# International Reserve-Holding in India: Self Insurance for Future?

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#### Abstract

The surge in international reserves holding in India has crossed prescribed limit suggested by the standard established benchmarks. The rule of thumb suggest in 2004-05, the excess reserves holding stood at fifty seven billion US dollar that marginally reduces to thirty two billion US dollar in 2005-06. This study, also analyzes the demand function of India' s reserves holdings with a large number of variables. Utilizing cointegration and VECM approach on Indian quarterly data, we find that most of these variables have significant impact on reserves demand of India. The analysis evidently explains that main purpose of reserves holding is precautionary. Further, higher economic growth provides a sense of confidence that encourages for lesser reserves demand, while capital flows and volatility in the external sector push up for more reserves piling.

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#### Introduction

At the end-March 1991 international reserves accumulation in India was less than six billion dollar but the liberalization in the India' s the external sector in the nineties has facilitated to a large capital inflows (mainly foreign investment, external commercial borrowings and banking capital), that finally helped to accumulate of huge foreign currency assets(FCA). In the recent years, one side this accumulation has given a sense of confidence in the external sector while another side the cost of holding of this huge reserves has been forcing Reserve Bank of India(RBI) to find some alternative for these accumulations. This circumstance has provided the opportunity to initiate a debate for the reason of huge reserves piling, the required level of reserves and use of excess of excess reserves accumulation.

The existing literature assigns various objectives for the holding of foreign exchange reserves. These motives are broadly divided in two parts-precautionary and mercantile motives. Precautionary motive reflects the desire for self-insurance against exposure to future sudden shocks and it encompasses both crisis prevention and crisis management (see Aizenman and Marion, 2003; Kim et al., 2005; Aizenman and Lee, 2005). Unrest could occur in currency market when capital outflows starts, sudden outward movement of capital may bring a shock in the country's exchange rate. To avoid the crisis, central bank could sell forex reserves and buy domestic asset. Kim et al. (2005) recognized three broad reasons of arising precautionary demand: (i) the ability to finance underlying payments imbalances; (ii) the ability to finance to provide liquidity in the face of run on the currency; and (iii) the prevention function of reducing the probability of the runs on the currency. The motive behind promoting export and FDI through reserve accumulation comes under mercantile motive (Calvo and Reinhart, 2002; Rajan, 2002; Dooley et al, 2003; Aizenman and Lee, 2005). Reserve accumulation can be used to keep the exchange rate favourable for export growth and it does encourage domestic employment. Many countries have used reserves for these purposes for example. China and East Asian countries (before 1997). Some commentators also added political vendettas behind the mercantile motives especially in the case of China (see Lindsay, 2003) However; several times it is difficult to distinguish the action taken by the central bank. For instance,

governments intervene in foreign exchange markets to dampen volatility and to slow or reverse currency movements. Their concern is that excessive short-term volatility and longer term swings in exchange rates that overshoot values justified by fundamental conditions may hurt their economies, both capital flows as well as international trade. Furthermore, most of the central banks keep both objectives in mind while hoarding reserves.

In recent years an important aspect of external transaction is private capital flows. Specially, short-term flows are risky in the case of abrupt reversal, exposing the developing country to greater hazard of a liquidity squeeze, occasionally leading to fullblown financial crises (Aizenman and Marion, 2003). Hording high level of reserves may prevent countries from this type of crisis. When private investors are putting upward pressure on the currency by buying domestic currency assets, the central bank can attempt to contain that pressure by selling domestic assets and buying foreign currency reserves. Similarly, when reverse gear of private capital flows threaten to weaken the currency, the central bank can sell reserves and buy domestic assets. However, it is unclear in the literature that how long a country can prevent crisis by reserves if macroeconomic fundamentals are weak? Sachs et al. (1996) argue sufficient level of reserves can compensate weak fundamentals.

A new motive of holding high levels of reserves has been observed after the East Asian crisis of 1997. The governments are opting to hold a relatively large pile of reserves if they believe that the populace is loss-averse. Aizenman and Marion, (2003), showed even when the return on domestic capital far exceeds the return on the safe asset; it still can be desirable for the government to hold large reserve balances if agents are loss-averse.

