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Cost of Holding Excess Reserves: The Indian Experience

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Over the last year, India witnessed reserve accumulation in excess of $100 billion on the back of strong capital flows looking to take advantage of the interest rate differential and a strong rupee. Given the central bank's preference for safety and liquidity, at the expense of return, while investing these reserves, the profitability of holding such large volume of reserves is being increasingly questioned. This paper estimates the volume of excess reserves held in India and evaluates the cost of holding these reserves by considering various alternative use of the resources employed in building up reserves.

It is hoped that this study will contribute to an informed discussion on this important issue, and help arrive at a decision for a more efficient utilization of these reserves.

(Rajiv Kumar)
Director & Chief Executive

March 1, 2008

Abstract

Most of the existing literature has used single reserve adequacy measures to evaluate the volume of excess reserves. In this paper, we employ empirical methods to generate a comprehensive reserve adequacy measure, incorporating the various objectives of holding reserves, and compare the actual reserve accumulation experience of various emerging markets with the prediction of our empirical model. Using this comprehensive reserve adequacy measure, we calculate the cost of holding excess reserves for India by looking at three different alternative uses of resources. We find that India is foregoing as much as 2% of its GDP by accumulating reserves instead of employing resources in alternative uses.

***JEL Classification**:* F37, F47, C33
Keywords: Reserve Holdings, Reserve Management

1. Introduction*

With the collapse of the Bretton Woods, the pressure on industrial countries to accumulate reserves eased as they moved to flexible exchange rate regimes and overcame the problem of "original sin" i.e., the inability to borrow from abroad in domestic currencies. On the other hand, emerging market policymakers have been struggling to define adequate reserve levels, and have been typically motivated by the principle of "non-satiability" or "more-is-better" while dealing with international reserves. In the last decade and a half, developing countries, particularly of East and South Asia, have built massive stockpile of international reserves. Emerging economies like China, South Korea, Russia, and India have accumulated reserves in excess of $2.5 trillion.[1] Such massive scale of reserve accumulation has raised several questions about the cost of holding high volume of reserves as most of it is held in the form of low-yield government bonds.

Prior to investigating the cost of holding reserves, it is important to understand the factors influencing the demand for international reserves. In most countries, the central bank maintains a stockpile of international reserves to meet imbalances in current account financing, cover short-term debt obligations, prevent excessive volatility in the exchange rate etc. In line with these objectives, the empirical literature points out that the demand for international reserves is based on a number of structural variables like economic size, current account openness, capital account openness, exchange rate regime, financial depth, etc.

Given the above objectives of reserve holding, every country would like to hold an adequate amount of international reserves to meet the needs mentioned above, and any holding in excess of that can only be deemed as "excess reserves". However most of the literature evaluating the cost of holding reserves has focused either on entire reserve holding or reserves holdings in excess of a single adequacy measure like three to four months of import cover. The implicit assumptions behind such computations are that holding international reserves do not generate any benefits or that they are held only to meet a single objective like current account financing. Such a perspective fitted well a world where financial markets were not integrated and trade openness reflected countries' vulnerability to external shocks i.e., the Bretton Woods period. However, with increased financial integration in recent years, the emerging markets have increased their exposure to volatile short-term inflows of capital that are subject to frequent sudden stops and reversals.[2] Consequently, emerging markets have increased their demand for

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[1] These reserves do not include gold.

[2] Sudden Stop refers to sudden unwillingness by international lenders to renew their credit lines at times of market uncertainty. The term came into vogue during the Tequila crisis in Mexico in 1994-95 and subsequently during the Asian crisis in 1997.

international reserves due to a desire for self-insurance against exposure to future sudden stops.

Greater financial integration is also associated with an increase in exchange rate volatility. Active international reserve management lowers the real exchange rate volatility, which in turn results in a smoother output and potentially higher growth rate. In a number of emerging markets, reserve accumulation is a by-product of the desire of the policymakers to keep the exchange rate undervalued and promote export-led growth.

Based on the above precautionary motives of holding international reserves, it would be more appropriate to consider reserves, held over and above what is required to meet the precautionary demands, as excess reserves. In this paper we use empirical methods to analyze the potential factors influencing the demand for international reserves in emerging markets. Using the results of our empirical analysis, we calculate the predicted volume of reserves and call the difference between actual and predicted volume of reserves as excess reserves. Thereafter, we focus on India and calculate the cost of holding these excess reserves. We consider three alternate uses of the resources used in building up the stockpile of reserves i.e., financing physical investment, reducing private sector's short-term external commercial borrowing and lowering public sector debt.

The rest of the paper is structured as follows. Section 2 undertakes a brief review of the existing literature. Section 3 highlights the pattern of reserve accumulation since the 1950s and makes cross country comparison of major reserve adequacy indicators. Section 4 enumerates the main benefits of reserve accumulation in various emerging markets. In Section 5, we analyze the main determinants of reserve holding using empirical methods and compare the reserve accumulation experience of major emerging markets vis-à-vis the predictions of our model. Section 6 focuses on India and highlights the cost of holding excess reserves using various alternative uses of resources. Finally, Section 7 lists out the main conclusions of the study.

2. Brief Review of Existing Literature

Several papers have looked at the cost of holding international reserves. These papers have reached very different conclusions depending on the measure used to calculate the opportunity cost of holding these reserves as well as the volume of international reserves on which the cost is calculated. Iyoha (1976) and Frenkel and Jovanovic (1981) treat the opportunity cost as the inverse of the discount rate and finds that demand for international reserves varies inversely with the opportunity cost. However, Shinkai (1979) points out that use of domestic discount rate to calculate the opportunity cost of holding reserves is erroneous as most the of reserves are held in dollar denominated assets. As a result, it makes sense to use the difference between returns on such assets and a country-specific interest rate, which measures the net gain (inverse cost) of holding reserves instead of investing the equivalent sum within the country. Most of these papers look at the entire stockpile of reserves thereby assuming that reserve holdings do not generate any benefits apart from the nominal return.

Another measure usually employed to capture the cost of holding reserves is the return on investment in physical capital. Neely (2000), Ben-Bassat and Gottlieb (1992b) and Baker and Walentin (2001) assume that if assets were not held as reserves they would be available to fund domestic investment in physical capital. These papers conclude that the increase in reserves represents an enormous cost to the developing nations as they are foregoing domestic investment in either physical or human capital. Baker and Walentin (2001) point out that such costs exceed 1% of GDP and possibly 2% of GDP for many developing economies.

In a recent paper, Rodrik (2006) terms excess reserves as reserves held over and above what is required to meet three months of import. Using this rule, Rodrik (2006) finds that by investing resources in accumulation of reserves, instead of reducing private sector's short-term borrowing, the developing nations are losing about 1% of their GDP.

On the other hand, there exists a large volume of empirical literature indicating that in a modern economy reserves are demanded for a variety of reasons apart from financing imports. These include maintaining a certain level of indebtedness, adhering to a particular exchange rate regime, depth of the financial market, degree of capital account openness etc.

According to Burke and Lane (2001), apart from trade openness, financial depth and external indebtedness also influence the demand for international reserves. Aizenman and Marion (2004) point out that the size of international transactions, their volatility, exchange rate arrangement and political stability are some of the key determinants of international reserve holdings in most of East Asia. They also point out that countries characterized by sovereign risk, costly tax collection and large inelastic fiscal liabilities are likely to exhibit greater precautionary demand for international reserves. Using a simple empirical model, Edison (2003) shows that real GDP per capita, the population level, ratio of imports to GDP and volatility of the exchange rate are found to be statistically significant determinants of reserve holdings.

The pattern of reserve accumulation has changed over the period of time. Aizenman and Marion (2004) point out that in the aftermath of the Asian crisis in 1997, the emerging economies of Asia increased their level of reserves for self-insurance performance. A similar increase in reserve holding was also observed in Latin America after the debt crisis of the early 1980s. Focusing on Korea, Aizenman et al. (2003) find evidence of a structural break in the pattern of reserve holding post-Asian crisis after which financial openness and external indebtedness have become significant and a strong predictor of reserve holdings, while trade openness loses some significance after the crisis.

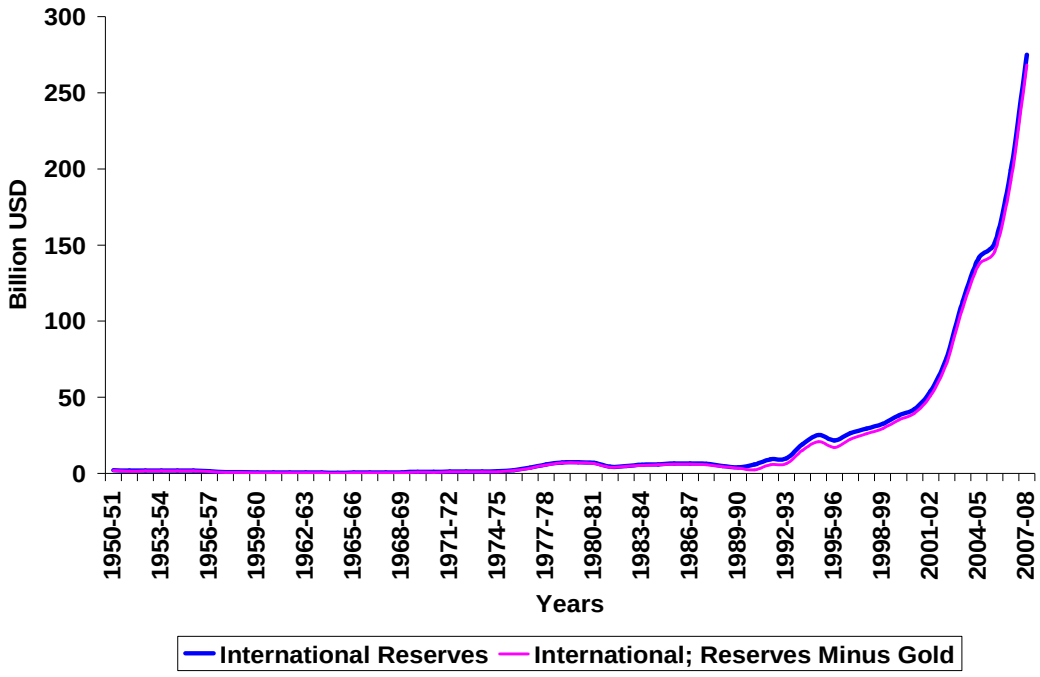
3. India's Reserve Accumulation

Prior to the time of financial globalization, countries used to hold reserves mainly to manage foreign exchange demand and supply arising from current account transactions. India was no exception to this rule. It followed a restrictive foreign trade policy and used its reserves for essential items like petroleum and food grains. Since 1991, there has been

a major shift in the external policy with import substitution giving way to export promotion. For this policy to succeed, sufficiency of international reserves was a major requirement.

