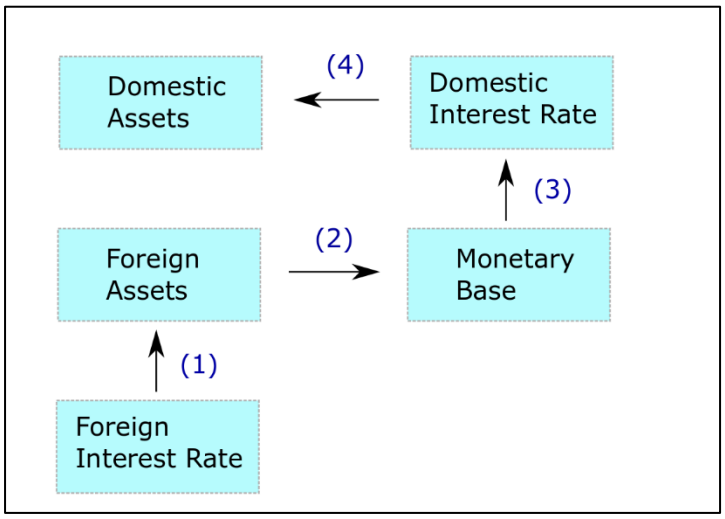
Both the MF and the MFS models can be located within the neo-Keynesian framework. While the closed economy IS-LM models treated the monetary base as exogenous, the MF and MFS approaches endogenize monetary base by extending the neo-Keynesian framework under open economy settings. The Compensation view extends the post-Keynesian endogenous money theory under open economy settings. This section outlines the distinguishing features of MF, MFS and Compensation view in fixed exchange rate regimes by highlighting the alternative routes by which they endogenize money.

Figure 1: Adjustment Mechanism in MF model under Fixed Exchange Rate



In the MF model following Mundell (1960 and 1963) and Fleming (1962), the possibility of endogenous money comes exclusively from endogenization of capital flow. Any deviation of domestic interest rate from foreign interest rate brings forth changes in capital flows and foreign assets, which in turn is argued to positively affect reserves, monetary base and money supply. The mechanism is analogous to Hume's price-specie-flow view where balance of payment surplus (deficit) brings about an inflow (outflow) of bullions and increase (decrease) in money supply (Ethier, 1988). The central assumption in this adjustment mechanism is that domestic assets are exogenous and remain unaffected by capital flows. By implication, any change in foreign interest rate under perfect capital mobility brings forth changes in domestic interest rate by affecting capital flow and monetary base. The adjustment mechanism triggered by a change in foreign interest rate and its relationship with domestic assets of central bank is described in figure 1, where the numbers in the parenthesis reflect the sequence of adjustment.

Figure 2: Adjustment Mechanism in MFS model under Fixed Exchange Rate



The monetary base in MFS framework gets endogenized due to endogenization of both foreign and domestic assets of central banks. Under interest rate-targeting policy, balance sheet operations of central banks is perceived to act as an additional policy instrument for making monetary policy effective. Central banks are perceived to adjust their domestic assets in response to the deviation of domestic interest rate from the targeted rate. By implication, while any change in foreign interest rate and capital flows can affect monetary base and domestic interest rate, the distinguishing feature of the MFS approach is that domestic assets respond to such

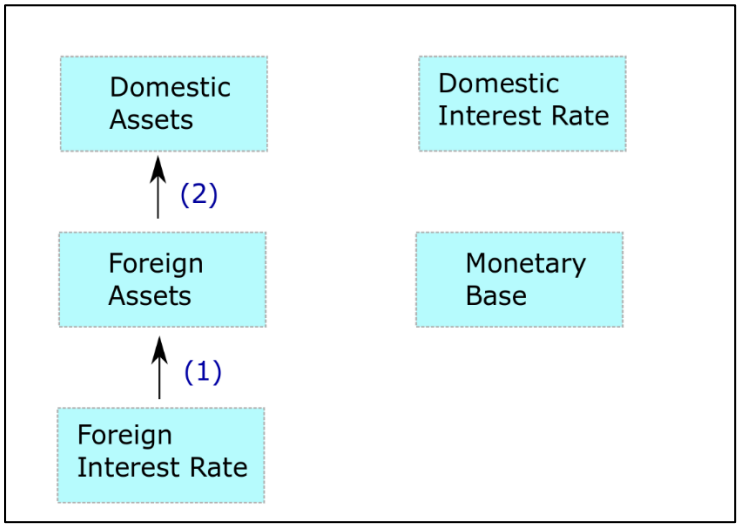
changes in domestic interest rate. The endogeneity in domestic assets in response to capital flows emerges exclusively on account of the central bank's interest rate targeting policy. The manner in which domestic assets respond to foreign interest rate under MFS model is described by figure 2.

An alternative approach of money endogeneity emerges from the post-Keynesian framework as in Kaldor (1970 and 1982), Moore (1988), Godley and Cripps (1983) and Lavoie (1984), where money endogeneity involves money supply and monetary base adjusting to the level of aggregate demand. The distinguishing feature of post-Keynesian monetary theory is the proposition of a causal relationship from loans to deposits at any *given* interest rate. The bank loans are determined by the level of aggregate demand and liquidity preferences. Since reserves of commercial banks are linked to its deposits, the former can be argued to be determined by the level of loans within this framework. The ability of central banks to influence short-term interest rate in this framework does not depend on their balance sheet operations *per se*; rather it emerges from their unique position in clearing and settlement system where all commercial banks are required by law to settle their clearing accounts with the central banks (Rochon and Rossi, 2011 and Fulwiler, 2017). The domestic assets of central banks adjust in response banks' excess demand or supply for reserves at any given interest rate. By implication, different levels of domestic assets and monetary base can be attained by the central bank at any given interest rate. This reflects what Borio and Disyatat (2009) described as the operational distinction between interest rate policy and balance sheet operations of central banks.

