

India's Trilemma: Financial Liberalisation, Exchange Rates and Monetary Policy¹

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1. INTRODUCTION

A key challenge for macroeconomic policy in open economies is how to simultaneously manage exchange rates, interest rates and capital account openness – the open economy trilemma. The basic premise of the international policy trilemma principle is that a trade-off exists between interest rate policy (monetary policy) independence, exchange rate stability (ES) and financial integration and that changing one component is necessarily associated with a corresponding change in a combination of the other two components.

The trilemma principle has come into greater focus in recent decades as emerging markets aim at exchange rate and macroeconomic stability while becoming increasingly integrated into world financial markets.² The trend towards greater financial globalisation in most emerging markets around the world is well documented and has imposed a new set of challenges for policy-makers (Lane and Milesi-Ferretti, 2005, 2007). Today, most emerging markets operate in the range of partial financial integration with regulations restricting the flow of funds and 'managed' floating regimes with central banks actively intervening in foreign currency markets (Aizenman, 2010).³

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² Aizenman (2010) provides a detailed description of the trade-offs faced by countries in making policy choices in context of the trilemma. Aizenman et al. (2010a, 2010b) have investigated the trilemma empirically in a cross-section of a large number of countries.

³ A few countries, notably China, have resisted this trend. China maintains strict controls on international capital flows, which, together with a massive build-up in international reserves, allow the maintenance of a rigid exchange rate and a large degree of monetary independence (MI) (Glick and Hutchison, 2010).

India also fits this general pattern, following a nuanced path of gradual capital account liberalisation. Since the early 1990s, the macroeconomic environment in India has changed substantially from being tightly controlled and regulated to one experiencing gradual deregulation and liberalisation (Shah, 2008; Mohan and Kapur, 2009). These developments and structural changes have impacted the financial environment and external constraints facing Indian policymakers and may have influenced operating procedures and effective policy trade-offs between the trilemma choices. In particular, the trilemma principle predicts that India's experience with increasing financial integration would likely have been accompanied, *ceteris paribus*, by a loss of MI and/or loss of ES. Evidence of increasing financial integration, for example, is closer linkage of short-term interest rates in India with those abroad (Hutchison et al., 2010, forthcoming).

To what extent has financial integration imposed greater constraints on exchange rate and interest rate policies in India? What has been the cost of international financial liberalisation in terms of macroeconomic policy? This study addresses these questions by measuring the trade-off between financial integration, ES and MI in India. We calculate a trilemma index for India and investigate its evolution over time using a methodology developed and employed for a cross-section of countries by Aizenman et al. (2009, 2010a, 2010b). A novel aspect of their work is measuring the trilemma over a large cross-section of countries while simultaneously taking into account the role of international reserves in macroeconomic management. We focus on India in our work, detail the evolution of the trilemma over time, associate changes in the macroeconomic policy trade-off with financial liberalisation and measure the extent to which international reserve management has played a role.

Previewing the results, our empirical measures confirm earlier research findings that financial integration has increased markedly after the mid-2000s. The rise in financial integration, in turn, has come with corresponding limitations on MI and ES. We find that this classic dilemma holds for India, in that greater MI is empirically and systematically associated with lower inflation. On the other hand, ES lowers inflation volatility, perhaps by stabilising import and commodity price volatility. Capital account openness is associated with higher inflation volatility, as India struggles to balance financial globalisation with domestic monetary stability. India has actively managed its exchange rate, building up a high level of international reserves by intervening heavily in the foreign exchange market (sterilised intervention), and has maintained some control over monetary policy. Active intervention in foreign exchange markets and maintaining a degree of control over international capital flows have proved a potent combination of policy instruments in India.

Section 2 provides a narrative account of the process of financial integration in India and describes how it was led both by explicit policy decisions and by

private market forces in India and abroad as part of a broader trend of financial globalisation. Measuring the evolution of the trilemma index in India is the subject of Section 3. The extent to which financial integration has impacted the trilemma facing India monetary authorities is evaluated empirically in Section 4. Section 5 discusses how changes in the external constraints, as represented by shifts in the trilemma indices, have influenced inflation and inflation volatility outcomes in India. Section 6 concludes the paper with a summary and discussion of future research directions.