Figure 1 looks at the growth of international reserves in India since 1950-51. It can be seen that the volume of international reserves was almost stagnant from 1950-51 to 1990-91. During this period it grew marginally from $2.16 billion to $5.83 billion. However, since then India's holding of international reserves has increased to over $270 billion, till December 2007. Acceleration in reserve accumulation was first witnessed in 1993, when India adopted the market-based system of exchange rates. In the mid and late 1990s, the growth rate of accumulation of reserves slackened a little bit. From 2001 there was again a spurt in this growth rate, which coincided with a current account surplus for the first time since 1978. The recent growth in international reserve holdings is on the back of unprecedented foreign capital inflow coming in to take advantage of the interest rate differential and a strong rupee.

Figure 1: India's Reserve Accumulation Experience (1950-51 to 2007-08)



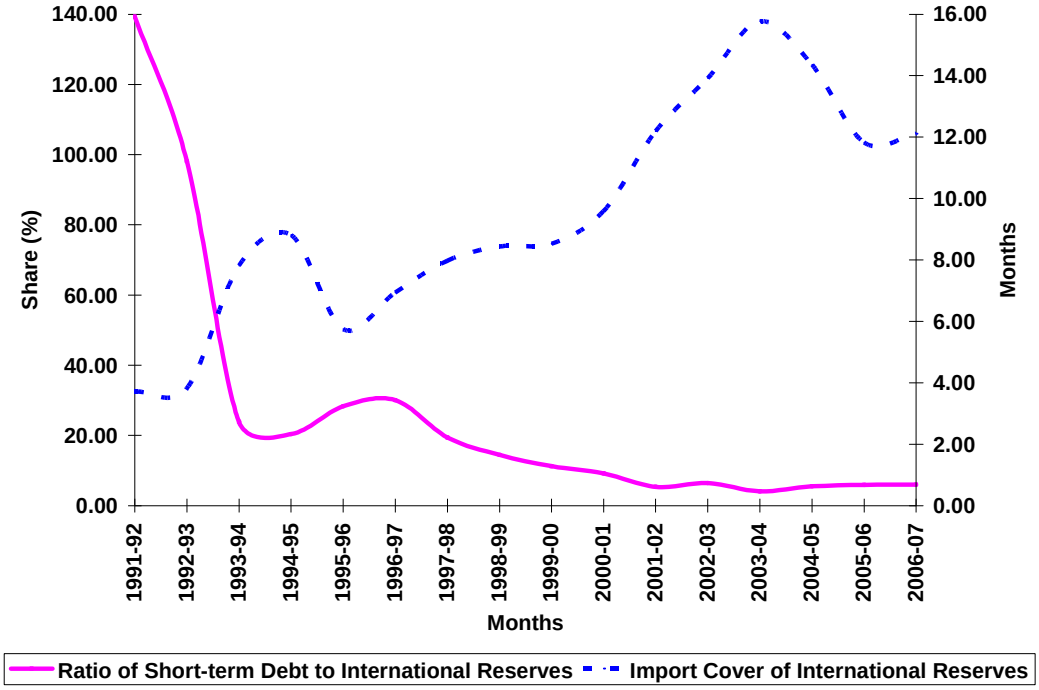
Source: Reserve Bank of India, Handbook of Statistics 2006-07

In Figure 2, we can see the change in the number of months of imports that could be financed by international reserves as well as the ratio of short-term debt to international reserves. As a result of the rapid accumulation of reserves, India's holding of international reserves in 2006-07 could finance more than a year's imports. This is in sharp contrast to June 1991 when India had reserves only to finance less than three weeks of imports. At that point, the Government of India had to ship 47 tonnes of gold to the Bank of England to secure a loan of $415 million before the funds were arranged from the International Monetary fund (IMF) to ride out the crisis. Today, India has a

comfortable cushion in the case it suffers a terms of trade shock or a sudden reversal of capital flow. This massive accumulation of reserves has also meant that the ratio of short-term debt to international reserves has witnessed a steep decline from nearly 150% in 1990-91 to well below 6% in 2006-07.[3] Thus, India is well prepared to cover its short-term external obligations.

Comparing India's holding of international reserves to some of the standard international reserve adequacy benchmarks, we get the sense that India's reserve holdings are more than adequate. The Greenspan-Guidotti rule stresses that sufficient international reserves must be maintained to meet external obligations for about a year, without any external assistance. In India, the current level of international reserves is almost 20 times the short-term external obligations. Also as stated earlier, there is a general consensus that import cover of reserves should be around 3-4 months. Most industrialized countries have an import cover of around three months. Given the weak financial system, limited access to international credit markets in the face of a crisis and other macroeconomic indicators associated with developing countries, these countries should hold additional reserves. Again on this count, India is comfortably placed with more than a year's import cover.

Figure 2: India's Reserve Adequacy Measures (1991-92 to 2006-07)



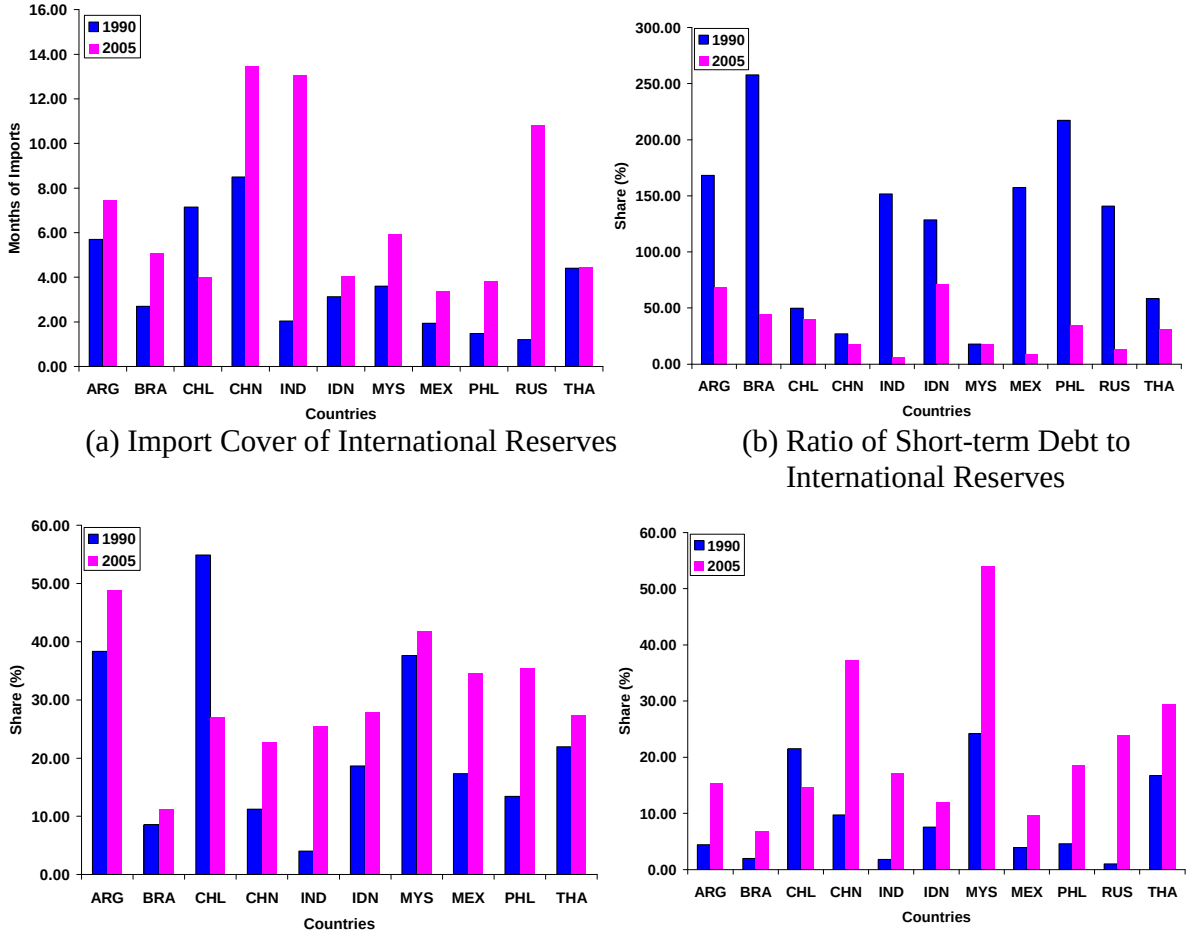
Source: Reserve Bank of India, Handbook of Statistics 2006-07

[3] Short-term debt has been redefined since 2005-06 to include suppliers' credit up to 180 days. However, to maintain consistency we stick to the original definition. As per the new definition the ratio of short term debt to the foreign exchange reserves stood at 12.5% as at end-March 2005, but increased slightly to 12.9% as at end-March 2006 and further to 13.2% at end-March 2007, but declined to 12.4% at the end of September 2007.