The Compensation view outlines the implication of post-Keynesian monetary theory under perfect capital mobility. Endogeneity in monetary base, money supply and domestic assets of central bank emerge from the endogeneity in commercial bank loans and the causal relationship from bank loans to deposits and reserves. The central proposition of the Compensation view is that any change in foreign assets of the central bank under fixed exchange rate regime brings forth automatic and compensating adjustment in its domestic assets such that the monetary base remains unchanged. Following Lavoie (2022), the adjustment mechanism following capital flows can be described as follows.

For any given level of loans, higher foreign assets acquired by the central bank would lead to an exante excess supply of reserves for commercial banks as the latter (primary dealers) sell foreign assets to the central bank in exchange of receiving higher reserves. Since excess reserves have zero or negligible return, commercial banks would attempt to get rid of it by buying more domestic securities or reducing their borrowings vis-à-vis the central bank at any given level of disbursed loans. Accommodating commercial banks' higher demand for securities or lower demand for central bank loans involves selling higher government securities or disbursing lower loans to the commercial bank by the central bank. The domestic assets of the central bank fall in these cases. Similarly, depletion of foreign assets by the central bank would lead to a rise in exante excess demand for reserves by the commercial banks as the latter buy foreign assets from the central bank. Financing additional reserves would involve commercial banks selling domestic securities or incurring additional loans vis-à-vis the central bank. For similar reasons, buying additional securities from the commercial bank or lending them more credit would lead to a rise in domestic assets of the central bank. Thus in contrast to the MFS approach, changes in foreign assets of the central bring about automatic and compensating changes in its domestic assets at any given interest rate. The manner in which domestic assets respond to foreign interest rate under Compensation view is described by figure 3. If foreign interest rate affects foreign assets, then domestic assets would respond to it at the given interest rate.

Figure 3: Adjustment Mechanism in Compensation view under Fixed Exchange Rate



Though all three approaches endogenize monetary base, the underlying mechanisms of endogenization are different. The MF model distinguishes itself from both the MFS approach and Compensation view by treating domestic assets of central bank as exogenous in relation to capital flow. The difference between Compensation view and the MFS approach is that the domestic assets in the former is endogenous on account of endogeneity commercial bank loans, while domestic asset is endogenous in the latter due to central bank's interest rate targeting policy. These differences have implications for the speed of adjustment in domestic assets in relation to changes in interest rate. While domestic assets under Compensation view would respond to changes in foreign assets *at a given domestic interest rate*, it would adjust under MFS approach *in response to changes in domestic interest rate*. The next section argues that this differential speed of adjustment in domestic assets across alternative closures has implications for the way equilibrium domestic interest rate responds to policy rate and foreign interest rate.

3. Reserves and Interest Rates under Fixed Exchange Rate Regimes: Alternative Closures

This section draws the distinction among the three alternative closures by outlining the underlying equations and highlighting their empirical implications. The models outlined in this section assume the exchange rate to be fixed and the currency risk premium to be zero. Perfect capital mobility is assumed throughout the analysis. The currency holding of central banks is assumed to be zero for the sake of simplicity, such that monetary base is equal to the reserves.

Though the essential arguments of each closure are kept intact, two modifications are included for the purpose of comparability across three models. First, since the adjustment mechanisms in MF model involves the IS equation, its implication is analysed also in the Compensation view[2]. The inclusion of IS equation is neither inconsistent nor essential for the compensation mechanism to work. Second, the MF model is a dynamic model, whereas the compensation mechanism is typically described in terms of levels. The dynamic implication of the Compensation view is used

[2] It can be noted, that inclusion of IS equation in the Compensation view is neither inconsistent nor essential for compensation mechanism to work.

in this analysis for the sake of comparability. Equations (1), (2a) and (2b) are general set of equations that are applied to all the three closures.

$$y = a - br \qquad (1)$$

$$H = N + F \qquad (2a)$$

$$\dot{H} = \dot{N} + \dot{F} \qquad (2b)$$

$$a > 0; b > 0$$

Equation (1) is the IS relationship and describes the negative relation between interest rate and output. Equation (2a) describes the balance sheet identity of the central bank by which monetary base is the sum of net domestic assets (N) and foreign assets (F). Equation (2b) is the dynamic variant of the balance sheet identity which states that the rate of change in monetary base ($\dot{H}$) is equal to the sum of rate of change in net domestic asset ($\dot{N}$) and foreign asset ($\dot{F}$) of the central bank. The model is closed in the three alternative frameworks by including additional equations. The medium run equilibrium condition in all closures would be given by a condition where monetary base is stable or the rate of change in monetary base is zero.

3.1 Mundell-Fleming Model without Sterilization (MF)

The specificity of the MF model can be described by equations (M.1)– (M.3). The net domestic assets (N) are assumed to be exogenously given as equation (M.1). The demand for money is positively affected by output and negatively affected by interest rate. Money supply is proportional to monetary base (H). Equation (M.2) shows the dynamics of nominal interest, which depends on the excess demand of money and the speed of adjustment θ_r. The MF model presumes perfect capital mobility to be same as perfect asset substitutability. By implication, any deviation of domestic interest rate from foreign interest rate (r_f) brings forth capital inflow or outflows. Equation (M.3) describes the dynamics of foreign assets (F) under fixed exchange rate regime.

