

ESSAYS ON MONETARY AND EXCHANGE RATE EFFECTS IN INDIA

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## **DEDICATION**

This dissertation is dedicated to my loving husband Sekhar and my beautiful daughter Sahasra.

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## LIST OF ABBREVIATIONS

ADF	Augmented Dickey Fuller
AFC	Asian Financial Crisis
AIC	Akaike Information Criteria
ARDL	Autoregressive Distributed Lag Model
BCD	Bond-Currency- Derivatives
BoP	Balance of Payments
BPLR	Benchmark Prime Lending Rate
BRIC	Brazil, Russia, India and China
CAB	Current Account Balance
CAD	Current Account Deficit
CAS	Credit Authorization Scheme
CMR	Call Money Rate
CPI	Consumer Price Index
CRR	Cash Reserve Ratio
CSO	Central Statistical Organization
ECB	External Commercial Borrowing
ERPT	Exchange Rate Pass-through
EU	European Union
FDI	Foreign Direct Investment
FGLS	Feasible generalized least squares
FPI	Foreign Portfolio Investment
FRBM	Fiscal Responsibility and Budget Management Act
GDCF	Gross Domestic Capital Formation
GDP	Gross Domestic Product
GDS	Gross Domestic Savings
GFC	Global Financial Crisis
GMM	Generalized Method of Moments
GNI	Gross National Income
IFS	International Financial Statistics
IIP	Index of Industrial Production
IMF	International Monetary Fund
INR	Indian rupee
IRPT	Interest Rate Pass-Through
ISIC	International Standard Industrial Classification
LAF	Liquidity Adjustment Facility
LERMS	Liberalized Exchange Rate Management System

MSF	Marginal Standing Facility
NEER	Nominal Effective Exchange Rate
NRI	Non- Resident Indian
NSE	National Stock Exchange
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Square
OMO	Open Market Operation
PPI	Producer Price Index
PTM	Pricing to Market
RBI	Reserve Bank of India
REER	Real Effective Exchange Rate
SITC	Standard International Trade Classification
SLR	Statutory Liquidity Ratio
SUR	Seemingly Unrelated Regression
SVAR	Structural Vector Auto regression
TB	Treasury Bills
UAE	United Arab Emirates
UN	United Nations
USD	United States Dollar
VAR	Vector Auto Regression
VEC	Vector Error Correction
WPI	Wholesale Price Index

## **ABSTRACT**

ESSAYS ON MONETARY AND EXCHANGE RATE EFFECTS IN INDIA

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Since the liberalization of the Indian economy in 1991, the country has experienced sustained current account deficits as domestic savings rates, while rising, were still exceeded by domestic investment rates. However, these deficits were serviced by a massive influx of capital inflows, made possible by the removal or reduction of restrictions on foreign investments. These inflows also generated significant net demand for the Indian rupee, which in turn increased the pressures for an exchange rate appreciation. A natural consequence of such currency appreciation would have been a loss of export competitiveness and a widening of the country's trade deficit but for the active foreign exchange intervention of India's central bank, the Reserve Bank of India (RBI). This in turn led to a substantial build-up of India's foreign exchange reserves, which also created excess liquidity in the system. The resulting excess liquidity was absorbed by the RBI (so-called monetary sterilization) in order to prevent the rise of inflationary pressures. This absorption of excess liquidity went on until the Global Financial Crisis (GFC) of 2008-09 when there was a sudden reversal of capital flow.

Even though India recovered quickly from the GFC, net capital flows did not reach the pre-crisis levels, which had peaked at \$107.9 billion in 2007-08 (Sen Gupta & Sengupta, 2013). Pressures due to adverse global developments, along with domestic structural constraints, have also contributed to the declining capital inflows. The reduced flows, along with the widening current account deficit, worked in tandem to lead to downward pressures on the Indian rupee, which in turn contributed to inflationary pressures.

This dissertation addresses the impact of interest rate and exchange rate changes on the Indian economy. Chapter 2 examines the effectiveness of the monetary policy by estimating the impact of policy interest rate changes on the retail lending rates in the economy. Using ordinary least square (OLS) regressions for the period 2001m4 to 2010m11, data analysis finds a more than complete pass-through from the policy to money market rates but incomplete pass-through, both directly and indirectly into the retail lending rates. The analysis also identifies inflation, bank concentration, costs of the banks, credit-deposit ratio, and bank ownership as factors affecting the transmission of policy changes to lending rates in India.

Chapter 3 analyzes the inflationary impact of exchange rate changes by estimating the impact of changes in the Indian rupee on import prices in the economy. Using a VEC model on data from 2003m1 to 2013m3, Chapter 3 finds a more than complete exchange rate pass-through into Indian import prices in the short run and even higher pass-through in the long run, indicating the inertial effect of rising prices. There is also evidence of non-linearities in exchange rate pass-through in terms of slight differences in the impact

of an appreciation, versus a depreciation as well as small-versus-large changes in the rupee value.

Chapter 4 investigates the effectiveness of exchange rate changes on trade competitiveness by estimating the impact of changes in the Indian rupee on the country's trade balance. The impact of these exchange rate changes on the trade balance is conventionally captured through the "J-curve effect," which states that the trade balance initially deteriorates following a currency depreciation before it improves. Using Pesaran et al.'s bounds testing approach on data over the period 2001m4 to 2013m3, the chapter finds that a real exchange rate depreciation leads to a positive impact on the trade balance in the long run - both at the aggregate as well as disaggregated bilateral and sectoral levels.

The analysis presented in this dissertation sheds light on the effectiveness of monetary policy in India as well as the impact that exchange rate changes have on imported inflation and the trade balance. These results and the proposed policy solutions might be relevant to the country as it deals with ongoing issues such as trade and current account deficits while trying to restore growth to its pre-crisis levels and keeping inflation under control.

## **CHAPTER 1. INTRODUCTION: OVERVIEW OF INDIA'S MACROECONOMIC ENVIRONMENT AND POLICIES**

Having originated in the advanced economies, the Global Financial Crisis (hereafter GFC) of 2008-09 spread to the rest of the world, including emerging markets and developing countries. The impact on the emerging markets, especially of Asia, though not as severe as that in the advanced countries, was still quite significant. Despite being affected by the GFC, India was also able to bounce back relatively quickly from the crisis, mainly because the country was driven by domestic demand and was less reliant on the export sector for its growth compared to some of the other East Asian economies (Bosworth et al., 2006). The country withstood the crisis initially, but could not remain unaffected for long (especially after the collapse of Lehman Brothers), given that it had a high level of integration with the rest of the world. India was affected by the GFC through the financial, real and the confidence channels (Patnaik & Shah; 2010a; Sinha, 2012). The Indian financial markets (equity, foreign exchange and credit) were the first to be hit by the crisis, which later spread to the real sector, as reflected in the moderation of growth from a high of around 9 percent before the crisis to 6.8 percent during 2008-09 (MoF, 2012; Subbarao, 2009).

India's central bank, the Reserve Bank of India (RBI), resorted to conventional and unconventional monetary policy measures to deal with the crisis. It tried to augment domestic and foreign exchange liquidity through a sharp reduction in the policy rates as

well as the liquidity adjustment facility (LAF), open market operations (OMO), cash reserve ratio (CRR) (Mohanty, 2011a). The aggressive intervention by the RBI helped the financial markets and the banking sector return to normalcy; real GDP growth quickly bounced back to 8 percent and 8.5 percent in 2009-10 and 2010-11 respectively, confirming the V-shape growth hypothesis for India (Figure 1.1) (Mohanty, 2011a; Sinha, 2012; Virmani, 2012). Even though it was felt by many economists that Indian business cycles exhibited co-movement with the business cycles in the industrial countries prior to the GFC, India continued to grow despite a slump in the industrial countries (Ghate et al., 2011; Jayaram et al., 2009; Patnaik, 2013a).

However, this bounce-back after the GFC was short-lived as growth slowed down to a little above 5 percent during 2012-13, with India's inflation and fiscal deficit becoming among the highest for emerging markets (IMF, 2013). Apart from cyclical and global factors, India's structural constraints and uncertain policy environment contributed to negative growth-inflation dynamics. One of the main constraints on growth has been "*infrastructural bottlenecks*," particularly in the power and mining sectors, which has led to a slowdown in industrial growth, in turn leading to pressure on the economy as a whole. The policy uncertainty on the tax front, coupled with a loose fiscal policy, reduced foreign investor interest in India.<sup>1</sup> This policy uncertainty, along with uncertainty about infrastructure and large scale investment projects due to regulatory issues, contributed to

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<sup>1</sup> The tax measures presented in the Budget of 2012-13 increased the tax net to bring in previously excluded elements which were considered offshore. These measures reduced the investor confidence in India. (IMF, 2013)

the slower growth along with growing macroeconomic imbalances (Goyal, 2013a; IMF, 2013; Patnaik, 2013a; RBI, 2013a).

The post-GFC growth slowdown notwithstanding, the turnaround of the country from being a low-income country to a high-growth emerging market since its liberalization in 1991 warrants discussion of India's broader macroeconomic environment and policies. Section 1.1 will focus on the macro growth story of India. Section 1.2 discusses India's balance of payment dynamics. Section 1.3 focuses on the evolution of monetary policy and the monetary framework and operating procedure of the RBI. Exchange rate policies and their impact, as well as the exchange rate regime, are discussed in Section 1.4. The final section provides some concluding remarks.

## **1.1 Background--Indian Macro Growth Story in Brief**

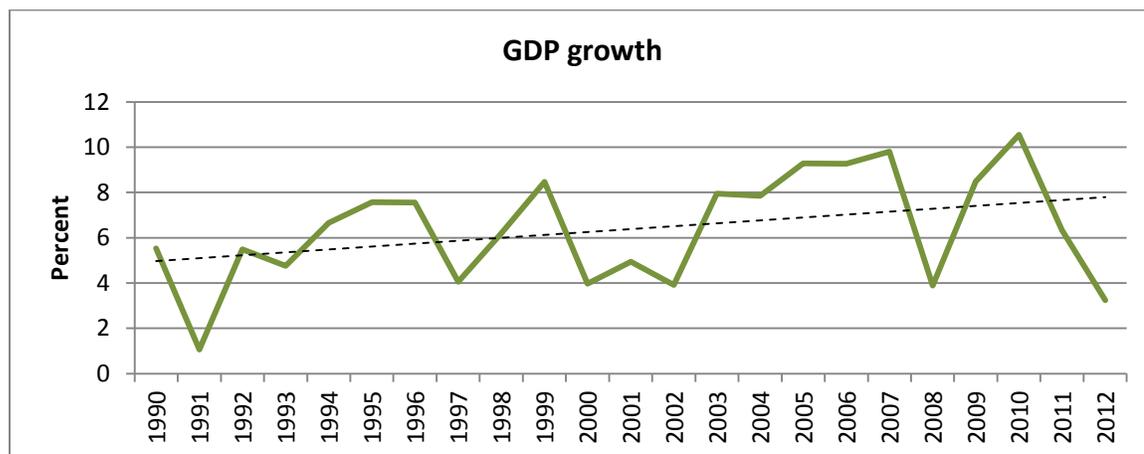
### **1.1.1 Growth**

Indian growth took off after its economic liberalization in 1991 (Figure 1.1).<sup>2</sup> India started the decade of the 1990s with a balance of payments (BoP) crisis. The crisis was caused by weak fundamentals in the economy since mid-1980s, particularly large fiscal and current account deficits (CAD). The CAD widened in this period due to a policy change of moving away from autarky and import substitution, which had been India's growth strategy since its independence, towards export-led growth. Exports

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<sup>2</sup> The turnaround in Indian growth has been a matter of contention, with extensive debate on when Indian growth took off. Ghate and Wright (2008), Rodrik and Subramanian (2005), Balakrishnan and Parameswaran (2007) estimate the turnaround point to be around 1980; Virmani (2012), Panagariya (2004) argue that Indian growth was more sustainable and stable only after 1992-93.

started to grow robustly, but imports rose even faster, especially given the rising demand for petroleum products.



Source: World Development Indicators

**Figure 1.1 Gross Domestic Product (% growth)**

From a savings and investment perspective, while gross domestic savings rose (from 18.5 percent in 1985 to 23 percent in 1990), gross domestic capital formation rose more sharply (20.6 percent in 1985 to 26 percent in 1990), leading to growing CAD. The rising CAD could not be met by the concessional finance available to the country, and therefore India resorted to external commercial borrowing (ECB). India's external debt rose to around 38 percent of its gross national income (GNI) by 1990, from around 11.5 percent in 1980. These developments made India vulnerable to shocks due to the rising CAD and increasing reliance on external commercial debt (Cerra & Saxena, 2002; Mohan, 2008; Saraogi, 2006; Sen Gupta & Sengupta, 2013).

Against the background of growing vulnerability, the trigger for the BoP crisis of the early 1990s was the rise in oil prices caused by unrest in the Middle East (the Iraqi–Kuwait war), which was compounded by the fragile political situation in India. Remittances declined as a result of the war in the Middle East, and so did exports due to a slower growth in the U.S., which was India’s most important trading partner after the European Union (EU) (constituting around 15 percent of India’s total exports in 1990–91). These factors led to a decline in investor confidence, resulting in a downgrade of India by the credit rating agencies, which added to the capital account problems. This downgrade in turn contributed to the already weakening BoP position by encouraging outflows and discouraging inflows into the country. The country was on the verge of a default, with reserves sufficient for only three weeks of imports. (Cerra & Saxena, 2002).

However, swift action was taken to resolve the crisis, and within two fiscal years (1991–92 and 1992–93), the country managed to emerge from the crisis. India undertook a combination of devaluation, deflation, and borrowing from the IMF to deal with the crisis. The rupee was devalued twice in July 1991 to deal with the withdrawal of reserves so as to instill confidence in the investors and improve domestic competitiveness (Ghosh, 2006). The Indian government initiated a process of economic reforms along with macroeconomic stabilization. With regard specifically to external liberalization, the Rangarajan Committee of 1991, set up to recommend reforms after the crisis, suggested the following: encouraging current account convertibility by liberalizing current account transactions, selectively liberalizing the capital account, focusing on encouraging long-term flows, and discouraging short-term debt and volatile flows. As part of these reforms,

Foreign Direct Investment (FDI) was opened up for domestic and foreign firms, while portfolio flows were opened up only for foreigners, ECBs were regulated, volatile elements of flows from non-resident Indians (NRIs) were discouraged, and there was a gradual liberalization of outflows and disintermediation of the government in the flow of external assistance (Shah & Patnaik, 2007).

The reforms undertaken after the crisis led to a change in the structure of the Indian economy. Unlike in the other emerging markets, where the manufacturing sector led the change, in India the services sector became a major driver of growth, particularly due to the opening of the current and capital account and the rising importance of international trade. This sector contributed to more than 55 percent of the GDP and thereby to the overall growth of the economy by 2000.<sup>3</sup> Even within the services sector, the tradables have grown faster in comparison to non-tradables. Despite the move towards services from agriculture, the share of employment in the agriculture sector has not declined commensurate with the decline in the share of this sector, implying declining productivity in the agricultural sector. To sustain the growth that India has achieved so far, it is essential to ensure that labor moves out of agriculture into both the services and manufacturing sectors (Eichengreen & Gupta, 2011; Kotwal et al., 2011; Bosworth et al., 2006). Greater trade and financial openness is found to have been responsible for the strong economic performance of the country since the reforms of early 1990s (Pradhan, 2010).

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<sup>3</sup> One reason for this increased contribution of the services sector is the fact that productivity in this sector has also experienced substantial growth as compared to the agriculture and manufacturing sector. It has also been established that productivity in manufacturing follows a J-curve pattern and India had just started to enter the rising portion of the curve when the GFC struck (Bosworth et al., 2006; Virmani and Hashim, 2011).

The period since 1991 can be divided into three phases of growth: (1) 1992-2003, when the country was recovering from the BoP crisis with an average GDP growth of little less than 6 percent; (2) 2003-2008, a period of high growth for India with average growth rates near 8.5 percent; and (3) a slowdown triggered by the GFC, when growth slowed to around 6.5 percent (Mohanty, 2012a; WDI, 2013). Total trade for India as a percentage of GDP tripled from around 14 percent in 1991 to 42 percent by 2012. This period also witnessed an increase in the capital flows, with net capital inflows more than doubling from around 2 percent in 1990s to above 4 percent of GDP during the high growth period of 2004-08. The openness of the Indian economy has been accompanied by an improvement in India's external position, as the foreign debt to GDP ratio fell from about 29 percent in the 1990s to around 18.5 percent by 2010; the debt service ratio also dropped from 26 to 5 percent during the same period. Prices remained stable till the beginning of the GFC, with both the wholesale price index (WPI) and consumer price index (CPI) inflation reducing from an average of around 8 percent in the 1990s to around 5.5 percent in the 2000s. However, India has experienced double-digit CPI inflation since the beginning of the GFC and the WPI also increased to over 7 percent (Mohanty, 2012a; WDI, 2013).

Even though the reforms enacted in the 1990s led to an improvement in efficiency, the growth impacts occurred with a long and variable lag and did not bear fruit until the early 2000s. Several reasons have been identified for this pattern. Most of the reforms enacted during this period, such as the tax reforms, related to efficiency improving with lagged effects on growth. Second, along with these reforms, the ensuing

market reforms, which would have led to an increase in the access to the means required to improve growth, were not implemented. Third, total factor productivity (TFP) followed a J-curve pattern, with an initial deterioration followed by an improvement over the long term. This pattern was due to the adjustment of the distorted prices based on protection to the industries until the 1990s, reduction in capacity utilization of unprofitable product lines, and gestation lags in investment in the newly profitable product lines (Virmani, 2012). This dissertation examines the effects of the monetary and exchange rate changes from the early 2000s, a period that corresponds with India's high growth.

As noted, it was initially assumed that the impact of GFC on India would not be too severe, as Indian growth was mainly driven by domestic demand and also because of the lack of U.S. toxic assets in Indian balance sheets. However, things changed with the collapse of the Lehman Brothers in September 2008. This change was because the crisis, which initially began as a localized sub-prime crisis, soon spread to the different sectors of the economy and countries of the world given the high level of trade and financial integration. For the same reason, India, which was not as severely impacted during the Asian Financial Crisis (AFC), was hit more during the GFC as its integration with international markets increased. This increased openness is well captured by the ratio of total external transactions (gross current account plus capital account flows) to GDP—an indicator of both trade and financial integration—which went up almost by a factor of three from 44 percent in 1998-99 to around 112 per cent in 2008-09 (Patnaik & Shah, 2010a).

India was mainly impacted by the GFC due to the freezing of the global credit markets, which hurt Indian corporations that had come to rely on the cheap credit available in the international markets to fund their expansions. These firms turned to domestic bank and non-bank sectors to bail them out, which ultimately led to a massive squeezing of credit in the domestic markets leading to a rise in the call money rate and a fall in the Indian equity market. The financial sector's troubles spilled over into the trade sector, and with the curtailed demand and supply of goods and the sharp decline in asset prices, along with increased cost of credit, this had an impact on industrial production and exports from India and finally brought about a slowdown in the GDP (Patnaik & Shah, 2010a; Sinha, 2012).

### **1.1.2 Inflation**

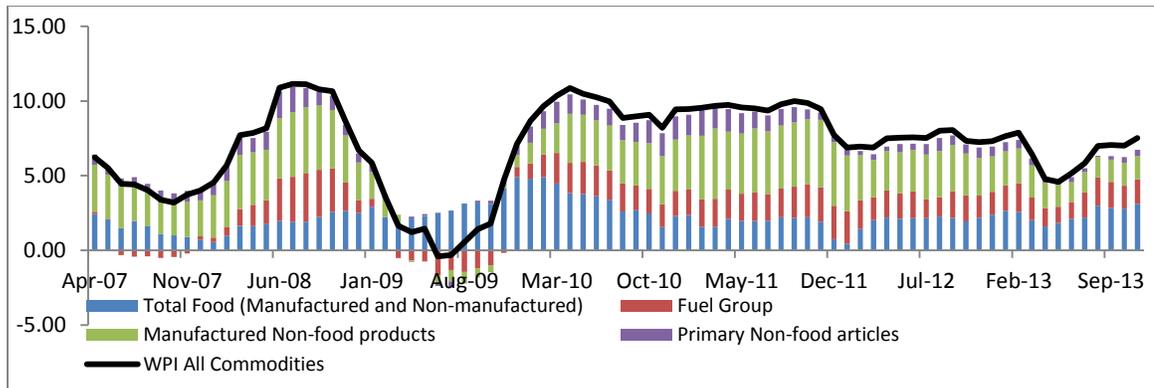
Another feature of this period, particularly since 2007, has been the high level of inflation in the country in comparison to the other emerging markets as well as developed countries, which had deflationary pressures. Inflation in India has been rising since 2007, with frequent episodes of double-digit inflation since 2010. Inflationary pressures have remained elevated since then, with a slight moderation in 2012. The inflationary problem in India has been due to pressures that have built up over the years related to the gap between demand and supply, with supply not catching up to the rising demand. India has been a severely supply-constrained economy, in the sense that an almost horizontal supply curve (rather than the traditional vertical supply) is subject to frequent cost shocks; in such an economy, price pressures are more exaggerated (Goyal, 2012a; Kocchar, 2011). Though some amount of inflation is necessary for growth, the current

levels in India are above the comfort level of the RBI, which is estimated at between 5-5.5 percent (Patel, 2012). The inflationary problem became particularly acute during 2010, when inflation was around 11 percent during the first half of that year. Since 2010, episodes of double-digit inflation (mainly driven by food and fuel inflation) have become common, with only a slight moderation for a few months in 2012 to around 7.5 percent.<sup>4</sup>

A further cause of rising inflation is rooted in the high dependence on rains for agriculture as well as supply chain rigidities in terms of lack of adequate warehousing and storage facilities. Rising global commodity prices, especially of food, primary commodities, and metals due to quantitative easing in many of the advanced countries to deal with the GFC were passed through to the Indian prices during 2010. As can be seen in figure 1.2, total food prices have had the maximum contribution to overall inflation during this period. The RBI was successful in easing inflationary pressures by 2012. However, supply shocks, particularly from oil and food prices since May 2013, reversed these efforts, causing a rise in inflation and inflationary expectations even as there was an easing of pressure due to non-food manufactured products (Goyal, 2013a). Oil and food prices contributed to around 87 percent of the rise in the WPI index in the first quarter of 2013-14 (RBI, 2012; RBI, 2013a). The problem of inflation has been compounded by exchange rate depreciation, leading to higher pass-through into the domestic prices (discussed in chapter 3).

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<sup>4</sup> After moderating for a few months after the GFC, inflation began to rise again in the second half of 2013, particularly on food and fuel inflation, and was 11.24 percent as of November 2013. Within the primary articles, it is the food prices that led the rise in inflation, accounting for almost 60 percent of the WPI increase (OEA, various issues).



Source: Office of the Economic Adviser, Ministry of Commerce and Industry, GOI

**Figure 1.2 Contribution of Various Components in WPI (year-on-year percent change)**

### 1.1.2.1 Inflation Targeting

The RBI has the twin objectives of output growth and price stability. With respect to economic growth, the aim is to provide adequate credit to the productive sectors of the economy so as to support aggregate demand and promote growth (Rangarajan, 1996). With regard to inflation, the objective is to preserve the purchasing power of the rupee and contain inflation in the range of 4-6 percent, which has been considered to be the threshold level of inflation for the country with a target level of five percent (Mohanty, 2011a, 2011c).

Though India has price stability as an objective, it did not choose inflation targeting as a monetary policy framework, unlike some of the developing countries. Mohan (2006) summarizes the reasons for this: the RBI had not considered the inflation targeting framework so far as India was considered to be a moderate inflation country for the most part since its independence in 1947, with only nine episodes of double-digit

inflation lasting more than five months since 1952. Adoption of inflation targeting requires efficient monetary transmission mechanisms through the operation of efficient financial markets and absence of interest rate distortions. In India, even though the money market, government debt market, and the foreign exchange markets have developed in the last couple of decades, they can still not be considered as completely efficient. Interest rate deregulation has been accomplished, but administered rates still persist. In addition, the choice of a universally acceptable measure of inflation becomes difficult for a diverse country like India, which has various regional differences as well as differences in the factor and product markets between regions. Measurement of inflation has been identified as a major problem by the RBI for monetary policy making. While the CPI is a better gauge of household inflation, the WPI is preferred over the CPI in India due to its higher frequency of availability—on a weekly basis, its coverage as well as its availability at a disaggregate level. On the other hand, the problem with WPI is that it does not include services. It follows fixed weights for the various categories of products, even as there are structural changes taking place in the Indian economy and a majority of the products included in WPI are tradable goods, the prices of which are determined in the international markets. Even though the CPI is available less frequently, it accurately reflects the consumption bundle of households, includes price of services, and is a better measure in the sense that it includes a large share of non-tradables, prices of which are determined in the domestic markets (Patnaik et al., 2011).

However, given the rising inflationary pressures since 2010, there is renewed focus on adopting an inflation targeting regime as a policy framework. It has been

emphasized by proponents of inflation targeting framework that countries which adopt an inflation targeting regime have performed better on macroeconomic variables like output and inflation (Patnaik, 2013a). It has been argued that adopting an inflation targeting framework might not be too different from the current monetary policy framework, as the RBI already has a medium term inflation target of around 5 percent (Rajan & Cavoli, 2009).<sup>5</sup>

## **1.2 Balance of Payments**

### **1.2.1 Current Account**

Moving beyond the general growth-inflation concerns, with the opening up since 1991, India has been exposed to greater potential vulnerabilities on account of its external sector. The impact of the opening up of the Indian economy led to a manifold increase in exports and imports starting in the early 1990s. On average, imports increased from 8.5 to 27 percent of GDP between 1990-91 and 2012-13, while exports rose from around 6 to 16 percent during the same period. India's merchandise trade balance has been in deficit since 1950; however the deficit has been particularly high since 2003-04, corresponding to the country's high growth phase (Figure 1.3). The main reason for the trade deficit and overall current account deficit (CAD) has been the rising global prices of oil and food and more recently gold. India relies heavily on imports of oil and gold to meet its consumption needs.<sup>6</sup> Oil imports doubled from 4 to 8 percent of GDP between 2004-05

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<sup>5</sup> For a more elaborate discussion on inflation targeting in India, see Jha (2008), Singh (2006), Kannan (1999)

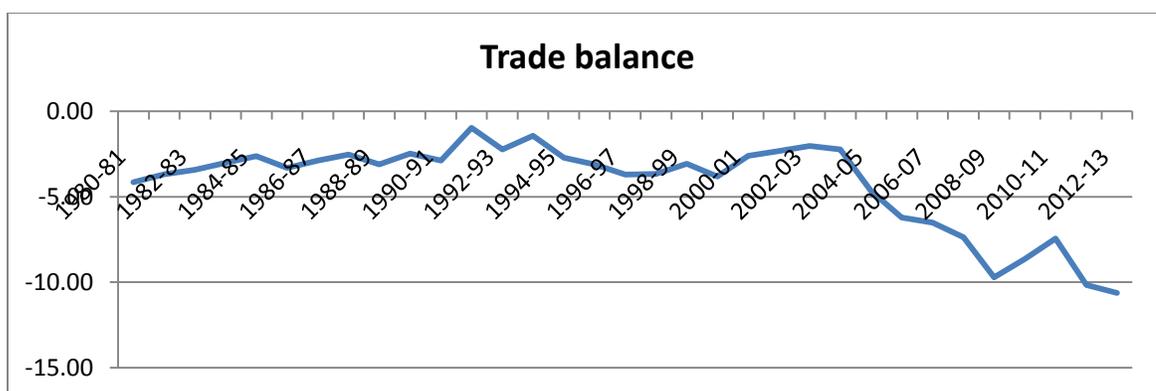
and 2011-12, while gold imports increased from 1.5 to 2.5 percent of GDP (Mishra and Rangarajan, 2013). Inelastic demand for oil imports, especially given the industrial growth along with “absence of local pass-through,” is one of the most important reasons for the deficit on the trade account along with gold, the demand for which was high in the “absence of inflation hedges” (Goyal, 2013b)<sup>7</sup>. Excluding oil and gold, India’s trade account has shown a surplus since 2000. In 2013, several restrictions were imposed on imports of gold, which helped reduce its imports and improve the trade and current account balance.<sup>8</sup> Total gold imports for Q2 2013 fell, leading to an improvement in the current account deficit to 1.2 percent of GDP from 5 percent of GDP in 2013 (Acharya, 2013; Kalra, 2013; PTI, 2013a).

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<sup>6</sup> India imports around 80 percent of its total oil consumption (Reuters, 2012).

<sup>7</sup> The reason for holding gold as an inflation hedge is the lack of financial instruments and savings schemes (customized to provide hedges against inflation) that provide flexible liquidity options along with providing a real rate of return to investors above the inflation rate. (RBI, 2013b) The common inflation hedges are inflation indexed bonds and foreign investments. However, India did not have inflation indexed bonds until December 2013, and individuals are not allowed to freely invest in foreign investments due to the lack of complete capital account convertibility, though corporations are allowed to a certain extent, which in turn ties in to the underdevelopment of financial markets (Razafimahefa, 2012).

<sup>8</sup> Restrictions imposed on gold were as follows, raising import tax from 2 percent in January to 15 percent in September 2013, requiring banks to ensure that at least 20 percent of the gold imports are made available for exports and a similar amount held with the customs bonded warehouses, restricting loans against gold jewelry and coins, restricting imports of gold in the form of coins and medallion without a license.



Source: RBI Handbook of Statistics on the Indian Economy

**Figure 1.3 Merchandise Trade Balance<sup>9</sup>**

Though merchandise trade contributed to the deficit on the current account, invisible inflows kept the current account from worsening to the same extent as the trade account, at least until 2011-12<sup>10</sup>. The fact that the current account was not affected to the same extent as the trade account is reflected in India's CAD, which was more or less in balance for most part of the period since 1980 and registered a surplus between 2000 and 2004 before experiencing a sustained worsening until 2011-12 to 3.6 percent of the GDP (RBI, 2013). Within invisible inflows, remittances have been relatively stable throughout the period since the 1990s. The counter-cyclical nature of remittances helps retain their stability even when other forms of capital flows experience sharp reversals, which makes them important macroeconomic stabilizers during a slowdown<sup>11</sup> (Mishra & Rangarajan,

<sup>9</sup> Merchandise trade balance inclusive of oil and gold.