Reserve hoarding is not a phenomenon that has been unique to India. Most of the South East Asian as well as Latin American economies have also been indulging in this kind of behaviour. This has been the primary response to currency crises these economies faced in the 1990s.

Figure 3 exhibits some of the key reserve adequacy indicators for major emerging economies. It can be clearly seen that, barring Argentina and Chile, most of the emerging economies have witnessed a significant increase in their import cover of international reserves as well as the ratio of international reserves to M2. Again, Chile was the only major developing country that did not experience a rise in the ratio of international reserves to GDP. Finally, all the major developing countries saw a fall in the ratio of short-term debt to international reserves. The fall was again smallest for Argentina and Chile.

Figure 3: Cross Country Comparison of Reserve Adequacy Measures



(a) Import Cover of International Reserves

(b) Ratio of Short-term Debt to International Reserves

(c) Ratio of International Reserves to M2

(d) Ratio of International Reserves to GDP

Source: World Development Indicators

Comparing India's performance with other emerging economies it can be clear seen that India has done remarkably well. Figure (a) shows that in terms of import cover of international reserves, India is better covered than most other major emerging markets. The only major emerging market with a higher import cover is China. Similarly, according to Figure (b), India is well placed in terms of ratio of short-term debt to international reserves. At 6%, this ratio is also smaller than most other developing countries. Even with the other two indicators, India is relatively comfortably placed. In terms of ratio of international reserves to GDP, India is behind economies like China, Thailand, Russia and Malaysia but ahead of most Latin American economies. On the other hand, at 25.53%, the ratio of international reserves to M2 in India is higher than China and Brazil but lower than most of the Latin American economies and Korea.

4. Benefits of Holding Reserves

Feldstein (1999) points out that the Asian crisis of 1997 has clearly shown that emerging economies must learn to protect themselves from such disaster. Neither the IMF, nor the 'new global financial architecture' will prevent such crisis from occurring. Even countries practicing sound macroeconomic policies are not immune to such crisis as they can be hit by contagion from anywhere. The key to self-protection is liquidity, and countries that have substantial international liquidity in the form of large foreign exchange reserves are less likely to be the object of a currency attack.

Another potential benefit of adequate reserves is that it provides self-insurance against sudden stops and adverse fiscal shocks. Sudden stops are typically associated with large reduction in the flow of capital followed by major exchange rate depreciation leading to significantly lower rates of return, investment and growth. International reserves help mitigating the effects of such sudden stops. Ben-Bassat and Gottlieb (1992b) argue that international reserves reduce the probability and the intensity of an output drop due to a sudden stop. Moreover, Aizenman and Marion (2004) point out those countries facing increased sovereign risk, high taxation costs and characterized by large inelastic fiscal liabilities also find it optimal to hold large precautionary reserve balances. Countries would also hold large precautionary balances of international reserves if they attach more weight to bad outcomes than good ones.

Reserves also help to lower the real exchange rate volatility, induced by terms of trade shocks. It has been widely argued that exchange rate volatility has an adverse impact on a country's growth. In a recent paper, Aghion et al. (2006) find that in countries characterized by low level of financial development, exchange rate volatility has a negative impact on the growth rate. Thus any mechanism that reduces the volatility of exchange rate will enhance the growth performance of an economy.

Dooley et al. (2003) point out that the growing stockpiles of international reserve can be attributed to a deliberate strategy, which facilitates growth by maintaining an undervalued exchange rate. This would imply that every time there is pressure on the domestic currency to appreciate, i.e., traders want to sell foreign currency and buy domestic

currency, the central bank intervenes by printing domestic currency and buying up all the foreign currency, which translates into additional reserves.

Looking specifically at the Indian case, Patnaik (2005) finds that in recent years there have been two episodes where the Reserve Bank of India (RBI) has actively engaged in currency trading. The first one was in 1993-95, when there was a huge capital surge into the country as a result of liberalization of portfolio investment. However, from January 1993 to July 1995, there was no change in the nominal exchange rate, which was fixed at slightly below Rs. 31.50 during this period. To ensure that the Indian rupee does not appreciate, the RBI had to absorb the excess foreign reserves, as a result of which the stockpile of international reserves nearly tripled from $6.7 billion in March 1993 to $19.5 billion in July 1995.

The second episode of currency trading was primarily due to a reversal in the capital account. It began in October 2001 and continued till June 2004. In 2001-02, the current account registered a surplus for the first time since 1978 and this had implications for the currency market. During this period, the RBI added more than $74 billion to its coffers. The RBI again was interested in preventing the rupee from appreciating and intervened actively to achieve this objective. In fact during the first few months of this episode i.e., till May 2002, the rupee actually depreciated from Rs. 47.97 against the US dollar to Rs. 49.03. The RBI allowed the rupee to appreciate from June 2002, when the reserves had crossed the $55 billion mark. The rupee continued to appreciate till March 2004, after which it depreciated marginally. The intervention in 1993-95 was associated with a small increase in the share of exports as a percentage of GDP from less than 10% to over 11% during this time. The intervention during the second episode was associated with a much more impressive performance of Indian exports, which increased from 13% of GDP to well over 19%.

5. Determinants of Reserves

Before looking at the costs of additional reserve holding it is imperative to know how much reserves a country needs to hold. Generally, several rule of thumb measures like three months of imports, Guidotti-Greenspan measure etc. have been cited as possible benchmark of reserve holding. However, in recent years, several studies like Aizenman and Lee (2006), Aizenman and Marion (2004) and Burke and Lane (2001) have pointed that a country's demand for international reserves depends on a number of variables and not just on the import bill and short-term debt. In this section, we use empirical methods to study the determinants of cross-country variation in the level of international reserves from 1980 to 2005. On the basis of the empirical analysis we would like to calculate the predicted demand for international reserves and thus be able to calculate the volume of excess reserves held by various countries.

The existing literature identifies a range of variables that influence reserve holdings. We look at a sample of 167 countries over a 25 year period, from 1980-2005. The dependent variable is the ratio of reserves minus gold to GDP. The reserves include special drawing rights, reserves of IMF members held by the Fund, and holdings of foreign exchange

under the control of monetary authorities. Data on reserve holdings and GDP are taken from the *World Development Indicators*.

We consider several control variables that have been found in the literature as being principal determinants of reserve holding. The first control variable is a measure of real income per capita, which acts as a measure of the overall development of the economy and captures a wide range of factors that affect reserve holdings. Owing to the large variation in this variable across the sample of countries, the log of real per capita GDP, instead of level, is used.

Another variable, which has a strong impact on reserve holdings is openness to trade. Reserves are viewed as financing option of last resort in covering import demand. Thus, there is a natural link between trade openness and international reserves. Countries with higher import to GDP ratio are expected to hold more reserves to tide them over during a crisis. We measure trade openness by the share of imports in GDP. There is a close association between domestic financial development and exposure to external crises. To the extent that the liabilities of the domestic sector are partly denominated in foreign currency, financial deepening should be matched by an increase in international reserves. We measure financial depth with the ratio of money and quasi money (M2) to GDP. Data on imports and M2 are also taken from the *World Development Indicators*.

The volume of reserves is also crucially affected by the existing exchange rate regime. A country with a currency peg is likely to hold more reserves either to defend against attacks on the exchange rate or as a consequence of resisting an appreciation of the domestic currency. On the other hand, in a flexible exchange rate regime, the exchange rate can freely float to reflect market reality and hence such a country is likely to hold fewer reserves.

To control for exchange rate regime, we use the exchange rate index formulated by Levy-Yeyati and Sturzenegger (2005), which is a de facto classification based on data on exchange rates. The index ranges from 1 to 5 with a lower number implying a more flexible exchange rate regime.[4]

The degree of capital account liberalization is another variable that influences the precautionary motive of capital account liberalization. As a country opens up to greater capital flows, it needs to put in place adequate safeguards to protect itself against sudden stops. Thus, greater capital account openness is likely to be associated with higher volume of reserves. We measure capital account openness using Chin-Ito index developed by Chinn and Ito (2006). The index is the first principal component of the binary variables pertaining to cross-border financial transactions, based on the IMF's categorical enumeration reported in Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). This is a compilation of four dichotomous variables accounting for restrictions on capital account transaction, current account transactions,

[4] Another popular exchange rate regime measure is the one created in Reinhart and Rogoff (2002). However, this measure ends in 2001 and is thus not suitable for our purpose.

requiring surrendering of export proceeds, and the presence of multiple exchange rate. Since these four binary variables account for the degree of control than openness, Chinn and Ito flip their values and construct an index based on the standardized principal components. The index ranges from −1.7 to 2.7 and a higher value of the index indicates greater financial openness.

Aizenman and Marion (2004) point out that political uncertainty will influence a country's strategy regarding holding of reserves. Suppose alternatively the government in a country has a 'tough' administration that ensures responsible fiscal behaviour and a 'soft' administration that behaves opportunistically in appropriating and allocating resources to special interest groups with high discount rates. A 'soft' administration would want to increase the consumption of special interest groups and reduce international reserve holdings and accumulate international debt to achieve that. On the other hand, a 'tough' administration would be reluctant to hold lot of reserves if there is a high probability that it will lose power in the near future and the future administration will be 'soft' and grab the rewards for the special interest rate groups. Thus, political instability can reduce the level of reserve holdings below the level supported by efficiency considerations. We use the political stability index developed by *Intra Country Risk Guide*. The index is made up of variables like government stability, socioeconomic conditions, conflicts, law and order etc. The index ranges from 0 to 100 with a higher number indicating a more politically stable regime.