$$N = \bar{N} \qquad (M.1)$$

$$\dot{r} = \theta_r(ky - lr - mH) \qquad (M.2)$$

$$\dot{F} = \theta_f(r - r_f) \qquad (M.3)$$

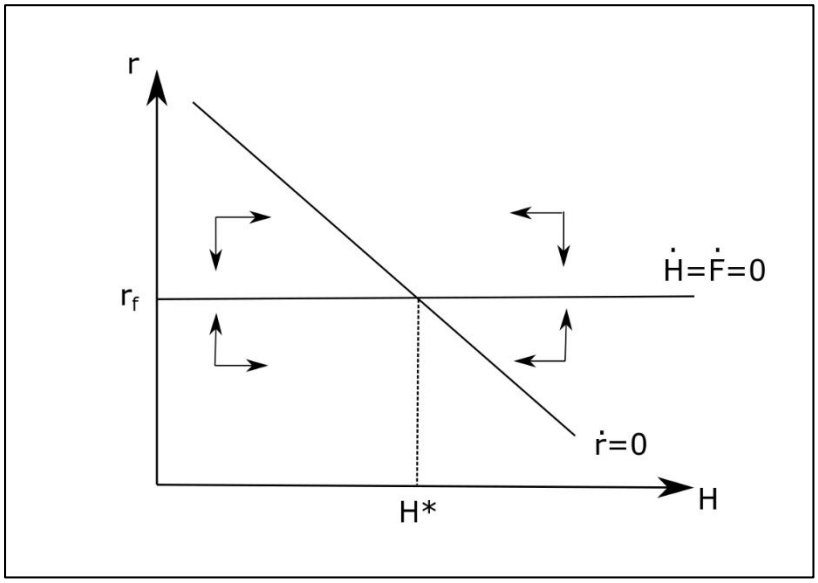
$$k > 0; l > 0; m > 0$$

Equations (1),(2a), (2b) and (M–1) - (M.3) define the MF model for the fixed exchange rate regime. Since domestic asset is exogenously given, i.e. $\dot{N} = 0$, the dynamics of monetary base can be derived from equations (2b) and (M.3) and described as equation (M.4). The dynamics of interest rate can be derived by plugging equation (1) in (M.2) and described as equation (M.5).

$$\dot{H} = \theta_f(r - r_f) \qquad (M.4)$$

$$\dot{r} = \theta_r[ka - (kb + l)r - mH] \qquad (M.5)$$

Figure 4: MF model under Fixed Exchange Rate



The two isoclines can be depicted in r-H space as figure (4), with H* and the r* denoting the steady state equilibrium. The Jacobian for the two dynamic equations is given by equation (M.6a). The trace and the determinant of the Jacobian are respectively given by equations (M.6b) and (M.6c). The equilibrium is stable as the trace and the determinant of the Jacobian are respectively negative and positive.

$$J = \begin{bmatrix} 0 & \theta_f \\ -m\theta_r & -(kb + l) \end{bmatrix} \qquad (M.6a)$$

$$Trace\, J = -(kb + l) < 0 \qquad (M.6b)$$

$$Det\, J = m\theta_r\theta_f > 0 \qquad (M.6b)$$

The steady state equilibrium values of domestic interest rate, monetary base and foreign assets are respectively given by equations (M.7), (M.8) and (M.9). The equilibrium domestic interest rate (r*) gets determined by the foreign interest rate. The equilibrium monetary base (H*) and foreign assets (F*) are endogenized as it responds positively to autonomous components of demand and negatively to the foreign interest rate. Any exogenous change in the level of domestic assets ($\overline{N}$) brings forth fully compensating change in foreign assets at the equilibrium as reflected in equations (M.9). Thus, the equilibrium level of monetary base in equation (M.8) remains unaffected by monetary policy or exogenous changes in domestic assets[3]. The monetary base settles to the equilibrium only if foreign assets settle to an equilibrium position, i.e. $\dot{H} = 0$ if $\dot{F} = 0$ and $\dot{H} \neq 0$ if $\dot{F} \neq 0$.

$$r^* = r_f \qquad (M.7)$$

$$H^* = \frac{ka}{m} - \frac{(kb+l)}{m} r_f \qquad (M.8)$$

$$F^* = \frac{ka}{m} - \frac{(kb+l)}{m} r_f - \bar{N} \qquad (M.9)$$

3.2. Mundell-Fleming Model with Sterilization (MFS)

In the MFS framework, central banks adjust their domestic assets to meet interest rate target. Any rise (fall) in short term interest rate with respect to the policy rate brings forth liquidity injection (absorption) through balance sheet expansion (contraction) of central bank. The dynamics of the net domestic assets can be described as equation (S.1).

$$\dot{N} = \theta_n (r - r_p) \qquad (S.1)$$

The key contrast with the MF model is the dynamics of the domestic assets which evolve as equation (S.1) instead of being exogenously given as equation (M.1). Equations (1), (2a), (2b), (M.2), (M.3) and (S.1) provide the model closure. The dynamics of monetary base can be derived

[3] In describing the effect of expansionary monetary policy under fixed exchange rate regime, Mundell (1963) argued that "*increase in the money supply arising from open market purchases is returned to the central bank through its exchange stabilization operations. What the central bank has in fact done is to purchase securities initially for money, and then buy money with foreign exchange, the monetary effects of the combined operations cancelling. The only final effect of the open market purchase is an equivalent fall in foreign exchange reserves: the central bank has simply traded domestic assets for foreign assets.*"

from equations (2b), (M.3) and (S.1) and described as equation (S.2). The dynamics of interest rate remain same as the MF model as described in equation (M.5).