2. THE TRILEMMA, FINANCIAL LIBERALISATION AND INTERNATIONAL RESERVES IN INDIA

Over the past 15 years or so, the Reserve Bank of India (RBI) has gradually eased capital controls, with implications for the functioning of domestic financial markets. Relaxations of capital controls included easing of requirements for and caps on foreign institutional investors (FIIs), streamlining of approval processes and allowing FIIs to hedge exchange rate risk in currency forward markets. However, with regard to capital account liberalisation, Indian policy-makers adopted a cautious stance from the very start (Hutchison et al., 2010a) as a result of which the process has been a continuous albeit a slow and gradual one. This perhaps was partly owing to possible linkages between capital account and current account transactions such as capital outflows and trade misinvoicing and partly owing to external events such as the Asian financial crisis, which reignited the debate on capital account openness for emerging markets.

Hence, although the Indian economy has witnessed gradual financial liberalisation over the past couple of decades, substantial controls on capital inflows continue to exist. These restrictions can be best described as ‘complex, discretionary and fragmented’ as in Hutchison et al. (forthcoming). Moreover, compared with other emerging market economies, India still has a relatively low degree of financial integration when measured as total external assets and liabilities as a per cent of GDP.

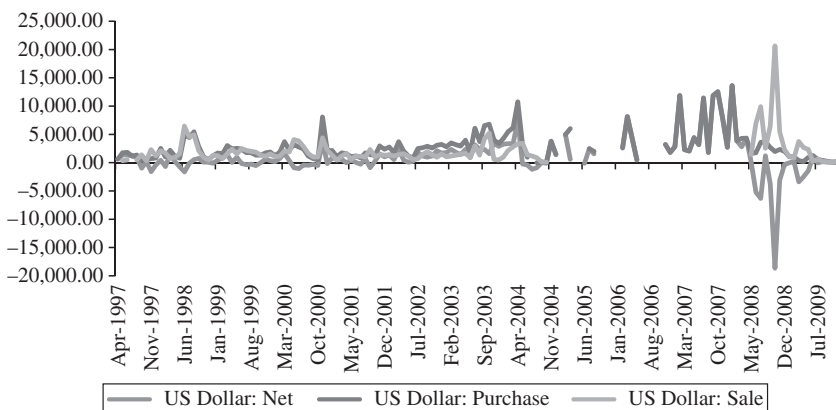
The economy also started witnessing sharp increases in capital inflows over the last decade, especially in the years prior to the recent global financial crisis that started in 2007. Unlike the fast-growing East Asian economies, India has mostly run current account deficits, albeit modest, so there have been net capital inflows over most of its history. Large capital inflows in some circumstances may increase the domestic money supply and put pressure on the exchange rate to appreciate. Moreover, given the relatively low exchange rate flexibility, the gradual process of capital account liberalisation has the potential to cause distortions in the monetary policy. Thus, during this period, the RBI

faced the traditional trilemma problem of maintaining an independent monetary policy in the face of international capital inflows and a desire to stabilise the exchange rate. The RBI also actively engaged in the sterilisation of inflows and began to accumulate foreign exchange reserves.

India has had an active foreign exchange management policy, with effective intervention in the foreign exchange market and very large growth in foreign exchange reserves. Foreign exchange reserves climbed from around US\$ 150 billion in mid-2005 to over US\$ 300 billion in mid-2010, a doubling in just five years and making India one of the largest reserve-holding countries in the world. The dramatic rise in reserves during this period indicates substantial and sustained US\$ purchases, and sales of the Indian currency, in the foreign exchange market by the authorities to limit rupee appreciation. This is shown in Figure 1. Since India had a current account deficit in the balance of payments during this period, so official purchases of foreign exchange were offsetting the substantial private capital inflows into India. These capital inflows are related in turn to partial relaxation of capital account restrictions, one part of the trilemma.