Finally, we also take into account the external indebtedness of the country and measure it using the ratio of external debt to the GDP. Data on external debt is taken from the *World Development Indicators*. We also include a series of dummy variables that indicate the behavior of the Asian and the Latin American economies after the Tequila Crisis of 1994 and the Asian crisis of 1997. The crisis dummies intend to capture the change in the reserve holding behaviour of these economies after they were hit by crises.

The empirical model is given by following equation

$$Y_{it} = \alpha_0 + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + \beta_4 X_{4it} + \beta_5 X_{5it} + \beta_6 X_{6it} + \beta_7 X_{7it} + \upsilon_i + \varepsilon_{it} \qquad (1)$$

where i refers to the country and t represents the time period. Here Y is the dependent variable, measured as ratio of reserves (minus gold) to GDP. Among the explanatory variable, X_1 is log of per capita GDP, X_2 is a measure of trade openness, X_3 is a measure of exchange rate regime, X_4 is a measure of capital account openness, X_5 measures financial depth, X_6 is a measure of political stability and X_7 is the ratio of short-term debt to the GDP.

In our sample of countries, a Woolridge test for autocorrelation, suggests the presence of first order serial correlation. In the presence of autocorrelation, the error term in equation (1) can be written as

$$\varepsilon_{it} = \rho_i \varepsilon_{it-1} + \mu_{it} \qquad (2)$$

In the literature, there are several ways to estimate the model in the presence of serial correlation. One can use a feasible GLS with AR1 correlation. However, this procedure

has been criticized for underestimating the standard errors. The panel corrected standard error estimates, which uses Prais-Winstein regression, addresses this problem. It assumes that the disturbances are heteroskedastic and contemporaneously correlated across panels. The panel corrected standard error estimates allow for first order correlation, AR(1), with a common coefficient of the AR(1) process across all the panels, ($\rho_i = \rho, \forall i$), as well as a specific coefficient of the AR(1) process for each panel, ($\rho_i \neq \rho, i \neq j$).

Table 1 displays the results of the Prais-Winstein regression with panel-specific autocorrelation coefficients. We focus on all the countries in our sample as well as emerging market economies. Across the entire sample, log of per capita GDP has a positive and significant impact on reserve holding. Richer countries tend to have higher reserve holdings. Trade openness also exerts a strong positive impact on reserve holding thereby highlighting the precautionary motive where countries having higher share of trade want to hold enough resources to be able to finance their imports.

Exchange rate regime also shows up as a significant predictor of international reserve holding. Across all specifications for the full sample it has a significant positive impact on reserves. According to the exchange rate regime measure used, a higher number indicates less flexible regime. Thus, countries with fixed exchange rate regime tend to accumulate greater reserves. Like trade openness, capital account openness also positively affects international reserve holdings, although the effect is not significant across all specifications. Thus, countries that opened up the capital account tend to hold greater reserves to protect themselves against episodes of sudden stops.

We also find that greater financial depth tends to have a positive influence on reserve holdings. In many countries, the liabilities of the financial sector are denominated in foreign currencies and this is reflected in higher volume of reserves. Political stability also has the expected positive impact on reserve holding but the impact is not significant across all specifications. Finally, we find that the extent of external indebtedness has no significant influence on reserve holdings.

Among the dummy variables, only the dummy for Asian economies after the Asian crisis has a strong positive and significant effect on reserves, implying that post-Asian crisis, the Asian economies made a deliberate attempt to bolster their reserve holdings to prevent another such attack.

When we focus only on emerging markets we find that per capita GDP, along with political stability and external indebtedness, are no longer significant predictors of the volume of reserves. However, both trade and capital account openness, along with exchange rate regime and financial depth, continue to be the major determinants of volume of reserves.

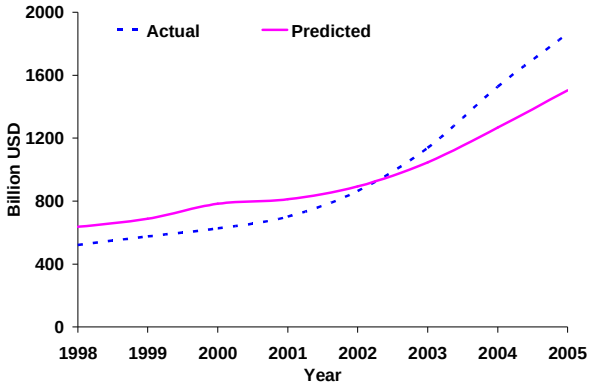
Next, we use the above empirical model to predict the demand for international reserves for various emerging countries and groups. In particular, we use the regression in Column (IX) of Table 1 to calculate the volume of reserves predicted by our model. If the actual reserves exceed predicted reserves then the difference is termed as excess reserves.

Table 1: Prais Winstein Estimates with Panel Specific Correlation Coefficient

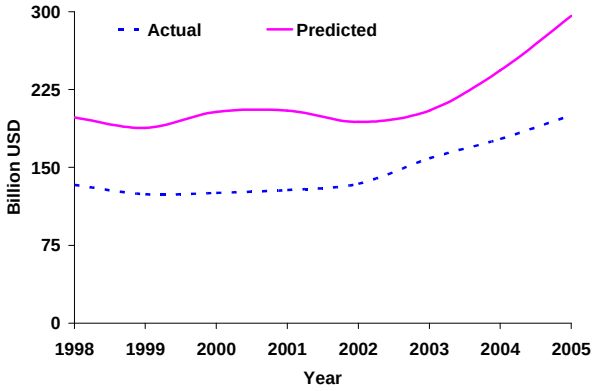
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)	(IX)
	Full Sample of Countries				***Emerging Market Economies***				
Per Capita GDP	0.917***	0.687***	0.254	1.409***	0.84	0.862	1.066	4.045***	2.444*
	[3.82]	[2.86]	[0.75]	[3.24]	[1.39]	[1.19]	[1.48]	[4.40]	[1.90]
Import Share	0.119***	0.144***	0.181***	0.150***	0.268***	0.254***	0.163***	0.114**	0.163***
	[12.69]	[14.35]	[11.26]	[8.44]	[9.47]	[8.05]	[3.92]	[2.41]	[3.46]
Exchange Rate Regimes		0.136**	0.280***	0.273***		0.093	0.072	0.094	0.235
		[2.37]	[3.50]	[3.13]		[0.78]	[0.51]	[0.59]	[1.13]
Capital Account Openness		0.533***	0.548***	0.549***		0.540**	0.467*	0.502*	0.790***
		[4.17]	[3.27]	[2.69]		[2.09]	[1.85]	[1.90]	[3.05]
Financial Depth			0.090***	0.116***			0.112***	0.134***	0.178***
			[6.08]	[5.71]			[3.84]	[4.19]	[7.68]
Political Stability			0.032*	0.059***			0.046	0.038	-0.056
			[1.92]	[2.80]			[1.58]	[1.10]	[1.11]
Short-term Indebtedness				0.004				0.022	0.049***
				[0.94]				[1.48]	[3.64]
Observations	3633	2958	1830	1455	585	516	440	388	168
Number of countries	167	158	112	89	24	24	24	22	21

Robust z statistics in parentheses
**** indicates significant at 1 % , ** indicates significant at 5 % and *indicates significant at 10 %*

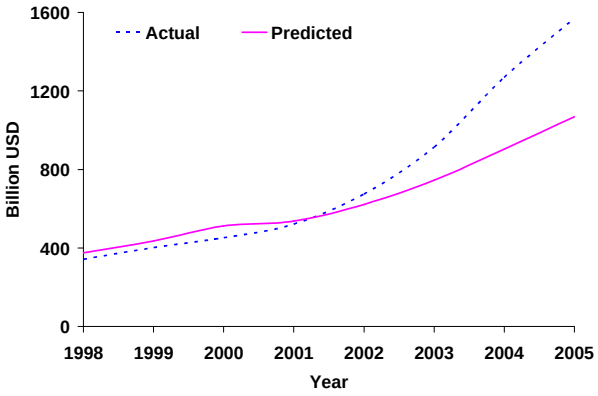
Figure 4: Reserve Accumulation in Selected Group of Countries



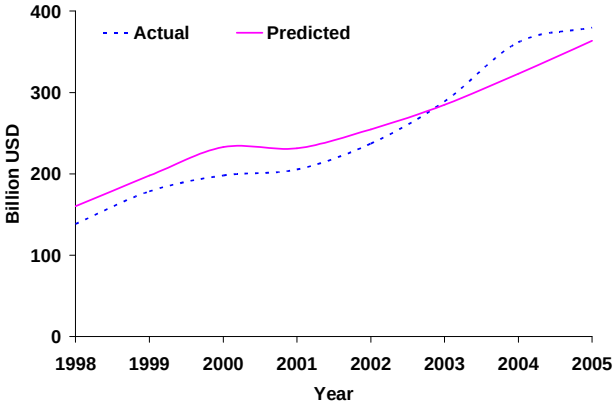
(a) Emerging Markets



(b) Latina American Economies



(c) Asian Economies

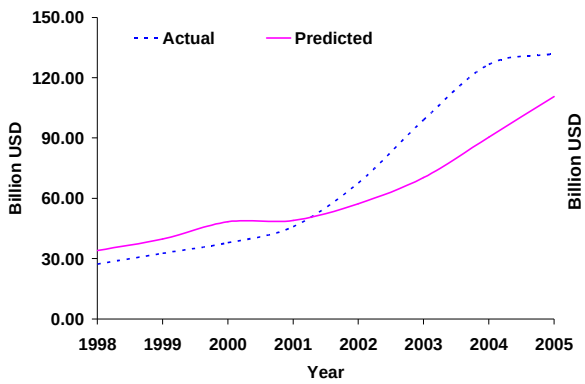


(d) Asian Crisis Economies

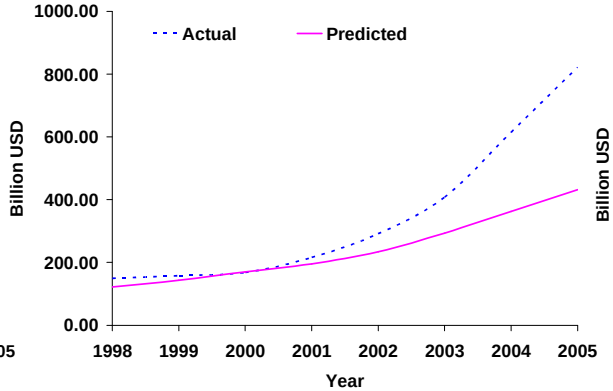
Several papers like Gosselin and Parent (2005) and Edison (2003) have pointed out a structural break in the volume of reserves in 1997 due to the emergence of financial crisis in several Asian economies. As a result, in Column (IX) we focus only on the period from 1998 onwards.