$$\dot{H} = \theta_n(r - r_p) + \theta_f(r - r_f) \qquad (S.2)$$

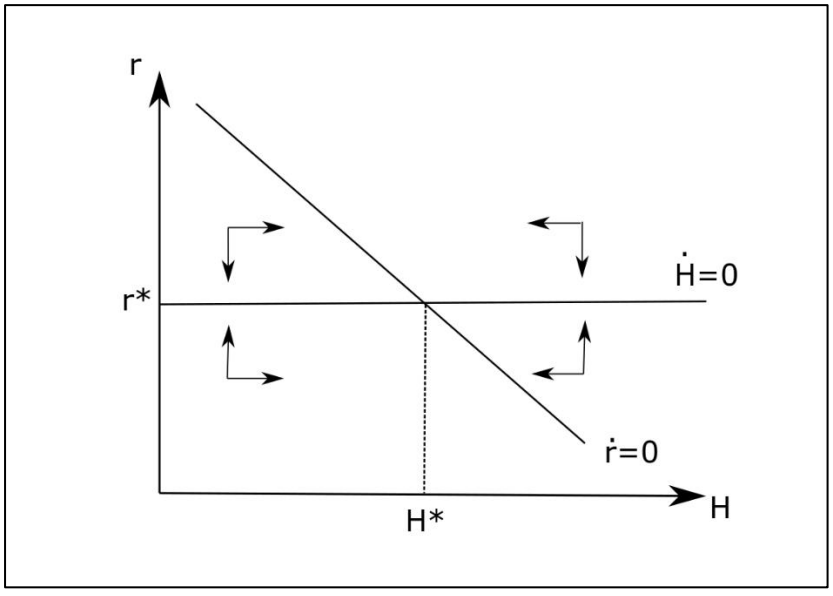
The two isoclines described by equations (S.2) and (M.5) are depicted in figure 5, with H* and the r* denoting the steady state equilibrium. The Jacobian for the two dynamic equations is given by equation (S.3a). The trace and the determinant of the Jacobian are respectively given by equations (S.3b) and (S.3c). The equilibrium is stable with negative trace and positive determinant of the Jacobian.

$$J = \begin{bmatrix} 0 & \theta_n + \theta_f \\ -m\theta_r & -(kb + l) \end{bmatrix} \qquad (S.3a)$$

$$trace\, J = -(kb + l) < 0 \qquad (S.3b)$$

$$det\, J = m\theta_r(\theta_n + \theta_f) > 0 \qquad (S.3c)$$

Figure 5: MFS model under Fixed Exchange Rate



The steady state equilibrium values of interest rate and monetary base are given by equations (S.4) and (S.5). Equilibrium domestic interest rate turns out to be the weighted average of domestic policy rate and foreign interest rate, with the weights being the relative speeds of

adjustment of foreign and domestic assets of central bank[4]. Due to sterilization, equilibrium domestic interest rate can be different from foreign interest rate even in the absence of currency risk premium. Monetary base (H*) is endogenized as it responds positively to autonomous components of demand and negatively to the foreign interest rate and domestic policy rate.

$$r^* = \frac{\theta_n r_p + \theta_f r_f}{\theta_n + \theta_f} \qquad (S.4)$$

$$H^* = \frac{ka}{m} - \left(\frac{kb + l}{m}\right)\left(\frac{\theta_n r_p + \theta_f r_f}{\theta_n + \theta_f}\right) \qquad (S.5)$$

The dynamics of foreign assets at the equilibrium interest rate is described by equations (S.6). Foreign assets do not stabilize even at steady state monetary base and interest rate if domestic and foreign interest are different. Higher equilibrium interest rate with respect to foreign interest rate, i.e. $r^* > r_f$, implies accumulation of foreign assets. The equilibrium interest rate would be higher as compared to foreign interest rate if the domestic policy rate is higher than the foreign interest rate, i.e. $r_p > r_f$. Similarly, a lower policy rate as compared to the foreign interest rate would lead to depletion of foreign assets, i.e. $\dot{F}\big|_{r=r*} < 0 \; if \; r_p < r_f$. The dynamics of domestic assets at equilibrium interest rate is given by equation (S.7). Due to sterilization policy, steady state monetary base at equilibrium interest rate involves domestic assets moving in opposite direction with respect to foreign assets.

$$\dot{F}\big|_{r=r*} = \theta_f(r^* - r_f)$$

$$= \frac{\theta_n \theta_f (r_p - r_f)}{\theta_n + \theta_f} \qquad (S.6)$$

$$\dot{N}\big|_{r=r*} = -\frac{\theta_n \theta_f (r_p - r_f)}{\theta_n + \theta_f} \qquad (S.7)$$

3.3. The Compensation View

The distinguishing features of Compensation view are the propositions of causal relation from loans to deposits and operational distinction between balance sheet operations and interest policy

[4] The influence of foreign interest rate on domestic interest rate remains when the central bank attains stable monetary base. Unless the policy rate happens to be equal to the foreign interest rate, setting the domestic interest rate equal to the policy rate would be inconsistent with attaining stable monetary base under this closure.

of central banks. Equations (1), (2), (3) and (C–1) -(C.7) outline the system described in the Compensation view.

$$D = \alpha_1 L \qquad (C.1)$$

$$L = l_0 + l_1 y \qquad (C.2)$$

$$H_b = \alpha_2 D \qquad (C.3)$$

$$\dot{N} = \theta_n [H_b - H] + \left[n_0 - \dot{F}\right] \qquad (C.4)$$

$$\dot{F} = f_0 + f_1 y + \theta_f (r - r_f) \qquad (C.5)$$

$$r_s = r_p \qquad (C.6)$$

$$r = r_s(1 + m) \qquad (C.7)$$

$$\alpha_1 > 0;\ l_0 > 0;\ l_1 > 0;\ 0 < \alpha_2 < 1\ ;\ \theta_n > 0;\ \theta_f > 0$$

Equation (C.1) shows deposits of commercial banks responding positively to their loans. The loans respond positively to output (y) and liquidity preferences (l_0) as equation (C.2). The required reserves of the commercial banks (H_b) is positively affected by deposits as equation (C.3). The required reserves include both reserve requirements set by central banks as well as commercial banks' requirement for reserves to carry out daily payment and settlement.