<sup>10</sup> Invisible inflows include net service receipts, income from financial assets, labor and property and remittances. (RBI, 2006)

<sup>11</sup> Some of the advantages of encouraging remittances are that they ease the pressure on the BoP, particularly when foreign investors exit the domestic markets, which has been the case since 2008. Another

2013). Remittance inflows increased from 0.7 percent of GDP in 1990 to 3.6 percent in 2012 (see Ratha et al., 2013).

From a macroeconomic perspective, the current account is a reflection of the savings and investment in the economy. For India, savings (measured as the gross domestic savings or GDS) increased at a rapid pace, particularly since the early 2000s—from an average of 13.5 percent during 1950-80 to 31 percent of GDP since 2000. All three components of savings—household, private corporate, and public savings—witnessed an increase during this period. Within these, household savings has been the most stable component, particularly since 1990, when they averaged around 20 percent of GDP. Private corporate savings witnessed an increase from 3 to 7 percent of GDP between 1990 and 2012. Public sector savings have been the most volatile component of savings, fluctuating to a negative percent of GDP from 1998-2003, before steadily increasing to 5 percent of GDP until the onset of the GFC. The volatility in the public savings is a result of reforms in the taxation system, when indirect taxes were reduced substantially, which lowered government revenues affecting public savings during 1997-02 (Mohan, 2008). The GFC led to a drop in the savings rate from 37 percent in 2007-08 to 32 percent of GDP the next year. Despite an improvement over the next couple of years, the GDS fell sharply to 31 percent of GDP in 2011-12. The fall in total savings was primarily due to a huge drop in public savings (from 5 percent of GDP in 2007-08 to 1.3 percent by 2011-12) due to the rising fiscal deficit of the government (Figure 1.4).

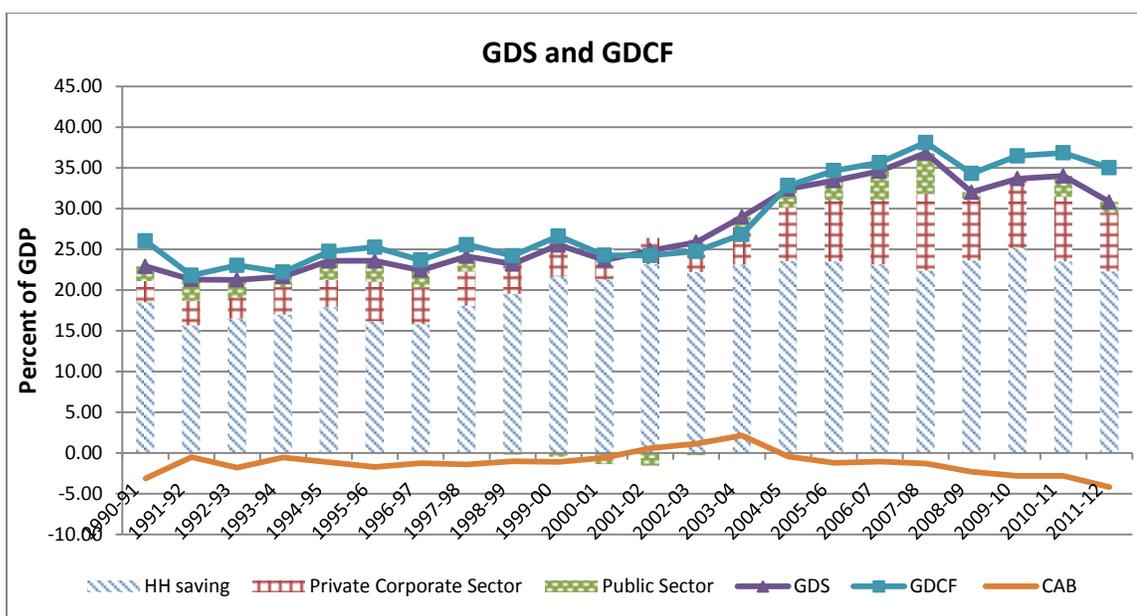
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advantage with remittances is that they do not create any future liabilities such as debt servicing (ET, 2011; World Bank, 2011).

The rise in the gross savings rate was matched by a similar rise in gross investment rate (measured by the gross domestic capital formation, GDCF), with an acceleration in investment in the post-AFC period. In fact, GDCF has been greater than GDS for most of the period. GDCF increased from an average of 15 from 1950-80 to 23 percent until 2000, before jumping to 32 percent between 2000 and 2011. The higher growth in the investment rate prior to the GFC was largely due to the capital inflows driven by foreign direct investment (FDI) flows (Seth, 2011). GDCF witnessed a decline in 2011-12 as an aftermath of the crisis, but the decline was aggravated by domestic constraints such as infrastructural bottlenecks, delays in project implementation, regulatory uncertainty, etc. (IMF, 2013). The GDS and GDCF have displayed a high degree of correlation for the whole period (around 0.99). The results of a cointegration analysis suggest that savings and investment are cointegrated and that in the short run a one unit change in savings leads to more than a unit change in investment, while a one-unit change in investment leads to a 0.75 change in the savings. (Annex 1.1 presents the cointegration analysis of savings and investment.)<sup>12</sup>.

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<sup>12</sup> For a discussion of the saving, investment, and growth nexus in India, see Verma (2007), Mohan (2008), and Jangili (2011)



Source: RBI Handbook of Statistics on the Indian Economy

**Figure 1.4 Gross Savings and Investment in India**

### 1.2.2 Capital Account

From 1992 until the GFC, India was able to finance its CAD relatively easily due to fairly large capital inflows. In fact, capital account surpluses in India far exceeded CADs, resulting in massive accumulations of foreign exchange reserves, with a general upward pressure on the INR until the GFC (Joshi & Sanyal, 2004).<sup>13</sup> The net capital inflows were facilitated by a policy of gradual and calibrated opening of the capital account. Non-residents have been granted a considerable degree of convertibility, while residents do not have the same degree of freedom. Even within residents, the corporates

<sup>13</sup> Discussed further in Section 1.3 below.

have the most freedom to invest abroad, followed by financial intermediaries and resident individuals (Mohanty, 2012a).

While encouraging capital flows from abroad, emphasis was placed on changing the composition of the flows from debt to non-debt, creating flows and within-the-debt flows, to longer-term flows in comparison to the short-term flows. This emphasis led to a change in the composition of inflows from the dominance of external financing in the 1990s to foreign investment in the late 2000s (Mohanty, 2012a). Within foreign investment, FDI is considered to be more stable, while foreign portfolio investment (FPI) is generally more unstable and volatile and can be withdrawn at the slightest hint of trouble, destabilizing the economy (Hattari & Rajan, 2011). Since the reforms of 1991, FDI flows have been encouraged, and the norms governing these flows were liberalized gradually. Currently, except for a few sectors such as real estate, atomic energy, agricultural business, FDI is allowed in almost all the sectors<sup>14</sup> (DIPP, 2013; Sen Gupta & Sengupta, 2013). FPI was allowed into both the equity and debt markets, and limits to equity investment were raised periodically after 1993.<sup>15</sup> Despite the global conditions and the Indian macroeconomic situation, FPI flows increased 31 percent year on year, taking their investment in India's biggest 500 companies to the highest level ever at 21 percent (Hutchison et al., 2010; IBEF, 2013). In addition to allowing FDI and FPI flows into the

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<sup>14</sup> 100 percent FDI is allowed in airports (Greenfield projects), atomic minerals, information technology services, manufacturing, drug, pharmaceuticals and chemicals, non-bank financial companies, power, wholesale cash and carry trading, special economic zones (SEZs), and more recently telecom; FDI is limited to 74 percent in private banks, 49 percent in single brand retailing through the automatic route, 49 percent in insurance and petroleum refining, over 26 percent in defense on a case by case basis and 20 percent in radio.

<sup>15</sup> FPI of up to 24 percent of the paid up capital of the Indian company and 10 percent for non-resident Indians (NRI) and persons of Indian origin (PIO) are allowed.

country, ECBs--especially short term debt—were regulated, because of the problems caused prior to 1991.<sup>16</sup>

As can be seen in Table 1.1, capital flows to and from the country mimic the growth story of the Indian economy. Capital flows were the highest during the high-growth periods at around six percent of GDP, with foreign portfolio investment (FPI) flows at around 1.5 percent of GDP and foreign direct investment (FDI) and other capital flows<sup>17</sup> at 0.7 and 0.4 percent, respectively. During the period from 1992-2003, total flows were lower, with both FDI and FPI flows around the 0.5 percent mark, while other capital flows were almost negligible. Total flows were lower in the period after the GFC due to the outflows of other capital from the country, even as FDI and FPI flows remained stable at around one percent of GDP.

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<sup>16</sup> ECBs faced a minimum average maturity of 3 years (up to U.S. \$20 million) in 2000 which was raised to 5 years (U.S.\$20-500 million) by 2004. The norms were relaxed further so that Indian companies could avail ECBs of an additional amount of U.S. \$250 million with an average maturity of more than 10 years. This limit is to be over and above the existing limit of USD 500 million during a financial year (Hutchison et al., 2012; Mohan & Kapur, 2009).

<sup>17</sup> Other capital flows includes external commercial borrowing (ECB), rupee debt service and non-resident Indian deposits

**Table 1.1 Current and Capital Account during 1992-2012**

Period	(% of GDP)		
	1992-2003 (Recovery)	2004-08 (High Growth)	2008-2012 (GFC and post GFC)
GDP growth (percent change)	5.8	8.7	6.5
Current Account Deficit (percent of GDP)	0.6	0.5	3.4
Capital Flows (percent of GDP)	2.2	5.7	3.2
1. FDI	0.6	0.7	1.1
2. FPI	0.6	1.4	1.1
3. Other capital flows	0.1	0.4	-1.1
Foreign Exchange Reserves (percent of GDP)	1.6	4.6	0.1
NEER <sup>18</sup> (percent change)	-1.22	1.30	-5.51

Sources: RBI Handbook of Statistics on Indian Economy; Mohanty, (2011a)

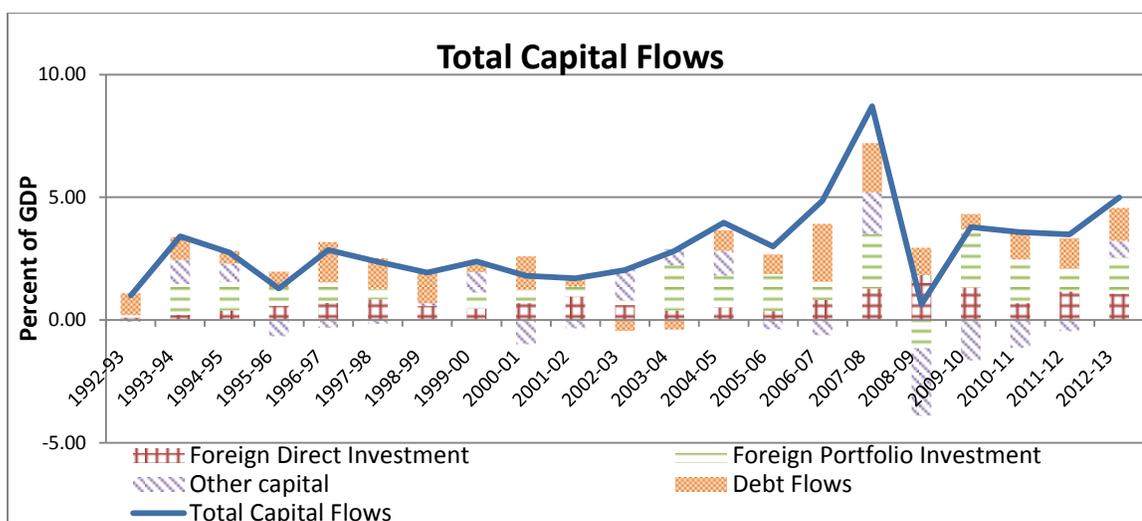
As shown in Figure 1.5, total foreign investment inflows increased from around USD 6 billion in 2001-02 (1% of GDP) to USD 47 billion by 2009-10 (5% of GDP) (RBI, 2013b). FDI inflows have remained stable over the years, while portfolio and other flows exhibited high volatility, particularly as a result of the GFC, when both these components reversed sharply. FPI flows revived in 2009-10 contributing to the rising capital flows. Total inflows into the country, which had declined following the GFC, revived to around 4 percent of GDP and remained buoyant in 2010-11 (Subbarao, 2010).

<sup>18</sup> The Nominal effective exchange rate (NEER) is the 36-country trade based index of the nominal exchange rate and is defined such that an increase indicates appreciation of the INR. Similar to the NEER, the real effective exchange rate (REER) is constructed as an index of the real exchange rate. Over the period from 1992-2003, the INR depreciated, whereas over the high growth period, there was an appreciation of the INR. The INR depreciated the most after the GFC.

While India continued to run a capital account surplus post GFC, the magnitude was lower than in the high-growth period.<sup>19</sup> At the same time, the CAD witnessed opposite trends, improving during the high growth period and worsening after 2008 (Goyal, 2012b). Thus, post-GFC, the overall BoP was in balance with some periods of deficit leading to INR depreciation and/or drain in international reserves (Mohanty, 2012a; RBI Handbook of Statistics on Indian Economy).

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<sup>19</sup> The decline in the capital account surplus immediately after the GFC was due to the FPI flows (down from 2.2 percent of GDP in 2007-08 to -1.15 percent in 2008-09) as well as other capital flows (declined from 1.7 percent in 2007-08 to -2.75 percent in 2008-09). Even though FPI flows revived the following year, other capital flows did not regain their pre-crisis levels. Apart from decline in the gross inflows, net inflows slowed further because of gross outflows from India. Outward FDI increased from USD 0.2 billion in 1990 to USD 22 billion by 2008-09, making India the third largest source of foreign investment in the period from 2000-08. The GFC brought about a slight moderation in outflows, which currently stand at USD 19.8 billion (Chowdhury, 2011).



Source: RBI Handbook of Statistics on Indian Economy

**Figure 1.5 Total Capital Flows**

### 1.3. Monetary Policy in India

The high growth and greater openness of the Indian economy and the ensuing volatility in its external sector, along with inflationary pressures, have increased the pressures on the RBI to proactively manage monetary and exchange rate policies to stabilize the economy. Monetary policy has thus become the *de facto* tool of choice to deal with the various pressures in the economy, especially given the persistent and growing fiscal deficits.<sup>20</sup> Indeed, monetary policy in India underwent a drastic change from being subdued to the fiscal policy to being the dominant policy contributing to the growth after the BoP crisis in 1991. This policy movement has mirrored developments in theory that suggest rising relevance of the New Keynesian view that interest rates were

<sup>20</sup> The fiscal deficit for India has been high since the GFC, with a deficit of 5.2% of GDP for 2012-13, which was well above the stipulated target of 3% by the Fiscal Responsibility and Budget Management Act (FRBM) enacted in 2004 (Planning Commission, 2013; Dasgupta, 2012).

more important in achieving output stability, as opposed to the original Keynesian position of fiscal dominance over monetary policy. The New Keynesian theory suggests that aggregate demand influences output and inflation, and demand itself depends on the interest rates in the economy set by the monetary policy (Goyal, 2011; Patra & Kapur, 2010).

Until the BoP crisis, the RBI was considered as being under the control of the politicians, with the RBI being viewed as a financier of the government. Despite having a central bank, the state controlled lending and fixed as many as 200 interest rates in the country. The shift in policy came in 1991, with the structural reforms and financial liberalization that India undertook following the BoP crisis and which marked the beginning of a change in the financing paradigm with market determined interest and exchange rates. Two agreements in 1997 and 2006 transformed the role of the RBI from being a passive organization in the country to being one of the best institutions not only in the country, but also in the world. These agreements prevented the government from exploiting the RBI to services its deficits (Mohanty, 2011b)<sup>21</sup>.

The focus of monetary policy in India at the time of the formation of the RBI (from around 1934-50) was to be a regulator of the supply and demand for credit in the economy using the bank rate, reserve requirements, and open market operations (OMOs) as instruments (see Annex 1.2 for definitions of macroeconomic variables). The conduct of monetary policy from 1951-70 was influenced by the need to support the five-year-plan finances of the government by accommodating their deficit financing. Several

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<sup>21</sup> Of course, independence of the RBI is qualified as the government appoints the governor of the RBI, and there are channels through which the RBI can be pressurized to submit to the government agenda.

quantitative control measures were introduced, such as the selective credit control, credit authorization scheme (CAS), and ‘social control’ measures for these purposes. From this period till 1991, the focus of monetary policy was on credit planning and helping raise resources for the government from the banks by adjusting the statutory liquidity ratio (SLR) and the cash reserve ratio (CRR). CRR was predominantly used to reduce the impact of government borrowing on the money supply. Credit to the private sector was crowded out as a result of the government borrowing. It was then that the Chakravarty committee suggested the move towards a monetary targeting regime to reduce the dominance of the fiscal policy over monetary policy. Under this regime, the RBI adopted a monetary targeting framework with reserve money as the operating target and broad money as an intermediate target. This period also saw the introduction of several money market instruments, such as certificates of deposits and commercial paper (Mohan & Kapur, 2009; Mohanty, 2011b).

### **1.3.1 Monetary Framework and Operating Procedure**

With the deregulation and liberalization of the Indian economy as well as the development of financial markets, monetary targeting was rendered ineffective, which led the RBI by 1998 to adopt a multiple indicator approach guided by multiple instruments and objectives. The RBI started focusing on financial and economic variables while still using the broad money as an information variable to formulate policy. Of these, short-term interest rates have emerged as the key indicators of monetary policy stance all over the world, and India is no exception. The rising importance of interest rates as a transmission mechanism meant that the speed and size of the pass-through from policy

rates to market rates became an important issue, more so because the rigidities in the market rates of interest negatively impact the effectiveness of monetary policy (RBI, 2003). The multiple indicator approach has also undergone a change since it was introduced and is now augmented by forward-looking indicators, drawn from the RBI's industrial outlook survey, capacity utilization survey, professional forecasters' survey, and inflation expectations survey. These indicators are then used in the projection of growth and inflation (Inoue, 2010; Inoue & Shigeyuki, 2009; Mohanty, 2011b).

The tools that the RBI uses to conduct policy have also evolved from tools such as CRR and open market operations (OMOs) to the liquidity adjustment facility in 2004, under which the repo rate has been made the only “independently varying policy rate,” with the reverse repo 100 basis points below the repo and the marginal standing facility (MSF) fixed at 100 basis point above the repo rate (Mohanty, 2012a).<sup>22</sup> The RBI has actively used these tools at its disposal to deal with problems of domestic liquidity, particularly during the GFC as well as to combat inflationary pressures in the economy since 2010. There was a period of moderation that began in 2012, but by the second half of 2013 the RBI had to start increasing the rates again to bring down the inflationary pressures in the country. However, the effectiveness of these actions of the RBI depends on the transmission of these policy rate changes to the economy. The monetary transmission mechanism is the process through which changes in the policy rate get translated into the ultimate objectives of inflation and growth. The transmission

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<sup>22</sup> The marginal standing facility (MSF) was introduced by the RBI in its Monetary Policy for 2011-12. Under this facility, commercial banks could borrow overnight up to one percent of their net demand and time liabilities from the RBI at 100 bp above the repo rate. “There was a subsequent revision which allowed them to borrow up to 2 percent of the demand and time liabilities and the banks were also allowed to borrow against their Statutory Liquidity Ratio (SLR) holdings” (Mohanty, 2012b).

mechanism adopted by a country depends on the monetary policy framework, structure and depth of the financial system, and the stage of development of the economy (Gigineishvili, 2011; Mohan, 2006).

Four key channels of the transmission mechanism are the interest rate channel, asset price channel, exchange rate channel, and the monetary aggregates channel. The transmission mechanism adopted by a country depends on the monetary policy framework, structure and depth of the financial system, and the stage of development of the economy (Mohan, 2006). The exchange rate channel works through the impact of policy rate changes on the net foreign inflows into the country, which in turn affects the real exchange rate and thereby demand and output. The asset price channel works through the impact on prices of assets and thereby the wealth effects.

Of the various channels, the *interest rate channel* has emerged as the dominant channel of transmission of monetary policy. This channel works through the impact of a change in the policy rate on the deposit and lending rates of the financial institutions and affects the spending and investment decisions of the households and firms in the economy. In other words, the interest rate channel impacts the cost of funds in the economy. When the central bank wants to increase liquidity in the economy, it lowers the policy rates which are reflected as lower interest rates for the businesses and individuals, thus lowering the costs of loanable funds. By lowering the cost of funds, the expansionary monetary policy raises investment and consumption demand and eventually gets reflected in aggregate demand, output and prices. The policy rate also works through its impact on the flow of funds to other assets, such as equities, which causes a rise in the

price of the assets and stimulates consumption in the economy through the wealth effect and through the impact on investment demand. A lower policy rate also causes the currency to depreciate and thereby stimulates net exports (Islam & Rajan, 2011).

In a large open economy, the interest rate channel is the most important channel of transmission and the exchange rate channel works through the interest rate channel. For an emerging market like India, the exchange rate channel has other effects on monetary transmission. The impact of exchange rate on inflation through the import prices occurs with a shorter lag than the demand channel. In addition, using the exchange rate channel as part of the medium term inflation zone targeting can help in price stabilization, stimulating exports as well as in preventing a crisis (Goyal, 2002). The impact of the interest rate and exchange rate changes on inflation and trade balance in India are examined in the chapters of this dissertation.

The first step in the monetary policy transmission mechanism is the pass-through of these policy rate changes to the retail rates, formally known as the interest rate pass-through (IRPT). *The estimation of the IRPT coefficients as well as factors affecting pass-through forms the first part of this dissertation (Chapter 2).* Using OLS regressions on the repo rate, call money rate and the lending rates, results for the period 2001m4 to 2010m11 suggest a complete pass-through to the money market rates but incomplete pass-through, both directly and indirectly into the retail rates. The chapter also identifies inflation, bank concentration, costs of the banks, credit-deposit ratio, and bank ownership as factors that affect the transmission of policy changes to the lending rates in India.

The policy rate changes also affects the exchange rate as well as its volatility (Goyal & Arora, 2010). A lower policy rate encourages capital outflows, causing a reduction in the demand for INR, in turn leading to a depreciation of the currency (Islam & Rajan, 2011). Exchange rate and related issues are discussed in the next section.

## **1.4. India's Exchange Rate Policy**

### **1.4.1 Exchange Rate Regime**

India's exchange rate policy has evolved over time with developments in the domestic and global economy, particularly since 1991 when wide-ranging reforms were introduced in the domestic and external sectors. The RBI undertook a two-step downward exchange rate adjustment on July 1 and 3, 1991, to deal with the BoP crisis and to stabilize the exchange rate market, ending the era of a fixed exchange rate regime. The downward adjustment was required to counter the massive withdrawal of reserves, to deal with the crisis, to instill confidence in the investors, and to improve domestic competitiveness. A dual exchange rate system was put in place in March 1992 under the Liberalized exchange rate management system (LERMS)<sup>23</sup> (Seshan, 2005). Finally a unified system of market determined exchange rate was introduced in 1993, which was a major change in the exchange rate policy of the country.

Under the *de jure* exchange rate regime classification of the IMF over the period 1975-1998, based on "self-reporting national policies of governments," India was

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<sup>23</sup> The LERMS replaced the system of a single official rate to enable the transition to the market determined exchange rate. The system consisted of an official rate for some government and private transactions and a market determined rate for the others.

classified as having an “exchange rate policy guided by the broad principles of careful monitoring and management of exchange rates with flexibility, without a fixed target or a preannounced target or a band, coupled with the ability to intervene if and when necessary.” However, after realizing that there was a disconnect between the *de jure* and *de facto* regimes, the IMF started publishing the *de facto* regimes since 1998, with a slight revision of a few categories to take care of some of the problems associated with the earlier classification since 2009.<sup>24</sup> While the IMF categorizes India as ‘floating,’ it is important to appreciate exactly what this term means. In particular, the IMF’s description of such as regime is as follows:

A floating exchange rate is largely market determined, without an ascertainable or predictable path for the rate. In particular, an exchange rate that satisfies the statistical criteria for a peg-like or a crawl-like arrangement will be classified as such unless it is clear that the stability of the exchange rate is not the result of official actions. Foreign exchange market intervention may be either direct or indirect, and serves to moderate the rate of change and prevent undue fluctuations in the exchange rate, but policies targeting a specific level of the exchange rate are incompatible with floating. Indicators for managing the rate are broadly judgmental (e.g., balance of payments position, international reserves, parallel market developments). Floating arrangements may exhibit more or less exchange rate volatility, depending on the size of the shocks affecting the economy.” (Habermeier, 2009, p. 14)

Table 1.2 presents the exchange rate regime of India under the three classifications (*de jure*, *de facto* regime as of 2008 and *de facto* regime as of 2012).

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<sup>24</sup> Managed floating became heterogeneous over time and the intervention of the monetary authorities in their exchange rate market had become increasingly complex while the data on these interventions was sometimes not available. In other words, the distinction between independent and managed floats was not clear (Habermeier et al., 2009).

**Table 1.2 IMF Classifications of India before and after the reclassification of 2009 – April 30, 2008 and April 30, 2012**

<b>Country</b>	<b><i>De jure</i></b>	<b><i>De facto – 2008</i></b>	<b><i>De facto – 2012</i></b>
India	The exchange rate policy was guided by the broad principles of careful monitoring and management of exchange rates with flexibility, without a fixed target or a preannounced target or a band, coupled with the ability to intervene if and when necessary.	Managed floating with no pre-determined path for the exchange rate <sup>25</sup>	Floating

Source: De Facto Classification of Exchange Rate Arrangements and Monetary Policy Frameworks, IMF, April 30, 2012.

Thus, a floating regime is not a pure float. Empirical studies also confirm that despite being classified as a floating regime, the Indian exchange rate has not been completely flexible. Using Frankel and Wei regressions, Shah and Patnaik (2011) find the INR to fluctuate between a tight and a flexible USD peg as well as a peg to a basket of currencies over the period 1993-2004, while it exhibited greater flexibility during the period 2004-09. Using a similar methodology, Zeileis et al. (2007) and Patnaik (2007) had earlier also find that during the period 1993-2006, the INR was a tight or flexible USD peg. For the period 1999-2011, Cavoli and Rajan (2013) find India to be a managed floater with slightly greater flexibility as compared to the other South Asian countries (Sri Lanka, Bangladesh and Pakistan), though India places a lower weight on the USD than these countries. Therefore, with greater capital account openness and monetary autonomy, there is more but not complete exchange rate flexibility in India.

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<sup>25</sup> IMF description of the regime: “The monetary authority attempts to influence the exchange rate without having a specific exchange rate path or target. Indicators for managing the rate are broadly judgmental (e.g., balance of payments position, international reserves, parallel market developments), and adjustments may not be automatic. Intervention may be direct or indirect.”

Thus India has generally followed a middle path to deal with the problem of the ‘impossible trinity,’ which postulates that a country cannot simultaneously have an open capital account, a fixed exchange rate, and monetary policy autonomy. Along with monetary autonomy, the country has a market determined exchange rate but intervenes and sterilizes its intervention to smooth out excess volatility and preserve macroeconomic stability. The capital account is not fully open, and non-residents can access the equity markets, while their access to the debt markets is subject to caps, and there are limits on the amount residents can take out of the country (Joshi & Sanyal, 2004; Leeladhar, 2008; Mohan & Kapur, 2009; Patnaik, 2004; Shah & Patnaik, 2007).<sup>26</sup>

#### **1.4.2 Trends in INR**

Since the move towards a “market determined unified exchange rate,” the RBI has intervened actively in the foreign exchange market to reduce the volatility. Specifically, management of the exchange rate involved trying to maintain the value of the rupee against the USD. However, the Indian rupee has generally depreciated against the USD since 1993 except during 2003-2005, 2007-08, and 2010-11 when there was an appreciation of the rupee due to the dollar’s weakness (Figure 1.6). With respect to the NEER as well, the INR has generally depreciated since 1993-94 with a few episodes of

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<sup>26</sup> This finding is not inconsistent with theory. In Frankel’s (1999) words, “There is nothing in existing theory, for example, that prevents a country from pursuing a managed float in which half of every fluctuation in demand for its currency is accommodated by intervention and half is allowed to be reflected in the exchange rate” (p. 7). The exchange rate regime of a managed float has been identified as the best for India under the current conditions as compared to a full float (Goyal, 2006). She emphasized that India is not yet ready to allow complete flexibility in the exchange rate, as excessive volatility in the exchange rate hurts the real sector: depreciation adds to the already high inflation levels in the country and appreciation affects the export competitiveness, which could worsen the trade deficit. She also suggests a band of around 10 percent for the volatility in the managed float beyond which excessive flows can hurt the real sector.

an appreciation (1997-98, 1998-99 to 2000-01, 2005-06, 2007-08, 2010-11). Figure 1.7 shows the movements in the NEER and the international reserves since 1993. The figure clearly shows that the RBI has tried to maintain the stability of the exchange rate by accumulating reserves.<sup>27,28</sup> The RBI has been able to retain monetary autonomy while maintaining an open capital account and managing its exchange rate by sterilizing its interventions in the foreign exchange markets.<sup>29</sup>

While the pressures on the rupee were initially abated, since the beginning of 2013, the rupee has depreciated by as much as 20 percent against the dollar and reached a new low of Rs 68.5 to the USD in August 2013 before stabilizing at around Rs 62 to the USD. In terms of the NEER and REER, the currency depreciated around 11 and 10 percent respectively between March and October 2013. The depreciating rupee is not only a cause of concern, due to the burden it places on the Indian corporate environment, which have borrowed abroad, but also because of the inflationary pressures it creates

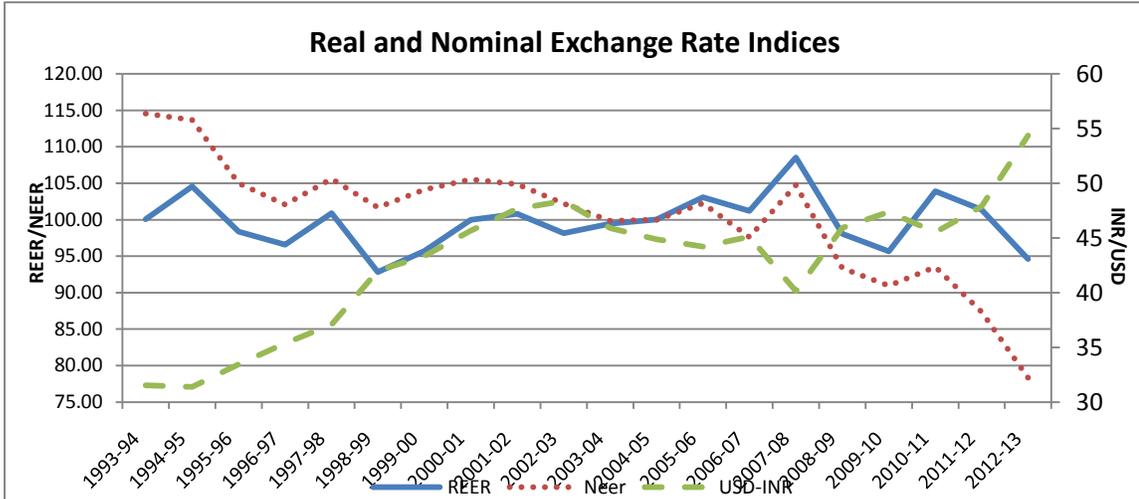
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<sup>27</sup> Of course, accumulation of reserves depends on the capital flows into the country, which are sometimes driven by global factors and not Indian risk factors. As a result, there have been periods when the RBI lost reserves, as happened in mid-2013. Part of the reason for changes in the reserves could also be due to valuation effects caused by changes in the exchange rate of the rupee.