However, high degree of risk is involved in hoarding large international reserves. For instance, if the domestic currency appreciates against the dollar (or other reserve foreign currency) the country will lose the value of the asset in the national currency. To make up this currency loss, the government either has to increase taxation rate or reduce public spending. Another risk arises owning sterilized purchases of reserves, since there is no clear limit of sterilization a central bank may continue to issue new liabilities and allow net domestic asset to fall below zero. The central bank would have to pay very high price as this and this type of policy generally results in a fiscal loss because it involves

purchasing relatively low-yield foreign assets while issuing relatively high-yield domestic liabilities.

In India, Ramchandran (2004, 2006) has attempted estimated demand function for international reserves, by using GARCH model. The results suggested that the opportunity cost impacted reserve demand much stronger than reserve volatility. However, his studies neglected several important variables that could be impacting the reserve holding.

Since RBI international holding has crossed two hundred billion dollar in 2006-07, the cost of holding reserves has increased substantially. The motive behind this costly accumulation is still unclear. Therefore, it would be interesting to analyze the reserves requirement for India then what are the factors derives reserves demand in India. In this scenario, present study has attempted to analysis these issues with overcoming most of the problems existing in literature on the determination of reserves. In the present scenario a large number of economic factor affect the reserves demand. Hence our study includes several macroeconomic variables in the model building process. Since, most of the variables are non stationary in the nature; we employ cointegration and a Vector Error Correction Model (VECM).

Rest of the paper is organized as follow: in the section two, we determine India's foreign exchange reserves adequacy using standard reserves benchmarking and applying an established rule of thumb we have measured excess reserves stockpiling in India. Section three, presents a brief discussion of model specification, data source and methodology. In the section four, we discuss empirical results and conclusions and policy recommendations.

# Section II

#### Benchmarking Adequacy of the international reserves and India

The traditional logic behind holding reserves is to face an eventuality of Balance of Payment (BoP) crisis. Contemporary literature considers reserve-to-import (R/M ratio) a proper measure of reserve adequacy and three months prospective level of imports cover became rule of thumb to judgment (Fischer, 2001).

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Judging India's reserve on RM ratio since 1990-91, it looks very healthy except in economic crisis period of 1990-91, after that the reserves is always more than three months import coverage. (See table-3) Despite the simplicity in measuring the size of trade openness and that a country can do external transactions without any hindrance even in a case of complete cease of inflows and outflows (IMF, 2000). However, recent crisis and incidents reflect several weaknesses of this criterion, the recent surge of capital inflows has made capital account equally or even more important, the R/M ratio measurement completely neglects this aspect. Another problem with R/M ratio is that of fails to take into trade growth in the account (Bird and Rajan 2003). Although, Frenkel and Jovanovic (1981) attempted to make this criterion little bit more relevant through adding trend movement and stock adjustment, but failed to solve the core of problem of this measurement.

The economic crisis of South-East Asia in 1997 reflected the deficiency involved in measurement of R/M ratio. In the light of this, many authors emphasized that the excessive accumulation of short-term external debt(R/STED) in comparison with levels of international reserves was a common characteristic of these crises. Furman and Stiglitz (1998) and Radelet and Sachs (1998) focused on analyzing the importance of this variable in greater depth. They came to the conclusion that the international reserves/short-term external debt ratio was one of the determining factors of the Asian crises in the second half of the 1990s. A measure comparing reserves and short-term external debt is useful to gauge risks associated with adverse developments in international capital markets. Short term debt provides a measure of all debt repayments to nonresidents over the coming year and, as such, constitutes a useful measure of how quickly a country would be forced to adjust if it were cut off from external borrowing (IMF, 2000). Moreover, R/STED ratio also provides a useful indicator of the threshold at which the investors lose confidence (Bird and Rajan 2003). . It is widely recommended that countries should hold reserves for four to five quarters in advance. In India, Short term external debt (STD) hasn' tincreased since 1990-91, while foreign currency assets (FCA) have grown around hundred times. This has made R/STED ratio better in last decade. The ratio reveals that minimum chance of occurrence of currency crisis as the reserves are very high.