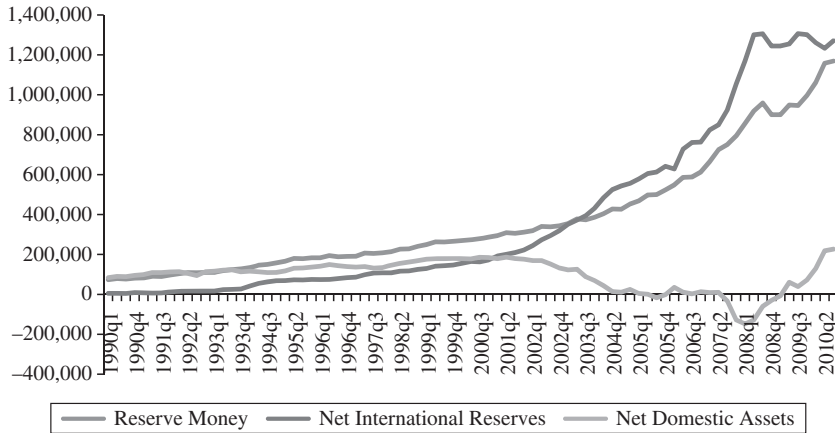
Another element of the trilemma trade-off is the extent to which the accumulation of foreign exchange reserves has had a substantial impact on monetary policy. Figure 2, showing the rise of the monetary base and its two main components (net domestic credit and international reserves), suggests that it has had a substantial impact. The major assets of the RBI supporting the growth of central bank money (reserve money) are international reserve assets. These have accumulated so rapidly in recent years that the central bank has been forced to sell off government securities (decline in net domestic assets) to

FIGURE 1
Foreign Exchange Market Intervention



Source: CEIC Asia Database.

FIGURE 2
Evolution of Monetary Base



Source: Reserve Bank of India.

maintain monetary control (*IMF Country Report 10/73, Table 4, March 2010*). The RBI attempted to limit the impact of international reserves on the money supply, but to what extent was it able to maintain monetary control in the light of financial liberalisation and large inflows of capital into India?

3. DATA AND METHODOLOGY

Our approach to analysing India's response to the trilemma follows Aizenman et al. (2010a, 2010b). We first construct indices for each of the three policy objectives of the trilemma: MI, ES and capital account openness (or financial integration). We then estimate a linear model for the trilemma configuration that is revealed by the data, by regressing a constant on the three indices. Next, we examine the impact of changes in international reserve accumulation on the outcomes of India's monetary policy in the context of the trilemma.

We depart from Aizenman et al. (2010a, 2010b) in several respects. While they use cross-country data and time-averages of annual data, so that their major source of variation is across countries, we use data for a single country. Furthermore, the data are higher frequency, being quarterly, and subject therefore to substantial time variation. Indeed, we find that there is variation in the results across three equal sub-periods into which we divide our sample. We also use a different measure of capital account openness than the preceding authors. Finally, our exploration of the impacts of reserve changes and sterilisation efforts also marks a departure from Aizenman et al. (2010a, 2010b).

a. Data

The data extend from 1996Q2 to 2009Q3, covering 54 quarters.⁴ For the trilemma indices, we have quarterly data on GDP, foreign investment inflows and foreign investment outflows, all from the RBI website (Database on the Indian Economy). The exchange rate is a weekly series obtained from the Global Financial Database (<http://www.globalfinancialdata.com>). We use the nominal Rupee-to-US dollar exchange rate. We use the weekly series to construct a quarterly index of ES, as described in the next subsection. From the same source, we use weekly 90-day rates on government securities for the United States and India. The correlations between these are used to create a quarterly index of MI, again as described in the next subsection.

To examine the impact of international reserves, we again use data from the RBI. In our analysis, we use changes in reserves, taken directly from a quarterly series in the RBI database.

The policy outcomes we examine are inflation and inflation volatility. For both measures, we begin with the weekly Wholesale Price Index, from the RBI database. We then calculate weekly annual inflation figures. Averaging these for each quarter produces a quarterly inflation series. The standard deviation for each quarter yields our inflation volatility series.

b. Methodology and Estimation

The key constructs for examining the policy configuration with respect to the trilemma are indices of MI, ES and capital account openness (KO). These indices are constructed as follows.