Equation (C.4) shows the dynamics of central bank's domestic assets. The first square bracketed term in the RHS of equation (C.4) reflects the adjustment of central bank's domestic assets in response to the gap between required reserve and available reserves, where the speed of adjustment θ_n is sensitive to the policy decision. The second square bracketed term reflects the adjustment in central bank's domestic asset in response to an autonomous component as well as *exante* excess reserves for commercial banks at given level of required reserve. Accumulation of foreign assets by the central bank ($\dot{F} > 0$) involves *exante* excess supply of reserves for commercial banks, which instantaneously leads to higher demand for domestic assets or lower credit demand by the commercial banks. This involves depletion of domestic assets by the central bank. Similarly, decumulation of foreign assets by the central bank ($\dot{F} < 0$) involves *exante* excess demand of reserves for commercial banks, which instantaneously leads to higher supply of

domestic assets and or greater credit demand by the commercial bank. This involves accumulation of domestic assets by the central bank.

The Compensation view makes a distinction between perfect capital mobility and perfectly asset substitutability. For the purpose of including realistic scenarios, Compensation view presumes perfect capital mobility but with imperfect asset substitutability[5]. Equation (C.5) shows the dynamics of capital flow under imperfect asset substitutability. Over and above interest rate differences, foreign assets respond both to the changes in current account as well as the capital account. Output negatively affects capital flows through the import channel, but positively affects it through the return on equity channel. The latter reflects the positive effect of output on firms' profit, which in turn is argued to have positive effect on the net inflow of foreign institutional investments[6]. The responsiveness of capital flow to changes in output is reflected by the parameter f_1, the sign of which remains ambiguous and depends on the relative strength of the two opposite effects of output on capital flow. Equation (M.3) in MF model can be perceived as a specific case of equation (C.5) in Compensation view with $f_1 = 0$ and $f_0 = 0$.

The short-term interest rate (r_s) is determined by the exogenously given policy rate (r_p) as described in equation (C.6). The lending rate of the commercial bank (r) that affects output is determined by a markup over short term interest rate as in equation (C.7). For the sake of simplicity, the mark up is assumed to be exogenously given and the lending rate is assumed to be the equal to the bond rate.

The dynamics of monetary base can be derived as the sum of change in domestic and foreign assets as described by equation (C.8a). The rate of change in monetary base remains unaffected by change in foreign assets due to compensating mechanism described in equation (C.4). Using equations (1), (C.1), (C.2) and (C.3), the rate of change in monetary base can expressed as equation (C.8b).

$$\dot{H} = \theta_n[H_b - H] + n_0 \qquad (C.8a)$$

[5] It can be noted, that this assumption has no implication for the relationship between equilibrium domestic interest rate, policy and the foreign interest rate. Nonetheless, it has implication for the direction of capital flow at any given domestic interest rate.

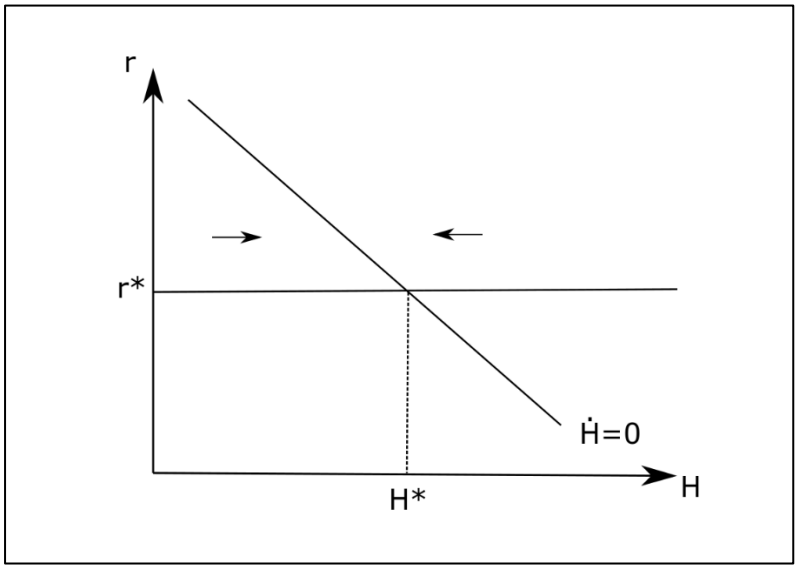
[6] See Lavoie(2022, Ch 7) for a detailed discussion.

$$= \theta_n[\alpha_1\alpha_2(l_0 + l_1 a - l_1 br) - H] + n_0 \qquad (C.8b)$$

The relation between monetary base and interest rate can described as figure 3, with H* and the r* denoting the steady state equilibrium. The isocline for monetary base can be derived from equation (C.8b) and is negatively sloped in H-r space[7]. The domestic interest rate as given by equation (C.7) is a horizontal line. The stability condition for equation (C.8b) is given by equation (C.9). The equilibrium is stable as the partial derivative in equation (C.9) is negative.

$$\frac{\partial \dot{H}}{\partial H} = -\theta_n < 0 \qquad (C.9)$$

Figure 3: Compensation model under Fixed Exchange Rate



Using equations (C.6) and (C.7), domestic interest rate is given by equation (C.10). The domestic interest rate is given by the policy rate and the mark up. Due to compensating adjustment of domestic assets, domestic interest rate remains unaffected by foreign interest rate and it is only by fluke that the two would be equal. Monetary base is endogenized and its steady state equilibrium value (H*) is given by equation (C.11).