#### <Figure 4 about here>

Though R/STED ratio is considered superior to R/M ratio, it has its own deficiencies. Many economists criticized this criterion because it tells only about 'external condition' while widely neglect 'internal drain' (see De Beaudort Wijnhold and Kapteyn 2001). Calafell and Bosque(undated) pointed out the availability of statistics needed to estimate this indicator appropriately is limited, as recording private external debt is not mandatory in many countries and data on short external debt amortizations are published with a lag of several months. In addition, differences in the methodologies and coverage of external debt statistics in individual countries render comparative analysis difficult. Bird and Rajan (2003) state an other significant deficiency with R/STED ratio is that it failed to reflect the dynamic of currency crisis. They argued that an indicator should be designed in such a way that it allows sufficient time to policy makers to take appropriate steps and once it is realized.

As pointed out earlier, R/STED ratio completely neglects the 'internalcondition'; Reserve to Broad Money Supply(R/M3) ratio covers this deficiency. Money-based indicators of reserves provide a measure of the potential for resident-based capital flight from the currency. An unstable demand for money or the presence of a weak banking system indicates a greater probability of such capital flight. In these circumstances the ratio of reserves to broad money is a potentially useful indicator. A low and declining ratio is among the leading indicators of a currency crisis. In case of India, this indicator also confirms that the probability of financial and currency crisis has gone down significantly in recent years and reserves holding is more than the required limit.

However, R/M3 ratio is not a good indicator of reserve adequacy where demand of money supply is stable and financial markets are strong. Furthermore, it also doesn't give an idea about potential capital flight. Although, empirical evidence suggest that reserve - to-money and reserve –to-short term debt both are not only good indicators of reserve adequacy but also useful in crisis predication (for details see Calvo and Mendoza (1996) and Berg and Pattillo (1999)).

<Figure 5 about here>

# Measuring excess reserves for India

One rule of thumb is to hold foreign currency assets (FCA) equal to three months import coverage plus Short term debt in addition to thirty percent of foreign stock market holding. Using this benchmarking on the annual Indian data since 1990, reveals that in 1990-91, RBI had four billion dollar less reserve than the requirements. However, sudden surge in reserves holding brought it in a minor comfortable zone. But more than double growth in STED in 1992-93 periods again brought reserves holding in danger zone. FY 1993-94 observed sudden surge in FCA accumulation, which made it more than required (as prescribed by the rule of thumb) in the year and the trend continues after that. Our stress test suggests that in 2005-06, excess reserves holding has reached thirty three billion dollar. (See table 1)

<Figure 6 about here>

### Section III

## Empirical strategy and data issues

Following Ford and Huang(1994) Huang and Shen,(1999) and Badinger(2004) this study analyses the demand for international reserves in a cointegraion-error correction framework for India. Therefore, in the empirical study the following specification for the Long-run demand for international reserves is employed:

 $LRES_{t} = a_0 + a_1LGDP_t + a_2Limport_t + a_3LRES_{t-1} + a_4LMS_t + a_5STD + a_5Pinv + a_6$  var  $BoP + e_t$ 

Where LRES<sub>t</sub> is logged reserves of the current period, LGDP is logged Gross domestic product, LMS is logged money supply, STD is short run external debt, Pinv is Portfolio investment in India, varBoP is variability in the BOP. Since quarterly data of GDP isn't available for India since 1991, the study has substituted it with Index of industrial production (IIP). We have also added exchange rate volatility and opportunity cost of reserves holding in the model.

3. A. The *Empirical Strategy* 

In the empirical analysis, the study tests for the existence of a long-run relationship among the variables, while the using of the vector error-correction (VEC) model captures the short-run relationship between the variables. Our empirical analysis can be divided in three stages. The first stage verifies the order of integration of the variables since the various cointegration tests are valid only if the variables have the same order of integration. To find the degree of integration the study has conducted Dickey and Fuller (1979, 1981) (ADF) tests. In the second stage, the test for cointegration is conducted using the Johansen maximum likelihood approach (Johansen, 1988, Johansen and Juselius, 1990, 1992). Johansen' s methodology requires the estimation of the vector autoregression regression (VAR) models and the residuals are then used to compute two likelihood ratio (LR) test statistics that can be used in the determination of the unique cointegrating vectors of  $X_t$ . The first test statistics considers the hypothesis that the rank *of II is less t* han or equal to r the cointegrating vectors is given by the trace test below:

$$Trace = -T \sum_{i=r+1}^{n} \ln(1 - \lambda_i)$$

The second test statistic is known as the maximal eigenvalue test which computes the null hypothesis that there are exactly r cointegrating vectors in  $X_t$  and is given by:

$$\lambda_{\max} = -T \ln(1 - \lambda_r)$$

The distributions for these tests are not given by the usual chi-squared distributions. The asymptotic critical values for these likelihood ratio tests are calculated via numerical simulations (see Johansen and Juselius 1990; and Osterwald-Lenum 1992).