(i) MI Index

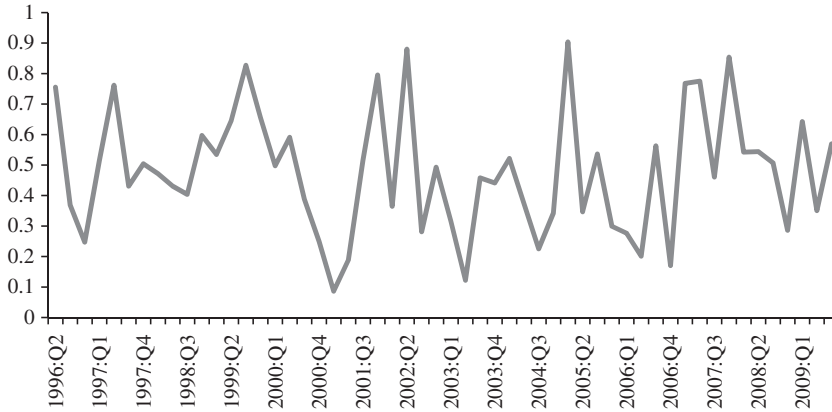
We follow Aizenman et al. (2010a, 2010b) in measuring MI as the reciprocal of the correlation between interest rates in the home country (here India) and the base country (here the United States). Quarterly correlations are calculated using weekly interest rate data. The interest rates are on 90-day government securities. The precise formula is:

$$MI = 1 - \frac{\text{corr}(i_i, i_j) - (-1)}{1 - (-1)}.$$

The scaling ensures that the index lies between zero and one, with the highest value indicating the greatest degree of MI. The plot of the MI index is shown in Figure 3.

⁴ These periods correspond to 1996–97: Q1 to 2009–10: Q2 according to the Indian fiscal year accounting.

FIGURE 3
Monetary Independence Index



Source: Reserve Bank of India Database and authors' calculations.

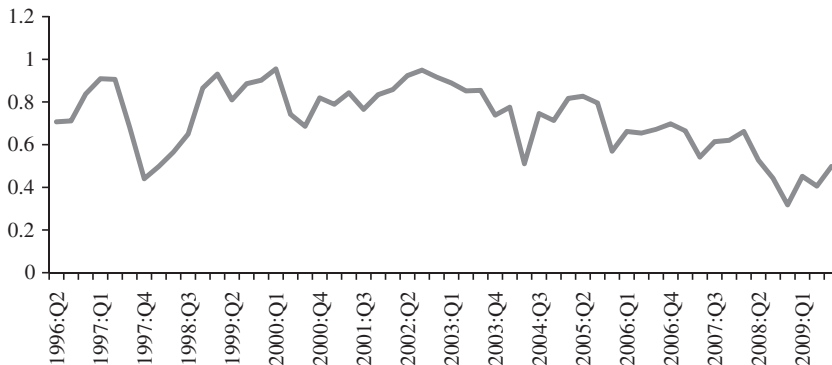
(ii) *ES Index*

The ES index is calculated using quarterly standard deviations of the change in the log of the Rupee-to-US dollar exchange rate, and the index is then constructed according to the formula:

$$ERS = \frac{0.01}{0.01 + SD(\Delta(\log(exch_rate)))}$$

Again, the scaling ensures that the index lies between zero and one, with the highest value indicating the greatest degree of ES. The evolution of this index for the sample period is shown in Figure 4.

FIGURE 4
Exchange Rate Stability Index



Source: Reserve Bank of India Database and authors' calculations.