[7] It can be noted, that Borio and Disyatat (2009) pointed towards a complete decoupling between interest rate and balance sheet operations where different levels of monetary base could be attained at the same levels of interest rate and different levels of interest rate could be attained at the same levels of monetary base. Their description was based on short run analysis where the IS relationship played no role in affecting monetary base. Our model is based on medium run analysis where the IS relationship affects monetary base through the loans channel. Thus, decoupling is only partial in this analysis. While different levels of monetary base can be attained at the same levels of interest rate, different levels of interest rate are associated with different levels of monetary base at the equilibrium.

$$r^* = r_p(1+m) \qquad (C.10)$$

$$H^* = \frac{n_0}{\theta_n} + \alpha_1\alpha_2\left[l_0 + l_1 a - l_1 b r_p(1+m)\right] \qquad (C.11)$$

The dynamics of foreign assets at the equilibrium interest rate is given by equation (C.12).

$$\dot{F}\big|_{r=r*} = f_0 + f_1 a - f_1 b r^* + \theta_f\left(r^* - r_f\right) \qquad (C.12)$$

Similar to the MFS model, there exists no guarantee that the foreign assets would stabilize at equilibrium interest rate and monetary base. But the distinguishing feature in this closure is that the direction of capital flow remains ambiguous at any given domestic and foreign interest rate. Higher (lower) domestic interest rate with respect to foreign interest rate does not necessarily lead to capital inflow (outflow). The direction of capital flow depends on the sign of autonomous capital flow (f_0) as well as the sign of responsiveness of capital flow with respect to changes in output (f_1). These parameter values depend on the structural specificity of a country. Due to the compensation mechanism described in equation (C.4), change in foreign assets and domestic assets move in opposite direction for any given set of interest rates.

3.4 Implications for Interest Rates

The three alternative theoretical closures under fixed exchange rate have different empirical implications for equilibrium domestic interest rates and the nature of relationship among the domestic interest rate, policy rate and foreign interest rate.

In MF model, domestic assets of central bank are exogenously given and equilibrium domestic interest rate is positively affected by foreign interest rate under perfect capital mobility. The strong positive relation between the two is described in equation (M.R1) by differentiating equation (M.7) with respect to foreign interest rate.

$$\frac{\partial r^*}{\partial r_f} = 1 \qquad \text{(M.R1a)}$$

The *necessary condition* for explaining a weak relationship between the domestic and foreign interest rate in this case would be the imposition of capital control. Its implication can be demonstrated by including imperfect capital mobility and substituting equation (M.3) with (M.10), where θ_f is negatively affected by the degree of capital control. Except for the sign of f_1

and the role of capital control in influencing θ_f, equation (M.10) closely resembles the equation for foreign assets described under Compensation view. The MF model in this case would be closed by equations (1), (2a), (2b) and (M.1), (M.2) and (M.10). The equilibrium domestic interest rate would be given by equation (M.11).

The effect of foreign interest rate on equilibrium domestic interest rate in the case of partial capital control can be derived as equation (M.R2) by differentiating equation (M.11) with respect to foreign interest rate. The effect of foreign interest rate is weaker in equation (M.R2) as compared to equation (M.R1). Higher the degree of capital control, lower would be the value of θ_f and lower would be the effect of foreign interest rate on domestic rate. Explaining a statistically insignificant relationship or near-zero correlation between domestic and foreign interest rate would require a very high degree of capital control and a very low level of θ_f. In the extreme case of complete capital control ($\theta_f = 0$), domestic rate can be argued to be unaffected by foreign interest rate, i.e. $\frac{\partial r^*}{\partial r_f}\Big|_{\theta_f=0} = 0$.

$$\dot{F} = f_0 + f_1 y + \theta_f(r - r_f) \qquad (M.10)$$

$$f_1 < 0$$

$$r^* = \frac{\theta_f r_f - f_0 - f_1 a}{\theta_f - f_1 b} \qquad (M.11)$$

$$\frac{\partial r^*}{\partial r_f} = \frac{\theta_f}{\theta_f - f_1 b} < 1 \qquad (M.R2)$$

The distinguishing feature of MFS model is that domestic assets of central bank respond to the deviation of interest rate from the policy rate. The foreign interest rate positively affects domestic interest rate at any given policy rate (S.R1). The policy rate positively affects domestic interest rate at any given foreign interest rate (S.R2). In the absence of capital control, a weak relationship between foreign and domestic interest rate cannot be explained at *unchanged* policy rate.

$$\frac{\partial r^*}{\partial r_f} = \frac{\theta_f}{\theta_n + \theta_f} \qquad (S.R1)$$

$$\frac{\partial r^*}{\partial r_p} = \frac{\theta_n}{\theta_n + \theta_f} \qquad (S.R2)$$

Considering the changes in both policy rate and foreign interest rate, the overall change in equilibrium domestic interest rate in response to foreign interest can be described by taking a total derivative of equation (S.4) and can be expressed as equation (S.R3). The *necessary* condition for explaining a weak response of domestic interest rate to changes in foreign interest rate under perfect capital mobility would be a *negative* response of policy rate to changes in foreign interest rate. Since $\theta_f > 0$ and $\theta_n > 0$, $\frac{dr^*}{dr_f} = 0 \; if \; \frac{dr_p}{dr_f} = -\frac{\theta_f}{\theta_n} < 0$.

$$\frac{dr^*}{dr_f} = \overbrace{\left(\frac{\theta_n}{\theta_n + \theta_f}\right)}^{+}\frac{dr_p}{dr_f} + \overbrace{\left(\frac{\theta_f}{\theta_n + \theta_f}\right)}^{+} \qquad (S.R3)$$

In the Compensation view, domestic assets of central bank respond to capital flows *at any given interest rate*. The policy rate positively affects domestic interest rate (C.R1). The foreign interest rate has no effect on domestic interest rate (C.R2). The equilibrium domestic interest rate does not depend on the value of θ_f and a weak relationship between foreign and domestic interest rate can be explained without imposing additional conditions on capital control. Since foreign interest rate does not affect domestic rate even at a given policy rate, a weak response of domestic rate to changes in foreign interest rate can be explained without imposing an additional condition of negative relationship between policy rate and foreign interest rate.