The third stage, the test for exogeneity of variables and examine the structural stability of the estimated relationship by utilizing VEC. Engle and Granger (1987) show that in the presence of cointegration there always exists a corresponding error correction representation which implies that changes in the dependent variable are a function of the level of disequilibrium in the cointegrating relationship, captured by the error-correction term (ECT), as well as changes in other explanatory variables to capture all short-term relations among variables.

#### 3. B. Data and its sources

The study has utilized quarterly data from 1990:2 to 2006:1(64 observations). India had faced financial crisis in 1990-91, and subsequent economic reform was initiated. This development has changed India' s reserves holding pattern completely, that is why the study has opted for 1990-91 as the starting year. Since the time span is too small to conduct a standard time series study on annual data, we use quarterly data. As both IIP and Money supply both are subject to seasonal effect, therefore they are seasonally adjusted. Details of variable formation are provided in Data Appendix.

### Section IV

#### Empirical Result

The ADF test for all variables presented in table-2. The ADF statistic suggests that all variables are integrated of order one, I (1), whereas the first differences are integrated of order zero, I (0). Therefore, the null hypothesis that the time series contain an autoregressive unit root is accepted for most of the variables.

### < Table 2 about here >

In the estimation procedure, we opted for unrestricted intercepts and no trends in the VAR estimation. Both of the test-statistics (max and trace) indicate six cointegrating vector at 5% significance level. The result of Johansen (1992) and Johansen and Juselius (1992) clearly shows a strong long run relationship between variables.

The normalized cointegration equation exhibits surprising result for India. LnIIP that is taken as an indicator of economic growth has negative relationship with reserves holding. It implies when the economy is performing well, its needs less reserves in long run and vice versa. This result is consistent with *Aizenman and Lee(2005)*. Import has found positively related with reserve demand that is consistent with economic theory. It exhibit that higher import bills forces the central bank to hold extra reserves for precautionary purposes. Another important variable that is found significant at five percent level is money supply and sign of the variable is negative. This may be because, RBI tries to

control the capital flows generated inflation. Other variables are not found significant at this stage.

#### < Table 3 about here >

#### < Table 4 about here >

In the adjustment process, all variables are found to be significant at 5% significant level. The result clearly indicates for no weakly exogenous variables, implies all variables in the model are taking part in the adjustment process to correct disequilibrium. Further, all variables are determined in the specified system itself.

#### < Table 5 about here >

### < Table 6 about here >

Table 6 presents the estimation results of VECM. The standard diagnostic tests for the significance of the regression (F-test) indicate that the models are correctly specified. The VECM explains the short run variation in the Indian international reserve movements. The result explains that most of variables are significant. Following the same trend as in the long run, industrial production has negative impact on reserves holding in the short run too. This noticeably explains that the higher growth rate of economy gives a confidence in the economy that lead to less holding of reserves for precautionary purposes. However, first lag is not found to be significant but second lag is significant at five percent level which reflects its take time in correction. Following the theory import has negative sign that may be because it hasn't been as taken seriously as portfolio investment in the current scenario. Further, this variable is a proxy for the marginal propensity to import in model, which should have negative effect on reserves under the Keynesian open economy model. Imports may not reflect indirect transactional requirement for reserves but the opposite flows of goods and money in and out of the country (Huang (1995) and Je Jo (2007)). The opportunity cost which is the cost of reserves holding, has negative significant impact on the reserves holding. This makes sense because higher cost of reserves holdings dampens the hoardings. Portfolio investment and Short term external debt variables signs are positives, this implies that highe values of them encourages for high reserves piling for precautionary purposes.

Volatility of the reserves (SDRES), variability in BOP (varBoP) and volatility in exchange rate (VOL\_XC) has positive impact on reserves hoarding, which is very obvious under precautionary motive for minimizing the macroeconomic risk.