(iii) KO Index

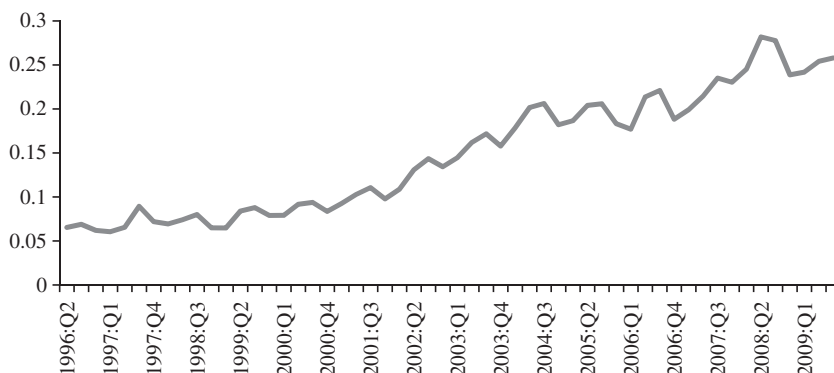
For the construction of the KO index, we depart from Aizenman et al. (2010a, 2010b), who use the Chinn-Ito index. For India, this index is essentially constant over the entire period and may not capture well the changes that have been occurring in India's management of the capital account. Even other *de jure* measures such as that of Nayar (2006) are not suitable, since they are only annual, and are not available for the latest part of our sample period. Therefore, we chose to go with a simple *de facto* measure of capital account openness, using the ratio of the sum of inward and outward foreign investment flows to GDP.

This measure also has drawbacks, since it is a function not only of the policy stance, but also of market sentiment. However, we believe it is a reasonable way of capturing changes in India's effective openness to international capital flows and how those have changed over time. This index is easy to construct as a quarterly series. One other point should be noted: the KO index is not theoretically constrained to lie between zero and one – the upper bound cannot be imposed. However, for the sample period, it is easily met. As we shall see in the next section, scaling issues are partly dealt with in the regression analysis for the trilemma policy configuration. The KO index for the sample period is shown in Figure 5.

4. EMPIRICAL RESULTS: POLICY STANCE

In this section, we first examine the policy stance with respect to the trilemma, using the indices constructed in the previous section, and then relate the

FIGURE 5
Capital Account Openness Index



Source: Reserve Bank of India Database and authors' calculations.

trilemma stance to the accumulation of foreign reserves, using the techniques introduced by Aizenman et al. (2010a, 2010b).

a. Measuring the Trilemma Policy Configuration

The central idea for measuring the trilemma policy configuration is that an increase in one of the indices must be balanced by a decrease in another, since there is an overall constraint on the three indices – all three cannot reach their maximum values simultaneously. At the same time, there is no reason for policy-makers to not try for a combination of the three indices that is as high as possible, if all three objectives of MI, ES and capital openness (or financial integration) are desirable for some reason. However, the latter is an empirical question and can be examined using the method of Aizenman et al. (2010a, 2010b).

The approach used is to regress a constant (we use the value two) on the three indices. Of course, the constant term is omitted on the right-hand side of the estimation equation. Since, unlike ACI, we are using a time series for a single country to estimate the trilemma configuration, and the period under consideration was one of dramatic changes in external conditions as well as shifts in policy stances, we divide the entire sample period into three equal sub-periods of 18 quarters each. This allows one to see how differences in policy across different segments of this 13.5-year span have played out. The results are reported in Table 1a.⁵ The coefficients are not always estimated with great precision (particularly those for MI), but the overall fit is extremely good, reflected in the very high *R*-squared numbers.⁶ This is consistent with the kind of results obtained by ACI, but it should be noted again that these results are obtained for a single country and a sample that incorporates short-run variability associated with quarterly data.

Table 1a also reports the means of the three indices for each of the three subperiods. According to these measures, MI is in an intermediate range in all three sub-periods. It falls in the second period and then partially recovers. ES is quite high in the first two periods and then falls somewhat. Capital account openness increases a little from the first to the second period and then dramatically in the third period.

Following ACI, the key measure of the trilemma policy configuration is obtained by examining the contribution of each policy dimension to the total –

⁵ In addition to dividing the entire sample period into three equal sub-periods, we also used an alternative truncation scheme based on the different exchange rate regimes characterising the Indian economy over the sample period from 1996 to 2009. We based our sub-periods on the regime classifications in Patnaik et al. (2011), and our results were very similar to those reported in Table 1a, thus attesting to the robustness of our findings.

⁶ Since there is no constant term on the right-hand side, the *R*-squared is non-centred. The goodness of fit is to be interpreted just as that and does not imply any desirable statistical properties.