<sup>28</sup> It has been shown empirically that monetary authorities intervene asymmetrically to allow depreciation, but not an appreciation as it can have a detrimental impact on the competitiveness of the economy. This phenomenon is also reflected in the sustained increases in reserves in the emerging markets since 2000, especially in the Asian emerging economies (Levy-Yeyati & Sturzenegger, 2007; Pontines & Rajan, 2011; Ramachandran & Srinivasan, 2007; Srinivasan et al., 2009).

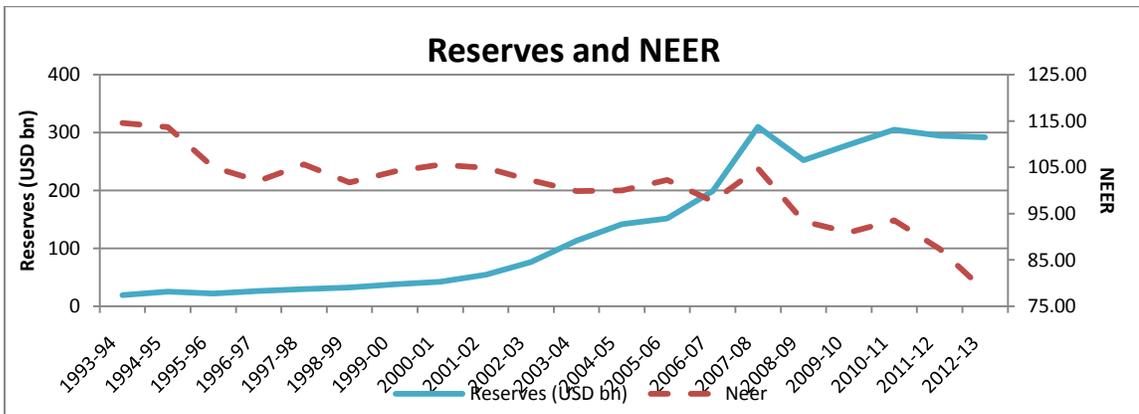
<sup>29</sup> For details on monetary sterilization policies and impacts in India, see Goyal (2006), Patnaik (2003), Patnaik (2004), and Dua and Ranjan (2010). As of April 2004, the RBI launched Market Stabilization Bonds (MSBs) which are “new government securities issued by the central bank with the specific aim of absorbing the liquidity created in the financial system due to forex intervention” (Ouyang & Rajan, 2008; p. 6) The advantage of these bonds is that they do not add to the fiscal deficit of the government but are kept in a separate account, Market Stabilization Scheme (MSS) maintained and operated by the RBI. The government cannot avail this money except to redeem or buy back MSS securities (Ouyang & Rajan, 2008).

(Subbarao, 2012). Some depreciation might be welcome to correct for the high inflation, but when the real exchange rate depreciates beyond competitive rates, it aggravates the problem of inflation in the country (Goyal, 2012b).



Source: RBI Handbook of Statistics on Indian Economy

**Figure 1.6 Real and Nominal Exchange Rate Indices**



Source: RBI Handbook of Statistics on the Indian Economy

**Figure 1.7 Reserves and NEER**

### 1.4.3 Exchange Rate Impacts

Exchange rate changes impact domestic inflation via import prices. This impact is captured through the exchange rate pass-through (ERPT), which is defined as the percentage change in import prices due to a percentage change in exchange rate in the importing nation's currency (Ghosh & Rajan, 2009; p. 377). When the exchange rate changes, an exporter can either pass on the entire change in the exchange rate to the importing nation or absorb some of the changes by adjusting his mark-up so as not to affect his market shares in the destination markets. The study of ERPT into import prices is particularly relevant to current circumstances in India, when there is immense pressure on the currency to depreciate. This depreciation of the Indian rupee is expected to add to the inflationary pressures through the pass-through effect in its imports prices (Shah, 2012).

ERPT is also important for its impact on the effective conduct of monetary policy. The issue of ERPT is related to the interest rate pass-through (IRPT) because both these factors have an important role to play in the choice of the optimal monetary policy strategy. In the case of an incomplete ERPT, the burden of adjustment falls on the interest rate channel, as the exchange rate channel becomes less effective. On the other hand, when the interest rate channel becomes weak, the burden of adjustment has to be borne by the exchange rate channel (Bhattacharya et al., 2011).

*The study of the ERPT is the second part of the dissertation (Chapter 3). This chapter contributes to the existing literature by capturing the impact of asymmetry and non-linearity in the impact of exchange rate changes on the import prices. The following*

research questions are addressed: Do the Indian import prices react less to smaller changes in the exchange rate than larger changes? Is there asymmetry in the adjustment of import prices with respect to appreciations and depreciations? Using a vector error correction (VEC) model, results for the period 2003m1 to 2013m3 suggest there is more than complete exchange rate pass-through into Indian import prices in the short run and even higher pass-through in the long run, indicating the inertial effect of rising prices. There is also evidence of non-linearity in exchange rate pass-through in terms of slight differences in the impact of an appreciation versus a depreciation, as well as small-versus-large changes in the rupee value.

The percentage of changes in the exchange rate that are passed through to the import prices also determines the trade balance of the country. The impact on trade balance of exchange rate depreciation is captured through the J-curve effect. The J-curve effect refers to the phenomenon where a depreciation initially leads to a worsening of the trade balance as the immediate impact of a depreciation is felt on the import prices  $dx_x$ , before causing an improvement as prices and quantities of exports adjust. When the exporters do not pass-through the changes in the exchange rate, the import prices are unaffected and may not affect the trade balance. Thus, the trade balance may not show the presence of a J-curve effect, or there might be a delayed J-curve effect. However, if the exporters pass on the changes, the trade balance will show the J-curve effect. *The third part of the dissertation looks at the issue of the exchange rate effects on India's trade balance in more detail (Chapter 4).* In particular, the chapter and addresses the following research questions: Does the J-curve phenomenon hold for India at the

aggregated and disaggregated industry level? Does it vary with the trade partner? Using Pesaran et al.'s bounds testing approach, results for the period 2001m4 to 2013m3 suggest that there is no evidence regarding the existence of a J-curve at the aggregate or disaggregate level. The analysis suggests that there is a positive impact of a real exchange rate depreciation on the trade balance of India in the long run.

### **1.5 Conclusion and Policy Recommendations**

India has been able to register high growth rates while running persistent current account deficits, which it has been able to finance through the large capital inflows into the country since its liberalization in 1991. The resulting pressures for the appreciation of the currency due to the inflows were countered by intervention in the foreign exchange market by the RBI. These interventions led to significant reserve accumulations, not to the magnitude of some of the other East Asian countries, but enough to position the country among the top ten reserve accumulators of the world. The excess liquidity that these reserves created was absorbed through sterilization operations by the RBI. Despite RBI's attempts to contain the inflationary pressures, India went through a phase of double-digit inflation at the beginning of the GFC, which led it to resort to policy rate changes in order to rein in such pressures.

Monetary policy has become the dominant policy in India contributing to growth since the BoP crisis of 1991. In order to understand the effectiveness of monetary policy actions of the RBI, it becomes important to understand the impact of these policy changes on key variables, such as inflation and growth, in the economy. Two important channels

through which the RBI conducts monetary policy are the interest rate and the exchange rate channel. Given the importance of these channels, it becomes important to understand the affects changes in these rates have on the economy. To this end, this dissertation aims to estimate the impact interest rate changes have on the lending rates in the economy, as these lending rates ultimately influence demand and output in the economy. It is also important to understand the impact of exchange rate changes on the import prices, which feed into inflation in the economy. This is particularly relevant for India given the inflationary pressures the economy is experiencing along with the pressures on the currency to depreciate. This impact of exchange rate changes on import prices are captured through the exchange rate pass-through in the second part of the dissertation. Finally, impact of exchange rate changes on the trade balance are estimated in the third part of the dissertation. It is important to understand the impact of exchange rate changes on the trade balance for the consequences it has on the current account balance and through it, the balance of payments.

The results of the analysis suggest that there is more than complete pass-through from the policy rate to the money market rates but incomplete pass-through to the retail rates. The pass-through to retail rates is influenced by inflation, bank concentration, costs of the banks, credit-deposit ratio, and bank ownership. Given the incomplete pass-through, there is a need for India to focus on improving the transmission mechanism. This improvement can be achieved by developing the yield curve further, through which short-term rates influence the longer term rates in the economy. With respect to the exchange rate pass-through, the analysis suggests that there is more than complete pass-

through to the import prices in the short run and an even higher pass-through in the long run indicating the inertial nature of prices in India. A move to inflation targeting *might* help the country deal with these inflationary pressures arising due to domestic as well as external factors. The results also suggest that there is evidence of non-linearity in exchange rate pass-through in terms of slight differences in the impact of an appreciation versus a depreciation as well as small versus large changes in the rupee value. With regard to the impact of the exchange rate changes on the trade balance, the results suggest that there is a positive impact of a real exchange rate depreciation on the trade balance in the long run, suggesting that the RBI could use this tool to improve the trade and current account balance in the long run for India.

## **CHAPTER 2. MONETARY POLICY EFFECTIVENESS IN INDIA: WHAT IS THE EXTENT OF INTEREST RATE PASS-THROUGH?**

### *Abstract*

Given the need to focus on monetary policy to bring about changes in the aggregate demand and prices under the current conditions in India where there is a lack of fiscal space, there is also a need to understand the channels through which monetary transmission takes place to improve its effectiveness in the country. This chapter estimates the interest rate pass-through from the policy rates to the money market rates and to the retail lending rates to understand the effectiveness of monetary policy in India. Results for the period 2001m4 to 2010m11 suggest a complete pass-through to the money market rates but incomplete pass-through, both directly and indirectly, into the retail rates. The chapter also identifies inflation, bank concentration, cost of the banks, the credit-deposit ratio, and bank ownership as factors that affect the pass-through coefficients in India.

### **2.1 Introduction**

Monetary transmission mechanism is the process through which monetary policy actions affect the economy, particularly output and inflation. Proper implementation of monetary policy requires an understanding of the instruments and channels through which policy operates. There are four main channels through which monetary policy operates: viz. interest rate channel, exchange rate channel, asset price channel and credit channel.<sup>30</sup> Although these channels may not be mutually exclusive, the channel a country chooses varies based on differing structural characteristics (Mohan, 2006).

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<sup>30</sup> The exchange rate channel is particularly relevant during the initial stages of financial development, as it is thought to be liquid and resistant to inflationary pressures. For efficient functioning of this channel, policy rate changes are immediately transmitted to the exchange rate and ultimately influence demand and

Of the various channels, the *interest rate channel* has emerged as the dominant channel of transmission of monetary policy. This channel impacts the cost of funds in the economy. When the central bank wants to increase liquidity in the economy, it lowers the policy rates which are reflected as lower interest rates for the businesses and individuals, thus lowering the costs of loanable funds. By lowering the cost of funds, expansionary monetary policy raises investment and consumption demand, and this eventually gets reflected in aggregate demand, output, and prices. The policy rate also works through its impact on the flow of funds to other assets, such as equities, which causes a rise in the price of the assets, which in turn stimulates consumption in the economy through the wealth effect and through the impact on investment demand (Islam & Rajan, 2011). The study of the interest rate pass through (IRPT) mechanism is important for understanding the effectiveness of the monetary policy for any country.

Studies on the subject to date have mostly focused on developed countries, with attention now shifting to developing countries and emerging markets. Many developing countries and emerging markets started moving towards more flexible regimes beginning in the 1990s<sup>31</sup> (Monetary and Financial Systems Dept., 2004). The greater exchange rate flexibility has, along with an open capital account, allowed greater flexibility to use the interest rate as policy instrument. In developing countries where the financial markets are less developed, the bank lending channel is an important channel of monetary

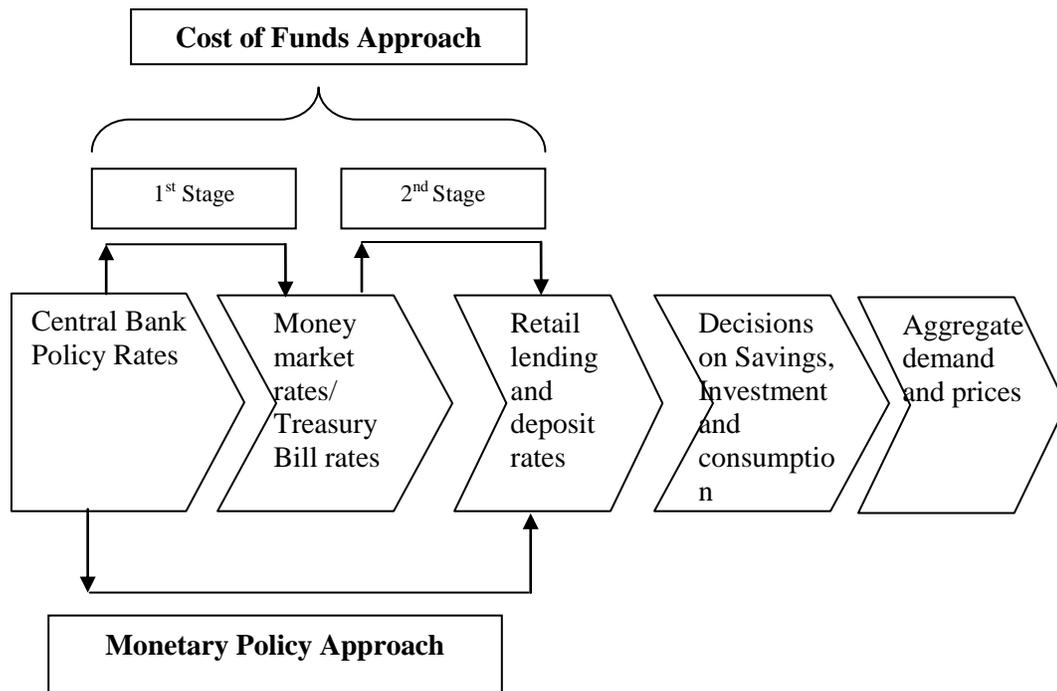
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output. The asset price channel works through changes in the price of assets such as bonds, stocks, and real estate. The credit channel works by influencing credit supply in the economy. The interest rate channel works by affecting the investment and saving decisions in the economy by transmitting changes in the policy rate to the retail lending and deposit rates.

<sup>31</sup> According to IMF estimates, between 1990 and 2002, there were 139 transitions to flexible regimes. (Monetary and Financial Systems Dept., 2004)

transmission (Mishra, 2012). An understanding of the factors driving the bank and market responses to the actions of the monetary authority would help strengthen the effectiveness of monetary policy.

The overall transmission of policy actions to output and prices is depicted in Figure 2.1. Changes in the policy rate affect money market rates, which in turn affect retail rates. These changes are then transmitted to the aggregate demand through the savings, investment, and consumption channels. For the purpose of this chapter, the focus is narrowly on the transmission of the policy rates into the retail rates; it does not focus on the impact of interest rate changes on final demand and prices.



Source: Based on Chirleşan and Apostoaie (2007).

**Figure 2.1 Transmission from Policy Rates to Aggregate Demand**

The following equation by Illes and Lombardi (2013) summarizes the different stages of the pass-through:

$$r_l - r_p = (r_l - r_g) + (r_g - r_m) + (r_m - r_p)$$

where  $r_l$  is the bank lending rate,  $r_p$  is the policy rate,  $r_g$  is the government bond yield, and  $r_m$  is money market/interbank rate. The equation above summarizes the pass-through: the spread between the policy and lending rate depends on spread between the policy rate and money market rate, between the money market and government bond rate, and

finally the government bond rate and the lending rate. In the first stage of IRPT, movements in the policy rate influence the interbank rate, which then affects the short-end of the yield curve. Since the money market provides the mechanism through which the central bank can affect the quantity and cost of liquidity in the system, it assumes importance in the transmission mechanism by being the link between policy operations and through the financial markets to the real economy. Incomplete pass-through between these rates would signal strains in the money market (Illes & Lombardi, 2013).

The second stage of IRPT occurs when changes in the money market rate alter the government bond yield, which in turn impacts the bank lending and deposit rate. For this second stage of IRPT to work, not only must the first stage work well, but there also needs to be a fairly well-developed liquid and stable yield curve that acts as an intermediate step in the transmission to the bank's retail lending and deposit rates. This two-stage IRPT is referred to as the "cost of funds approach" to monetary policy (de Bondt, 2005). These changes in the bank rates are then passed through to the aggregate demand and prices through the consumption, savings, and investment channels.

The structure of the financial markets is extremely important for smooth and efficient transmission of policy actions (Mishra et al., 2010). For some countries, particularly developing ones with underdeveloped financial systems and banking structures that are less competitive and where the yield curve is not developed, it is plausible that the first stage of IRPT would work, but not the second stage. This, however, does not necessarily imply that the IRPT via the bank lending channel does not work. It is possible that there is a direct impact of policy rates on bank retail rates. This

direct effect is called the “monetary policy approach” (Sander & Kleimer, 2004). This direct effect is especially true, for instance, for predominantly bank-based systems and in cases where the banking system is rather non-internationalized and its market structure is oligopolistic and susceptible to moral suasion from the central bank; all of which are prevalent where the banking sector is state-dominated (Gigineishvili, 2011).

The monetary policy framework as well as the operating procedure in India have evolved over the years towards the use of interest rates as a policy tool, which was made possible in part by a gradual movement towards greater flexibility in the exchange rate regime (Mohanty, 2011c).<sup>32</sup> Consistent with this trend, the Reserve Bank of India (RBI) started to gain greater autonomy over time even though it is not fully independent given the pressures of a democratic society (Goyal, 2011). The RBI neither has goal nor instrument independence, as aptly summarized by Chandravarkar (2005):

The goals of a central bank in a democracy are necessarily determined by the legislature while instrument independence appertains to the central bank, except in regard to the exchange rate where government authority is necessarily supreme even though the management of reserves is vested in the central bank. The RBI enjoys instrument independence only by inference. (p. 3841)

How effective is monetary policy in India? More to the point, how effective is the bank lending channel in India? This paper answers these questions by estimating the

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<sup>32</sup> Though during the recent financial crisis, when interest rates had reached the zero lower bound, countries such as the U.S. had to resort quantitative easing, in which they work through the asset price and credit channel to stimulate growth in the country.

IRPT to bank lending rates and by examining the determinants of the IRPT in India. The rest of the chapter is organized as follows: Section 2.2 provides an overview of monetary policy and the banking sector in India. Section 2.3 discusses the empirical literature on IRPT in general as well as for India specifically. Section 2.4 offers an overview of the empirical methodology to be followed, data sources, and definitions as well as the results for interest rate pass-through. Section 2.5 focuses on factors impacting the evolution of IRPT in India over time. The final section provides conclusions and recommendations.

## **2.2 Overview of Monetary Policy and Banking Sector in India**

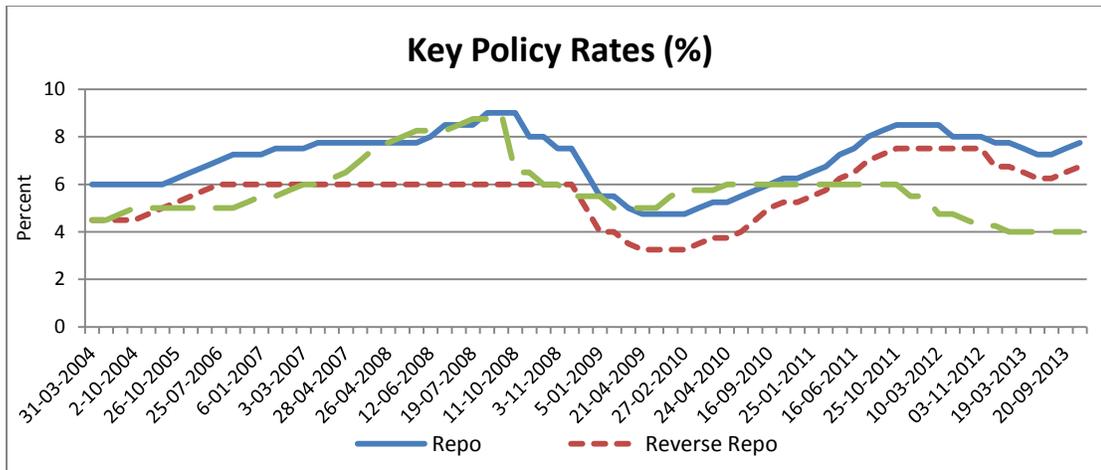
During the 1980s and early 1990s, India followed a monetary targeting framework under which broad money was used as the target for the monetary policy. This framework was possible due to the fact that India had a closed capital account. However, the financial development following the reforms introduced after the balance of payment (BoP) crisis of 1991 made money demand unstable, which made the control of monetary aggregates difficult. Therefore, the RBI moved to a multiple indicator approach in 1998-99, whereby a number of macroeconomic variables such as interest rate, exchange rate, inflation, fiscal position, currency, credit by banks and financial institutions, trade, capital flows, etc., were considered along with broad money and output to formulate policy along with forward-looking indicators (Mohanty, 2012b).

Traditionally, the cash reserve ratio (CRR) (see Annex 1.2 for definitions of the macroeconomic variables) and the open market operations (OMO) were used as instruments of monetary policy. With the introduction of the liquidity adjustment facility

(LAF) in 2004, overnight management of liquidity emerged as one of the most important instruments of monetary policy, with the RBI operating through the repo rate and reverse repo rate. Along with this move, the weighted average call money rate was made the operating target of the monetary policy (Mohanty, 2011a). The repo rate is defined by the RBI as a “money market instrument, which enables collateralized short term borrowing and lending through the sale/purchase operations in debt instruments.” In other words, the repo rate is the “annualized interest rate for the funds transferred by the lender to the borrower.” And the reverse repo is said to be the “mirror image” of the repo rate, in that the reverse repo is the rate at which the borrower transfers funds to the lender (RBI, 1999). Since the 2000s, the RBI has been using monetary policy tools more aggressively to maintain price stability and growth, as can be seen in Figure 2.2, which shows the movement in the key policy rates of the country since 2004, when the LAF was introduced. Since there was a lack of a single policy rate, a new operating procedure was introduced in 2011, with the repo rate being the only “independently varying policy rate” and the reverse repo was fixed at 100 basis points below the repo rate, while the marginal standing facility (MSF)<sup>33</sup> was fixed at 100 basis points above the repo rate (Mohanty, 2012b).

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<sup>33</sup> The marginal standing facility (MSF) was introduced by the RBI in its Monetary Policy for 2011-12. Under this facility, commercial banks could borrow overnight up to one percent of their net demand and time liabilities from the RBI at 100 bp above the repo rate. There was a subsequent revision which allowed them to borrow up to 2 percent of the demand and time liabilities and the banks were also allowed to borrow against their Statutory liquidity ratio (SLR) holdings (Mohanty, 2012b).



Source: RBI Database on Indian Economy.

**Figure 2.2 Key Policy Rates**

The Indian banking system was dominated by private and foreign banks till the mid-1950s, when the government took over control of the then-largest bank in the country—the Imperial Bank, which was renamed the State Bank of India. The Indian government nationalized all the larger banks in 1969; by 1982, the share of private and foreign banks had declined to less than 10 percent of the total bank assets (Banerjee et al., 2004; Eichengreen & Gupta, 2012). During this period, there were barriers to entry, limits on asset allocation, as well as interest rate barriers. It was not until the reforms of 1991 that the Indian banking sector started shedding some of these regulatory barriers. The reforms made it easier for the private sector and foreign banks to enter the market as well as allowed for market-based credit allocation. The reforms also led to the creation of an interbank money market, auction-based repo and reverse repo agreements, and reductions in the CRR and Statutory Liquidity Ratio (SLR) requirements.

This opening up of the banking sector to private and foreign players increased their share in the banking assets from less than 3.5 percent in 1991 to around 21 percent in 2007. Despite the increase in the share of the private and foreign banks, the Indian banking sector is still dominated by state-owned banks that hold more than 3/4 of the deposits of the scheduled commercial banks. The share of public-sector banks in banking assets further increased during the Global Financial Crisis (GFC) for precautionary reasons when depositors moved to these banks for stability.

India has historically followed a system of administrated interest rates, with the central government guiding the setting of interest rates in the country rather than the central bank. However, since the 1990s, efforts have been underway to liberalize the interest rates, which resulted in the almost complete deregulation of lending rates by October 1994. The prime lending rate system was introduced in 1994, and certain lending rates of the commercial banks were freed for loans greater than Rs 200,000. The RBI introduced the benchmark prime lending rate (BPLR) in 2003 to help banks price loans on the actual cost of funds. This was the rate that the banks charged their premier customers. The intent behind the introduction of the prime lending rate was to ensure that lending rates followed the changes in the policy rate to ensure a smooth monetary policy transmission. However, this system of the BPLR was not transparent and lending, particularly to the corporate customers, was often at rates below the BPLR as the banks often subsidized lending to corporates by charging the retail and small and medium enterprises a higher rate.

On July 1, 2010, the RBI introduced the base rate system to deal with the problems associated with the BPLR system. The base rate is the minimum rate that banks must charge on their lending. The rate can be set by each bank on its own, but must be consistent and has to be approved by the RBI. The banks have to make this rate public<sup>34</sup> (Singhal, 2010). In contrast, savings rates in India remained repressed and controlled until 2011. It was only in October 2011 that the RBI deregulated interest rates on the savings deposits accounts of commercial banks, which meant that banks were allowed to set their own interest rates according to their needs and market liquidity conditions instead of the central bank setting the rates for them (Ray & Virmani, 2012; RBI, 2011). Since this chapter focuses on the period prior to the savings rate deregulation, it estimated the IRPT to bank lending rates rather than deposit rates.

While the bank rates react to the policy rates in general, there is a noted asymmetry in the reaction of these rates. Figure 2.3 shows the movement in the money market rate (i.e., the call money rate and the 91-day Treasury Bill rate (TB)) and the bank lending<sup>35</sup> and deposit rates.<sup>36</sup> Table 2.1 provides the simple correlation between the changes in these variables for the period 2001m4 to 2010m11. It is evident from the figure that, on average, the rates have moved in tandem, but there seems to be asymmetry in the movement and also a lag between movement in the market rate and the retail rates.

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<sup>34</sup> At the time of the introduction of the rate, most of the public banks kept their base rates at 8 percent, while some of the private sector banks, foreign banks, as well as some state owned banks fixed rates at 7.5 percent and a few private sector banks kept the rate at seven percent. The lending rate charged by the banks is usually a premium over the base rate. The premium might include a tenor premium, a risk premium, and a product premium, and these premiums have been allowed by the RBI (RBI, 2010; Singhal, 2010).

<sup>35</sup> The 1-3 year rate has been used for the deposit rate.

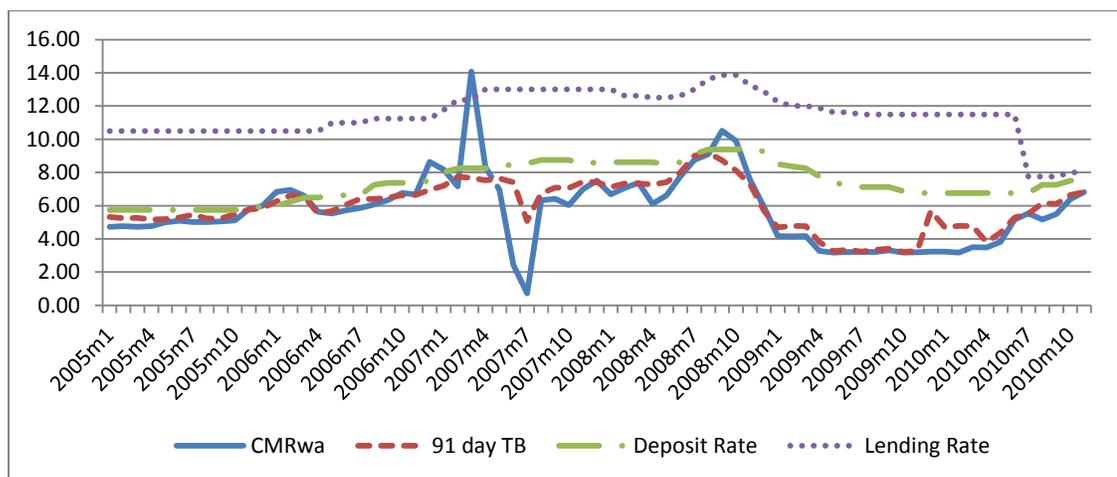
<sup>36</sup> The key Lending Rates as Prescribed by RBI (All Commercial Banks including SBI) - Minimum Rate General has been used for the lending rate.