Figure 4 looks at a group of countries and compares the actual volume of reserve with the predicted demand for the same. Looking at the entire group of emerging markets, we find that actual demand for reserves is well above the predicted demand and the gap has increased in recent years. The difference between actual and predicted reserves for the emerging markets can be largely explained by the behaviour of both Asian and Latin American economies. The emerging Asian markets witnessed a strong upswing in the actual volume of reserves from 2002 onwards and it became greater than the predicted volume of reserves. On the other hand, in the Latin American emerging markets, actual volume of reserves has been trailing the predicted volume of reserves and the gap has more or less remained constant. When we focus on a select group of countries that were affected by the Asian crisis i.e., South Korea, Thailand, Indonesia, Malaysia and the Philippines, we find that actual reserve accumulation was more or less in line with our model's forecasts till 2002. However, since then these countries have witnessed a rapid increase in their actual reserve accumulation and the gap between actual and predicted reserves widened significantly.

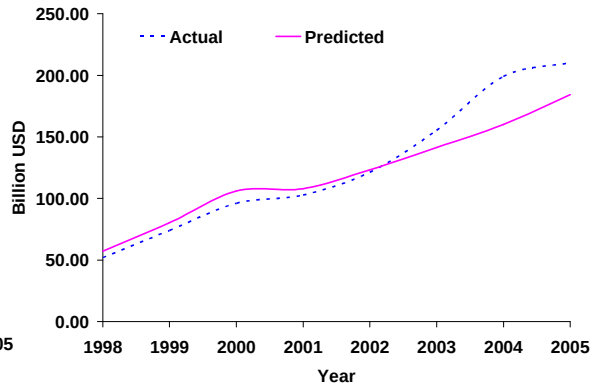
Figure 5: Reserve Accumulation in Selected Emerging Markets



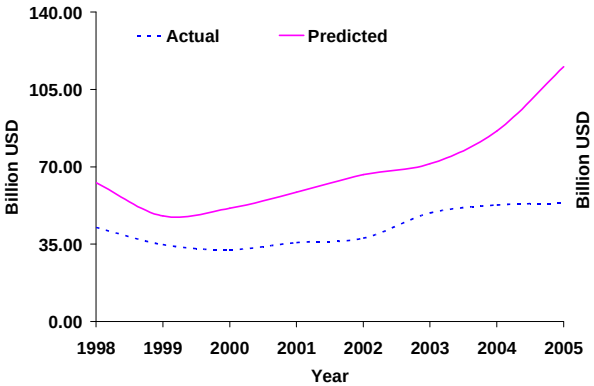
(a) India



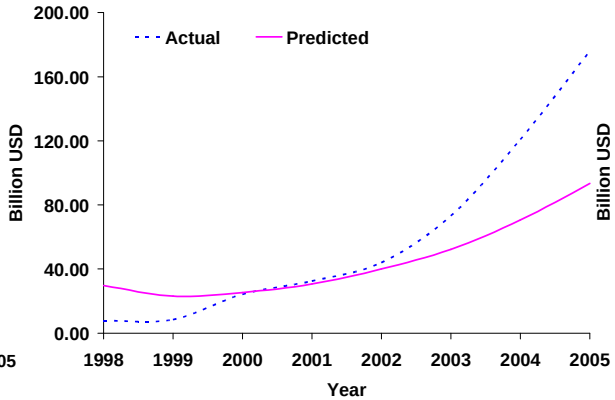
(b) China



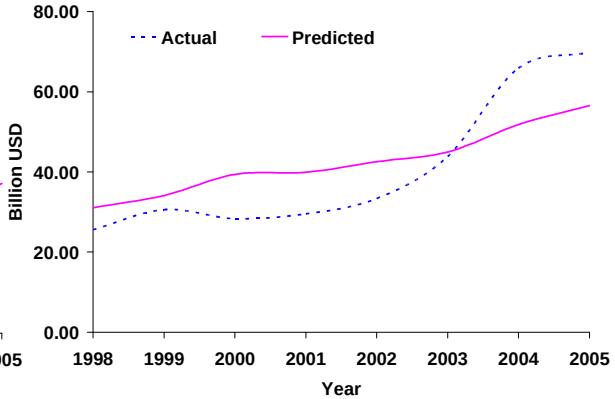
(c) Korea



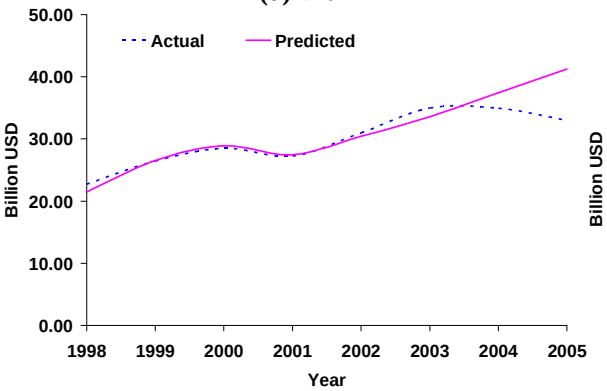
(d) Brazil



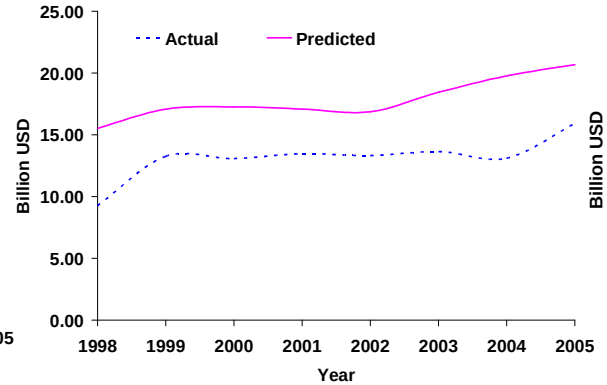
(e) Russia



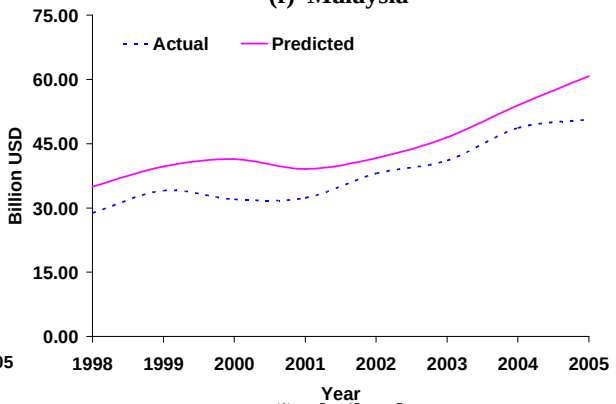
(f) Malaysia



(g) Indonesia



(h) Philippines



(i) Thailand

In Figure 5, we look at the reserve accumulation performance of some selected emerging markets in Asia and Latin America. Figure 5 brings out several interesting facts. There are five countries whose actual reserve accumulation was significantly higher than what our model predicted. These include India, China, Korea, Russia and Malaysia. By 2005, the excess reserve accumulation in these countries stood at $22 billion, $390 billion, $26 billion, $83 billion and $13 billion, respectively.

On the other hand, countries like Indonesia, Philippines and Thailand by 2005, had accumulated reserves close to the amount predicted by our model. Finally, only Brazil faced a shortfall in excess of $60 billion in 2005.