TABLE 1
 (a) Trilemma Indices for India, 1996–2009. (b) Trilemma Contributions

	<i>1996:Q2 to 2000:Q3</i>	<i>2000:Q4 to 2005:Q1</i>	<i>2005:Q2 to 2009:Q3</i>
(a)			
Means			
MI	0.5348	0.4197	0.4828
ES	0.7601	0.8107	0.5901
KO	0.0385	0.0788	0.3140
Coefficients			
MI	0.640 (0.442)	-0.063 (0.130)	0.515** (0.229)
ES	1.798** (0.314)	2.041*** (0.100)	2.294*** (0.525)
KO	6.169* (3.104)	4.021*** (1.042)	1.148 (1.131)
Observations	21	18	15
R^2	0.9738	0.9921	0.9710
(b)			
Contributions			
MI	0.342	-0.026	0.249
ES	1.367	1.654	1.354
KO	0.238	0.317	0.361
Sum of contributions	1.947	1.945	1.963

Notes:

(i) MI, monetary independence; ES, exchange rate stability, KO, capital account openness.

(ii) Newey – West standard errors in parentheses.

(iii) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

here set to be two. This can be calculated quarter by quarter, but we calculate and report the average contributions, by multiplying the coefficients by the means for each sub-period. The results are quite striking. Given the high goodness of fit, it is unsurprising that the contributions sum up to close to two in each sub-period. The contributions themselves are of great interest in terms of the trilemma policy configuration and how it changes over time.⁷ The story they tell is as follows:

- 1 ES receives high policy weight throughout the entire 13.5-year period.
- 2 In the second sub-period, as capital openness or financial integration increases, MI is completely lost, whereas there is an attempt to retain, or even strengthen, ES.

⁷ Here, we can explain why there is some freedom from scaling issues with respect to the capital openness index not being constrained to a maximum of one, in the final analysis. Suppose that, for example, the KO index were multiplied by two, so that average capital openness was doubled in the new measure. First, relative values over time would still have the same proportions. Second, the regression coefficient would be halved, so that the contribution would be unaffected by the rescaling.

- 3 In the third sub-period, as capital openness continues to increase, some ES is sacrificed to recover some MI; however, the final configuration involves less MI and greater financial integration, as compared to the first sub-period.⁸

The story that emerges from Table 1 is consistent with the broad outlines of what happened in India over this period. The variation in policy stances with respect to the trilemma may have not corresponded exactly to the three sub-periods we have chosen – but the policy stances themselves were not sharply discrete events. However, that makes the results even more striking, in our view. Our results suggest that the ACI approach can be used effectively for single country time series and not just for panels or cross-sections with time variation smoothed out.

b. Trilemma Policy Stance and Reserve Accumulation

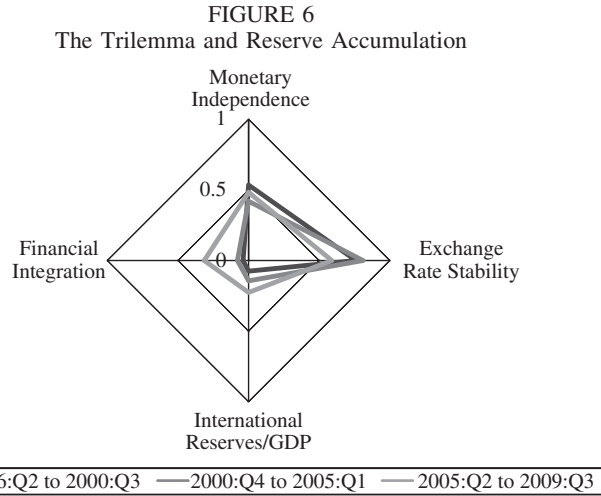
An important part of the ACI analysis is their connection of reserve accumulation to the trilemma policy configuration. The broad idea is that reserve accumulation gives policymakers more flexibility in dealing with the short-run trade-offs between MI and ES, where financial integration is a given. This is examined in the context of regressions that examine the role of reserves in achieving certain policy goals, and we present such results shortly. However, we first illustrate this fourth policy dimension with the diamond graph developed by ACI. Again, the difference here is that the graph represents a single country's experience, rather than any kind of average over a group of countries. The diamond graph, Figure 6, shows that India has increased its ratio of reserves to GDP along with its increased financial integration, as it has tried to balance MI and ES. The story in Figure 6 is that of Table 1, with the addition of the changing role of foreign reserves. Finally, Figure 7 shows the increase in international reserves over the time period under consideration.