### V.Conclusion

The surge in international holding in India has crossed prescribed limit suggested by the standard established benchmarking. The rule of thumb suggest in 2004-05 excess reserves holding touched to fifty seven billion US dollar that marginally reduces to thirty two billion US dollar in 2005-06. This study, also analyzed the demand function of India's reserves holdings with a large number of variables. Utilizing cointegration and VECM approach on Indian quarterly data, we found that Most of variables have significant impact on reserves demand in India. The analysis Cleary explains that main purpose of reserves holding is precautionary. Further, higher economic growth provides a sense of confidence that encourages for lesser reserves demand, while capital flows and volatility in the external sector push up for more reserves piling.

### **Policy suggestion**

Our measurement clearly suggests that, India is holding excess international reserves. Therefore, excess reserves should be used for alternative purposes, such as the recapitalsation of public sector banks, invest in overseas financial markets (like china), funding in development projects (like Taiwan), the repayment of costly external debt (like Russia) or setting up oil funds.

Our results confirm that variations in the balance of payments are cause of reserves holding in the short run. Therefore, authorities should make an attempt to minimize the imbalances in the BOP by taking other measures such as enhancing exports by ensuring quality and competitiveness, attracting more foreign direct investment by providing easy clearance and lower regulation with good infrastructure, so there is a reduction in balance of payments deficits in the future.

Other important result in short run reserves accumulation is Volatility in Reserves and Exchange rate; therefore policy makers should try to stabilize theses factors. Furthermore, it is unambiguous from result that India's reserves holding are mainly for precautionary purposes, since the accumulation of reserves is too high therefore it could be used for mercantile purposes too.

## **Data Appendix: Definitions of the Regression Variables**

India: quarterly data from 1990:2 to 2006:1

STD: Short term debt to India, Measured in million in U.S. dollars. (Source: Handbook of Statistics on Indian Economy, <u>http://rbi.org.in</u>)

LRES: log of international reserves holdings minus gold, Measured in million in U.S. dollars. (Source: IFS)

LIIP: log of Seasonally adjusted index of industrial production (IIP): (Source: Handbook of Statistics on Indian Economy, <u>http://rbi.org.in</u>)

LMS: log of Seasonally adjusted money supply (M3), Measured in Billion Rupees; (Source: IFS)

LIMPORT: log of Import, Measured in Billion Rupees; Measured in million in U.S. dollars. (Source: IFS)

VOL\_XC: exchange rate volatility, calculated from the monthly exchange rate against the U.S. dollar.

OPPURCOST: bank rate of India minus US discount rate (Source: IFS, 2007)

PINVT: net portfolio investment; Measured in million in U.S. dollars. (Source: Handbook of Statistics on Indian Economy, <u>http://rbi.org.in</u>)

SDRESEV: last twenty periods Standard Deviation of Reserves. (Source: IFS, 2007).

varBoP: variability in Balance of Payment, (Source: Handbook of Statistics on Indian Economy, <u>http://rbi.org.in</u>)

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#### APPENDIX (Tables and Diagrams)

### Table-1

Measurement of	excess reserves	in	India:	Stress	Test

year	Foreigner's Stock Investment	STED	Three Months Imports	FCA	Excess Reserve
1990-91	6	1753	4511	2236	-4034
1991-92	4	1900	3521	5631	206
1992-93	244	4190	3945	6434	-1945
1993-94	3958	3480	4388	15068	3242
1994-95	4402	3488	5682	20809	7237
1995-96	3456	4137	7287	17044	2164
1996-97	4953	7085	7274	22367	3055
1997-98	5573	7034	8330	25975	5038
1998-99	3225	4814	7455	29522	14028
1999-00	9951	6779	9265	35058	9063
2000-01	13619	11244	8722	39554	5969
2001-02	9259	5562	9353	51049	26875
2002-03	8833	5176	10943	71890	46938
2003-04	28218	11089	14395	107448	53746
2004-05	40536	17394	20418	135571	57223
2005-06	68115	19355	24613	145108	33025

Data source: Handbook of statistics, RBI, 2007-08, million US\$.and authors' calculation.