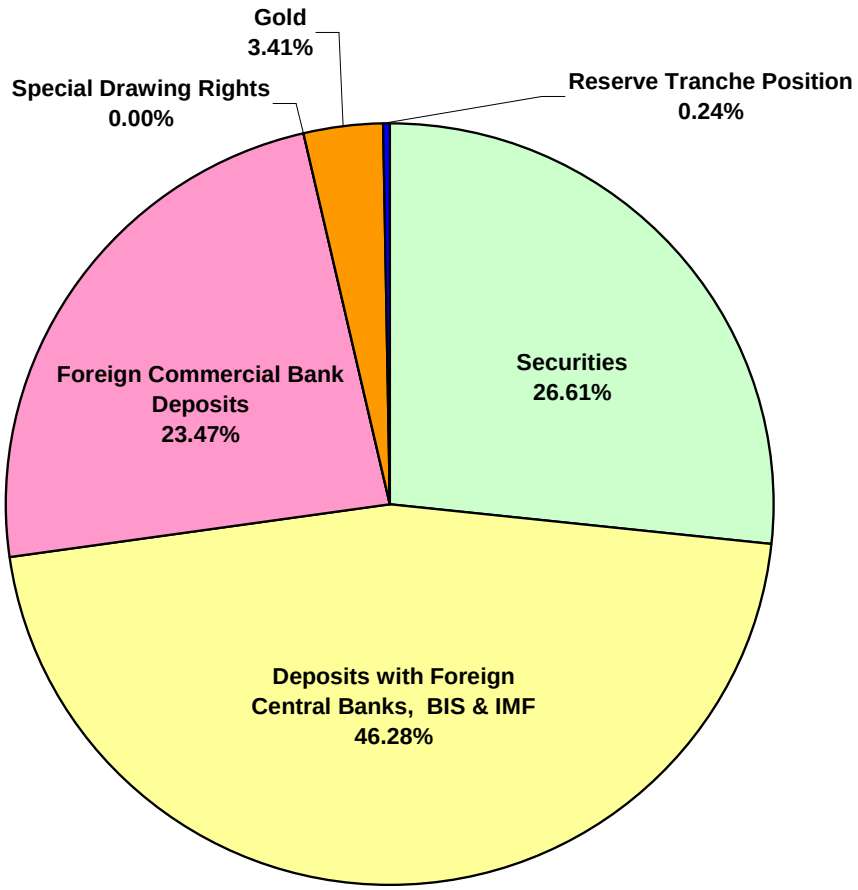
6. Cost of Reserve Holdings

The benefits of reserve holdings have been outlined in Section 4. In the case of India, the dominant policy objectives in regard to international reserves include maintaining confidence in monetary and exchange rate policies, limiting external vulnerability by maintaining foreign currency liquidity to absorb shocks during the times of crisis, providing confidence in the market that external liabilities will always be met, and adding to the comfort of the market participants. Thus, in India lot of weight is put on the precautionary and self-reliance motive. A lot of this has to do with India's historical experience. One of the causes of the crisis in mid-1991, apart from widening current account deficit and political uncertainty, was the loss of investor confidence. During this period commercial bank financing became difficult to obtain. Moreover, outflows began to take place on short-term external debt, as creditors became reluctant to roll over maturing loans. There was also a reversal of the strong inflows on non-resident Indian (NRI) deposits. Again, an immediate aftermath of the Pokhran explosions in 1998 was the imposition of sanctions, which curtailed India's access to global financial market. Reddy (2002) points out that given these experiences an overwhelming desire for international reserve buildup is understandable. However, as highlighted by Lal et al. (2002), with current reserves being able to finance more than a year's import and India doing exceptionally well on all reserve adequacy measures, continuation of such a policy is highly questionable given the high costs associated with such a policy, some of which are highlighted below. Lal et al. (2002) conclude that if capital flows were fully absorbed and invested, instead of being neutralized by building up of foreign reserves, growth could have been significantly higher.

In India, international reserves are managed by the RBI in consultation with the Government of India. The main objectives of international reserve management are liquidity and safety with due attention being paid to the currency composition and duration of investment so that a substantial part can be converted to liquid form at a short notice. The framework for deployment of these international reserves is guided by the RBI Act, 1934, which requires that the investments be made in government securities of a foreign country maturing within 10 years, deposits be placed with other central banks, international commercial banks, IMF, World Bank, Asian Development Bank and the Bank of International Settlement following a multi-currency, multi-asset and multi-market approach. Accordingly, as of September, 2007, out of the total foreign currency

assets of $240 billion, $67.2 billion was invested in securities, $137.4 billion was deposited with other central banks, BIS and IMF and $35.4 billion was in the form of deposits with foreign commercial banks. Thus, bulk of India's reserves are held in the form of securities or deposits with foreign commercial banks and international organizations.

Figure 6: Deployment of India's International Reserves

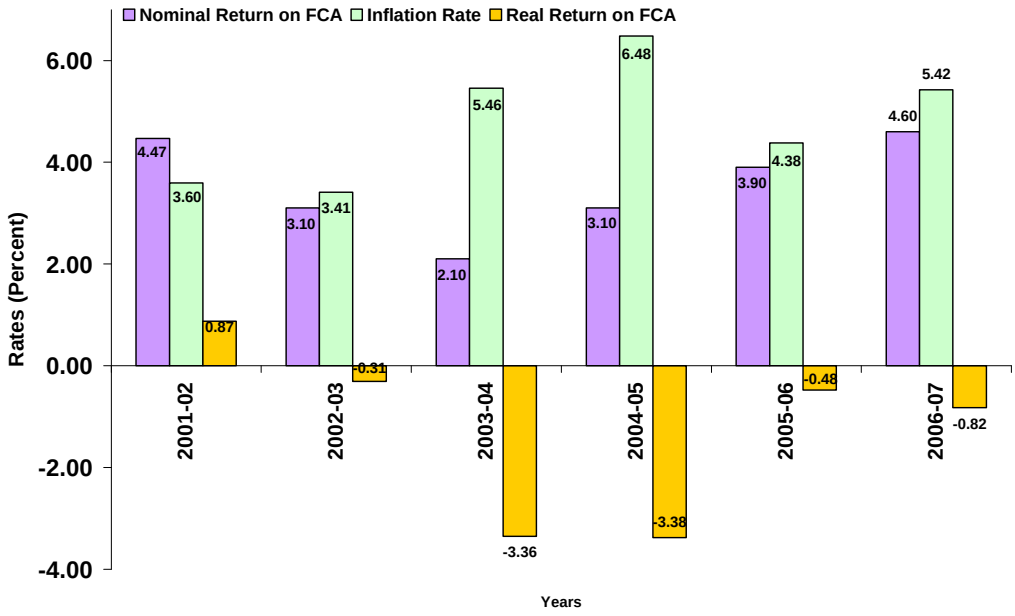


Source: Reserve Bank of India, Report on Foreign Exchange Reserves January 2008

The strategy to focus on safety and liquidity at the expense of return has had strong implications for the rate of returns on investment of the international reserves. Given the low interest rate prevailing in most of industrialized countries like the US, Japan, and the Euro area, etc., the direct financial return on holdings of international reserves has been low. RBI (2007) points out that the central bank's earning from the deployment of foreign currency assets increased to Rs. 35,153 crores in 2006-07 from Rs. 24,538 crores in 2005-06. This was primarily due to the increase in level of international reserves as well as a rise in global short-term interest rates, particularly in the US. However, the rate of earning on foreign currency assets and gold, after accounting for depreciation was only 4.6% in 2006-07 and 3.9% in 2005-06. The inflation rate during these two years was around 5.43% and 4.38%, implying a real rate of return of -0.82% in 2006-07 and -0.48% in 2005-06.

Indeed, as shown in Figure 7, in recent years, the real rates of return on foreign currency assets have been largely negative. The low returns are due to the RBI's cautious policies, which are guided by principles such as maintaining mark-to-market value and liquidity by taking minimal credit and market risk. The RBI limits itself to investing in short dated AAA-rated government debt securities.

Figure 7: Rates of Return on Foreign Currency Assets



Source: Reserve Bank of India, Handbook of Statistics

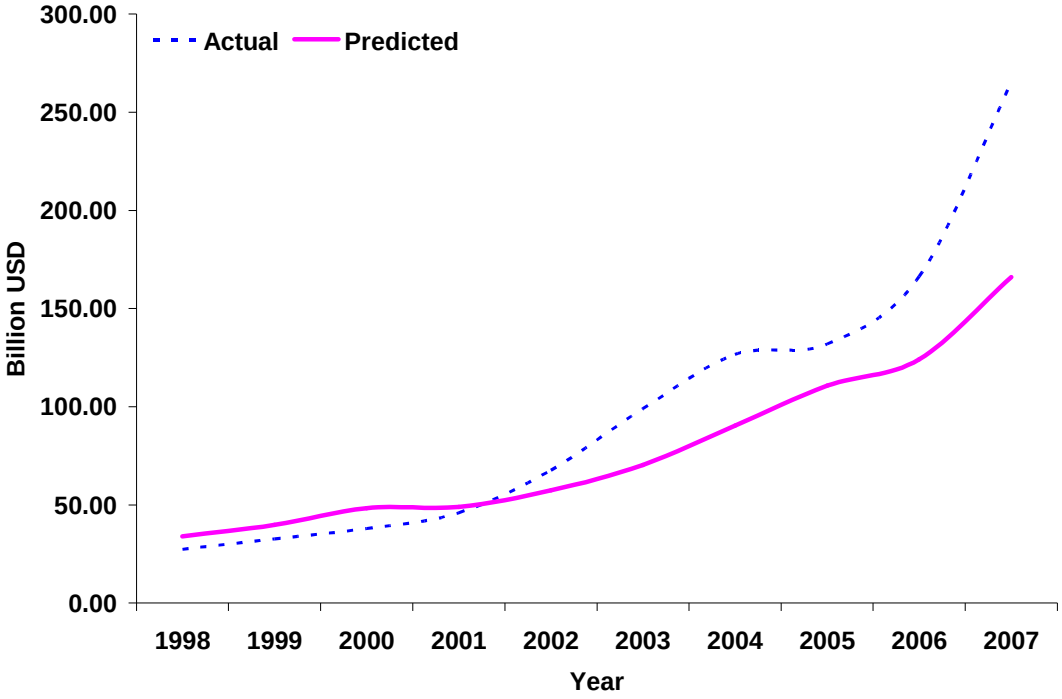
However, such low returns have raised several questions about the management of international reserves by the RBI. In particular, there has been a focus on calculating the cost of holding reserves. As shown in Section 5, India is one of the countries that has accumulated more reserves than is predicted by our model. In this section, we extend the analysis for India till 2007 by taking into account the behaviour of the explanatory variables for additional two years.[5]. Figure 8 shows the result of the extended analysis.