The lending and deposit rates appear to be downwardly inflexible, one reason being that the administered interest rates on several government small savings schemes and provident funds are generally higher than instruments available in the market (Guimarães & Ruiz-Arranz, 2009). To compete with these schemes for funds, banks set a floor for the lending rates which is above the market determined rates. The greater rigidity on the downside in the lending and deposit rates is also depicted in the low correlation between these variables.

**Table 2.1 Correlation between changes in call money rate, 91-day TB rate, and retail rates**

	$\Delta$ Call Money Rate	$\Delta$ 91-day TB	$\Delta$ Lending Rate	$\Delta$ Deposit Rate
$\Delta$ Call Money Rate	1.000			
$\Delta$ 91 day TB	0.33	1.000		
$\Delta$ Lending Rate	0.04	0.10	1.000	
$\Delta$ Deposit Rate	0.13	0.28	0.25	1.000

Source: RBI Database on Indian Economy



Source: RBI Database on Indian Economy

**Figure 2.3 Money Market and Bank Retail Rates**

## **2.3 Empirical Review of Literature**

### **2.3.1 General Studies**

There is a vast literature on the subject of IRPT to bank retail rates, but most of these studies focus on advanced economies (e.g., DeBondt, 2002; Hansen & Welz, 2011; Mojon, 2000; Roelands, 2012; Sorenson & Werner, 2006). Studies on emerging and developing countries are somewhat fewer in number, though more attention is now being paid to these country studies (e.g., Aydin, 2007; Cas et al., 2011; Durán-Viquez & Esquivel-Monge, 2008; Jamilov & Egert, 2013). Even within these studies, most comprise multi-country studies, with very few individual country studies.

A well-cited paper on the subject of IPRT is by Cottarelli and Kourelis (1994), who estimate the short- and long-run pass-through for 31 developed and emerging market countries. They also identify factors that determine the pass-through to the retail bank rates. The authors study interest rate stickiness as a barrier to smoother monetary policy transmission in their paper. They find that the impact multiplier of changes in the money market rate on lending rates varies from one in certain countries to zero in others. They also find differences in the impact on the lending rate 3 to 6 months after the change in the money market rate. However, the long run pass-through for most countries is complete—i.e., the IRPT coefficient is one. Using OLS regression on monthly data for 31 countries over the period 1980-93, they find that a higher inflationary environment, competition in the banking sector, capital mobility, development of the money market lead to an improvement in IRPT, while money market volatility reduces the pass-through.

Gigineishvili (2011) expands the coverage of Cottarelli and Kourelis' (1994) paper to include a wide cross-section of countries from all regions to reflect a heterogeneous sample. He studied 70 countries over the period from 2006-09. A shorter time period was chosen to minimize the structural changes in these countries. Using panel regressions, he supports the findings of previous studies in that per capita GDP and inflation lead to an increase in IRPT, and market volatility has a negative impact on it. The paper also finds that, among the financial market variables, overhead costs, banking competition, and credit quality improve the transmission mechanism, while excess banking liquidity weakens it. Gigineishvili groups the 70 countries by region, size, level of development, and exchange rate regime to compute the pass-through coefficients. He finds that among the regions, countries in Middle East and Central Asia have lower IRPT coefficients, as do countries of a smaller size (mainly small island nations). He also finds that countries with fixed exchange rate regimes have a weaker pass-through as compared to those with more flexible regimes, suggesting that they are able to use their control over the interest rates in the economy to influence the monetary transmission.

In a comparative study of the Euro-zone and the U.S. in the recent crisis period, Karagiannis et al. (2010) find that IRPT was complete in the long run. In particular, the money market rate for the Euro was completely transmitted to the deposit rates in the long run, whereas for the U.S., the central bank rate worked more effectively in transmitting to the deposit rate in the long run. While banks tend to pass through only decreases in the money market rate to the deposit rates in both the Euro-zone and the U.S., they tend to pass on increases rather than decreases of money market rate to

borrowers in Euro-zone as compared to more of decreases in the central bank rate in the U.S. This difference highlights the asymmetry in the IRPT mechanism in these countries.

A paper on the subject for Central American countries by Cas et al. (2011) identifies factors that are weakening the IRPT in Central American countries as compared to Latin American countries. In terms of the factors mentioned above, IRPT can be greatly improved by increasing exchange rate flexibility and by reducing financial dollarization, financial sector development, and bank concentration. The authors use annual data from a sample of 40 countries for the period 2004-10. They use a system-generalized method of moments (GMM) estimator to find a pass-through coefficient of 0.55 for all the countries studied. They also find that IRPT is higher for the Latin American countries as compared to the Central American countries.<sup>37</sup>

Tai et al. (2012) examine the effectiveness of second-stage IRPT for some of the countries affected by the Asian Financial Crisis (AFC), viz. Hong Kong, Indonesia, Korea, Malaysia, Thailand, the Philippines, and Singapore, to observe the impact of the crisis on the pass-through to deposit and lending rates across countries. Using a seemingly unrelated regression (SUR) over the period 1988-2010, they find a slow pass-through to the retail rates, with the deposit rate pass-through being slightly higher than the lending rate pass-through. They also find that there has been a slowdown in the adjustment after the AFC for all countries studied except for Malaysia. These findings suggest a lower effectiveness of the monetary policy, imperfect financial markets, and lower degree of financial integration of these economies.

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<sup>37</sup> Latin American Countries: Brazil, Chile, Colombia, Mexico, Peru and Uruguay. Central American Countries: Costa Rica, Dominican Republic, Guatemala, Honduras and Nicaragua.

### 2.3.2 India-Specific Studies

For India, there have been relatively more studies on the impact of the policy rate on the volume of bank credit growth rather than interest rates (e.g., see Bhaumik et al, 2010; Khundrakpam, 2011; Pandit & Vashisht, 2011; and Pandit et al., 2006). In the handful of studies on the IRPT from the policy rates to the retail rates, India has been studied as a part of a panel. There is no consensus among these studies on whether IRPT is complete in the long run, as results vary with the methodology and the time periods considered. Annex 2.1 summarizes some of the studies on IRPT for India.

Using a disaggregated GETS (general-to-specific) model tested by a non-linear least squares regression for the BRIC (Brazil, Russia, India, and China) countries for the time period of 1998 and 2007,<sup>38</sup> Karagiannis et al. (2009) find that, though there are variations across these countries, the transmission is not smooth and IRPT is generally incomplete. In particular, they find that policy rate decreases are transmitted to the loan rates and that there is considerable asymmetry in upward and downward adjustment in the retail markets. For India, the authors find that there is complete IRPT in the long run. The authors focus on the second stage pass-through from the money market rate to the retail rates.

Contrasting results were obtained by Patnaik and Ramanathan (2007) and Guimarães and Ruiz-Arranz (2009), who find a low degree of IRPT in the long run for India. Patnaik and Ramanathan (2007) use quarterly data for the period from 1997-2005 to obtain their results. They suggest that partial transmission takes place in the short run,

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<sup>38</sup> For their study, they do not use the exact time period for all the countries. They use monthly data for Brazil, Russia, and India ranging between 1998m1 to 2007m9, and for China they use quarterly data.

but the “policy impulses” are weakened in the long run. Guimarães and Ruiz-Arranz (2009) find a pass-through coefficient of 0.3 for India in the long run and suggest that the existence of small saving schemes might be responsible for the lower adjustment in the lending rates. They also find that it takes around 1.2 months to transmit changes in the policy rate to the lending/deposit rates. They use an autoregressive distributed lag model (ARDL) for the study of monthly data over the period 2001-09 for nine countries (Australia, Indonesia, India, Japan, Korea, Malaysia, New Zealand, the Philippines, and Thailand).

Hattari et al. (2011) also estimate the IRPT coefficients for four South Asian countries (India, Bangladesh, Pakistan, and Sri Lanka) utilizing an ARDL model on monthly data for the period January 2001-October 2009. They only focus on the response of the lending rates to the interbank interest rates. They find pass-through coefficients to be low for all the countries and that lending rates do not adjust immediately because of rigidities such as inherent inefficiencies in the banking system and regulatory requirements on setting deposit and lending rates, along with the less-developed short-term public debt market and structural rigidities. They find the short-run IRPT coefficient for India to be negligible, while that in the long run to be 0.3.

There are also a handful of studies that look at the impact of policy rate changes on the aggregate demand and prices. Using a Structural Vector Auto Regression (SVAR) model, Khundrakpam and Jain (2012) examine the importance of the various channels of monetary transmission to study their impact on GDP growth and inflation. They find that

during the period between 1996-97Q1 and 2011-12Q1, the interest rate, credit channel, and asset price channel of transmission were important.

However, the exchange rate channel was found to be a weak channel of transmission mechanism, contrary to what was found by Bhattacharya et al. (2011), who found that monetary policy changes had the most effective impact on inflation through the exchange rate channel, particularly in emerging markets where the financial systems are not well developed. Bhattacharya et al. (2011) use a VEC model on monthly data from 1997-2009 for India to establish this result. They suggest that in countries where trade liberalization precedes financial liberalization, the exchange rate channel might be a more important channel of monetary transmission than the traditional monetary transmission channels, which may be ineffective as they work through the domestic financial system. However the assumptions underlying some of these studies using the SVAR are questionable, given that they exclude a policy reaction function and also the non-linear effects of the policy rates.

Kapur and Behara (2012), in their study of quarterly data over the period April-June 2006 to January-March 2011, find that for a 100 basis point (bp) increase in the policy rate, non-agricultural growth increases by 40 bp, with a two-quarter lag, while the non-food manufactured inflation increases by 25 bp with a five-quarter lag. They also suggest that these results are consistent with that of the advanced economies.

Dhal (2011) goes a step further to examine the impact of monetary transmission on use-based industries and concludes that the capital goods and consumer durables are

more affected than basic, intermediate and non-durable goods. He uses a VAR model to reach his conclusion for the period of April 1993 to October 2011.

Ray and Prabhu (2013) examine the transmission mechanism to the various segments of the financial markets (government securities, corporate bond, foreign exchange and stock markets) in India. Using an SVAR model for the period of January 2005 to November 2012 and using daily market data, they find that transmission is fast and efficient to the government securities and bond market and modest to the foreign exchange markets. However, they find pass-through to be limited to the stock markets. They also examine the transmission mechanism under the surplus and deficit liquidity phases over the period of study to find that transmission is more effective under a deficit liquidity period than a surplus liquidity period.

None of the foregoing studies on India has systematically examined the two-stage IRPT, nor have they examined the factors affecting the IRPT, all of which are the focus of this research. This study uses monthly data for the time period of 2001m4 to 2010m11.<sup>39</sup>

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<sup>39</sup> In a recent paper, Ansari (2013) conducts an analysis of the impact of regulatory requirements on IRPT. Since the regulatory requirements affect a bank's balance sheet and therefore the lending rates, he suggests that for monetary transmission to be effective changes in the policy rate need to be accompanied by changes in the regulatory parameters to bring about the desired effect. He also estimates that there is a tradeoff between the regulatory requirements and effectiveness of monetary transmission and competitiveness in the loan markets. He further suggests that the capital markets could be linked to the IRPT if banks were subjected to a required return on their capital base.

## 2.4. Extent of Interest Rate Pass-Through in India

### 2.4.1 Empirical Model

This study first computes the interest rate pass-through using the policy variables before introducing the macroeconomic and financial determinants which influence pass-through in section 2.5. It looks at the effect of both the monetary policy approach as well as the cost of funds approach to estimate the IRPT coefficients. Two sets of broad estimating equations are used to estimate the pass-through coefficients.

For the first stage IRPT, i.e., from the policy rate to the call money rate, the following model is estimated:

$$\Delta \text{cmr}_t = \alpha + \beta_1 \Delta \text{repo}_t + \gamma \Delta \text{crr}_t + \theta \Delta \text{repo}_t * \Delta \text{crr}_t + \varepsilon. \quad (1)$$

where  $\text{cmr}_t$  is the money market rate (call money rate),  $\text{repo}_t$  is the repo rate, and  $\text{crr}_t$  – cash reserve ratio.  $\beta_1$  is IRPT coefficient from the repo rate to the call money rate. The CRR and its interaction term with the repo rate are included in the analysis to take into account the liquidity in the system, because monetary policy transmission depends on liquidity and both CRR and the repo rate directly impact liquidity in the system.<sup>40</sup> Therefore, this study includes CRR and its interaction term with the repo rate in the analysis.

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<sup>40</sup> The use of CRR as a monetary policy tool is conditioned on the fact that there are large exogenous shocks to liquidity in India due to the government cash balance and foreign investment flows. However, CRR is generally used when there are longer-term or structural changes in liquidity.

For the second stage IRPT, i.e., from the call money rate to the lending rate, the following model has been used:

$$\Delta r_t = \beta_2 \Delta \text{cmr}_{t-1} + \lambda \Delta \text{diffrr}_{t-1} + \varepsilon. \quad (2)$$

where  $r_t$  is the retail lending rate,  $\text{cmr}_{t-1}$  is weighted average call money rate, and  $\text{diffrr}_{t-1}$  is difference between the repo and reverse repo rate in the system.  $\beta_2$  is the IRPT coefficient from the call money rate to the lending rate. When the RBI increases both the repo and reverse repo, it is following a contractual monetary policy to reduce the money supply available in the system. Similarly, when the RBI decreases both the repo and reverse repo rates, it becomes cheaper for banks to borrow from the RBI and there is an expansion in the money supply. The reduction in the reverse repo also makes it less attractive for banks to lend to the RBI, further contributing to the effectiveness of the central bank actions. However, if the RBI decreases the repo rate to expand money supply and simultaneously increases the reverse repo, banks will likely park their money with the RBI and not lend it out, in which case and the central bank's monetary policy action will not have been effective. Therefore, the differential between the repo and reverse repo is used.

In addition to estimating the two-stage IRPT above, the direct impact of the policy rate on the lending rate is also estimated using the following model:

$$\Delta r_t = \beta_3 \Delta \text{repo}_{t-1} + \varphi \Delta \text{crr}_t + \delta \Delta \text{repo}_{t-1} * \Delta \text{crr}_t + \varepsilon. \quad (3)$$

$\beta_3$  is the IRPT from the repo rate to the lending rate. The repo rate is used with a lag, as the lending rates respond to the policy rate with a lag, but CRR affects the banks' liquidity directly and therefore is used as a contemporaneous variable. The  $\beta$ s will equal 1 if IRPT is complete, which is usually the case when there is perfect competition and full information available to all the agents. However, in practice, IRPT is usually incomplete with  $\beta < 1$  and also depends on the country and markets under consideration. For the purpose of this study, variations of the above-mentioned models have been used to compute the IRPT coefficients.

#### **2.4.2 Data**

As noted, based on data availability, this study uses monthly data for the period of 2001m4 to 2010m11. The weighted average call money rate has been used as the interbank market rate.<sup>41</sup> The prime lending rate, which relates to the five major banks, is used as the bank lending rate. The data on these variables as well as the policy rates are obtained from the RBI Database on Indian economy.

#### **2.4.3 Results**

To determine the appropriate methodology for the computation of the IRPT, the Augmented Dickey-Fuller tests and Zivot-Andrews test were conducted to determine whether the series were stationary or not. While the former test is more commonly used, the latter test allows for the possibility of structural breaks in the series. Results reveal that the lending rate is non-stationary in levels and is stationary in the first difference,

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<sup>41</sup> The results are similar when the 91-day Treasury Bill is used as the market rate. See annex 2.2 for details.

suggesting that it is an I(1) process. Similarly, the weighted average of the call money rate is stationary in levels using the ADF but is stationary in the first difference using the Zivot-Andrews test (Table 2.2). The Johansen test of cointegration reveals that the variables are not co-integrated. Since the variables are not co-integrated, simple regressions have been used to estimate the IRPT coefficients (Durán-Viquez & Esquivel-Monge, 2008).

**Table 2.2 Unit Root Tests**

<i>Variable</i>	<i>ADF</i>		<i>Zivot-Andrews<sup>#</sup></i>	
	<i>Levels</i>	<i>First Difference</i>	<i>Levels</i>	<i>First Difference</i>
(1)	(2)	(3)	(4)	(5)
Call Money Rate	-3.931*	-12.205*	-4.856 (Nov 2008)	-8.603* (Apr 2007)
Lending Rate	-0.710	-9.924*	-1.681 (May 2006)	-10.742* (Nov 2008)
Repo Rate	-1.646	-7.161*	-3.593 (Oct 2008)	-5.339 ** (Aug 2008)
<b>Critical Values</b>				
1 percent level	-3.505		-5.43	
5 percent level	-2.889		-4.80	

Notes: \*- Significance at the 1% level; \*\* - Significance at the 5% level.

<sup>#</sup> - Months in parentheses indicate the point of structural break.

*a) First Stage IRPT*

As mentioned earlier, the first-stage IRPT is from the policy rate to the call money rate. When the RBI changes the repo rate it is expected to be completely passed on to the call money rate immediately. The results of the regression analysis of equation (1) are presented in Table 2.3. The short run / instantaneous pass-through coefficients are

slightly greater than one, effectively implying complete pass-through. The overshooting of the response of the call money rate to the policy rate could be to offset the risks associated with asymmetric information between borrowers and lenders (DeBondt, 2005). These results confirm the hypothesis that pass-through from the policy rate to the call money market is complete. This implies that the first stage IRPT is smooth in India and is important for the effective transmission of monetary policy changes to the real economy through the financial markets.<sup>42</sup>

**Table 2.3 First Stage Pass-Through**

(1)	(2)	(3)	(4)	(5)
Model	$\Delta \text{cmr}_t = \alpha \Delta \text{repo}_t + \varepsilon$	$\Delta \text{cmr}_t = \alpha \Delta \text{repo}_t + \gamma \Delta \text{crr}_t + \theta \Delta \text{repo}_t * \Delta \text{crr}_t + \varepsilon$	$\Delta \text{cmr}_t = \alpha \Delta \text{repo}_t + \gamma \Delta \text{crr}_t + \theta \Delta \text{repo}_t * \Delta \text{crr}_t + \varepsilon$ if time < 04/2007	$\Delta \text{cmr}_t = \alpha \Delta \text{repo}_t + \gamma \Delta \text{crr}_{t-1} + \theta \Delta \text{repo}_t * \Delta \text{crr}_t + \varepsilon$ if time > 04/2007
$\Delta \text{repo}_t$	1.31*** (0.450)	1.34*** (0.503)	1.13* (0.584)	1.57* (0.862)
$\Delta \text{crr}_t$		0.584 (0.44)	0.661 (0.429)	0.651 (1.14)
$\Delta \text{repo}_t * \Delta \text{crr}_t$		0.789 (0.622)	16.50*** (5.80)	0.989 (1.26)
Constant	0.022 (0.112)	0.003 (0.113)	0.069 (.105)	-0.202 (0.267)
N	115	115	71	44

\* Significant at the 10% level; \*\* Significant at the 5% level; \*\*\* Significant at the 1% level  
Standard errors in parentheses

The Zivot-Andrew test suggests a structural break in April 2007 for the dependent variable, the call money rate (Table 2.2, col 5). The results are significant (though slightly

<sup>42</sup> Approximately similar results were obtained when the 91-day Treasury Bill (TB) was used as the money market rate. The pass-through coefficient was significant at around 72 percent. See Annex 2.2 for details.<sup>43</sup>  
The same result holds when using the 91-day Treasury bill ( $\beta=0.04$ ). See Annex 2.2

less significant than for the overall period), and the coefficient remains around one both before and after the structural break. Since the break is closer to the financial crisis, one can suggest that the financial crisis has not had an adverse impact on the first-stage pass-through and that the transmission mechanism has remained robust i.e. there is complete first-stage pass-through. With respect to asymmetry, there are only 14 cases of an increase in the repo rate of the total 114 cases, which made it difficult to run the analysis.

*b) Second Stage IRPT*

The second stage of IRPT, which is what is usually studied, is from the call money rate to the lending rates (equation 2 above). This pass-through is usually not complete and depends on the macroeconomic, financial, and regulatory environments of the country being studied (Apostoaie, 2012). Regression analysis of equation (2) yields the following results.

**Table 2.4 Second-Stage Pass-through**

Model	$\Delta r_t = \alpha \Delta \text{cmr}_{t-1} + \varepsilon$	$\Delta r_t = \alpha \Delta \text{cmr}_{t-1} + \beta \Delta \text{diffrr} + \varepsilon$
$\Delta \text{cmr}_{t-1}$	0.023 (0.030)	0.023 (0.029)
$\Delta \text{diffrr}$		0.463** (0.190)
Constant	-0.0304 (0.037)	-0.025 (0.036)
N	114	114

\* Significant at the 10% level; \*\* Significant at the 5% level; \*\*\* Significant at the 1% level  
Standard errors in parentheses

The short-run IRPT is negligible, at around two percent, and thus not significant.<sup>43</sup> However, the differential between the repo and reverse repo has a significant impact on the lending rate, with pass-through at 47 percent. This means that when the repo rate increases or the reverse repo rate decreases it has a larger impact on IRPT. If this were not the case, and the reverse repo and repo moved in opposite directions, then any action by the RBI would not have the desired effect. If the RBI decreased the repo rate to expand money supply and on the other hand, increased the reverse repo, the banks would park their money with the RBI and not lend it out, and the central bank's monetary policy action would not be effective. Because of the importance of maintaining this differential, the RBI fixed the reverse repo to be 100 basis points below the repo rate since May 2011. When the RBI increases both the repo and reverse repo, it follows a contractual monetary policy to reduce the money supply available in the system. Similarly, when the RBI decreases both the repo and reverse repo rates, it becomes cheaper for banks to borrow from the RBI and there is an expansion in the money supply. The reduction in the reverse repo also makes it less attractive for the banks to lend to the RBI, contributing further to the effectiveness of the central bank actions.

However, it is essential that the second-stage pass-through be effective for monetary policy transmission, as the RBI wants to reduce the bank's dependence on the LAF and make the banks borrow from each other at the call money rate. For there to be an impact of call rates on the lending rate, well-developed and stable yield curve is

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<sup>43</sup> The same result holds when using the 91-day Treasury bill ( $\beta=0.04$ ). See Annex 2.2

required. As the former deputy RBI governor has noted, “the Government securities market is important for the entire debt market as it serves as a benchmark for pricing other debt market instruments, thereby aiding the monetary transmission process across the yield curve” (Mohan, 2009, p. 2).

Lack of a Bond-Currency-Derivatives (BCD) nexus has been seen as a cause for the negligible pass-through from the money market rates to the lending rates in the economy. This nexus refers to the integration of the government and corporate bond markets as well as the currency and derivatives markets. Currently, these markets are illiquid and disconnected, which prevents information from this nexus from being correctly used for monetary policy decisions (Shah, 2008). For a financial system to function well, these markets need to be integrated and tightly linked through arbitrage. Focusing on creating a well-functioning BCD nexus would aid in the effective functioning of policy by increasing the pass-through from the policy rates to the economy through the interest rate changes in the government bond and corporate bond market (Rajan, 2009)<sup>44</sup>. This would require the development of deeper and liquid secondary markets in government securities as well as the overnight call markets. The following statement by former RBI governor Dr. Reddy summarizes the need for these reforms:

The repo market is growing in volume and the number of participants and variety of instruments are increasing, except in the overnight call market.

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<sup>44</sup> The other benefits of improving this nexus range from financing the fiscal deficit at a lower cost and with fewer distortions; improving financing of the debt-heavy infrastructure projects by providing information about the interest rates at various maturities which in turn influence the investment decisions and improving this nexus would reduce the interest rate differentials between India and the world by linking up the Indian bond markets with the world markets through the currency spot and derivatives market. (Rajan, 2009)

However, the short-term yield curve is yet to emerge...., there is a continued orientation towards longer-term fixed rate products.... Developing deep and liquid secondary markets in government securities has been the main objective of the RBI in the recent period. To that end, the RBI has initiated legal, regulatory and taxation reform, infrastructure and technology improvement, safe settlement systems, and market dissemination of information on all trades in the wholesale market. It also improved methods of issuance such as reopenings and price-based auctions thereby improving fungibility, introduced derivatives such as interest rate swaps and enlarged the repo markets. Liquidity support facilities to the primary dealers and timely open market operations have also been felt necessary to prevent the drying-up of liquidity in the secondary markets. In all these areas, the dilemmas have been resolved through a phased sequencing towards a clear ultimate objective” (Reddy, 2002 pp.122-3).

It is more than a decade since the above statement was made, yet India’s bond market development lags the high level of equity market development.<sup>45</sup> However,

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<sup>45</sup> While equity market development is under the purview of the *Securities and Exchange Board of India (SEBI)*, the RBI is in charge of bond market development. Shah (2000) has suggested that the relatively slow pace of reform of bond market compared to equity markets have to do with regulators in charge of the two markets. As he notes: “At first blush, it is glaringly obvious that RBI’s vision for market design has been proved inferior when compared with the innovations which have delivered results on the equity market. Many observers are puzzled at RBI’s unwillingness to learn from the success of the equity market, and abandon the non-transparent, clubby nature of the bond market. In this article, I will argue that the truth lies in between. There are some aspects where the equity market is clearly the role model for the debt market, and RBI should not hesitate in abandoning its existing vision for market design. At the same

India's bond market has many restrictions in terms of limits on government debt that can be held, which hinder the meeting the objectives of economic policy set by the government. These restrictions also make the country less open to foreign debt investment as compared to other emerging market nations (Patnaik et al., 2013; Sundaresan, 2013).

c) *Monetary Policy Approach*

As noted, while the second stage of the two-stage IRPT does not seem to work in India, this does not mean that the IRPT transmission mechanism per se does not operate. There could be a direct impact of the policy rates on the lending rates – known as the monetary policy approach (Sander & Kleimer, 2004). This approach might be more relevant in the Indian context than the two-stage pass-through, given the large size of state-owned banks in the domestic financial system.

Using the lending rate as the dependent variable and the lag of the repo rate as the independent variable (equation 3 above), the IRPT is significant at around 38 percent. The result remains robust even when the changes in CRR are controlled for. While lending rates adjust with a lag to the repo rates, the CRR affects a bank's liquidity directly, therefore for the regression the repo rate has been used with a lag and the CRR as a contemporaneous variable.<sup>46</sup> Introducing an interaction term of the repo rate and CRR into the regression reduces the short run pass-through coefficient slightly, to 35

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time, there are many aspects where RBI's concerns are well founded, where existing market practice on the equity market is dubious, and should not feature in the future of the debt market.”

<sup>46</sup> The difference is marginal when a lag of the CRR is used in the regression instead of contemporaneous CRR.

percent. The interaction term is positive, indicating that CRR tends to increase pass-through but is not significant. The results are presented in the following table (Table 2.5).

The structural break for the dependent variable, the lending rate, seems to occur in November 2008 as suggested by the Zivot Andrews test (Table 2.2. Col 4). The IRPT coefficient is significant at around 35 percent prior to the break. It loses its significance after the break, which roughly coincides with the GFC (though limited observations post-GFC should be kept in mind). The decline in the IRPT after the crisis could be due to the fact that the RBI resorted to conventional and unconventional measures of monetary policy to mitigate the impact of the crisis, like the advanced countries of the west. These measures included reducing the policy rates sharply along with increasing the domestic and foreign exchange liquidity, a special refinance facility for the scheduled commercial banks to help them face the liquidity stress brought about by the crisis, which might have led to a breakdown of the transmission mechanism (Mohanty, 2011d). Overall, the IRPT coefficient has been around 35 percent on average during the period under consideration.

**Table 2.5 Pass-through from the Policy Rate to the Lending Rate**

	(1)	(2)	(3)	(4)	(5)
Model	$\Delta r_t = \alpha \Delta \text{repo}_{t-1} + \varepsilon$	$\Delta r_t = \alpha \Delta \text{repo}_{t-1} + \beta \Delta \text{crr}_t + \varepsilon$	$\Delta r_t = \alpha \Delta \text{repo}_{t-1} + \gamma \Delta \text{crr}_t + \theta \Delta \text{repo}_t + \varepsilon$	$\Delta r_t = \alpha \Delta \text{repo}_{t-1} + \gamma \Delta \text{crr}_t + \varepsilon$ (prior to Nov 2008)	$\Delta r_t = \alpha \Delta \text{repo}_{t-1} + \Delta \text{crr}_{t-1} + \varepsilon$ (after Nov 2008)
$\Delta \text{repo}_{t-1}$	0.377** (0.146)	0.361** (0.149)	0.350** (0.150)	0.347*** (0.084)	0.213 (0.513)
$\Delta \text{crr}_t$		0.064 (0.100)	0.139 (0.159)	0.067 (0.044)	0.035 (0.180)
$\Delta \text{repo}_t$ * $\Delta \text{crr}_t$			0.123 (0.202)		
Constant	-0.021 (0.036)	-0.021 (0.036)	-0.025 (0.037)	0.023 (0.017)	-0.208 (0.171)
N	114	114	114	90	24

\* Significant at the 10% level; \*\* Significant at the 5% level; \*\*\* Significant at the 1% level  
Standard errors in parentheses

Given that the RBI required the banks to move to a base rate system in July 2010, the pass-through coefficients are also estimated, excluding the period that the banks were following a base rate system—i.e., until July 2010. The following tables present the results of the analysis for the period of 2001m4 to 2010m6. The results are similar to the results of the analysis for the entire period of study.