5. TRILEMMA AND INFLATION: IMPACTS ON MACROECONOMIC OUTCOMES

We have measured the policy trilemma in India over time and find that rising financial integration has come at the cost of MI and ES. The overriding macroeconomic question, of course, is how the change in the trilemma configuration has influenced inflation and inflation volatility in India.⁹ Has the

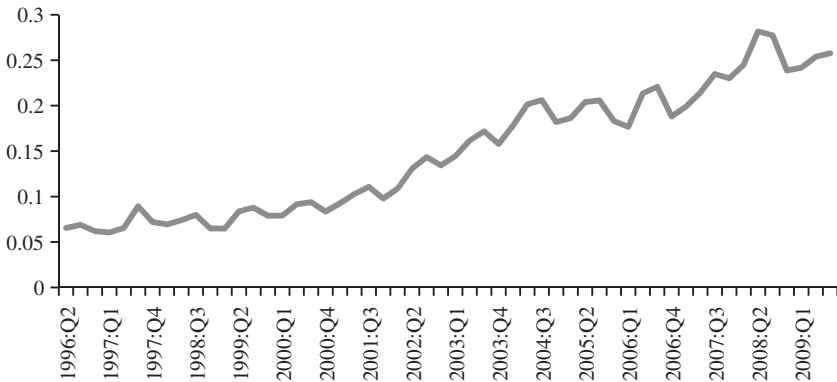
⁸ It is worth noting here that these results are at best indicative and the econometric properties of the same need further investigation, which is left as a future task.

⁹ In a cross-section of countries, ACI consider the relationship between the trilemma configuration (assumed constant over time) and output volatility, inflation and inflation volatility. Since output data are not available for sufficiently high frequencies to allow the construction of a quarterly output volatility series, we focus on inflation and inflation volatility.



Source: Authors' calculations (see Section 4 in text for further details).

FIGURE 7
Reserves/GDP Ratio



Source: Reserve Bank of India Database and authors' calculations.

trilemma been binding, in terms of a clear trade-off between internal and external policy objectives, in the Indian context? Has the loss of MI associated with greater capital market liberalisation or an ES objective been associated with deterioration in inflation performance? Has the heavy intervention in foreign exchange markets, and the associated rise in international reserve holdings, given the RBI more leverage and thereby mitigated the effects of the loss of MI on inflation?

To address this issue empirically, we explore the linkages between inflation (and inflation volatility) and our time-varying measures of the policy goals

associated with the trilemma configuration. Specifically, we regress inflation (inflation volatility) against a constant, the lagged dependent variable and two of three indices of the trilemma configuration – MI index and the ES. The third index, capital account openness – KO – is a linear combination of MI and ES since the three indices together sum to two effective instruments, so we also report regressions where the set of explanatory variables is MI and KO (leaving out ES).¹⁰ Finally, we also consider the role of increasing international foreign exchange reserves as a percentage of GDP (Res/GDP).¹¹

The expectation (maintained hypothesis) is that greater MI is likely to lower inflation and inflation volatility. Greater ES and capital market openness, in tandem with the loss of MI, may come at the cost of higher inflation and greater inflation volatility. Intervention in the foreign exchange market, measured by changes in international reserves, may soften the trilemma trade-off, particularly between ES and monetary policy independence, and thereby contribute to lower inflation and less inflation volatility.