$$\frac{\partial r^*}{\partial r_p} = 1 \qquad (C.R1)$$

$$\frac{\partial r^*}{\partial r_f} = 0 \qquad (C.R2)$$

There are at least two common features among these closures. First, imposition of capital control can be argued to affect capital flows and foreign assets in all three closures as changes in foreign asset ($\dot{F}$) respond to θ_f in each of the equations (M.3), (S.6), (C.5) and (M.10). Second, a weak relationship or a near-zero correlation between foreign and domestic interest rate can be explained under all three closures. The key difference between Compensation view and the Mundell-Fleming framework lies in the fact that MF model requires an additional assumption of high degree of capital control, whereas the MFS model requires an additional assumption of negative relationship between foreign interest rate and policy rate.

The necessary condition for explaining a near-zero correlation between domestic and foreign interest rate under MF model is imposition of high degree of capital control. The precondition of a high degree of capital control may seem odd as compared to the real-world experience of many countries during the globalization period. The precondition of the central bank adjusting its policy rate in *opposite* direction with respect to changes in foreign interest rate would appear implausible for at least for *two* reasons. First, central bank's act of reducing policy rate in the midst of higher foreign interest rate can exacerbate capital outflow, whereas increasing policy rate in response to lower foreign interest rate implies undertaking contractionary policy despite lower global interest rates. Second, the short-term interest rates of domestic and foreign countries can be determined by the inflation-targeting policy of the central banks of respective countries. Unless the inflation rate of domestic and foreign countries happens to move in opposite directions, the precondition of a *negative* relationship between foreign interest rate and domestic policy rate would appear unrealistic.

In contrast to the MF and MFS models, the Compensation view can explain both a near-zero correlation between domestic and foreign interest rate as well as a strong positive relationship between policy rate and domestic interest rate without imposing the two restrictive preconditions. The next section describes the trend in the interest rates of India that lends support to the Compensation view.

4. Discussion on Interest Rates in India

The Indian economy has registered significant capital inflow particularly since the decade of 2000s involving a surge in foreign institutional investments (Srinivas and Dasgupta, 2023). Such capital flows have been associated with sharp rise in foreign exchange reserves as India in effect maintained a managed-float exchange rate regime (ibid).

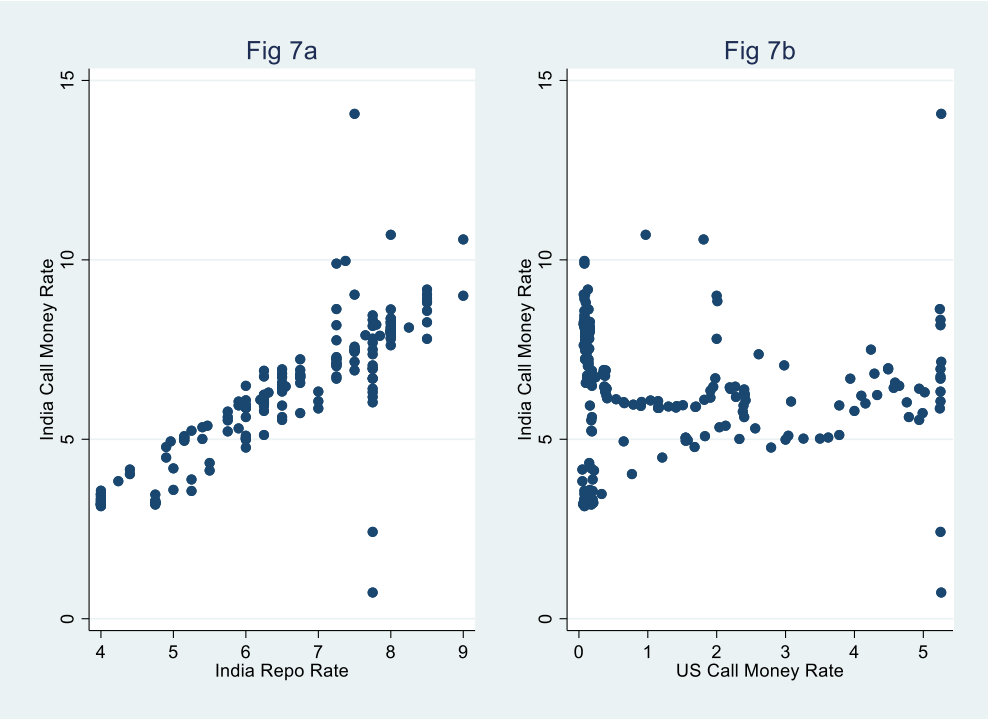
The Reserve Bank of India (RBI) explicitly set the short- term interest rate as the operational target of monetary policy since the adoption of Multiple Indicator Approach in 1998 and it continued to do so after the subsequent implementation of Inflation-Targeting framework in 2015 (RBI, 2014). The sterilization operations in response to capital flows are conducted within the policy frameworks outlined in RBI (2003a, 2003b and 2019). The interest rate targets are met

by adhering to a corridor system in the money market, where the repo rate acts as the key policy rate. The interest rate-targeting policy along with the surge in foreign exchange reserves makes the analysis of interest rate trends in India relevant for the discussion.

This section outlines the trend in India's monthly short term interest rate, its policy rate and the foreign interest rate between the period April 2005 to March 2023. The call money rate is considered as the indicator for the short-term interest rates. The US call money rate is considered as the indicator for the foreign interest rate.