# Table 2

# Test for unit root applying Augmented Dickey-Fuller (ADF) Test

Variables	Test statistics	Optimal Lags	Test statistics	Optimal Lags
	(levels)	(AIC)	$(1^{st} difference)$	(AIC)
LRES	-1.004	8	$-2.845^{+}$	10
LIIP	-0.158	4	-3.096*	3
LIMPORT	-0.091	2	-8.613*	1
LMS	0.002	4	-3.511*	3
OPPURCOST	-1.267	2	-4.184*	1
PINVT	-2.836	1	-6.818*	2
SDRESEV	-2.303	3	$-2.689^{+}$	4
STD	-2.731	2	-6.571*	3
VOL_XC	-1.884	1	-5.645*	1
varBoP	-6.242*	1	-	-

\*significant at 5% level, + significant at 10% level.

 Table-3

 Table 3 : Unrestricted Cointegration Rank Test (Maximum Eigenvalue and Trace )

Null	Max-Eigen	Critical Value		Trace	Critical Value	P Value <sup>+</sup>
hypothesis	Statistic	(5 %)	P Value <sup>+</sup>	Statistic	(5 %)	
$\mathbf{r} = 0$	124.19*	64.50	0.0000	503.59*	239.23	0.0000
r≤1	111.85*	58.43	0.0000	379.39*	197.37	0.0000
$r \leq 2$	66.99*	52.36	0.0009	267.53*	159.52	0.0000
r≤3	64.83*	46.23	0.0002	200.54*	125.61	0.0000
r≤4	52.19*	40.07	0.0014	135.70*	95.75	0.0000
$r \leq 5$	46.11*	33.87	0.0011	83.50*	69.81	0.0027
r≤6	18.92	27.58	0.4202	37.39	47.85	0.3291
$r \leq 7$	12.18	21.13	0.5294	18.46	29.79	0.5315
$r \leq 8$	5.94	14.26	0.6202	6.28	15.49	0.6620
r≤9	0.33	3.84	0.5609	0.33	3.84	0.5609

Max-eigenvalueand Trace tests indicate for 6 cointegrating equations at the 0.05 level, <sup>+</sup> MacKinnon-Haug-Michelis (1999) p-values,

### Table-4

### Normalized cointegrating coefficients

	LRES	LIIP	LIMPORT	LMS	OPPURCOST	PINVT	SDRESEV	STD	VOL_XC	varBoP
Normalized	1	-6.626*	9.680*	-0.870*	-0.088	-0.0007	-0.0003	0.0002	-0.435	-0.0003
β										
SE		1.257	0.783	0.864	0.024	0.000	0.000	0.000	0.0336	0.000

\*significant at 5%level

### Table-5

Speed of adjustment coefficients and weak exogeneity

variables	$\alpha_{_{LRES}}$	$\alpha_{LIIP}$	$\alpha_{LIMPORT}$	$\alpha_{LMS}$	α <sub>oppurcost</sub>	$\alpha_{PINVT}$	$\alpha_{SDRES}$	$\alpha_{_{STD}}$	$\alpha_{VOL_XR}$	$\alpha_{_{VARBoP}}$
Normalized α	1	-6.626*	9.680*	-0.8701*	-0.088*	- 0.0007*	-0.0003*	0.0002*	-0.4357*	-0.0003*

\*significant at 5% level

## *Table-6* The result of VECM Dependent variable- LRES

variables	$\Delta$ lres	$\Delta$ LIIP	$\Delta$ LIMPORT	$\Delta$ LMS	$\Delta$ oppurcost	$\Delta$ pinvt	$\Delta$ SDRESEV	$\Delta$ STD	$\Delta$ VOL_XC	$\Delta$ varBoP
Lag 1	-0.1875	-0.2083	-0.4626	2.4379 <sup>+</sup>	-0.0316	$0.0001^{+}$	0.0002	0.0001*	$0.0474^{+}$	$0.00004^{+}$
Lag 2	0.2903*	-	-1.7454*	3.9959*	-0.1133*	0.000	-0.0002	0.000	0.0695*	0.00002*
		1.8391*								<u> </u>
$R^2$ : 0.662590, F-statistic: 2.805364										

\*significant at 5% level, + significant at 10% level





Source – World Development Indicators (WDI) Online.



Figure-2

Source – World Development Indicators (WDI) Online.

Figure-3

Source – Handbook of statistics, RBI, 2007-08, and Authors' calculation.





Source – Handbook of statistics, RBI, 2007-08, and Authors' calculation.



Source – Handbook of statistics, RBI, 2007-08, and Authors' calculation.

Figure-6

Source – Handbook of statistics, RBI, 2007-08, and Authors' calculation (Million \$)