**Table 2.6 First-Stage Pass-Through until July 2010**

(1)	(2)	(3)
Model	$\Delta \text{cmr}_t = \alpha \Delta \text{repo}_t + \varepsilon$	$\Delta \text{cmr}_t = \alpha \Delta \text{repo}_t + \gamma \Delta \text{crr}_t + \theta \Delta \text{repo}_t * \Delta \text{crr}_t + \varepsilon$
$\Delta \text{repo}$	1.33*** (0.474)	1.37** (0.532)
$\Delta \text{crr}_t$		0.582 (0.485)
$\Delta \text{repo}_t * \Delta \text{crr}_t$		0.796 (0.634)
constant	0.021 (0.117)	0.001 (0.118)
N	110	110
R <sup>2</sup>	0.0686	0.0838

\* Significant at the 10% level; \*\* Significant at the 5% level; \*\*\* Significant at the 1% level  
Standard errors in parentheses

**Table 2.7 Second-Stage Pass-through until July 2010**

(1)	(2)	(3)
Model	$\Delta r_t = \alpha \Delta \text{cmr}_{t-1} + \varepsilon$	$\Delta r_t = \alpha \Delta \text{cmr}_{t-1} + \beta \Delta \text{diffrr} + \varepsilon$
$\Delta \text{cmr}_{t-1}$	0.053*** (0.013)	0.052*** (0.013)
$\Delta \text{diffrr}$		0.252*** (0.190)
Constant	0.001 (0.016)	0.003 (0.016)
N	109	109
R <sup>2</sup>	0.1263	0.1940

\* Significant at the 10 % level; \*\* Significant at the 5% level; \*\*\* Significant at the 1% level  
Standard errors in parentheses

**Table 2.8 Pass-through from the Policy Rate to the Lending Rate – Until July 2010**

(1)	(2)	(3)	(4)
Model	$\Delta r_t = \alpha \Delta \text{repo}_{t-1} + \varepsilon$	$\Delta r_t = \alpha \Delta \text{repo}_{t-1} + \beta \Delta \text{crr}_t + \varepsilon$	$\Delta r_t = \alpha \Delta \text{repo}_{t-1} + \gamma \Delta \text{crr}_t + \theta \Delta \text{repo}_t + \varepsilon$
$\Delta \text{repo}_{t-1}$	0.400*** (0.062)	0.384*** (0.062)	0.376*** (0.063)
$\Delta \text{crr}_t$		0.065 (0.041)	0.119* (0.065)
$\Delta \text{repo}_t * \Delta \text{crr}_t$			0.089 (0.082)
Constant	0.012 (0.016)	0.013 (0.015)	0.010 (0.015)
N	109	109	109
R <sup>2</sup>	0.2794	0.2960	0.3037

\* Significant at the 10% level; \*\* Significant at the 5% level; \*\*\* Significant at the 1% level  
Standard errors in parentheses

## 2.5. Determinants of Interest Rate Pass-Through in India

Having estimated the extent of IRPT, the second part of the chapter deals with its determinants.

### 2.5.1 Literature Review

The literature on the determinants of IRPT is limited.<sup>47</sup> The factors affecting the IRPT from the policy rate to the bank rate can be divided into macroeconomic factors, financial factors, and regulatory environment factors.

*a) Macroeconomic Factors:* During periods of faster *growth* it becomes easier for banks to transmit changes in the policy rate to the lending and deposit rates. A higher

<sup>47</sup> For instance, see Cas et al. (2011); Cottarelli and Kourelis (1994); Durán-Vázquez and Esquivel-Monge (2008); Égert et al. (2006); Gigineishvili (2011); and Saborowski and Weber (2013)

*inflation rate* is also known to lead to a higher IRPT as banks adjust their lending rates more frequently to protect their profit margins. This adjustment is because of the uncertainty associated with a high inflation environment, which also leads banks to pass on their risks to the consumers at a higher rate to maximize their risk-adjusted return and reduce their losses. A lower degree of *exchange rate flexibility* could also lead to a decline in IRPT. This results from letting the exchange rate become more flexible; the monetary authorities can signal to the markets that the policy rate has been set with the primary purpose of steering interest rates in the country. This action would ensure that policy rate changes are perceived as credible signals of the policy stance of the central bank.

b) *Financial Factors*: In terms of the financial factors, *bank competition* has emerged as an important indicator in the literature. Most of the studies in this area argue that weak competition in the banking sector leads to a lowering of the pass-through. In the presence of competition among banks, the spread between the market interest rate and the retail rates decreases and therefore the latter responds more strongly and faster to changes in the market interest rate. On the other hand, with lower competition, banks are less worried about losing their customer base and thereby earnings through their lending as opposed to losing their profit margins through the cost of funds. This could weaken the effectiveness of the monetary transmission (Leuvensteijn et al., 2008). With limited competition, lending rates might react more intensely to increases in the policy rate rather than decreases, and the opposite holds true for the deposit rates (Horvath et.al., 2004;

Mishra & Montiel, 2012). For India, Ansari (2013) estimates that bank competition reduces IRPT unless efficiency in the system rises. He also suggests that a positive policy shock increases cost of funds and reduces the bank spread. Conversely, there have also been arguments suggesting that bank concentration, a measure of competition, can increase IRPT through moral suasion. Barriers to entry, costs to entry or regulation, which make it difficult for firms to enter the market, hinder competition in the market and therefore contribute to lower IRPT.

Costs of the banks are another factor influencing IRPT. If banks set their retail rates by adding a margin over their costs, then the IRPT to the retail rates would also take into account the impact of policy rate changes on the total costs of banks. For example, if the operating costs of the banks are high then even with a reduction in the policy rate, the bank may not reduce its retail rates to cover for these costs, thereby adversely impacting the IRPT mechanism (Mojon, 2000). The size and health of the financial sector are also important determinants of IRPT. As the size of the financial sector increases, there is more competition among financial institutions, leading to a higher IRPT. Weaker banks do not pass through a lowering of the interest rates to the consumers by holding on to the excess liquidity. Having a higher share of bad loans on the bank's account could crowd out new loans and adversely impact IRPT (Sander & Kleimeier, 2004).

The type of bank-ownership also matters. More often than not, state-owned banks are "influenced" (moral suasion) to respond immediately to changes in the policy rate, which the banks respond to within a few days of the rate change announcement by the central bank. However, private banks will take their time to respond to changes in the

policy rate. This distinction could be an important factor for influencing pass-through in the country. The next section considers proxies for all these factors in the analysis.

c) *Regulatory Factors:* In addition to the foregoing factors, the literature also identifies some regulatory and institutional factors that could affect the degree of IRPT. For instance, in a weak regulatory environment, it becomes difficult to access adequate information and have certainty about enforcing contracts in addition to problems associated with corruption and lack of rule of law. These factors lower the elasticity of demand for loans and thereby affect the transmission mechanism (Gigineishvili, 2011).

Similarly, *central bank independence*--both instrument independence and target independence--could impact IRPT. Such independence gives autonomy to the monetary authority to undertake policy actions to influence the macroeconomic environment of the country as well as enhance its signaling function to market participants.<sup>48</sup> With respect to the financial dependence, if the government depends directly on central banks for financing its expenditures, then monetary policy may be subordinated to fiscal policy. On the other hand, an indirect dependence implies that the central bank manages government debt (Eijffinger & Haan, 1996). Countries where monetary policy is subordinated to fiscal policy also have a lower pass-through. Direct lending by the central banks to the government has also been found to constrain the transmission mechanism, as it impedes the central bank's ability to signal changes in the policy by raising interest rates and

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<sup>48</sup> Some of the characteristics that determine the independence of a central bank are the role of the government in appointing or dismissing members of the governing board; the voting power of the government on the board; the degree of budgetary control by the government; the extent to which the government borrows from the central bank; and the existence of well-defined policy goals in the central bank's charter.

performing open market operations. (Cas et al., 2011; Giginishvili, 2011). However, these factors are excluded due to unavailability of data/proxies.<sup>49</sup>

### **2.5.2 Data**

The proxies used for the various determinants are as follows. Growth is captured using the GDP growth rate while the rate of inflation in consumer prices has been used as a measure of inflation in the country. Exchange rate flexibility is measured as a dummy representing periods when the exchange rate was flexible or fixed, based on Shah and Patnaik's (2011) classification of the exchange rate regime. Competition in the banking system has been captured through bank concentration. Size and development of the financial system has been captured through the ratio of bank deposits to GDP, private sector credit to GDP as well as the non-interest income to total income (portfolio diversification). Health of the financial system has been captured using credit-deposit ratio. Operating costs are used here as a proxy for the total costs and therefore, the higher the share of the operating costs in the total costs, the smaller the expected pass-through (Mojon, 2000). The share of non-performing assets in total assets has been used to capture the asset quality (Saborowski & Weber, 2013). The share of state-owned and nationalized banks in the total deposits has been used as a measure of the bank ownership. Table 2.9 summarizes the determinants and their priors.

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<sup>49</sup> Other factors that affect pass-through are the perceived nature of the change, whether it is permanent or temporary change in the policy rate as well as the size of the policy rate change.

**Table 2.9 Factors affecting pass-through**

Factor	Expected Sign
GDP growth	+
Inflation	+
Exchange Rate Flexibility	+
Bank concentration	Ambiguous
Bank deposits to GDP (Size of the banking sector)	+
Cost structure (Cost to Income Ratio)	-
Credit-deposit rate (indicating health of banks)	+
Non-performing assets	-
Portfolio diversification	+
Private Credit to GDP	+
Bank ownership	+

The data for most of the factors affecting IRPT were available on an annual basis.<sup>50</sup> Annual data were converted to monthly data using cubic spline interpolations for the period of 2001m4 to 2010m11.<sup>51</sup> The data on the macro variables were mostly obtained from the RBI, along with that of credit-deposit ratio, while the rate of inflation was collected from the Ministry of Statistics & Program Implementation, Government of India. Data on the financial factors were obtained from the Financial Development

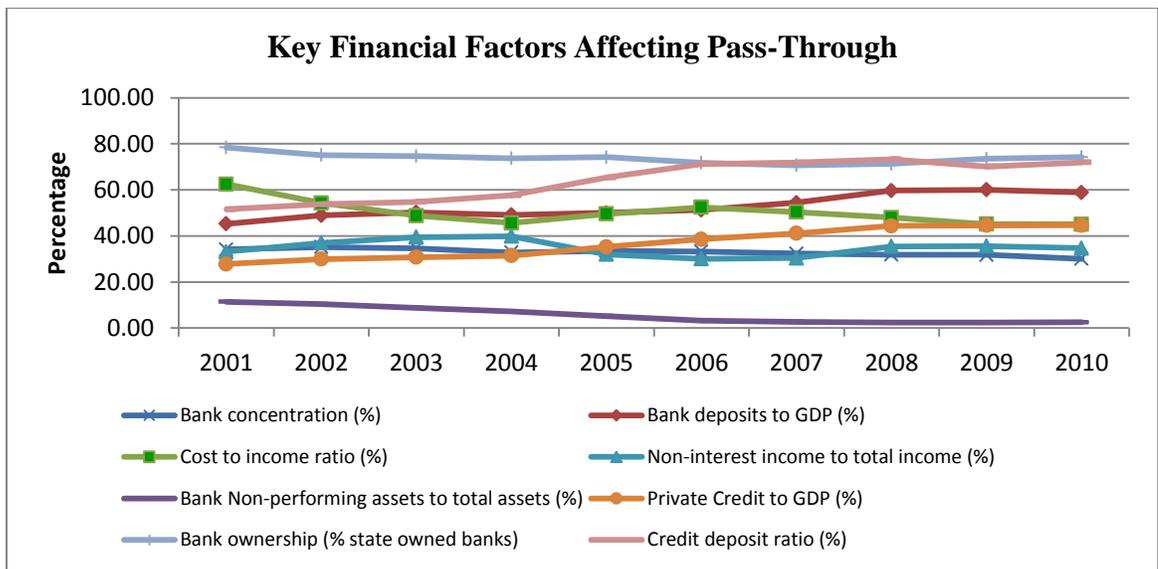
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<sup>50</sup> Inflation rate and credit-deposit ratio were the two factors for which data was available on a monthly basis.

<sup>51</sup> A spline is defined as a polynomial between pairs of data points. Spline interpolations are used to interpolate data between two points and these are preferred over other interpolations as they reduce the interpolation error. Of these, cubic splines provide better interpolations over linear splines as they tend to produce an interpolated function that is continuous through to the second derivative. The linear interpolations do not capture the curvature of a function. An explanation of the process of converting data at a lower frequency to a higher frequency is given by Columbia Economics LLC (2010): “Cubic splines are commonly used to split data at a lower frequency into higher frequency. In the case of the present exercise, we split annual data into monthly data. Say, we start with n annual data points. These n points have n-1 spaces between them and the cubic (3<sup>rd</sup> degree) polynomial connects two points across each space. By ensuring that the derivatives on each side of the connecting point are equal, the connecting line is smooth. The resulting system can be solved for the coefficients of all n-1 cubic polynomials. Once the n-1 piecewise polynomials are determined, one can plug in x values for whatever time intervals we want (monthly, weekly or daily). These polynomials will give us a pretty good interpolation between the annual points.”

Indicators of the World Bank. (FDI, 2013; MOSPI, 2013; RBI Handbook of Statistics on Indian Economy, various issues;)

Figure 2.4 shows the trend of these factors since 2001. As the figure shows, bank deposits to GDP and the cost-to-income ratio experienced the most change in the period under study. Bank deposits increased from 45 percent to around 60 percent while the cost to income ratio decreased from 62 percent to 45 percent. Bank concentration did not change much (a decrease from 34 percent to 30 percent), and neither did the non-interest income as a fraction of total income.



Source: World Bank – Financial Development Indicators; RBI Basic Statistical Returns of Scheduled Commercial Banks in India, various issues

**Figure 2.4 Key Financial Factors Affecting Pass-Through**

### 2.5.3 Methodology and Results

The estimation of IRPT is carried out in the same way as the estimation of pass-through from policy to lending rate, along with the factors that influence the transmission mechanism. The following equation (4), based on equation (3), is estimated by adding the factors affecting pass-through and their interactions with the repo rate as follows:

$$r_t = \alpha_0 + \beta \Delta \text{repo}_{t-1} + \gamma \Delta \text{crr}_t + \Delta \text{repo}_t * \Delta \text{crr}_t + \mu \Delta z'_{t-1} + \theta \Delta \text{repo}_t * z'_t + \epsilon_t \quad (4)$$

where  $r_t$  is the deposit/ lending rate, repo is the policy rate,  $\beta$  is the pass through coefficient, and  $z$  captures the other factors that influence the impact of the policy rate on the retail rates.

Regressions were run to determine factors affecting pass-through from the policy rate to the lending rate. Since cubic spline interpolation was done to obtain monthly estimates from the annual data, Newey-West regressions have been used to account for any autocorrelation introduced by cubic splines.<sup>52</sup> The Augmented Dickey-Fuller tests and Zivot Andrew test were conducted to check for the stationarity of the series and the Akaike Information Criteria (AIC) was used to check the appropriate lags for each of the variables (Annex 2.3 a and b). Regressions were carried out separately for the macroeconomic and financial factors as well as for all the factors together.

Table 2.10 presents the results of the Newey-west regressions. Column (2) of the table is the base model for this analysis on which the complete model would be built,

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<sup>52</sup> This is because data points interpolated by cubic splines are related to each other by a cubic polynomial and would violate the standard OLS assumptions (Columbia Economics, 2010).

taking into account the factors known to affect pass-through. The pass-through coefficient is the same as in column (3) of Table 2.5. Adding the macroeconomic variables of GDP growth, exchange rate flexibility and inflation rate reduces the pass-through coefficient slightly, to around 32 percent. However, the result is more significant when the macroeconomic variables are controlled for. A similar result is obtained when the financial variables are added to the base model (col 4): a highly significant pass-through coefficient of around 33 percent. The all-inclusive model is what would be used for the purpose of this analysis. For the complete model, the IRPT coefficient is significant at 0.28, which is consistent with the coefficients obtained in the base model, suggesting that the results are robust to alternative specifications of the model.

Focusing on the interaction terms (since this study is interested in the impact these variables have on the pass-through from the policy to retail rates), CRR, inflation, credit-deposit ratio, cost-to-income ratio, and bank ownership emerge as the significant factors with the expected signs. Bank concentration is also significant, but with a positive sign. GDP per capita is not significant in any of the models.

**Table 2.10 Policy Rate and Lending Rate<sup>53</sup>**

(1)	(2)	(3)	(4)	(5)
Variable	Base Model	Base Model + Macro variables	Base Model + Financial Variables	All Inclusive model
Repo rate	0.35** (0.154)	0.317*** (0.103)	0.326*** (0.10)	0.283** (0.115)
CRR	0.139 (0.139)	0.356** (0.171)	0.163 (0.114)	0.281 (0.181)
GDP Growth		0.388 (5.47)		-3.367 (5.14)
Inflation Rate		-0.001 (0.046)		-0.009 (0.025)
Exchange Rate Flexibility <sup>54</sup>		-0.053 (0.069)		0.007 (0.091)
Credit-deposit Ratio			-0.026 (0.057)	0.030 (0.021)
Bank deposit to GDP			16.45 (18.62)	5.17 (9.48)
Bank concentration			6.98 (10.48)	2.88 (10.35)
Cost-to-income ratio			-0.085 (0.080)	-0.095 (0.122)
Non-interest income to total income			3.11 (2.95)	0.473 (3.42)
Non-performing Assets			0.030 (0.024)	-0.0009 (0.013)
Private credit to GDP				-6.44 (16.6)
Bank Ownership				-0.015 (0.025)
<b><i>Policy Rate Interacting with</i></b>				
CRR	0.123 (0.202)	0.348* (0.192)	0.160 (0.132)	1.30*** (0.361)
GDP growth				-0.228 (1.66)

<sup>53</sup> A joint F-test on the interactions of the factors with the policy rate did not show them to be jointly significant.

<sup>54</sup> Defining fixed exchange rate as a deviation of the Indian rupee with respect to the USD of less than 1 percent, also did not yield good results.

Inflation Rate				1.36*** (0.432)
Exchange Rate Flexibility				-
Credit-deposit Ratio				0.814*** (0.276)
Bank deposit to GDP				2.478 (5.42)
Bank concentration				10.41* (5.47)
Cost-to-income ratio				-3.98* (2.38)
Non-interest income to total income				-9.97 (6.93)
Non-performing Assets				-11.05 (7.57)
Private credit to GDP				-3.09 (4.42)
Bank Ownership				7.96* (4.50)
Constant	-0.025 (0.037)	0.000 (0.031)	5.21 (3.59)	-0.208 (0.177)
Number of Observations	114	108	109	108
F-Statistic	2.44*	4.15***	3.00***	6.85***

\*\*\* Significant at the 1% level; \*\* Significant at the 5% level; \* Significant at the 10% level  
Standard errors in parentheses

Inflation emerges as a significant variable in terms of its impact on the lending rate through its interaction with the policy rate. A one standard deviation increase in inflation leads to an increase in the pass-through from 0.04 to 0.08.<sup>55</sup> Inflation has been a major cause of concern in India in recent years (see chapter 1). There might appear to be a tradeoff between inflation and strength of pass-through, with higher inflation leading to

<sup>55</sup> These calculations for the impact of each of the variables are based on the Cas et al. (2011) estimation of the marginal effects. The marginal effects are computed as:

$$\frac{dr}{dm} = \beta_2 + \theta z'$$

from equation 4.

better pass-through, suggesting that by meeting its objective of reducing inflation, a central bank weakens the effectiveness of the monetary transmission mechanism. However, it is important to note that ensuring smooth transmission itself is not an objective of the central bank but rather a means of achieving its objectives. And if controlling inflation leads to a reduction in the pass-through, it can be compensated for by focusing on other factors to ensure smoother transmission (Gigineishvili, 2011).

The credit-deposit ratio, used as a proxy for the health of the financial sector, also emerges as an important factor affecting pass-through in the country. The interaction term has the expected positive sign and is highly significant. A one standard deviation increase in the credit-deposit ratio can lead to an increase in the pass-through from 0.45 to 0.52. Credit-deposit ratio is a key measure of the health of the banking system in India, as it indicates the amount the banks have lent out of the deposits they have mobilized. The ideal level of this ratio for India is at around 70 percent, given the need to maintain CRR and SLR by the banks. The credit deposit ratio for most part of the period of study was less than 70. A lower level of this ratio indicates that banks are not utilizing their resources appropriately, and a higher ratio (>70%) indicates pressure on the resources, i.e., capital adequacy issues as the banks are lending out more than their deposits, indicating that they might be lending out of their capital. The ratio was consistently rising over the years, reaching a peak of 75 percent in October 2008 before decreasing again. The reason for the increase is the increasing reliance of the corporate sector on the domestic banking system when funds dried up in the international markets during the GFC. The ratio once again reached record highs during the second quarter of 2013, owing

to the tighter liquidity conditions resulting from the RBI action to support the depreciating rupee (Nayak, 2012; Shetty, 2013).

The cost-to-income ratio also has a moderately significant effect on IRPT, and the interaction term indicates that as the cost-to-income ratio rises, the pass-through to the lending rate decreases. The cost-to-income ratio reflects the operating efficiency of the banks and could include costs related to day-to-day operations, legal obstacles in obtaining and liquidating collateral, etc. When such costs are high, a reduction in the pass-through may not be passed on to the lending rates, as the banks could use the extra income earned from the higher interest rates to service these costs. Even though this ratio has come down for India from around 85 percent in 1992 to 45 percent in 2010, it remains very high to allow banks the flexibility to pass through any rate changes to the public. The lower the ratio, the higher would be the efficiency of the banks and therefore better the monetary transmission. A decrease in the cost-to-income ratio is associated with an increase in the pass-through by 0.1 point (RBI, 2012).

Bank concentration also emerges as a significant variable influencing pass-through from the policy rate to the lending rates. An increase in the bank concentration by one standard deviation is expected to increase pass-through by 0.15 points. In the case of two-stage IRPT, one would expect high bank competition to lower concentration and consequently ensure that banks are responsive to policy and interbank rates. However, in the event that a few large banks dominate the market, a high level of bank concentration may lead to greater IRPT as the central bank can use moral suasion to effect changes it desires. Indeed, there is some evidence that during the GFC, monetary policy

transmission was higher and more effective in countries like India and China that have a high concentration of state-owned banks (Islam & Rajan, 2011). Consistent with this argument, results in this chapter suggest that higher the share of the state-owned banks, the higher the pass-through due to moral suasion. This factor emerges as moderately significant in our analysis. A one standard deviation increase in the bank ownership percentage can lead to a 0.14 point increase in IRPT. The coefficient of CRR is also significant and has the expected positive sign because when the central bank raises the CRR, banks have less cash to lend and the lending rate rises.

## **2.6. Conclusion and Policy Recommendations**

Study of the IRPT mechanism is the first step in understanding the effectiveness of the monetary policy for any country. This is because monetary policy actions are passed on to the rest of the economy through the financial markets via price and quantity variables such as interest rates, exchange rates, asset prices, yields, money supply, foreign denominated assets, etc. Of the various channels, the interest rate channel in particular has risen in importance over the years along with the emergence of the interest rates as a key monetary policy instrument of central banks across the world, including India (Mohan, 2009). Unlike developed countries, where there are substitutes to bank loans for financing, individuals and small and medium enterprises (SMEs) in developing countries like India are heavily dependent on bank loans for their finance needs, thus making interest rate pass-through via bank interest rates particularly important (Islam & Rajan, 2011).

Given the importance of this issue, this chapter estimated the pass-through to the lending rates as well as determined the factors affecting pass-through in India. As in many other countries, while the first stage IRPT from the policy rate to the interbank rate is complete, the second stage IRPT to lending rates is negligible. This breakdown in the second stage is possibly due to the lack of well-developed government bond markets and yield curve. However, this does not imply that monetary policy via interest rates is completely ineffective. Results suggest that lending rates vary directly with the policy rate even though the pass-through is incomplete (at approximately 35 percent). However, the weak pass-through suggests that to bring about any desired change in the demand and prices, the RBI has to change policy rates by a large amount. Improving the transmission mechanism ought to ensure that the central bank can control inflation and output through smaller changes in the interest rate. The stronger the pass-through, the more efficient would be the transmission mechanism and the easier it would be for the RBI to achieve its objectives (Patnaik, 2008).

The analysis of factors influencing pass-through from the repo to the lending rate indicate that inflation rate, cost-to-income ratio, credit-deposit ratio, CRR, bank concentration, and bank ownership influence the pass-through. While inflation rates, credit-deposit ratios, bank ownership and concentration, and CRR have a positive impact, cost-to-income ratio has a negative impact on the pass-through. The RBI should focus on these factors along with developing the yield curve further to improve the transmission mechanism. The more stable the yield curve, the more proportionate would be the pass-through from the policy rates to the market rates.

The yield curve in India is underdeveloped, with no arbitrage or separate liquid markets for the short term and longer term interest rates. In addition, only securities of a few maturities are traded more than the others along the yield curve. For example, the 10-year bond is traded the most as compared to bonds of 5-year or lower maturities. Thus, making the markets for the other securities (other than the 10-year bond) along the yield curve deeper and more liquid would also ensure an efficient transmission from the policy rates through the assets of various maturities to the other rates in the economy. Doing so would imply that any shocks to either of the short-term or long-term maturities would raise the risk for all borrowers and lenders in both the short-term and long-term markets (Shah, 2009). The Indian bond markets do not, as of yet, have adequate liquidity and depth across all maturities.<sup>56</sup> In the absence of a well-developed yield curve, new financial products cannot be introduced, which would further help improve the transmission from shorter to longer term rates. In this regard, India can follow the example of Thailand and Korea, which developed their government bond yield curves after the 1997 crises in order to improve the transmission of policy rates as well as develop their financial markets and bring about financial stability (OECD, ND; Rhee, 2013). (See Annex 2.4 for a discussion of the Korean and Thailand cases.)

Of concern is that as India continues to liberalize its banking sector, the direct IRPT from the repo rate to the lending rate may decline. If monetary policy via interest rates is to be effective in such a scenario, such liberalization needs to be accompanied by

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<sup>56</sup> One way of ensuring greater liquidity might be by opening up the domestic currency bond market to foreign investment. For an exploration of this idea, see Patnaik et al. (2013).

greater debt market development so as to ensure that second-stage IRPT becomes more significant. Failure to address debt market development may render monetary policy ineffective.<sup>57</sup> This is particularly concerning for India given that its lack of fiscal space limits the aggressive use of fiscal policy to moderate business cycles.

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<sup>57</sup> Of course, monetary policy could still be effective if the other monetary policy channels (via asset market, exchange rates, etc.) work.

## **CHAPTER 3. EXCHANGE RATE CHANGES AND INFLATION IN INDIA: WHAT IS THE EXTENT OF EXCHANGE RATE PASS-THROUGH TO IMPORTS?**

### *Abstract*

Absence of inflation hedges and lack of inflation indexation in India make the society very sensitive to inflationary pressures. A potential source of such pressures that is often mentioned is the depreciation of the Indian rupee which has occurred over the last few years. This study computes the exchange rate pass-through into import prices of India at the aggregate and disaggregated sectoral levels for the period 2003m1 to 2013m3 using both trade-weighted and bilateral USD exchange rates. The study also examines the asymmetry and non-linearity in the exchange rate pass-through at the aggregate level. The results suggest that there is more than complete exchange rate pass-through into Indian import prices in the short run and even higher pass-through in the long run, indicating the inertial effect of rising prices. There is also evidence of non-linearity in exchange rate pass-through, in terms of whether the rupee is appreciating or depreciating, as well as in terms of whether there are small or large changes in the rupee value.

### **3.1 Introduction**

The exchange rate channel of monetary policy is important for many developing countries. When a central bank lowers the policy rates, this action often results in a depreciation of that country's currency, which in turn makes imports more expensive while presumably enhancing the price competitiveness of that country's exports. However, for the exchange rate channel to operate effectively, the implicit assumption is that exporters will adjust the home price of their goods or services in such a way as to keep the price in the importing country more or less unchanged (by either adjusting costs or mark-ups or some combination of the two). More generally, it is possible that

exporters may pass through less than proportional change in the prices due to exchange rate movements.

Formally, exchange rate pass-through (ERPT) refers to the transmission of exchange rate changes into import prices in the destination market currency price of goods. ERPT is said to be partial or incomplete if the import price rises by less than one percent, as the exporters absorb a portion of the exchange rate change. ERPT can be divided into two-stages: the first stage refers to the changes in import prices caused by a change in the exchange rate; in the second stage, changes in the import prices are passed on to the consumer and wholesale prices in the country. A closely related concept to ERPT is pricing to market (PTM), which measures the change in the export prices in the exporter's currency due to a one percent change in the exchange rate. A higher PTM elasticity by the exporting nation implies lower ERPT in the importing country.

As noted, the issue of ERPT is particularly important in view of its policy implications for small and open economies. Specifically, if ERPT is low, use of any exchange rate-based adjustments to improve the trade balance and overall economy may be rendered less effective. On the other hand, low ERPT also implies that small and open economies may be less concerned about the potential inflationary consequences of exchange rate fluctuations (Rajan, 2011). Thus, understanding ERPT is important to anticipate inflation developments and to ensure appropriate and effective monetary policy response by the authorities. The study of ERPT is also important given the impact it has on the price level in the country through its impact on import prices. The two largest

items of import for India are oil and gold, and the demand for both is inelastic, the former for lack of alternatives and the latter for lack of proper inflation hedges (Goyal, 2013c).

The concept of ERPT first emerged formally in the academic literature when it was observed that the Japanese exporters did not pass on the increase in prices of their exports to the United States (U.S.) after the appreciation of the yen following the Plaza-Accord in 1985 (Ghosh & Rajan, 2009; Goldberg & Knetter, 1997; Knetter, 1993; Marston, 1990). Initial studies on the subject focused at the aggregate level of imports and exports but then it was realized that such aggregate studies hide important sectoral differences. This motivated studies at the disaggregated level.

While much of the earlier ERPT literature focused on the U.S. and other developed countries (see Bussière, 2007; Dornbusch, 1987; Goldberg and Knetter, 1997; Krugman, 1987; Menon, 1995; and Przystupa and Wróbel, 2011), over the years greater attention has been paid to developing economies in Asia and elsewhere (for instance, see Ghosh and Rajan, 2007a). Within Asia, however, the literature on India is quite limited, a gap this chapter aims to fill. Another feature of most of the studies on ERPT is the assumption of a symmetric response, i.e., these studies assume that increases and decreases in the exchange rate are transmitted in the same proportion. However, given price rigidities--particularly the fact that prices are sticky downwards than upwards--assuming a symmetric response might be restrictive (Delatte & López-Villavicencio, 2012).