The results are shown in Table 2. Columns (1)–(3) present the results where the dependent variable is the level of inflation. (Newey-West standard errors are shown in parentheses below the individual coefficient estimates). The key empirical result in columns (1)–(3) is the greater MI that leads to lower inflation. This result is robust and highly statistically significant. Once controlling for MI, the international variables (capital market liberalisation, ES and change in international reserves) have the expected signs (positive) but are not statistically significant. About 50 per cent of inflation variation is accounted for by the trilemma policy configuration and, in addition to MI (and the constant term), lagged inflation is highly significant. The change in international reserves is not statistically significant, suggesting that foreign exchange market intervention has not mitigated the trilemma trade-off nor reduced inflation once controlling for the other policy constraints.¹²

Columns (4)–(6) present the results where the dependent variable is inflation volatility. Interestingly, the key determinants of inflation volatility contrast sharply with the determinants of the level of inflation. In particular, the international policy indices are statistically significant in these regressions while the

¹⁰ We also consider the set of explanatory variables as ES and KO (dropping MI), but the results were not significant owing to high multicollinearity between ES and KO (the correlation is -0.6) – ES comes at the cost of capital account liberalisation. These results are not reported for brevity but are available from the authors upon request.

¹¹ We also considered the level of international reserves as a percentage of GDP as an explanatory variable. The results were qualitatively very similar and are not reported for brevity but are available from the authors upon request.

¹² We also considered interaction terms of the changes in reserves (and reserve levels) with MI, to measure nuances in how the trilemma constraints may have changed over time with an active intervention policy. None of these results were statistically significant, however, and are omitted for brevity.

TABLE 2
Inflation, Trilemma Contributions and Change in Reserves

Variables	Inflation			Inflation Volatility		
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged dependent variable						
MI	0.712*** (0.104)	0.694*** (0.113)	0.706*** (0.104)	0.146 (0.140)	0.211 (0.154)	0.131 (0.144)
ES	-0.017*** (0.007)	-0.018*** (0.007)	-0.017*** (0.008)	-0.001 (0.002)	-0.002 (0.002)	-0.001 (0.002)
KO	0.005 (0.022)		0.006 (0.022)	-0.009* (0.005)		-0.008* (0.005)
Δ Res/GDP		0.011 (0.023)			0.007* (0.004)	
Constant	0.018 (0.018)	0.022*** (0.008)	0.024 (0.046)		0.005*** (0.001)	0.014 (0.019)
Observations	53	53	53	0.012*** (0.005)	53	0.012*** (0.004)
R^2	0.4984	0.5019	0.4996	0.1792	0.1349	0.1897

Notes:

(i) MI, monetary independence; ES, exchange rate stability; KO, capital account openness.

(ii) Newey – West standard errors in parentheses.

(iii) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

(iv) Mean of inflation is 0.050, and the mean of inflation volatility is 0.006.

MI index is not. Greater ES is associated with lower inflation volatility, and greater capital account openness is associated with higher inflation volatility. (Changes in international reserves are again not statistically significant). The latter result is predicted by theory – greater capital account openness may lead to a loss of monetary control and hence greater inflation variability. However, the simple Mundell–Flemming framework would also suggest a positive correlation between greater ES and inflation volatility since the implication is that MI is reduced. In our regressions, however, we are holding constant MI. The result that ES leads to greater inflation stability may therefore be working through a secondary channel – more stable import and commodity prices.

Overall, it is striking that the results distinguish so sharply between the dominant policy determinant of the level of inflation (MI) and the dominant policy determinants of the volatility of inflation (ES and KO).

6. CONCLUSION

In this study, we empirically explore this question and associated issues, such as accumulation of international reserves and sterilisation by the RBI. Specifically, using quarterly data from 1996 to 2009, we construct trilemma indices for each of the three policy objectives: MI, ES and capital account openness, for India following the methodology developed for a cross-section of economies by Aizenman et al. (2010a, 2010b). Our empirical analysis confirms that an increase in financial integration, especially after the mid-2000s, has changed the policy trade-offs facing emerging market economies like India. The increase in capital account openness has come at the cost of reduction in monetary policy independence or of limitations on ES. We also find that the loss of MI associated with both greater ES and more financial openness poses a challenge to policymakers – the loss of monetary autonomy is correlated with higher inflation in India. Greater financial integration, once controlling for MI and ES, is associated with greater inflation volatility in India. On the other hand, we find that a secondary benefit of greater ES is lower inflation volatility.

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