Figure 7 shows the scatter plot for India's call money rate, its repo rate and the US call money rate. The scatter plot in figure 7a shows a strong positive relationship between India's call money rate and its policy rate. The scatter plot in figure 7b shows a weak relationship between India's call money rate and the US call money rate. Both these figures demonstrate the autonomy in monetary policy that RBI attained despite large capital inflows in the last two decades.

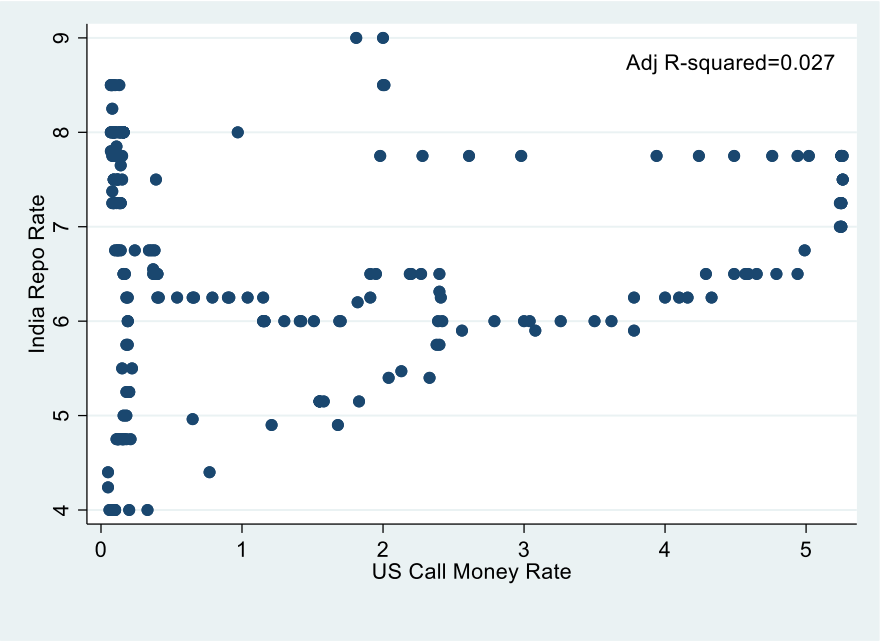
Figure 7: Scatter Plot for India's Call Money Rate, Repo Rate and US Call money rate



The weak relationship between the short-term interest rates of India and US was registered despite the absence of any negative relationship between India's policy rate and the US call

money rate. The scatter plot in Figure 8 demonstrates the weak relationship between the repo rate and the US call money rate. The correlation coefficient turns out to be 0.178, indicating absence of any negative relationship between the two variables.

Figure 8: Scatter Plot for India's Repo Rate and US Call money rate



The mutual relationship among the three interest rates as exhibited by the scatterplots are consistent with the Compensation view. The positive responsiveness of domestic interest rate to the policy rate as well as its weak relationship with the foreign interest rate follow from the automatic compensating adjustment of domestic assets in response to capital flows. Unlike the MFS model, the absence of a negative relationship between the policy rate and foreign interest rate (as exhibited in figure 8) does not pose any constraint for the explanation of monetary policy autonomy.

5. Concluding Remarks

This paper outlined the analytical distinction between MF, MFS and the Compensation models and argued for latter's theoretical superiority in terms of explaining monetary policy autonomy under less restrictive set of assumptions. The paper argued that a weak relationship between the domestic and the foreign interest rate, along with a strong relationship between the domestic rate and the policy rate, can be explained in the Compensation view even in the *absence* of high

degree of capital control, flexible exchange rate regime and the requirement of a negative relationship between policy rate and the foreign interest rate. The distinction among the three frameworks emerged on account of the differences in the way they endogenize money and the role they assign to commercial bank loans. The relationship observed among short-term interest rates in India was argued to be consistent with the Compensation view.

The theoretical analysis also has implication for the explanation of monetary policy constraints under fixed or managed-float exchange rate regimes. The source of monetary policy constraints in the Mundell-Fleming framework is any form of capital flow and the inability of the central bank to mitigate its effect. In the MF model, the constraint on monetary policy emerges due to automatic adjustment of the monetary base and the domestic interest rate in response to foreign interest rate. The constraint on monetary policy in the MFS model emerges because balance sheet operations of the central bank have to meet two distinct objectives in response to capital flows- stabilizing monetary base and keeping interest rate at the policy rate. Stabilizing monetary base through balance sheet operations implies dropping the other objective and the domestic interest rate deviating from the policy rate in response to foreign interest rate. None of these constraints appear under the Compensation model because of the automatic adjustment of the domestic assets in response to capital flows at any given interest rate. But monetary policy constraint can appear under Compensation view because of a balance of payment constraint. The latter emerge from currency hierarchy across countries and depletion of foreign exchange reserves. The foreign exchange reserves get adversely affected by rise in foreign interest rates and exogenous capital outflows. The policy rate may respond positively to foreign interest rate if the central bank happens to use its policy rate for restricting capital outflow. Thus, the implication of capital outflow on monetary policy autonomy would be different from that of capital inflow under the Compensation view.

In other words, the constraint on monetary policy under Compensation view can be perceived as an assignment problem under currency hierarchy and imperfect asset-substitutability. By the Tinbergen rule, policy constraints would necessarily emerge if the number of policy instruments is less than the number of policy targets. Due to the presence of currency hierarchy, most countries confront at least two policy targets- an internal target including output or inflation

targets and an external target of maintaining a minimum amount foreign exchange reserves. The domestic policy rate can be used to meet either the internal or the external target. The external target would be satisfied under episodes of capital inflow. But episodes of capital outflow can pose constraints on monetary policy if the policy rate is made to meet the external target. The direction of capital flow remains ambiguous at any given interest rate and depends on the structural specificity of an economy. Addressing the monetary policy constraint during capital outflow involves locating additional policy instruments that can meet the external target, while allowing the policy rate to meet the internal target.

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