This chapter focuses on computing the ERPT in India using monthly data for the period January 2003 to March 2013. In addition to computing aggregate ERPT

coefficients, the chapter examines whether two kinds of asymmetries in ERPT exist, viz. size of currency changes (small versus large) as well as their direction (appreciation versus depreciation). Finally, it also examines ERPT at the disaggregate (product) level. Following much of the recent literature, the focus will be on first stage ERPT (i.e., into import prices) rather than second stage ERPT in overall inflation (given that a number of other exogenous factors could impact the latter).

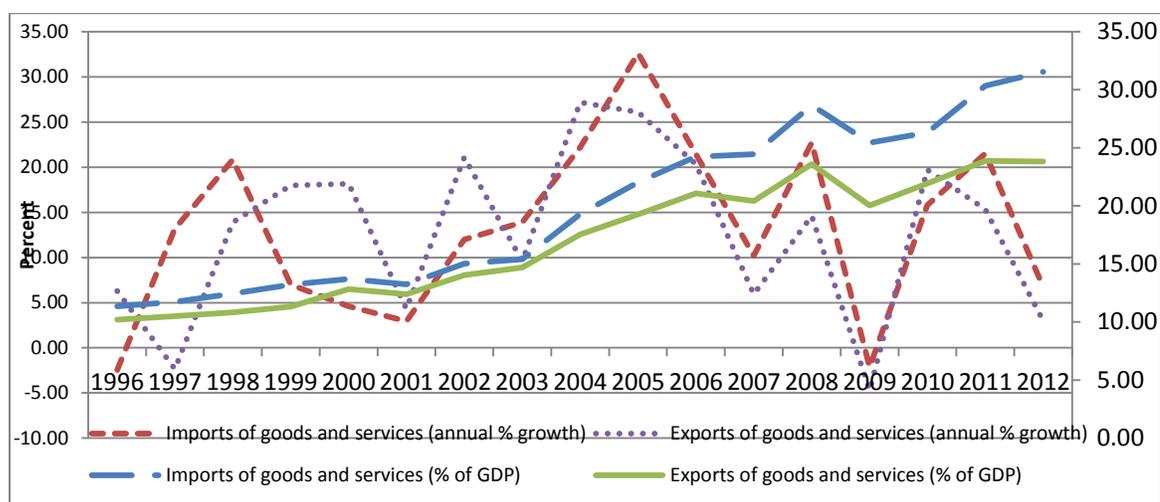
The remainder of the chapter is organized as follows. The next section provides some stylized facts on India's trade as well as exchange rates in brief. Section 3.3 reviews some of the empirical literature on ERPT in general and the literature on the asymmetric behavior as well as the ERPT literature on India to date. Section 3.4 outlines the research questions. Section 3.5 provides a description of the methodology and the data. Section 3.6 summarizes the results. Section 3.7 offers some concluding remarks and policy recommendations.

## **3.2 Stylized Facts on Indian Trade and Exchange Rate**

### **3.2.1 Trade**

India initiated trade liberalization efforts in the 1990s, with removal of quantitative restrictions, reduction in tariffs, and reduction of protection to industries, which had a favourable impact on the total trade of India (Srinivasan, 2001). Since then, both imports and exports have been rising as a percentage of GDP, with growth of

imports rising faster than that of exports for most part of the period from 1996.<sup>58</sup> This trend continued until 2004-05, when both imports and exports reached their peak growth rates of 33 and 26 percent, respectively (Figure 3.1). Imports as a share of GDP were more than 30 percent as of 2012, while exports slowed down and were less than 25 percent of GDP. India's share in the world's exports and imports rose from 0.7 and 0.8 percent respectively in 2000 to 1.7 and 2.5 percent in 2011 (Economic Survey, 2012-13).



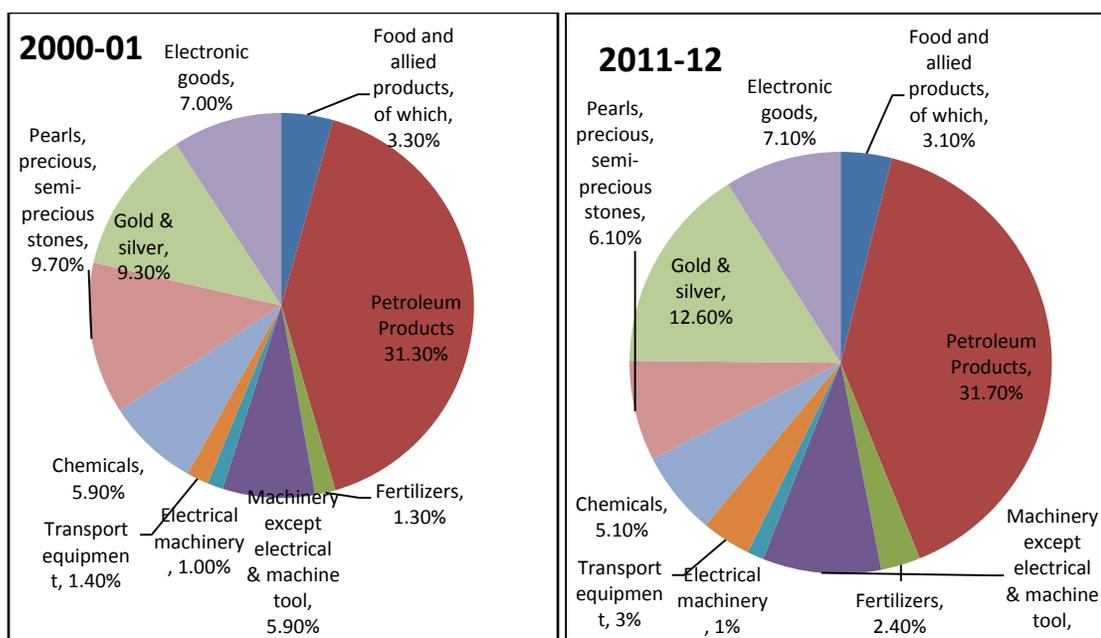
Source: World Development Indicators (WDI), World Bank (2013).

### Figure 3.1 Indian Exports and Imports – Growth and Share of GDP

Along with the rapid growth in trade, there has been a change in the composition and direction of India's trade. With respect to exports, the share of primary products and manufacturing has declined over this period, while that of petroleum (both crude and refined) products has increased, though India regained some of the increase in primary

<sup>58</sup> These data refer to merchandise trade only.

product exports in 2011 (Annex 3.1). With respect to imports--which is the focus of this paper--the share of manufactured goods in India's imports declined, while that of petroleum as well as gold, silver and precious stones has risen significantly since 2000 (Figure 3.2).



Source: Economic Survey of India 2012-13.

**Figure 3.2 Product Share in Indian Imports – 2011-12**

There has also been a change in the direction of India's trade in terms of source of imports since the beginning of 2000. Europe's share fell from 27.6 percent to 16.7 percent by 2012-13, while that of the Asian countries more than doubled from 27.7 percent to 61.1 percent during the same period. This rise in the Asian countries is mainly

due to the increase in the petroleum imports from the Middle Eastern countries and gold, silver, and precious stones, etc., from China and other East Asian countries (Table 3.1).

**Table 3.1 Ranking of Countries in Indian Imports**

<b>Rank</b>	2000-01	2005-06	2009-10	2011-12	2012-13
1	UK	China P RP	China P RP	China P RP	China P RP
2	Switzerland	USA	UAE	UAE	UAE
3	USA	Switzerland	Saudi Arabia	Switzerland	Saudi Arabia
4	Belgium	Germany	USA	Saudi Arabia	Switzerland
5	Japan	Australia	Switzerland	USA	USA
6	Germany	Belgium	Australia	Iraq	Iraq
7	China P RP	Korea RP	Iran	Kuwait	Indonesia
8	Singapore	UAE	Germany	Germany	Germany
9	Malaysia	France	Indonesia	Australia	Hong Kong
10	Australia	Japan	Korea RP	Indonesia	Singapore

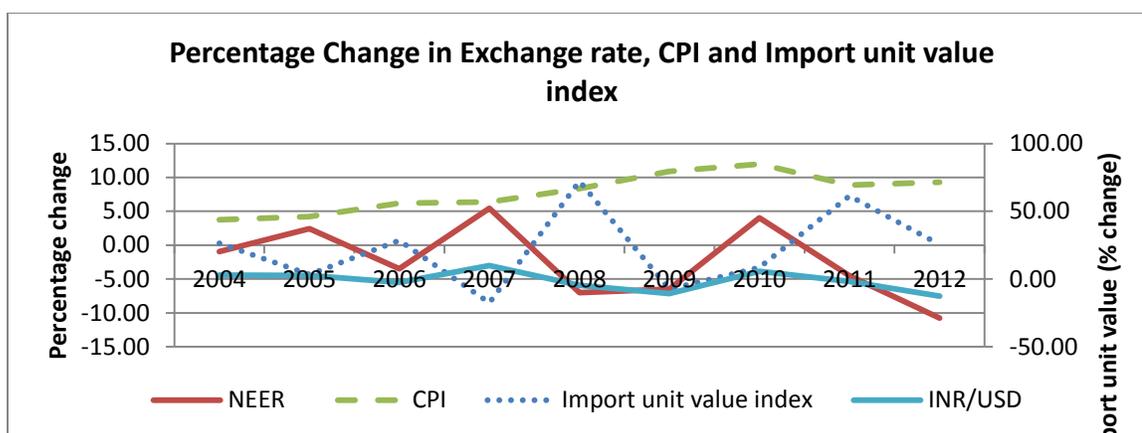
Source: Directorate General of Foreign Trade (various issues)

### **3.2.2 Exchange Rate**

India's exchange rate policy has evolved over time, with developments in the domestic and global economy, particularly since 1991 when wide-ranging reforms were introduced in the domestic and external sectors. As mentioned in Chapter 1, the era of fixed exchange rate regime for India ended in 1993 with a two-step downward exchange rate adjustment in 1991. Since the mid-1990s, India has moved towards a "market determined unified exchange rate" with the RBI intervening in the foreign exchange market to reduce volatility (though it sometimes leans against the wind) (see chapter 1). The Indian rupee (INR) has generally depreciated against the USD since 1993, except during 2003-2005 and 2007-08 when there was an appreciation of the INR due to the

dollar's weakness and the large capital inflows into India. Since the beginning of 2013, the INR depreciated by as much as 20 percent against the USD and reached a new low of around Rs 68.8 to the USD in August 2013.

Figure 3.3 shows the percentage change in the nominal effective exchange rate (NEER) for India as well as the consumer price index and the bilateral USD-INR exchange rate. The Nominal Effective Exchange Rate (NEER) used in this chapter is the RBI's 36 country trade-based weights index, which provides the most comprehensive coverage. The NEER is the weighted average of the bilateral exchange rates, where the INR is defined in terms of the foreign currencies and is constructed by the RBI both as a 6-currency index and 36-currency index based on three-year moving averages of both trade based and export based weights. An increase in the NEER represents an appreciation of the Indian rupee relative to the partner currency, while a decrease represents a depreciation. In addition to the country's share in the total exports and total trade and availability of data, the countries are chosen to represent the changing direction of Indian trade towards more Asian countries. The 36 countries, including the 12 countries of Euro, in effect take the total number of countries to 47. These 36 currencies together accounted for around 77 percent of the total trade and 89 percent of the total exports during the period 2002-03 to 2004-05 (RBI, 2005).



Source: RBI, CSO, Pacific Exchange Rate Service

**Figure 3.3 Exchange Rate and CPI<sup>59</sup>**

As can be seen, the NEER and the INR-USD move in tandem, with both the series representing an appreciation with an increase. The inflation rate based on CPI has been constantly rising since 2003. Over the time period considered (January 2003 to March 2013) there were 57 months when the currency appreciated and 64 months when it depreciated. Similarly, with respect to the size of the change, if the large change is considered as being above the mean NEER, then there were a total of 61 months when the change was equal to or greater than the mean while for 62 months, the change in the NEER was less than mean.<sup>60</sup>

Simple correlations between percent changes in the import unit value index and the NEER, CPI and INR-USD suggest that these variables exhibit co-movement for the

<sup>59</sup> NEER constructed as the 36 country trade based weights is used here.

<sup>60</sup> When median NEER is considered: the total number of months when the change in the NEER was greater than the median change were 62, whereas for 61 months, the size of the change was less than the median change. When the USD-rupee index is considered, there were 66 episodes when there was an appreciation of the currency and 57 months when there was a depreciation.

period 2003m1 to 2013m3 (Table 3.2). The high correlation between India's NEER and bilateral USD rate despite the U.S. having a relatively smaller share in imports to India (5-6 percent as of 2012-13) may seem curious *a priori*. However, it is important to note that India's direction of trade is shifting more towards countries either heavily managed or entirely pegged to the USD or using the USD as their currency and the share of imports invoiced in USD has also increased from around 60 percent in 1990-91 to around 89 percent in 2005-06 (Arabi, 2008). In terms of the total trade, the top ten countries India trades with are the UAE, China, USA, Saudi Arabia, Switzerland, Germany, Singapore, Iraq, Indonesia, and Hong Kong. The high correlation between the NEER and CPI with import prices indicates is indicative of the existence of some degree of ERPT into domestic inflation.

**Table 3.2 Correlation between Import unit value indices, exchange rate and CPI**

	Import Prices	NEER	CPI	USD/INR
Import Prices	1			
NEER	-0.8676	1		
CPI	0.9010	-0.8679	1	
INR/USD Index	-0.6389	0.8698	-0.5869	1

Source: RBI Handbook of Statistics on Indian Economy, CSO Monthly Abstract, Pacific Exchange Rate service

### 3.3 Empirical Literature on ERPT

This section briefly summarizes the literature for the developed countries before discussing the literature on India in particular.

### 3.3.1 General Review of Literature

Most of the empirical work on ERPT has dealt with advanced economies like the U.S., Germany, and Japan. As mentioned, the PTM behaviour of the Japanese in the 1980s led to the interest in this subject. Marston (1990) was the first to investigate the PTM behaviour of the Japanese firms. Since then there have been a host of studies that have investigated the pass-through relationship empirically for the advanced economies.<sup>61</sup> Menon (1995) and Goldberg and Knetter (1997) provide good surveys of the early literature on the subject. Many other studies since then have focused on understanding the determinants of ERPT. Gaulier et al. (2006) find that PTM varies with the types of goods being exported and the destination market structures. They conduct this study using the UN COMTRADE database for 70 countries on annual data over the period 1989-2003 using a panel fixed effects model. Final consumption goods tend to show a higher PTM than other goods, and so do goods traded on referenced markets. They also observe that PTM is smaller in small and concentrated markets and when the exporter has a larger market share in the destination market.

In a particularly significant study on ERPT using quarterly data from 1975 to 2003 for 23 OECD countries, Campa and Goldberg (2005) test the importance of changes in macroeconomic variables on ERPT to import prices. They find that the lower the average rate of inflation and the less variable the exchange rate, the lower the extent of ERPT. They also suggest that macro factors play a relatively minor role in affecting

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<sup>61</sup> For instance, see Burnstein et al. (2002); Campa and Goldberg (2005); Froot and Kemplerer (1989); Goldberg and Knetter (1997); Goldfajn and Werlang (2000); Ito et al. (2005); Kamin and Klau, (2003); Knetter (1993); Marazzi et al. (2005); Otani et al. (2003); Vigfusson et al. (2009).

ERPT compared to the changing composition of a nation's imports away from raw materials and energy imports towards manufacturing imports. They use OLS estimations on the variables in log differences.

While Campa and Goldberg do not find ERPT to be declining over the years for the OECD countries, Takhtamanova (2008) claims that the ERPT coefficient has declined during the 1990s for the OECD countries. He reaches this conclusion using Feasible Generalized Least Squares (FGLS) regressions for the period 1980-2007 on data from 14 OECD countries. For the U.S. import prices, Marazzi et al. (2005) note that there has been a sustained decline in the ERPT coefficient from around 0.5 in the 1980s to 0.2 in the early 2000s. The authors attribute this decline to factors such as share of the industrial imports as well as the rising share of Chinese products in U.S. imports. They reach this conclusion using quarterly data over the period 1972Q4 to 2004Q4.

A declining ERPT was also observed for Japanese imports by Otani et al. (2003) for annual data over the period 1980 to 2001 using Seemingly Unrelated Regression (SUR). They observe a reduction in ERPT for each of the products and identify this to be a reason for the overall decline rather than a shift in the trade shares towards manufactured goods from primary products. This result was also supported by Shioji (2012), who re-estimated ERPT into the import prices of Japan along with the impact on the consumer prices as well as export prices for the period January 1980-January 2010 using a time-varying parameter VAR model. The author finds that ERPT to import prices experienced a decline in the 1990s, while those to CPI experienced a sharp decline in the 1980s.

Overall, the existing literature broadly suggests that ERPT has been incomplete and declining for the developed nations. In the case of developing countries, it might be expected *a priori* that ERPT into import prices may be somewhat high given the less competitive market structures and--at least for smaller developing economies--of less importance as a market for foreign goods. However, some studies have disproved the idea of complete ERPT for at least some of the developing nations. Webber (1999) examines the ERPT into import prices for nine countries in the Asia-Pacific region, viz. Korea, Pakistan, Thailand, the Philippines, Malaysia, Singapore, Japan, Australia, and New Zealand. Using the Johansen cointegration methodology, the author finds a long-run stable linear relationship between import prices and exchange rates for seven of the nine countries using quarterly data from 1978-1994, though the ERPT estimates vary between countries. ERPT is highest for the lowest income countries, Pakistan (109 percent) and the Philippines (89.6 percent), while ERPT is partial for the other six nations, ranging from 25 to 50 percent.<sup>62</sup> Notwithstanding macro-level differences between countries, the author surmises that the different ranges of ERPT for the countries are due to the different varieties of goods imported by the countries. This result emphasizes the need for studies using more disaggregated data (i.e., at industry or product levels).<sup>63</sup>

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<sup>62</sup> The estimates of ERPT for the other countries are as follows: Korea (40.3 percent), Australia (26.3 percent), Japan (44.8 percent) and New Zealand (35.9 percent). The estimated ERPT for Singapore was 77.1 percent, far higher than most other estimates for the city-state.

<sup>63</sup> Our focus here is on studies on Asia examining ERPT into import prices not exports. For an example of the latter, see Cui et al (2009) for China, Mallick and Marques (2008a, 2008b, 2010) for India, Athukorala and Menon (1994) and Sasaki, (2002) for Japan and Parsley (2004) for Hong Kong .

Using a VAR methodology, Kang and Wang (2003) analyze the effect of exchange rate changes on both import prices and CPI for Japan, Singapore, Korea, and Thailand for the period 1991 to 2001 using monthly data. The impulse response functions show that for all the four countries, the response of import prices to changes in exchange rate is higher than the corresponding response of CPI. Moreover, for the post-Asian financial crisis period (1998-2001), both import as well as consumer prices in Korea and Thailand appear to have responded more to exchange rate changes, while there was no difference pre and post crisis for Japan and Singapore. This may be explained by the fact that Japan and Singapore were not as impacted by the crisis in a structural sense (i.e., directly) as were Korea and Thailand. The authors contend that the adoption of a free-floating exchange rate regime--and consequent temporary exchange rate fluctuations--by these two economies after the currency crisis may have been a further reason for the amplified ERPT in the post-crisis period.<sup>64</sup> Ghosh and Rajan (2007a) provide a good overview of the existing literature on the subject for the Asian economies.

Some of the oft-cited studies at the disaggregated sectoral level are by Yang (1997), Knetter (1993), and Mumtaz et al., (2006), all of whom find variation in the ERPT across industries. Yang (1997) estimates the ERPT for 87 U.S. industries using OLS regressions on quarterly data for the period 1980-1991.<sup>65</sup> Broadly, he finds that ERPT is incomplete and varies across industries, though the average ERPT is lower than

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<sup>64</sup> On the other hand, it has been suggested that the greater the degree of exchange rate flexibility, the lower will be ERPT as firms may be less willing to pass on exchange rate changes to their customers when there is a chance that they will be subsequently reversed. The role of exchange rate regimes on ERPT is clearly an issue in need of further research (for instance, see Steel and King 2004).

<sup>65</sup> The 87 industries include 51 3-digit and 36 4-digit SIC industry series

0.5 for most of the sectors in absolute value. His results more specifically indicate that ERPT varies positively with the extent of product differentiation (i.e., market power). Machinery except electrical and instruments and related products have higher ERPT into import prices, whereas wood and textiles show lower ERPT. Olivei (2002) estimates the ERPT to import prices for 34 U.S. manufacturing industries at the 2, 3, and 4-digit Standard Industrial Classification (SIC) using quarterly data over the period 1981-99. He finds a decline in the ERPT over the period of his study and also suggests that there is variation across industries.

Using quarterly data from 1984Q1 to 2004Q1 for a set of industries in the UK at the 2-3 digit SITC level, Mumtaz et al. (2006) find heterogeneity across industry groups. They group industries into food, manufacturing, energy, and raw materials and find partial ERPT in the food and manufacturing sectors in the long run and inconclusive/insignificant results for the other two sectors. They estimate that aggregation across industries can lead to an upward bias in the economy-wide ERPT estimates and attribute this to significant cross-sectional heterogeneity across industries. They find the coefficient of short-run ERPT to be 0.44 when aggregate import price index is used, which declines to 0.38 when disaggregated data is used. In his study, Shioji (2012) also looks at the ERPT into import and export prices at the sectoral level for Japan for the period 1980-2010. He also finds that there are differences across sectors, with ERPT into import prices of capital goods high at around 50 percent, while that to consumer non-durables is around 25 percent in the short run, reflecting the lower pricing power of Japanese firms in the international markets for consumer non-durables.

One of the few studies on micro-level ERPT is by Gopinath and Rigobon (2008), who study monthly data on 20 harmonized code groups of goods for U.S. over the period 1994-2005 using Bureau of Labor Statistics (BLS) data. They use simple regressions on import and export data to conclude that ERPT into U.S. prices is low at 22 percent, and that the “import price rigidity has increased by 10 percentage points, with increasing rigidity at differentiated goods prices” (p. 531). They also find that 90 percent of the imports and 97 percent of exports are actually invoiced in the USD, suggesting producer currency prices in exports and local currency pricing for imports. In another interesting study, using the same data as in the above mentioned study, Gopinath et al. (2010) find that the choice of currency invoicing matters to ERPT. They find that ERPT to import prices is higher when the goods are priced in the producer currency than in local currency, with pass-through coefficients of 95 and 25 percent respectively. Though they conduct this study for U.S. imports, they suggest that this is applicable across countries and disaggregated sectors as well. They use the same micro-level monthly data over the period 1994-2005 for U.S. imports.

So overall, it appears that ERPT might vary across industries, and working with aggregate data might mask important differences across industries (Bussière, 2007; Campa et al., 2006). ERPT varies across industries depending on factors such as competition in the industry, import substitutes for the products, share of imported products used in an industry, and degree of product differentiation. Those industries with a higher degree of product differentiation experience a higher ERPT. Similarly, industries that face a higher degree of competition have a smaller markup over marginal cost and

therefore higher ERPT. With product differentiation, there is lesser substitutability between imported and domestically produced goods and therefore higher the ERPT would be. Products that are well traded in the international markets and have a well-established price also experience a higher ERPT. Crude oil, mineral fuels, manufactured goods, and chemicals are some sectors where ERPT tends to be high, whereas sectors like food and live animals, miscellaneous manufactured goods, animal and vegetable oils etc., experience smaller ERPT.

### **3.3.2 Non-linearity and Asymmetry in ERPT**

Beyond the extent and causes of ERPT, other strands of the literature examine the possibility of nonlinear relations and asymmetry between exchange rate changes and import prices.

There may be thresholds below which exchange rate changes do not have an impact on import prices. These thresholds depend on the adjustment costs such as menu costs to changes in the exchange rate as well as the size and persistence of the exchange rate changes. For example, for smaller or temporary changes in the exchange rate, exporters may worry about menu costs and could decide to absorb changes into their markups, in which case, ERPT to the import prices would be somewhat lessened. For instance, see Baldwin (1988), Baldwin and Krugman (1989), Dixit (1989), Froot and Klemperer (1989), and Pollard and Coughlin (2003).

Distinct from the issue of thresholds, most of the studies on ERPT assume that the impact of the exchange rate changes on the import prices is symmetric. They do not take

into account the fact that appreciations and depreciations might have a different impact on prices. In particular, many of the studies on ERPT which assumed a symmetric response have obtained a lower and a declining value of the ERPT. However, studies that relax this assumption find ERPT to generally be higher, suggesting that the previous studies based on the symmetric assumptions have underestimated the real impact of the exchange rate variations. When the home country currency appreciates, the exporters might maintain their producer currency pricing and let the price of the imports fall, or they might maintain the local currency pricing and increase their profit margins if they are not worried about their market share.

In terms of maintaining market share, exporters may have a higher ERPT for an appreciation, as they can reduce the import prices while maintaining their mark-ups in the case of an appreciation. With a depreciation in the importing nation currency, the exporter might have to reduce ERPT if he wishes to protect his market share. With capacity constraints and trade restrictions, the exporter may not be able to reduce the import prices in the case of an appreciation and would be constrained to increase the supply to match the demand that comes about with reduced prices. In such a case, the exporter may absorb exchange rate changes into his mark-up to keep importing nation prices constant. On the other hand, with a depreciation, these constraints may not be binding and the exporter can still raise the import prices. Therefore, with capacity constraints, ERPT may be higher in the case of a depreciation than an appreciation.

Mann (1986) suggests that ERPT was higher during periods of appreciation than depreciation into U.S. import prices, although the differences were not significant. She

compared the annual data over the period of depreciation of the USD from 1977 to 1980 to the period from 1981 to 1985 when the USD was appreciating. She also finds that at the disaggregated level, import prices increased across the board for all the products during periods of depreciation, while they fell for only a few products (such as steel and construction machinery) during appreciation.<sup>66</sup> In contrast, Delatte and López-Villavicencio (2012) and Webber (1999) find that ERPT is higher when the importer's currency depreciates than when it appreciates. Delatte and López-Villavicencio use an asymmetric co-integrating ARDL model over the period 1970: Q1 to 2009:Q3 for Japan, U.S., Germany, and the UK, while Webber uses quarterly data over 1978-1994 for the nine Asian countries mentioned above.

Campa et al. (2006) estimate the non-linear adjustment of the import prices in countries in the European Union (EU) for the period 1989-2004 at the sectoral level. They consider three different types of non-linearities: non-proportional adjustment, asymmetric adjustment, and the threshold below which no adjustment takes place and use a non-linear error correction model to estimate the ERPT. They reach the conclusion that asymmetric adjustment is present in manufacturing industries and symmetric adjustment in primary industries. Within manufacturing industries, appreciations of the domestic currency lead to a faster adjustment in the import prices than depreciation as the foreign firms try to maintain their market share.

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<sup>66</sup> The import products considered were men's and boy's suits and coats, paper mill products, weaving mill, canned fruits and vegetables, leather footwear, rolling mill and electrometallurgical steels, and construction machinery.

A study by Wickremasinghe and Silvapulle (2004) over the period January 1975 to June 1997 for Japan also found evidence of asymmetric ERPT. with appreciations having a larger impact on import prices than depreciations. They find that ERPT during appreciations is almost 100 percent, while that during depreciation ERPT is 83 percent using a VEC model.

Contrasting results were obtained by Yang (2007), who suggests that there are differences even within an industry. Investigating the ERPT for 98 manufacturing industries using the SIC classification, he finds that a number of industries did not experience a change in the ERPT over periods of appreciation and depreciation in the 1980s and goes on to argue that a depreciation of the dollar led to increased ERPT for some industries and decreased ERPT for the others. At the aggregate level too, he finds contrasting results in that there is no evidence of a decline in ERPT over the years, unlike some of the other studies mentioned above. He applied OLS regressions to quarterly data over the period December 1980 to December 1991 to obtain his results.

Bussière (2007) also finds the presence of a non-linear adjustment (both size and direction of exchange rate change) in ERPT using quarterly data for the period 1980-2006 for the G7 economies. He finds that non-linearities are present more on the export than import side and that there are differences across countries in their response to these non-linearities. He summarizes the reason for the difference between export and import prices as follows:

First, total imports of the G7 economies include a much higher share of oil and non-oil commodities than exports. As oil and non-oil commodities are

generally characterized by higher ERPT, this could somewhat blur the picture, even though oil prices have been added as an explanatory variable. A second, more likely factor, is related to the fact that the signs of the convexity varies across countries for export prices. This may result in non-linearities cancelling each other when considering total imports. (p. 28)

Pollard and Coughlin (2003) analyze ERPT into the import prices for 30 U.S. industries at the 2-digit and 3-digit ISIC (International Standard Industrial Classification) classification for the period 1978q1 to 2000q4 using OLS and find that the size of the exchange rate change matters more than the direction, even though taken separately both the size and direction lead to an asymmetric response to exchange rate changes. They attribute the reason for the significant impact of the size of the menu costs.

### **3.3.3 ERPT in India**

The literature on ERPT involving India is highly limited, with no studies so far considering the asymmetric affects of the exchange rate on the ERPT, both with respect to the direction and size of the exchange rate change. (See Annex 3.2 for a summary of studies on India). There are a few papers that examine second-stage ERPT to domestic inflation. Ghosh and Rajan (2007b) find that between 1980Q1 and 2005Q3, the EPRT into India's CPI was between 40 and 45 percent using the U.S. producer price index (PPI) as a measure of the cost conditions in the exporting nation and the bilateral Indo-U.S. exchange rate. When the NEER is used, ERPT seems to have been insignificant, which

suggests that movements in the bilateral USD/INR exchange rate have more of an influence than changes in the NEER.

Applying a VAR framework on monthly data from September 1997 to October 2007, Bhattacharya et al. (2008) estimated that a 10 percent shock to the exchange rate changes the CPI by around 1 percent in the short run and between 0.3-1.7 percent in the long run. It also affects the WPI by 1.3-1.4 and 2.8-2.9 percent in the short and long run respectively. They use monthly data from September 1997 to October 2007 for the variables bilateral USD/INR exchange rate and the index of industrial production (IIP) (as a proxy for monthly GDP) to estimate these coefficients.

Saha and Zhang (2012) estimate the impact of exchange rate changes on import prices, CPI and WPI using monthly data over the period 1990:01 to 2011:03 for Australia, China, and India. Using a VAR model, they find that ERPT to the CPI is higher for Australia than the other two countries and that a depreciation of the INR and Chinese renminbi reduces import prices and raises domestic inflation in these countries through its impact on internal factors like industrial production.