In 1998, India's actual accumulation of reserves were slightly less than predicted and this trend continued till 2001 with the gap between the two reducing significantly during the latter part of the period. However, since then actual volume of reserves have overtaken the predicted volume, mainly due to a current account surplus in some of these years and rising net investment inflows. There was a marginal moderation in the growth rate of

[5] We extend the data on India for 2005 and 2006 by looking at various publications of the Reserve Bank of India and Ministry of Finance, Government of India. We reestimated our model using the additional information. However, there were only marginal change in the coefficients and their significance level (changes were only at the second decimal point). As a result we used the coefficients in Column (IX) of Table 1

reserves in 2005 but it picked up again in 2006. Increased opening up of trade and capital account along with financial deepening also meant that predicted volume of reserves also showed an upward trend but the gap between the two widened significantly and by Dec. 2007 the amount of excess reserves stood well over $80 billion.

Figure 8: Reserve Accumulation in India (1998-2007)



Below, we compute the cost of accumulating reserves instead of utilizing the resources to increase the productive capacity of the economy. All the costs are reported in terms of income foregone as well as loss in terms of percentage of the GDP. In the literature, different measures have been used to calculate the cost of hoarding reserves. We look at some of the important measures and calculate the costs of holding reserves in India.

6.1 Cost in Terms of Physical Investment Foregone

Several papers like Ben-Bassat and Gottlieb (1992a) and Neely (2000) have pointed out that the opportunity cost of reserve holdings can be equated to the marginal product of capital. The underlying rationale being that resources that could have been used to increase the domestic capital have been employed in hoarding reserves. In such cases, the cost of holding reserves is given by the interest rate spread between the return on foreign currency assets and marginal product of capital, which is a proxy for the return on physical investment. We look at the opportunity cost in terms of actual income foregone as well as a percentage of the GDP.

Typically, the marginal product of capital is seen as the inverse of the incremental capital-output ratio (ICOR), with the latter reflecting the amount of additional capital required to generate a unit increase in output. The growth rate of the real output y can be stated as

$$y = \frac{1}{Y}\frac{\Delta Y}{\Delta T}, \tag{3}$$

where Y is the real output, T is time and Δ is the first difference operator. Multiplying the numerator and the denominator by $\frac{\Delta K}{\Delta Y}$ we obtain

$$y = \frac{1}{Y}\frac{\frac{\Delta K}{\Delta T}}{\frac{\Delta K}{\Delta Y}}, \tag{4}$$

where K is the capital stock of the economy. In the above equation, $\frac{\Delta K}{\Delta T}$ refers to the change in capital stock from one period to the next and is equal to the investment undertaken (I). Similarly, $\frac{\Delta K}{\Delta Y}$ reflects the increase in output brought about by an increase in capital and can be approximated by the ICOR. Thus the above equation can be rewritten as

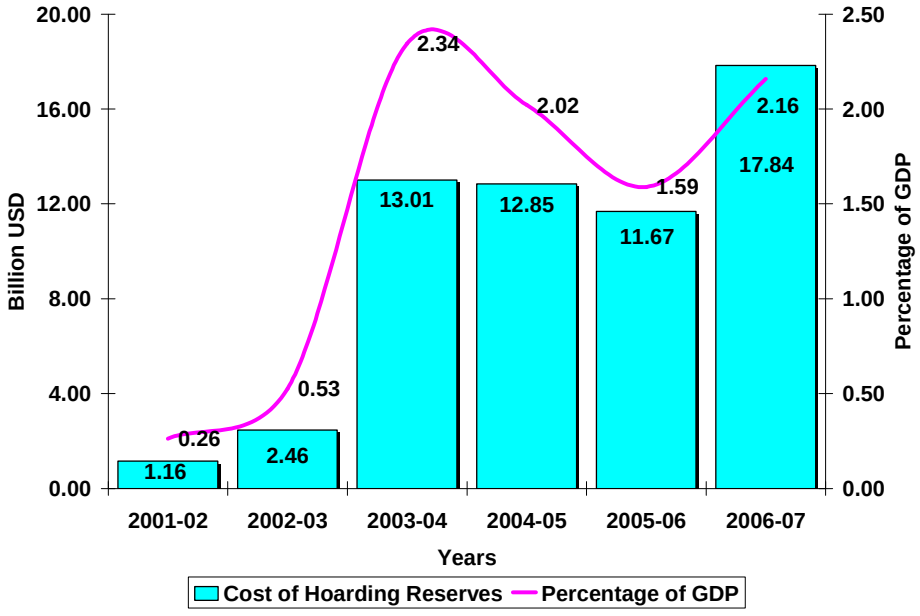
$$y = \frac{1}{Y}\frac{I}{ICOR} \tag{5}$$

Thus the marginal product of capital, which is the inverse of the ICOR, is given by

$$MP_K = \frac{y}{\frac{I}{Y}} \tag{6}$$

Data on I and Y is obtained from Central Statistical Organization (CSO). Briefly, I and Y are Gross Domestic Capital Formation (GDCF) and GDP in constant prices, while y is the growth rate of the GDP in constant prices.

Figure 9 : Cost in terms of Physical Investment Foregone



The opportunity cost of accumulating reserves is shown in Figure 9. It is clearly evident that India is losing a huge amount of revenue because of excessive reserve holdings. By diverting resources from physical investment and employing them for reserve accumulation, India lost nearly $13 billion, or 2.34% of the GDP in 2003-04. In the next couple of years the loss was slightly lower due to a higher return on the foreign currency assets. However, with a relatively low ICOR and hence a high marginal product of capital in 2006-07, the loss rose sharply to nearly $18 billion, or 2.16% of GDP. Thus, we find that in terms of physical investment foregone India is paying a substantial cost.

6.2 Cost in Terms of Excess External Commercial Borrowing

Another opportunity cost of holding reserves can be formulated in terms of short-term borrowings that the private sector has to undertake. A country living by the Greenspan-Guidotti-IMF rule will increase reserves by the same amount by which the private sector increases in external short term liabilities. In a recent paper, Rodrik (2006) calculates the social cost of holding reserves based on this idea.

Consider an economy that is made up of three entities – central bank, commercial banks and the private sector. The central bank is the sole holder of international reserves. It also holds domestic bonds that are issued by the private sector. The domestic bonds and international reserves comprise the assets of central banks. Among its liabilities are the reserves of the commercial banks, which the commercial banks have to keep with the central bank by law under the reserve ratio. Another liability of the central bank is the currency in the hand of the private sector. In our example, the central bank holds $2,000 as international reserves and $3,000 in the form of domestic bonds. Total currency in circulation is $4,000 and reserves worth $1,000 of commercial banks are held by the central bank.

The reserves are the assets of the commercial banks along with the domestic bonds that are issued by the private sector and held by these banks.[6] We assume that the commercial banks hold domestic bonds worth $9,000. The primary liabilities of the commercial banks are the checkable deposits which are assumed to be $10,000. Thus, we are assuming a reserve ratio of 0.1. Finally, the two main assets of the private sector are the checkable deposits and currency, while the main liabilities are the bonds, worth $12,000, that have been issued to the central and commercial banks. The private sector also has the option of borrowing short-term from the international market.

Now suppose that this country is abiding by the Greenspan-Guidotti-IMF rule. The private sector takes a short-term loan from abroad for $1,000. The central bank, which has to increase its reserves by an equivalent amount, will purchase foreign currency worth $1,000 in the domestic market to invest in short-term foreign securities. Thus, its stock of international reserves will go up from $2,000 to $3,000. By selling domestic

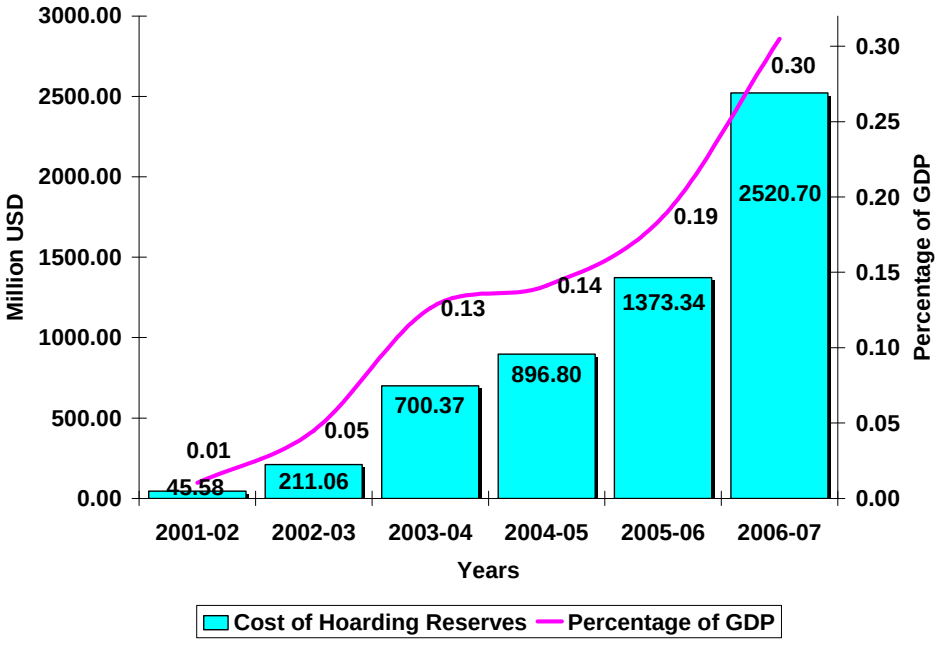
[6] Apart from holding bonds issued by the private sector the banks also make loans to the private sector. However, for our purpose a distinction between the two is not important and hence it is assumed that the banks do not make any loans.

currency to the private sector, the overall money supply has gone up by $1,000. To sterilize the effect of this intervention on the money supply, the central bank will sell some of the private sector domestic bonds it holds back to the private sector. Thus, it sells back $1,000 of domestic bonds issued by the private sector so its stock of domestic bonds decreases from $3,000 to $2,000. Similarly, due to this sell back, the value of domestic bonds outstanding for the private sector decrease from $12,000 to $11,000.