For the first-stage ERPT, using panel data estimation on annual data for the period 1991-92 to 2005-06, Pyne and Roy (2008) find incomplete EPRT to import prices in India at around 65 percent into import prices, with variations across commodity groups. Specifically, they find significant results only for chemicals where they find an ERPT of just over 40 percent.

Dash and Narsimhan (2011) use quarterly data over the period 1993:Q2-2004:Q3 and apply an error correction framework. They find pass-through into Indian imports to

be more than complete, with an ERPT coefficient of 1.70 in the long run, and they also find that the long run ERPT is higher than that in the short run.<sup>67</sup>

Dholakia and Raveendra (2000) also find complete ERPT into Indian import prices but increased ERPT by Indian exporters after 1991 using a partial adjustment model, a special case of the ARDL model on quarterly data from 1980 to 1996<sup>68</sup>. They conclude that India does not have a significant bargaining power both as a buyer and a seller in international markets.

Mallick and Marques (2008c) find that the INR prices of imports increased with depreciation. Using Feasible generalized least squares (FGLS) estimations for panel data of 38 2-digit SITC sectors over the period 1990-2001, they find that there are significant sectoral differences in ERPT. For 12 of the 38 sectors studied, there is a one-to-one or higher ERPT into the import prices, whereas for the other sectors there is zero or incomplete ERPT. The authors attribute the share of each sector in the total imports and the protection offered to these sectors as a cause for these differences. These results imply that exporters to India are absorbing the exchange rate changes into their mark-ups.

While ERPT to Indian imports is the primary interest of this chapter, for completeness this study notes some of the more important research on the pricing to market practiced by Indian exporters. Mallick and Marques have undertaken a few studies on the behaviour of the Indian exporter. Mallick and Marques (2006) examine the extent of PTM in Indian exports for 34 SITC 2-digit commodities over the period 1980-

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<sup>67</sup> The authors also find incomplete ERPT on the part of Indian exporters.

<sup>68</sup> The authors also estimate the ERPT to export prices and find that there was incomplete pass-through prior to 1991 but complete pass-through after 1991.

2001. Given that the Indian economy went through a significant liberalization program in 1991, the authors estimated ERPT coefficients for two sub-periods (1980-1990 and 1991-2001) to analyze the impact of reforms on ERPT to Indian export prices. The average ERPT into foreign prices of India's exports in the pre-liberalization period was 0.20, while that for the post-liberalization period was 0.65. During the former sub-period, the authors did not find any ERPT for most commodity categories with the exceptions of clothing (47 percent) and footwear (40 percent). This suggests that during the pre-liberalization period India acted predominantly like a small, price-taking country in world markets. For the post-liberalization period the study found significant ERPT for most categories of products, ranging from 12 percent to 79 percent. The authors argue that liberalization allowed India to gain some price-making power in some of these industries. In their opinion, this is because of the increasing share of manufacturing in India's exports (which rose from 68 percent of merchandise exports in 1986-87 to 76 percent in 2001-02).

Mallick and Marques (2008a) reach a similar conclusion in another paper examining ERPT to sectoral export prices during the pre- (1980-90) and post reform period (1991-2000) using panel data estimations. Mallick and Marques (2008b) have argued that there has been incomplete ERPT to export prices from India both for the G3 countries of U.S., Japan, and UK as well as emerging market economies of Brazil, China, and South Africa. For the period 1992-2005, they find the response of INR export prices to exchange rate changes to be 18 percent for all countries, 30 percent for developed countries, and zero for emerging markets using a FGLS panel model.

Mallick and Marques (2010) also study the impact of the frequency of the data used on the ERPT by using both annual and monthly data of the pricing behaviour of Indian exporters. In this paper they use data on 2-digit industry classification for 1991-2006 on annual data and from 1996-2001 on a monthly basis. They find that data at higher frequencies reflect less ERPT than data at lower frequency. They also find that with the increased manufacturing sector exports, the Indian exporters are gaining some market power and therefore these sectors exhibit incomplete ERPT.

### **3.4 Research Questions**

Not only is the ERPT literature on India somewhat sparse, it gives ambiguous results and has not examined or estimated the possibility of non-linearities of ERPT in the Indian context. The empirical part of this chapter will compute the non-linear and asymmetric ERPT into import prices for India at the aggregate level as well as disaggregate sectoral level. The analysis in this chapter is different from the initial VAR-based ERPT studies in that the earlier studies estimated pass-through to the CPI/WPI whereas for this section, the pass-through to the import unit value index is estimated. The following research questions are addressed:

*Research Questions:* What is the extent of ERPT into Indian imports at the aggregate and disaggregate sectoral level? Is there non-linearity and asymmetry in the adjustment of import prices with respect to changes in the exchange rate?

### 3.5 Theoretical Framework

The following section presents a simple framework of ERPT, based on Campa and Goldberg (2005). Consider two countries trading a single good Y, with country A being the importing nation and country B the exporting one. Let S be the bilateral exchange rate defined as the number of units of A's currency per unit of B's. The import prices in country A can be expressed as follows:

$$PM_{AY} = S_B^A \cdot PX_{BY} \quad (1)$$

where PM is import prices in domestic currency and PX is export prices in foreign currency. Taking logs, we get:

$$\ln PM_{AY} = \ln S_B^A + \ln PX_{BY} \quad (2)$$

The export prices are usually a markup over the marginal costs for the exporter. Therefore, the export prices can be expressed as follows:

$$PX_{BY} = MC_{BY}(1 + \pi) \quad (3)$$

where MC is the marginal cost of producing good Y and  $\pi$  is the markup over marginal cost. As an approximation, taking logs on both sides we have:

$$\ln PX_{BY} = \ln MC_{BY} + \ln \pi_{BY} \quad (4)$$

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<sup>69</sup>By considering  $\ln(1+\pi) \cong \ln(\pi)$ .

Substituting this in equation (2) we derive:

$$\ln PM_{AY} = \ln S_B^A + \ln MC_{BY} + \ln \pi_{BY} \quad (5)$$

Markups further depend on the sector and general macroeconomic conditions in the economy, which can be proxied for by the exchange rate as well as the demand conditions in the destination market.<sup>70</sup> Therefore, markups can be expressed as:

$$\ln \pi_{BY} = \theta + \varphi \ln y_A + \tau \ln S_B^A \quad (6)$$

where  $\theta$  is the sector specific effect,  $\varphi \ln y_A$  captures the demand conditions in the destination market, and  $\tau \ln S_B^A$  is the extent of pricing to market by the exporter, i.e., the extent to which foreign exporters adjust domestic currency price to exchange rate change.

Substituting (6) in (5):

$$\ln PM_{AY} = \theta + (1 + \tau) \ln S_B^A + \ln MC_{BY} + \varphi \ln y_A \quad (7)$$

where  $(1+\tau)$  would be the ERPT coefficient of interest. Here, if  $\tau = 0$ , the import prices in the destination market rise one-for-one with the exchange rate, implying complete ERPT. On the other hand, if  $\tau = -1$ , then the exporters are absorbing all the changes in the exchange rate into their markup implying zero ERPT.

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<sup>70</sup> Of course, marginal cost could also be impacted by the exchange rate, depending on the extent of imported intermediate inputs used in domestic production, which for India was around 20 percent as of 2005. (OECD, 2011)

### 3.6 Empirical Model

Based on equation (7), the estimation model would be as follows:

$$\ln PM_t = \beta \ln S_t + \delta \ln P_t^* + \theta \ln Y_t \quad (8)$$

-            +            ?

where  $\ln PM_t$  is the import price index of the importing nation at time  $t$ ,  $\ln S_t$  is the change in the log of the exchange rate for the importing country at time  $t$ ,  $P_t^*$  is the price index of the exporting nation, used as a proxy for their costs of production, and  $Y_t$  is the home country demand for imports. The expected signs of the coefficients are shown below the equation. As the costs of production ( $P^*$ ) in the exporting nation increase, the prices of imports are also expected to increase. The import unit value index is used as a proxy for the import prices in India. Since data on monthly GDP are not available, we use Index of Industrial Production (IIP) as a measure of the size/growth of the real economy. We also include another measure that captures the financial side of the economy, viz. turnover in the national stock exchange (NSE). This variable is expected to have a similar sign as the IIP. With regard to the exchange rate, an increase in the exchange rate, indicating an appreciation, ought to lower the import prices.

Stationarity tests performed on the variables indicate that the variables were stationary in the first differences (Table 3.3). The Akaike Information Criteria (AIC) were used to check for the appropriate lags for the model (Annex 3.3). The Engle and Granger two-step cointegration test as well as the Johansen test for cointegration suggest that the variables are cointegrated, which implies the existence of a long-run relationship

between the import prices and the exchange rate, foreign prices, domestic demand for imports, as well as the price of domestic imports (Table 3.4)

**Table 3.3 ADF tests for Stationarity**

	<b>Level</b>	<b>First difference</b>
PM (Unit value Index)	-1.224	-10.144
NEER (S)	-0.103	-8.912
IIP (Y)	-1.372	-20.835
World Cpi (P*)	0.242	-7.864
NSE	-2.367	-12.148
Critical values		
1%	-3.503	
5%	-2.889	

**Table 3.4 Johansen test of cointegration for the Base model (NEER, IIP, WorldCPI)**

Maximum rank	Trace statistic	Critical value
0	62.5630	47.21
1	27.2773*	29.68
2	8.4077	15.41
3	0.2567	3.76

The following error correction model based on equation (8) was estimated.

$$\Delta \ln PM_t = \vartheta Z_{t-1} + \sum_{i=1}^k \beta_i \Delta \ln S_{t-k} + \sum_{i=1}^k \gamma_i \Delta \ln P_{t-k}^* + \sum_{i=1}^k \rho_i \Delta \ln Y_{t-i} + \sum_{i=1}^k \varphi_i \Delta \ln PM_{t-k} + \epsilon_{jt} \quad (9)$$

where:  $Z_{t-1} = (\ln PM_{t-1} - \beta_1 \ln S_{t-1} - \gamma_1 \ln P_{t-1}^* - \rho_1 \Delta \ln Y_t)$  is the deviation from the long run relationship in the last period.  $\mu$  describes the form of adjustment of the import

prices to their long run equilibrium. The short-run ERPT is given by the coefficient of the first lag of the exchange rate and the long-run coefficient is given by normalizing the lagged coefficients of the exchange rate on the coefficient of the lagged dependent variable. The long-run coefficient can be expressed as follows:

$$\text{LRPT} = \frac{\sum_{i=1}^k \beta_i}{(1 - \sum_{i=1}^k \varphi_i)} \quad (10)$$

Once the ERPT coefficients are estimated, the next step is to check if ERPT is impacted differently depending on exchange rate by appreciations versus depreciations as well as large versus small changes. As discussed previously, the impact of a depreciation in the home country currency is usually to increase the price of imports, while that of an appreciation is to decrease them. If the exporters wish to maintain or increase their market share, then ERPT might be higher when the INR is appreciating than when it is depreciating.

The asymmetry and the impact of the size of change in the exchange rate will be estimated using equation (9) in an asymmetric error correction format as follows:

$$\Delta \ln \text{PM}_t = \vartheta Z_{t-1} + \sum_{i=1}^k \beta_{1i} \Delta \ln S_{t-k}^+ + \sum_{i=1}^k \beta_{2i} \Delta \ln S_{t-k}^- + \sum_{i=1}^k \gamma_i \Delta \ln P_{t-k}^* + \sum_{i=1}^k \rho_i \Delta \ln Y_{t-i} + \sum_{i=1}^k \varphi_i \Delta \ln \text{PM}_{t-k} + \epsilon_{jt} \quad (11)$$

where  $S^+$  represents appreciations and  $S^-$  represents depreciations as well as large change and small change as follows:

$$\text{For an appreciation } S^+ = \begin{cases} \ln S & \text{if } \Delta \ln S > 0, \\ 0 & \text{otherwise} \end{cases}$$

$$\text{For a depreciation: } S^- = \begin{cases} \ln S & \text{if } \Delta \ln S \leq 0, \\ 0 & \text{otherwise} \end{cases}$$

Large changes and small changes are defined based on the mean or the median ( $\mu$ ) as well as based on the standard deviation from the mean. A change in the exchange rate larger than the average (mean and median) is considered large and a change smaller than the average is treated as a small change.

$$\text{For a large change } S^{lc} = \begin{cases} \ln S & \text{if } \Delta \ln S \geq \mu \\ 0 & \text{otherwise} \end{cases}$$

$$\text{For a small change } S^{sc} = \begin{cases} \ln S & \text{if } \Delta \ln S < \mu \\ 0 & \text{otherwise} \end{cases}$$

With respect to the standard deviation, a large change is defined as one where the change is greater than one standard deviation from the mean and any change within it is considered a small change.

$$\text{For a large change } S^{lc} = \begin{cases} \ln S & \text{if } \mu - \sigma > \Delta \ln S \text{ \& } \Delta \ln S \geq \mu + \sigma \\ 0 & \text{otherwise} \end{cases}$$

$$\text{For a small change} \quad S^{\text{sc}} = \begin{cases} \ln S & \text{if } \mu - \sigma \leq \Delta \ln S < \mu + \sigma \\ 0 & \text{otherwise} \end{cases}$$

The hypothesis of asymmetry can be tested if  $\beta_1$  and  $\beta_2$  are both statistically different from zero and if the null of equality of the coefficients is rejected:

$$H_0: \beta_1 = \beta_2$$

$$H_a: \beta_1 \neq \beta_2$$

### 3.7 Data

The ERPT coefficients are first estimated for India as a whole, using the aggregate import unit value index for the period 2003m1: 2013m3, followed by an estimation at the sectoral level using sector specific import unit value indices. Unit value index is measured as the ratio of total value of imports divided by the quantity. Since import price data are not available for India, this proxy has to be used to measure the import prices. These data are available on a monthly basis from the Monthly Abstract of Statistics of the Central Statistical Organization (CSO)<sup>71</sup>. The Nominal Effective Exchange Rate (NEER), based on the 36 currency bilateral trade weights, is used as the exchange rate for the computation of the ERPT coefficient of the country. The NEER, available from the *RBI Handbook of Statistics on the Indian Economy*, is constructed in such a way that an increase shows appreciation of the INR while a fall in the index

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<sup>71</sup> Data for the period January 2003-March 2007 was available on a quarterly basis which was intrapolated to monthly using cubic spline interpolations.

indicates depreciation (as discussed in Section 3.2.2). Data on the national stock exchange (NSE) were obtained from the RBI. The IIP data are obtained from the Ministry of Statistics and Implementation. In the absence of a PPI measure for the world, the world CPI has been used as a proxy for their costs. The data are obtained from the International Financial Statistics of the IMF. Overall at the aggregate level we have 123 observations.

## **3.8 Results**

### **3.8.1 ERPT at the Aggregate Level**

We start with a model with just world CPI, IIP and NEER (baseline model). The vector error correction model was run after taking into the account the optimal lags (4) as specified by the Akaike Information Criteria. The estimated error correction model suggests a short-run ERPT coefficient of -1.16 in the base model, i.e., a one percent appreciation in the INR is expected to lead to a 1.16 percent decrease in the import prices in the short run (Table 3.5). Results are statistically significant, though rather weakly at the 10 percent level. ERPT into Indian aggregate imports is complete as also found by Dash and Narsimham (2011), Dholakia and Saradhi (2000) and Mallick and Marques, (2008c). The coefficient of the cointegrating equation reflects the movement in the import prices towards their long-run equilibrium in each period, which in the case of this analysis is 0.289. This means that prices move around 29 percent towards their long-run equilibrium each period. The long-run coefficient is -2.29, which indicates that in the long run import prices rise by much more than the change in the exchange rate. One

reason for the rising import prices in the long run could be due to a “hysteresis induced effect.” This effect suggests that once there is a change in the exchange rate and thereby prices, this change could lead to changes in the market structure and thereby persistent real effects in the long run. These changes could also alter the import prices and quantities in the long run (Baldwin, 1998). The high and persistent inflation increases the inflationary expectations, in turn leading to further rise in prices.

We next re-run the regression by replacing IIP with NSE (model 1) and then include both simultaneously (model 2). The results for the ERPT are robust to alternative specifications of the base model. Both short run and long run ERPR are complete in all the models, with the former ranging between -1.1 and -1.3, while the long run ERPT are slightly wider, ranging between -2.3 and -1.4. Thus, we can conclude that ERPT into Indian imports in response to a change in the NEER is at least complete in the short run and the ERPT in the long run is more than complete. In addition, since around 89 percent of Indian imports are invoiced in USD, the model is re-estimated by replacing NEER with the INR/USD (Arabi, 2008). The index is constructed using the bilateral exchange rate and taking 2004-05 as the base year and an increase in the index reflects an appreciation.

Once again, the results reveal complete ERPT in the short-run, though the long-run ERPT coefficient suggests complete rather than over-complete ERPT. With respect to the controls, IIP, NSE and World CPI, none of them is significant in any of the regression models, suggesting that the exchange rate change might be an important determinant in the exporters decision to price to market or to pass-through the exchange rate change to

the importing nation. This result is also in line with Campa and Goldberg (2005) who find that the macro factors play a minor role in affecting ERPT.<sup>72</sup>

**Table 3.5 Short-run and Long-run ERPT coefficients - Aggregate**

(1)	(2)	(3)	(4)	(5)
	<b>Base Model</b>	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>
ERPT coefficients	NEER, World CPI, IIP	NEER, World CPI, NSE	NEER, World CPI, NSE, IIP	USDperRe index, World CPI, NSE, IIP
Short run	-1.167*	-1.102*	-1.337*	-1.192*
Long run	-2.290	-1.402	-2.066	-1.059
World CPI	0.833	4.017	1.928	0.783
IIP	-0.093		-.321	-0.099
NSE		.0768	0.087	0.102

\* Significant at 10% level

After having computed the ERPT coefficients, the next step is to examine the impact of the direction and size of the exchange rate changes. The results of this exercise can tell us if the ERPT is higher during a depreciation than an appreciation. Similarly, results would show if there are thresholds below which exchange rate changes are not passed on due to factors such as menu costs and currency invoicing. If products are invoiced in the exporter currency, then for small changes in the exchange rate, exporters might not change the prices in their currency due to menu costs. In such a case, there would be complete ERPT. On the other hand, for large changes in the exchange rate, the

<sup>72</sup> A simple error correction model of only the NEER and Import unit value index gives similar results with a short run pass-through coefficient of -1.106 significant at 10% level. However, we include the controls since they are based on the theoretical model in equation (7).

exporter might find it in his interest to change the price in his currency and thereby absorb changes in the exchange rate and reduce the change in the importing country currency prices, ultimately reducing ERPT. However, the prior here is not unambiguous. It is plausible that for small appreciations the exporter may be willing to absorb the loss of price competitiveness via a reduction in markups implying no ERPT, though for larger appreciations they may be less able to do so, implying incomplete ERPT.

Table 3.6 presents the results of the asymmetric analysis using Model 2. Column 1 shows the coefficients being measured in the model. S+ stands for an appreciation in column 2, for a large change greater than the average in column 3 and a large change greater than the median in column 4. S- stands for depreciation in column 2, small change less than the average in column 3 and a change less than median in column 4. Column 5 captures a large and small change as one standard deviation above and below the mean respectively. With respect to appreciation and depreciation, both the coefficients are statistically different from zero and the null hypothesis of equality of the coefficients is also rejected based on the chi-squared test in column 2. Even though the coefficients are similar, they are statistically different based on the chi-squared test. This indicates that there is a statistical difference in the ERPT during periods of appreciation and depreciation, though the economic significance is marginal. For the size of exchange rate change measured with respect to the mean and median the coefficients are quite similar and the null hypothesis of equality of the coefficients is not rejected. This finding suggests that large change and small changes in the exchange rate with respect to the mean and median do not have any economic or statistically significant difference in terms

of their impact on the ERPT. However, when a large change is measured as one standard deviation from the mean on either side, we do get significant results. The coefficients of the large and small change are significant, as is the coefficient of the chi-squared test, which suggests that we reject the null hypothesis of equality of the coefficients. The result implies that there is a statistical difference in the ERPT coefficients for a large and small change based on this measure of large change. Thus, one can conclude that when the threshold is one standard deviation from the mean of the exchange rate change, there is a difference in the ERPT between a large and small change.

**Table 3.6 Asymmetric ERPT**

1	2	3	4	5
	Appreciation versus Depreciation	Large change ( $\geq$ mean) versus Small change ( $<$ mean)	Large change ( $\geq$ median) versus Small change ( $<$ median)	Large change ( $\mu+\sigma$ ) versus Small change ( $\mu-\sigma$ )
S <sup>+</sup>	-2.345**	-1.971*	-1.999**	-1.287*
S <sup>-</sup>	-2.336**	-1.956*	-1.982**	-1.299*
Test Statistic (Chi-squared)	66.08	10.72	12.69	54.75
Probability	0.000	0.5527	0.392	0.000

\* Significant at 10% level \*\* Significant at 5% level

An argument might be made that large depreciations in the importing country (INR) may be associated with lower ERPT than other types of exchange rate changes (i.e., INR appreciations or small INR depreciations). The argument here is that for large INR depreciations exporters may feel compelled to absorb some of the potential INR

price change in their exports to India by PTM, implying lower extent of ERPT. Table 3.6 presents the results of the error correction model using a large depreciation, small depreciation, and appreciations.

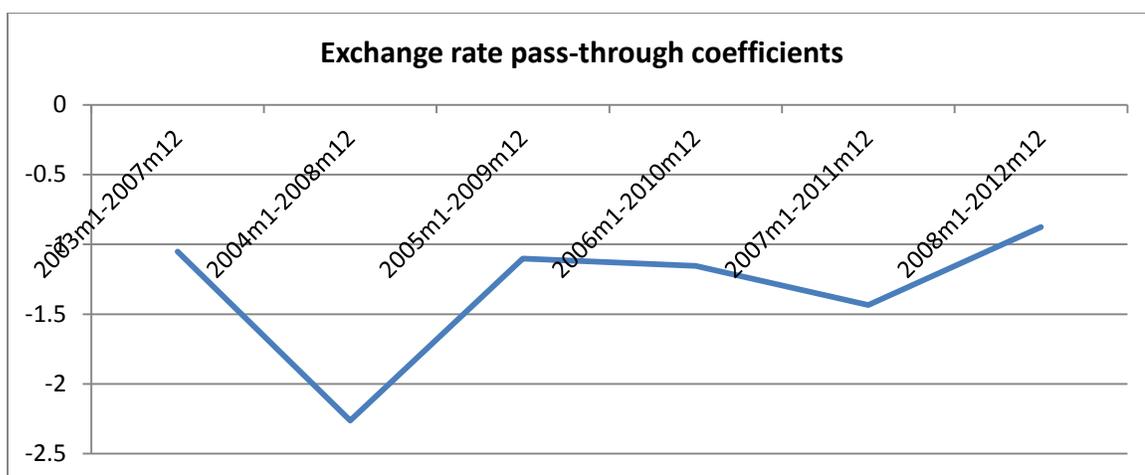
A large depreciation is considered as one where the change in the exchange rate is larger than the mean (represented by S+ and the others, i.e., small depreciation and appreciation, by S-). A second model is also run where a large change is one where the exchange rate change is larger than the median (larger depreciation than median represented by S+, small change and appreciations by S-). The results of the mean and the median change are similar, with a large depreciation, short-run ERPT is around -1.956, and with the median it is around -1.983. Even though the coefficients are significant, the null hypothesis of the equality of the coefficients cannot be rejected, suggesting that the response to a large depreciation is similar to that of any other change. A third model, based on the deviation from the mean, is also used as a threshold to see if there is any impact on the ERPT. The results (in column 4; Table 3.7) suggest that both large depreciations (S+) and other changes in the exchange rate (small depreciations and appreciations, S-) are significantly different from zero, and the null hypothesis of the equality of the coefficients is also rejected, once again suggesting that there is a differential impact on ERPT of a large depreciation and other changes in the exchange rate.

**Table 3.7 Asymmetric ERPT with a large depreciation**

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
	Large depreciation (> mean)	Large depreciation (> median)	Large depreciation (> $\mu \pm \sigma$ )
S <sup>+</sup>	-1.956*	-1.982*	-1.393**
S <sup>-</sup>	-1.971*	-1.999*	-1.402**
Test Statistic (Chi-squared)	10.72	12.69	50.78
Probability	0.5527	0.392	0.000

\* Significant at 10 % level \*\* Significant at 5 % level

Looking at ERPT over time, we find that pass-through has generally been complete over the period under study between -1 and -1.5. These coefficients have been estimated using rolling regressions over a 60-month window. The range of the ERPT coefficients obtained is consistent with the point estimates obtained in Table 3.4. Results are generally stable except for the period 2004-2008 when ERPT rises sharply (touching 2). This period coincides with the period of slightly higher growth for India, with an average growth rate around 9 percent during 2004-07 as compared to 7.6 percent for the whole period under study. The period from 2004-2008 was the period when the Indian imports of power and electric machinery increased along with imports of consumer goods, particularly from China, whose shares in total Indian imports doubled from 3.3 percent in 2001-02 to over 6.6 percent in 2004-05 and tripled to 9.4 percent by 2006-07. (DGFT, India)



**Figure 3.4 ERPT Coefficients over Time**

### **3.8.2 ERPT at the Disaggregated Level**

Given that estimation at the aggregate level might mask important sectoral differences, ERPT coefficients were also estimated at the disaggregated level. The sectors considered are based on the SITC one-digit classification provided by CSO (definitions in Annex 3.4).

It is usually expected that sectors which have product differentiation or which face a high degree of competition have a higher ERPT. Also, products that are well-traded in the international markets and which have well-established markets and prices--such as petroleum products, gold and silver, machinery, and transportation equipment--would experience a higher ERPT with a depreciation (Campa et al., 2006; Mallick & Marques, 2006).

An error correction model similar to equation (9) was applied to the sectors as well after establishing cointegration (Unit root results for the sector unit values are

presented in Annex 3.5). The results of the error correction model using both the model including both IIP and NSE are shown in Table 3.8. The results indicate that the ERPT coefficient is not significant for any of the sectors except for miscellaneous manufactured goods, which experience a very high ERPT in the short and long run. The other sector ERPT coefficients do not emerge to be significant in the short run and some are incorrect signs.<sup>73</sup> This lack of significance could be due to a number of factors:

First, the study does not consider sector specific mark-ups which might be important in determining the sectoral ERPT coefficients. Applying aggregate costs to the sectors might have been responsible for the insignificant results. However, for lack of sector specific costs data, one has to rely on the aggregate cost data as a proxy. Second, most of these commodities are invoiced in foreign currency, specifically the USD, which is almost 90 percent, noted previously. Therefore, another way to check for the sector-specific ERPT coefficients is to use the bilateral USD/INR exchange rate index instead of the NEER. Using the bilateral exchange rate, the error correction model also gave similar results like the NEER with a high and significant negative coefficient for miscellaneous manufactured goods and a positive and significant coefficient for beverages (Table 3.9). The overall lack of statistical significance at a disaggregated level is not inconsistent with the results of Pyne and Roy (2008) whose panel data analysis finds only chemicals to be statistically significant.

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<sup>73</sup> Similarly, tests for asymmetry, both direction and size of the exchange rate change, at the sectoral level did not yield any significant results. The results for the sectoral pass-through as well as sectoral asymmetries were similar for any of the models in Table 3.5.

**Table 3.8 Sectoral ERPT Coefficients<sup>74</sup>**

<b>Model</b>	<b>NEER, World CPI, IIP, NSE</b>	
	<b>Short run</b>	<b>Long run</b>
Food and Live Animals	-0.224	0.544
Beverages and Tobacco	0.981	1.396
Mineral Fuel	-0.039	0.825
Animal and Vegetable Oils	-0.467	-0.126
Chemicals	-0.377	0.003
Manufactured Goods	1.048	0.445
Machinery & Transportation Equipment	0.652	1.174
Miscellaneous Manufactured Goods	-3.970***	-2.248

\*\*\* Significant at 1% level

**Table 3.9 Results of the ECM with Bilateral USD and INR exchange rate**

<b>Variables considered</b>	<b>NEER, World CPI, IIP, NSE</b>	
	<b>Short run</b>	<b>Long run</b>
<b>USDperRe index</b>		
Food and Live Animals	-0.254	0.096
Beverages and Tobacco	2.692**	9.321
Mineral Fuel	0.125	1.288
Animal and Vegetable Oils	-0.326	0.020
Chemicals	-0.569	0.490
Manufactured Goods	-0.614	-0.655
Machinery and Transportation Equipment	0.730	1.163
Miscellaneous Manufactured Goods	-3.74***	-1.903

\*\* Significant at 5% level \*\*\* Significant at 1% level

<sup>74</sup> Crude was not considered for the ECM as the variable is stationary in levels.

### **3.9. Conclusion and Policy Recommendations**

This chapter examined the exchange rate pass-through (ERPT) into import prices in India using monthly data for the period January 2003 to March 2013. Such a study is important to understand the impact of exchange rate changes on import prices to anticipate inflation developments and ensure appropriate monetary policy response by the authorities.

The results obtained from the analysis indicate that, at the aggregate level, there is complete ERPT to the import prices in the short run, with some evidence of even higher ERPT in the long run. This finding is likely due to inertial effects of rising prices, and is particularly true for India, where current inflation feeds into the inflationary expectations at a very fast pace and leads to higher inflation in the future as well (Patnaik, 2013b). These inflationary pressures since 2007 have been influenced by global developments and changes in the production structures in India as well as the supply-demand dynamics of important traded commodities. The effect of exchange rate changes on these dynamics and on the import prices therefore has to be monitored on a continuous basis to influence monetary policy in the country (Patra & Kapur, 2010). Even though growth has moderated in India, contrary to expectations it has not led to a decline in imports and thereby an improvement in the trade balance (Subramanian, 2013).

The analysis also found that there is asymmetric response with respect to the direction of the exchange rate change, with an appreciation and depreciation. This implies that exporters to India, who are worried about the market share, may pass-through more during an appreciation than depreciation. However, the size of the exchange rate change

did not seem to matter when the average or the median of exchange rate change was considered.