Rodrik (2006) points out three consequences of such transactions. First, there is no net resource transfer from abroad as the increase in private sector's liability is matched by an increase in central bank's international reserves. Second, the short term borrowing does not increase the availability of liquid resources available to the private sector for investment. The decline in total amount of debt issued by the private sector through domestic bonds is equivalent to the rise in short-term foreign debt. Finally, aggregating the balance sheets of the various sectors, it can be seen that the economy has borrowed short-term abroad (at the domestic private sector's cost of foreign borrowing) and has invested the proceeds in short-term foreign assets.

In such a setting, the cost of holding reserves would be measured by the interest rate spread between the private sector's cost of short-term borrowing abroad and the yield that the central bank earns on its liquid assets. Generally, there is no direct source of information on costs of short-term borrowing, most of which takes the form of commercial bank lending, information on which is generally not publicly available. In a recent article, Bhagwati (2006) pointed out that the average cost of short-term external commercial borrowings for the private sector is roughly about 3-month LIBOR+2.5%. Figure 10 shows the cost of hoarding excess reserves using this measure.

Figure 10: Cost in terms of Excess External Commercial Borrowing

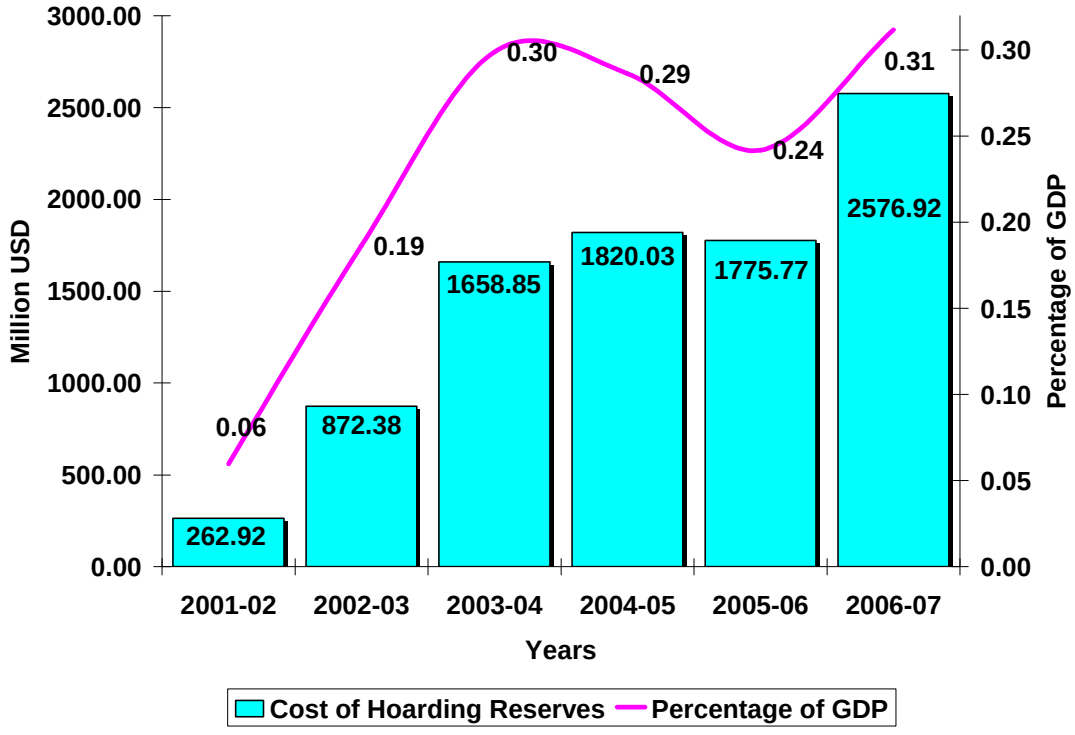


It can be seen that the cost of excess reserves has been increasing steadily and in 2006-07 stood in excess of $2.5 billion, or 0.30% of the GDP. The sharp increase in the cost in 2003-04, compared to the previous year, is largely because of the low return on foreign currency assets that year. On the other hand, the increase in cost in 2005-06 and 2006-07 is primarily explained by a sharp rise in the average 3 month LIBOR rate to 4.11% and 5.36%. As a result of monetary tightening in several industrialized countries, there was a sharp increase in the cost of borrowing. On the other hand, during this period the dollar had become marginally stronger thereby providing some boost to the returns on international reserves.

6.3 Cost in Terms of Public Sector Borrowing

The rising burden of public debt and gross fiscal deficit should be an issue of serious concern for the Indian economy. The combined domestic liabilities of the centre and states have increased from 40.52% of GDP in 1980-81 to 77.25% in 2006-07. Ahluwalia (2002) points out that the growth of public debt in India has equaled or exceeded that in Russia, Turkey and Argentina before these countries hit a crisis. Using yields on public debt issued domestically to evaluate debt sustainability, Kletzer (2004) provides a strong argument for a fiscal adjustment. Following Kletzer (2004) and Mohan (2002), we use the weighted average yield on central and state government securities to calculate the opportunity cost of hoarding reserves. The results are shown below in Figure 11.

Figure 11: Cost in terms of Public Sector Borrowing



It can be clearly seen that using the spread between interest rate on domestic government bonds and the yield on reserves, the cost is quite significant and in excess of $2.5 billion, or 0.31% of the GDP. Again, the sharp increase in the cost in 2003-04 is explained by the low yield on foreign assets. In contrast, the increase in cost by $1 billion between 2005-06 and 2006-07 is explained by significant increase in the volume of excess reserves as well as an increase in the cost of borrowing for the public sector. The extent of this cost has been mitigated to an extent by the ability of the government to borrow at concessional rates. Since 1995-96, there has been a steady decline in the yield of central government securities along with a rise in maturity. However, this trend was reversed in 2004-05 and 2005-06, when there was a sharp increase in interest rates. With global hardening of monetary policy, and opening up of the Indian economy to capital flows, domestic interest rates will have to align themselves with international rates. This would imply that the government's ability to borrow at concessional terms might get severely eroded in the near future, thereby increasing the cost of hoarding reserves.

6.4 Cost in Terms of Balance Sheet Risks

Another cost of holding international reserves arises when the exchange rate adjusts. As shown above, the RBI has intervened actively in the currency market to keep the value of the Indian rupee low vis-à-vis the US dollar, which has resulted in accumulation of the dollar. However, the central bank can only delay the inevitable process of appreciation and can not prevent it. This was also observed in the case of India. After trying to keep the value of the rupee around Rs. 48 during 2001-02, the RBI allowed the Indian currency to appreciate. As a result, the value of dollar fell from Rs. 49.03 in May 2002 to Rs. 45.32 in October 2003. This adjustment would imply that there was a sharp fall in the rupee value of India's international reserves. For example, international reserves worth $1 billion, which was valued at Rs. 490.3 crores in May 2002, was worth only Rs. 453.2 crores in October 2003 – a loss of Rs. 37 crores. Similarly, the recent appreciation of the Indian rupee has resulted in a significant fall in the valuation of reserves in domestic currency.

7. Conclusion

The primary objective of this paper is to evaluate the cost of holding excess reserves. Using empirical methods we formulate a comprehensive measure of reserve adequacy to calculate the volume of excess reserves in several emerging markets, including India. This is in contrast to most of the existing literature, which generally uses a single reserve adequacy measure to calculate excess reserves.

Using the comprehensive measure of reserve adequacy we find that overall emerging markets have outperformed in their reserve accumulation objective compared to the predictions of our model. This result is primarily driven by the Asian economies which have amassed far more reserves than suggested by our model. Among these, the Asian emerging markets that suffered the adverse impact of the Asian crisis have significantly increased their reserve accumulation endeavours compared to the predictions of the

model. On the other hand, Latin American economies fall well short of the levels predicted by our model.

Looking at individual countries we find that Indonesia, Thailand and the Philippines have accumulated reserves close to the amount predicted by our model. On the other hand, Brazil's reserve accumulation efforts have fallen well short of our model's prediction. Finally, China, India, Korea, Russia and Malaysia had accumulated significantly more reserves than predicted by our model.

Next, focusing on India, we find that by 2007 India had accumulated more than $80 billion of excess reserves. We impute the costs of holding these reserves by considering various alternative use of the resources employed in building up reserves. The cost is substantial across all specifications, both in terms of actual income foregone as well as loss in terms of percentage of the GDP. India is losing more than 2% of its GDP by accumulating reserves instead of employing resources to increase the physical capital of the economy. Even if the resources absorbed in reserve accumulation were utilized to reduce the private sector's external commercial borrowing or public sector debt, India could gain more than 0.3% of the GDP.

Alternatively, RBI could well do to maintain an adequate level of reserves in the form of low return but highly liquid assets for meeting its needs like current account financing, meeting short term external debt obligations, restraining excessive volatility in the exchange rate etc., and park the excess reserves in an account with an objective of maximizing returns subject to acceptable risks. The funds in such an account could be profitably invested in non-treasury based assets like equities, private equity company and real estate, which are associated with greater market risk and hence correspondingly higher returns.

Such investments are not new as Singapore and Korea have been doing this for a number of years now. Singapore's Government Investment Corp. (GIC) and Korea Investment Corp. (KIC) in Korea have been investing a large part of their reserves in a variety of top-grade corporate and sovereign bonds, equities and real estate holdings spread across the globe. By investing $3 billion of its reserves with Blackstone, China has also initiated the move away from US treasuries to more profitable equity holdings. Other countries like Malaysia and Thailand are also examining ways of lowering their exposure to low yield US bonds.

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