For the disaggregated sectoral level, only miscellaneous manufactured goods has a significant ERPT. The reason for insignificant ERPT at the sectoral level could be because sector specific shocks and sector specific mark-ups have not been considered.

Even though this study does not compute the second-stage ERPT to overall CPI, it is likely that the high ERPT at the first stage will inevitably have an impact on overall inflation (especially given the high correlations between CPI and import prices in India as shown in Table 3.2). As mentioned earlier, the Indian rupee has experienced a depreciation over the years; particularly since the beginning of 2013, the rupee lost around 20 percent of its value. The impact of this depreciation on import prices and domestic price indices is being felt now as inflation numbers are once again rising for India after a brief period when they fell. This currency devaluation is a cause of concern for India, which has already been experiencing high levels of inflation since 2010. These inflationary concerns, caused by domestic factors as well as imported inflation through the exchange rate, suggest the need to look for appropriate policy response.

There has been an active discussion among policymakers whether to move to an inflation targeting monetary policy strategy to combat the higher levels of inflation. It has already been empirically established that inflation targeting leads to a decline in the ERPT (Nogueira & Reginaldo, 2006; Coulibaly & Kempf, 2010) as well as to a low and stable inflation. This step might be an option for India to consider, especially given the high levels of inflation that the country has been witnessing since 2010. India could

follow the example of other emerging market economies which experienced similar high levels of inflation and used clearly articulated monetary policy strategies to combat it. Brazil has been among the emerging market countries which adopted inflation targeting and had favourable results. The recent announcement by the RBI governor, Dr. Raghuram Rajan, of a 5 percent wholesale price index (WPI) target is a step in the right direction. The target inflation rate will eventually have to be extended to the CPI as well to clarify the intent of the central bank's monetary policy strategy (Patnaik, 2013b; PTI, 2013b).

Inflation targeting entails using the policy interest rates to keep inflation within the target range. Since the interest rate is used as a monetary policy instrument and with an open capital account, it was conventionally believed that an inflation-targeting regime would require a flexible exchange rate regime to deal with the issue of impossible trinity. However, neglect of the exchange rate might be undesirable given the impact it has on inflation and output through the exchange rate transmission channel. An increase in interest rates to control inflation would also lead to capital inflows into the country and cause an appreciation of the currency, in turn reducing the ERPT to the import prices. But it would also have an adverse impact on the trade balance through the impact on exports and thereby compromise growth of the tradable sector. However, if the exchange rate affects output and inflation it will be incorporated in the monetary policy rule in the sense that interest rate changes will take into account the impact they would have on the exchange rate, which in turn affects output and inflation.<sup>75</sup> Therefore, the exchange rate

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<sup>75</sup> This is aptly summarized in Goyal (2014) as follows:

likely ought not to be included in the monetary policy rule directly. The interest rate can still be used as the main monetary policy instrument, but the RBI could intervene directly to manage volatility in general and especially in "exceptional" circumstances.

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In the current Indian stage of capital account convertibility, where interest-sensitive inflows are still a small share of total inflows, it is better if the exchange rate does not directly enter the policy reaction function. The policy rate should respond to the indirect effect of the exchange rate on inflation. But the interest defence, which requires raising the policy rate to appreciate the exchange rate, is likely to be counterproductive. Instead intervention, smoothing net demand, signalling can all be used, to reverse deviations of the exchange rate from equilibrium or prevent excessive depreciation thus reducing the pressure to raise interest rates in response to inflation. To the extent nominal exchange rate movements reduce inflation, the policy rate can respond less to inflation and focus more on deviations from potential output.

## **CHAPTER 4. IMPACT OF EXCHANGE RATE CHANGES ON INDIA'S TRADE BALANCE: DOES A J-CURVE EXIST?**

### *Abstract*

The conventional J-curve effect suggests that a depreciation of a country's currency leads to a worsening of the trade balance in the short run and to an improvement in the long run. This chapter examines the J-curve effect for India at the aggregate and disaggregate levels for bilateral and sectoral trade, using monthly data for the period 2001m4 to 2013m3. Overall, there is no evidence regarding the existence of a J-curve at the aggregate or disaggregate levels. The analysis suggests that there is a long-run relationship between the real exchange rate and trade balance for India, with a positive impact of a depreciation at the aggregate level, in India's trade with Germany as well as in the crude materials sector. Using the USD-INR exchange rate, there is a deterioration in the trade balance of mineral fuels, which include petroleum and related products.

### **4.1 Introduction**

According to conventional wisdom, depreciation of a currency should lead to a reduction in imports and give a boost to exports, thereby improving the country's trade balance. However, the improvement in trade balance may not be immediate. There has been considerable evidence to suggest that there is a lag between the devaluation of a currency <sup>76</sup> and its impact on the trade balance, with an initial worsening of the trade deficit before an improvement. This scenario occurs when imports are priced in foreign currency and exports are priced in domestic currency; prices are sluggish and there are

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<sup>76</sup> For the purpose of this study, depreciation and devaluation are used interchangeably. There are studies that suggest the impact of a depreciation on the trade balance might be different from a devaluation due to the fact that a devaluation is anticipated while a depreciation is usually unanticipated. When the exchange rate change is anticipated, there may be a rise in the imports prior to the devaluation leading to a worsening of the trade balance (Himarios, 2008).

contracts still in place that have been finalized at the earlier exchange rates which prevent quantities from adjusting.<sup>77</sup> In this case, the only effect of a currency depreciation is to raise the domestic price of imports, hence worsening the trade balance. Over time, as contracts are renegotiated, quantities can start adjusting in response to the exchange rate change. Assuming prices still remain sluggish, currency depreciation should give the country a price competitiveness boost and vice versa, making foreign goods relatively more expensive compared to import substitutes, hence improving the trade balance following the initial deterioration. Assuming the elasticity of exports and imports (in absolute terms) is “sufficiently large,” the trade balance should improve compared to its starting point prior to the initial valuation effect-induced deterioration.<sup>78</sup>

This pattern of adjustment resembles the letter J and hence was coined the J-curve effect. Magee (1973) brought this issue to light in his seminal paper on the deterioration of the U.S. merchandise trade balance of 1971.<sup>79</sup> As he summarizes,

The implications frequently drawn from the events following the 1971 devaluation of the dollar are that (1) improvement in the trade balance depends on whether the devaluation affects the real volume of trade, and (2) a trade balance must get worse after a devaluation before it can get

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<sup>77</sup> See Rose and Yellen (1989). Another reason for the delay in the response to revised prices is because production could take time to adjust (Bahmani-Oskooee & Ratha, 2004; Halicioglu, 2007).

<sup>78</sup> In the textbook case starting with a trade balance and no other complications (such as foreign currency invoicing, pricing to market, etc.), “sufficiently large” (so-called “Marshall-Lerner” condition) implies that the sum of the export and import elasticities (in absolute terms) is greater than one.

<sup>79</sup> For relatively more recent discussions, see Arora et al. (2003); Petrović and Gligorić (2010); Rose and Yellen (1989); and Shirvani and Wilbratte (1997).

better. While some ex post support can be found for these propositions, they are by no means inevitable theoretically. Proposition (2) implies the widely discussed "J-curve" of a country's trade balance after devaluation. The idea of the J-curve has been developed in light of the adverse short-run movements of the trade balance after both the 1967 British and the 1971 U.S. devaluation (p. 308).

The size and timing of the adjustment of the trade balance to the exchange rate change depending on the size of the change in the exchange rate, the kind of trade involved, and the short-run and long-run elasticities (Meade, 1988). It also depends on the pace at which prices and the volumes adjust. For high-inflation countries, devaluation may lead to higher domestic prices, in turn negating the positive impact of the devaluation on the trade balance in the long run <sup>80</sup> (Bahmani-Oskooee & Ratha, 2004; Magee, 1973; Shirvani & Wilbratte, 1997). Similarly, the greater the extent of pricing to market, the faster the domestic price adjustment and, consequently, the less likely that nominal currency changes translate into real ones, implying little to no change in trade balance or overall aggregate demand. This in turn has implications for the use of the exchange rate as a stabilization tool in the short run.

While the literature on the issue of impact of real exchange rate changes on the trade balance is age-old, empirical evidence on the issues remains inconclusive

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<sup>80</sup> If the nominal exchange rate alignments are offset by domestic price movements, then the real exchange rate will not have any impact on the balance of trade.

(Bahmani-Oskooee & Ratha, 2004; Petrović & Gligorić, 2010).<sup>81</sup> While some studies find a worsening of the trade balance in the short run, others find no impact. Among other things, the ambiguity of the results might be due to the aggregation of the data both at the country level (bilateral as opposed to trade-weighted) and the product level (Rose & Yellen, 1989). Hence, studies started examining disaggregate data to measure the impact of exchange rate changes. Aggregate data might suppress the actual movements taking place at the bilateral level, as the trade balance could be improving against one country but at the same time be deteriorating against another. (Bahmani-Oskooee & Ratha, 2004). Therefore, it might be relevant to study this effect using bilateral trade data. Disaggregation at the product level is also required, as the response of the manufactured sectors may differ from that of agricultural products and natural resources. Countries that specialize in manufactured products find their trade to be more sensitive to exchange rate movements than countries that trade in natural resources and agricultural products (Arndt, 2009).

This chapter focuses on the impact of the Indian rupee (INR) on India's trade balance, both at the aggregate level as well as at the bilateral and sectoral levels, for a few of India's important trading partners. India has been experiencing trade and overall current account deficits (CADs) since its economic liberalization in 1991. These deficits were exacerbated in the 2000s, a period of robust economic growth. Until the global financial crisis of 2008-09, these CADs were quite easily financed via huge capital flows.

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<sup>81</sup> The real exchange rate (RER) could be affected by the nominal exchange rate changes or the domestic price movements. However, the focus of this chapter is not on the causes of the movement of the RER but rather the impact of these changes on the trade balance. Similarly, the aim is not to identify the determinants of the trade balance per se or the reasons for the existence of the trade deficit but rather the impact of the exchange rate changes on the trade balance.

In fact, India was faced with surges in capital inflows that led initially to an accumulation of foreign exchange reserves and, over time, much more so in terms of upward pressure on the INR with a movement towards greater exchange rate flexibility. However, since the global financial crisis of 2008, capital inflows to the country have become less robust and certain, while simultaneously the CAD has remained relatively high. This financing gap has in turn led to downward pressure on the INR. Indeed, the rupee has lost around 20 percent of its value since January 2013 and hit a low of Rs 68 to the USD before rebounding. On the trade-weighted basis, the 36-currency REER depreciated 9.8 percent between March and October 2013 (RBI, 2013a).<sup>82</sup>

To what extent have these INR changes impacted India's trade balance in the short and medium runs? Generally, the empirical evidence to date on the impact of a depreciation on the trade balance is inconclusive for India. This paper revisits the issue of the J-curve in India. After considering the issue at an aggregate level, the chapter undertakes a disaggregated analysis (at both the country and sector data levels) for India with a few of its top trading partners.

The remainder of the section is organized as follows. Section 4.2 outlines some stylized facts of India's overall trade balance. Section 4.3 discusses the relevant literature on the subject in general and with specific reference to India. The research question is laid out in Section 4.4. Section 4.5 outlines a simple model for the trade balance, discusses the empirical methodology, and outlines data sources. The results of the

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<sup>82</sup> Of course, there are a multitude of other technical and other factors that are responsible for the sharp gyrations in the INR. For a discussion of rupee movements, see Annunziata (2013) and Mody (2013).

empirical analysis are presented in Section 4.6. The final section concludes with some policy recommendations.

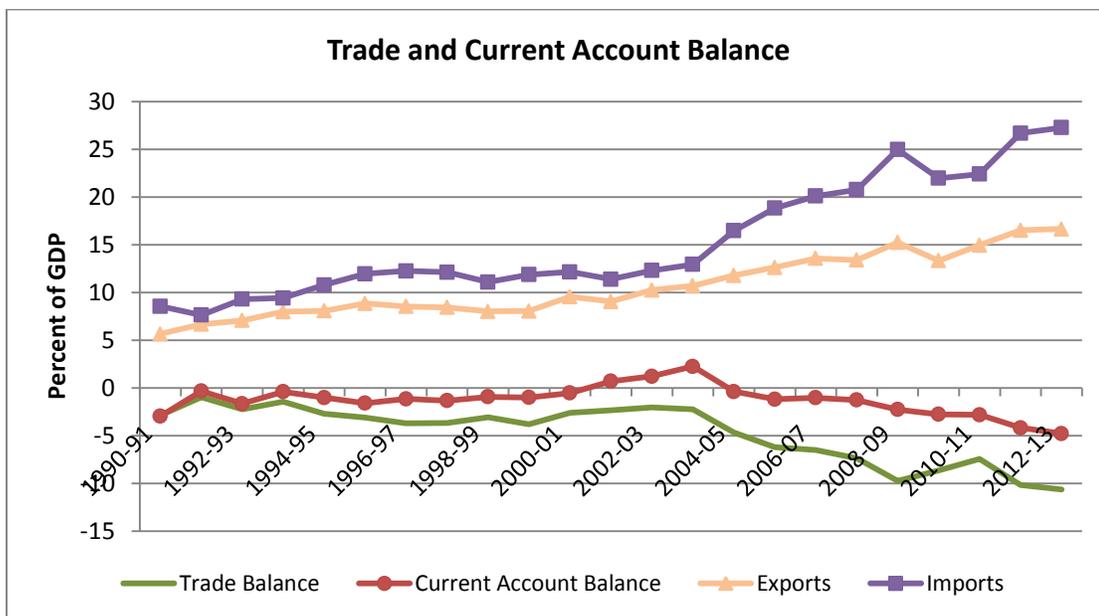
## **4.2. Stylized Facts on Indian Trade and Exchange Rate Trends**

As mentioned in the previous chapters, until the beginning of the global financial crisis (GFC), India's CAD was a very manageable one percent of GDP. By the first half of 2011-12, the impact of the crisis increased the CAD to around 3.6 percent of GDP, which was considered unsustainable by the RBI and is higher than the level of 3 percent reached by the country at the time of the balance of payments (BoP) crisis (BS Reporter, 2012). With respect to the merchandise trade balance (the focus of this chapter), India has run a trade deficit since 1950. However, since 2004, this deficit started to balloon as imports to India increased at faster rates than exports from India. (Figure 4.1) This was due to the fact that during this period, India experienced a growth spurt of around 8-9 percent, growth that required the imports of power and electrical equipment as well as petroleum products.<sup>83</sup> As a share of GDP, imports increased from around 13 to 16.5 percent between 2003-04 and 2004-05, while exports increased from 10.6 to 11.7 percent during the same period, causing the sharp fall in the trade balance. The trade deficit increased as a share of GDP from 2.2 percent to 4.7 percent during the same period. The annual growth rates of imports and exports also suggest that imports have been rising faster than exports for most of the period since 1991 with the exception of the GFC-

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<sup>83</sup> Even though the trade balance has been highly negative, the current account balance has fared better due to the net invisibles, which comprise of services, income from financial assets, labor, and property as well as remittances, which has been constantly rising and is emerging to be on par with exports as a principal source of foreign exchange earnings for the country (RBI Bulletin, 2006).

induced dip in 2007-08.<sup>84</sup> As of 2012-13, trade deficit stood at 10.6 percent of GDP, with exports at 16 percent and imports at 27 percent of GDP (RBI, Handbook of Statistics on Indian Economy, 2013).



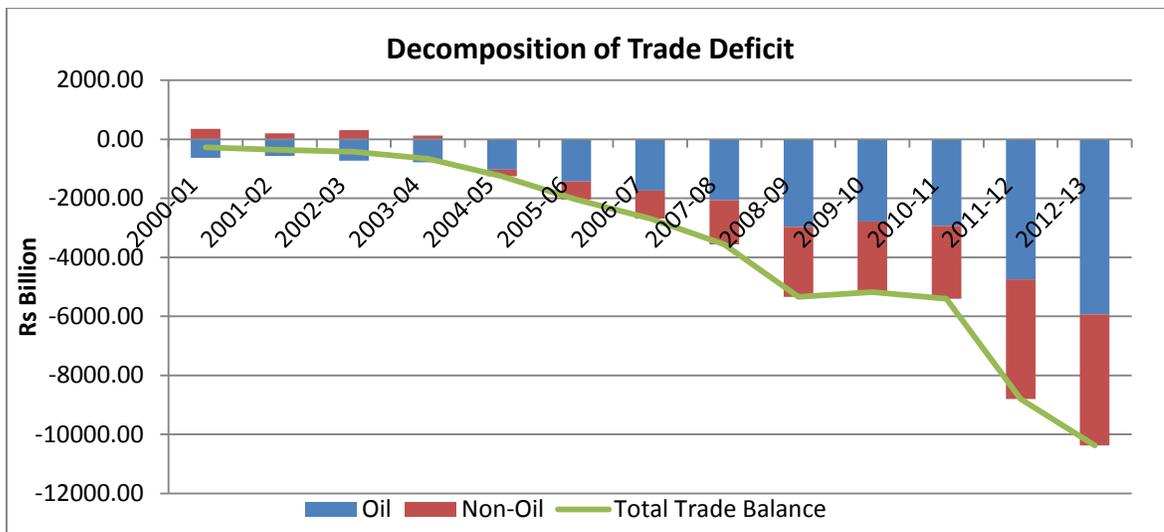
Source: RBI Handbook of Statistics on the Indian Economy (2013)

**Figure 4.1 Trade and Current Account Balance for India**

As mentioned in Chapter 3, there has been a change in the composition of trade towards petroleum and petroleum products as well as gold, silver, and precious metals for India since 2000. The increased imports of petroleum are reflected in the rising contribution of the petroleum products in the trade deficit (Figure 4.2). In terms of exports, the share of primary products has gone down while that of petroleum, crude, and

<sup>84</sup> India's imports rose much more sharply than exports since 2011 largely due to the inelastic demand for oil and gold, with demand for gold rising due to the absence of inflation hedges (Goyal, 2013c).

refined products increased particularly in the recent period. With respect to imports, the share of manufactured goods has declined while that of petroleum, gold, silver, and precious stones has increased.



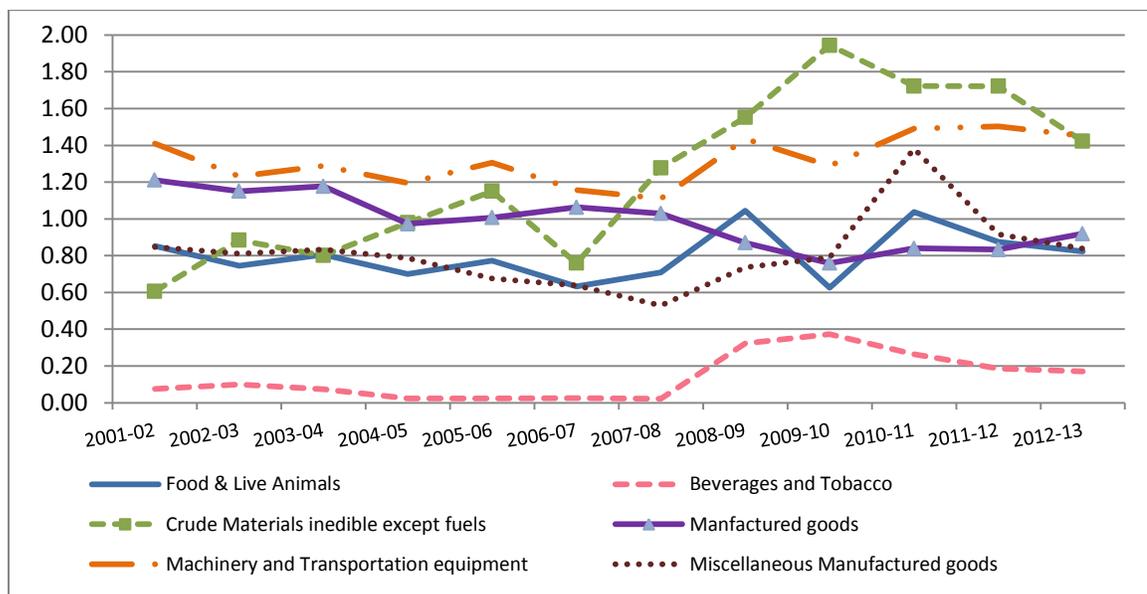
Source: RBI Handbook of Statistics on the Indian Economy (2013)

**Figure 4.2 Decomposition of Trade Deficit**

Figure 4.3 shows the trade balance for a few sectors at the one-digit SITC classification provided by the Central Statistical Organization (CSO) in their Monthly Abstract of Statistics. These are the sectors that have been considered for the disaggregated analysis later in this chapter. The data suggest that India has a trade surplus in machinery and transportation, and a trade deficit in food and live animals, beverages

and tobacco, miscellaneous manufactured products, as well as manufactured products.<sup>85</sup>

With respect to crude materials inedible except fuels, India had a trade deficit until 2007-08, after which there has been a surplus on the trade for this sector.



Source: CSO – Foreign Trade Statistics in Monthly Abstract of Statistics (various issues)

**Figure 4.3 Sectoral Trade Balance**

The trade partners studied in this chapter are Germany, Saudi Arabia, Singapore, Switzerland, and the U.S.. Country choice is guided by the availability of data. These countries are among the top seven trading partners of India as of 2012-13. United Arab Emirates (UAE) and China are the major trading partners of India, but due to lack of data

<sup>85</sup> Trade balance is measured as the ratio of export values to import values for these sectors given the lack of data on actual imports and exports on a monthly basis. The import and export unit value and quantum indices have been used to construct the trade balance for these sectors. A value of less than one indicates more imports than exports, and a value more than one indicates more exports than imports.

on these two countries, the five countries mentioned have been chosen. Together the top seven countries account for around 40 percent of the total trade. And these five account for 25 percent of the total trade of India as of 2012-13 (Table 4.1).

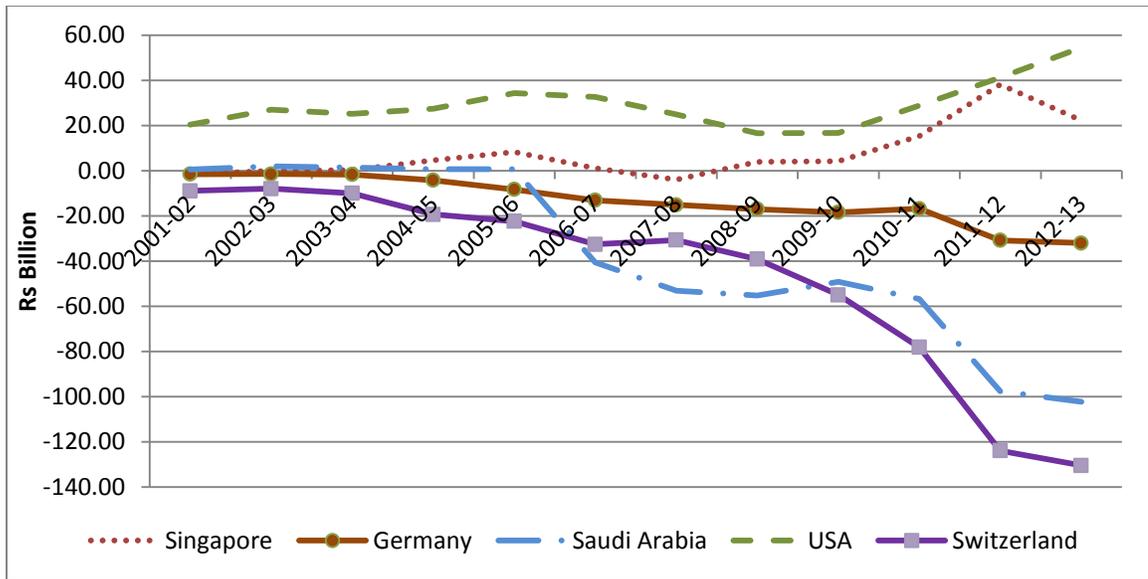
**Table 4.1 Trade Share of the Top Seven Countries (2012-13)**

(Rs Billion)

<b>Rank</b>	<b>Country</b>	<b>Export</b>	<b>Import</b>	<b>Total Trade</b>	<b>Trade Balance</b>	<b>Total trade share (%)</b>
1	UAE	1,978.32	2,129.23	4,107.55	-150.91	9.55
2	China	735.30	2,843.85	3,579.14	-2,108.55	8.32
3	USA	1,967.41	1,372.39	3,339.79	595.02	7.76
4	Saudi Arabia	532.44	1,846.85	2,379.29	-1,314.40	5.53
5	Switzerland	60.79	1,745.12	1,805.91	-1,684.33	4.20
6	Germany	394.08	779.34	1,173.42	-385.26	2.73
7	Singapore	739.95	407.64	1,147.59	332.31	2.67

Source: DGFT Export Import Database (2012-13)

India runs a trade deficit with Germany and Switzerland, but it has run a trade surplus with U.S. since 2001-02. With Singapore, even though initially the trade was almost in balance, India moved into a surplus position, while with Saudi Arabia, starting from an initial position of balanced trade, India went on to have a huge deficit. This is primarily due to the fact that Saudi Arabia is one of the most important sources of petroleum for India, and India imports more than 70 percent of its total petroleum needs, constituting a share of around one-third of total imports (Figure 4.4).

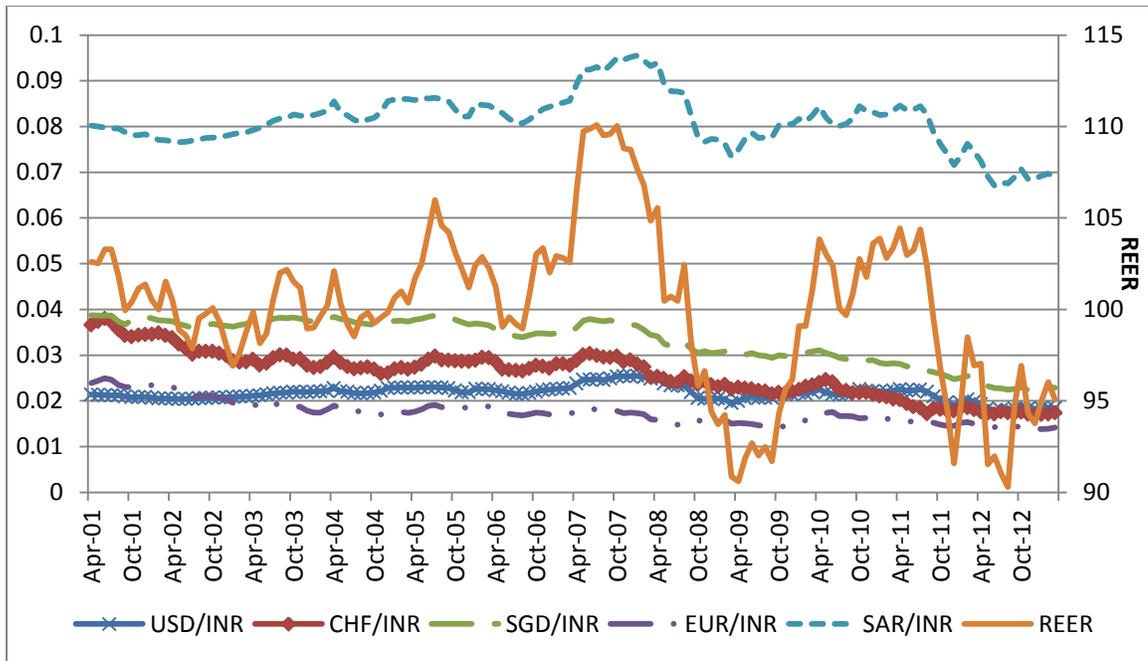


Source: CSO – Foreign-Trade Statistics in Monthly Abstract of Statistics

**Figure 4.4 Trade Balance of India with Partner Countries**

Examining trends in the Indian rupee, the REER has been depreciating since 2007-08, with a depreciation of around 9.8 percent since March 2013.<sup>86</sup> Indeed, the INR has also depreciated against the trading partner currencies, as can be seen from Figure 4.5.

<sup>86</sup> REER is defined as “a weighted average of nominal exchange rates adjusted for relative price differential between the domestic and foreign countries.” (RBI, 2005).



Source: Pacific Exchange Rate Service

**Figure 4.5 Bilateral Exchange Rate of INR with the trading partners and REER**

With this background, the next section discusses the literature on the relationship between exchange rates and the trade balance at the aggregate country level as well as the disaggregate bilateral and sectoral levels.

### 4.3. Literature Review

This section offers an overview of the literature on the subject in general before discussing the literature on India in particular. Given the massive literature in this area, the aim here is not to offer a comprehensive overview (see, Bahmani-Oskooee & Ratha, 2004; Petrović & Gligorić, 2010). Rather, this section offers a flavour of the literature to date in general, with focus on the sectoral studies as well as the India-specific ones.

### 4.3.1 J-Curve Effect–General Studies

The earlier studies on the subject used aggregate data to find mixed results on the relationship in the case of U.S.--some studies find a delayed J-curve effect (Mahdavi & Sohrabian, 1993; Wassink & Carbaugh, 1989), while others find no support for J-curve and results vary with the model employed (Rose & Yellen, 1989).<sup>87</sup> Marwah and Klein (1996) find an S-curve pattern for the U.S. using quarterly data over the period 1977-1992, i.e., an initial deterioration followed by an improvement and again a deterioration in the trade balance. A number of studies have been conducted for other countries as well. Using monthly data between January 1990-June 2005 for 11 East European emerging economies, Bahmani-Oskooee and Kutun (2009) see evidence of a J-curve in Bulgaria, Croatia, and Russia.<sup>88</sup> They study the impact of the real exchange rate on trade balance using the Pesaran bounds testing approach and error correction modeling. For Serbia, Petrović and Gligorić (2010) find evidence of a J-curve effect in the impact of the REER depreciation on the trade balance. They use an autoregressive distributed lag model (ARDL) as well as Johansen's cointegration approach over the period 2002m1: 2007m9 to arrive at their results.

For Asia, Wilson (2001) studies the relationship between the trade balance and real exchange rate for three East Asian countries (Singapore, Korea, and Malaysia) in their bilateral trade with U.S. and Japan. Using quarterly data over the period 1970-1996

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<sup>87</sup> Bahmani- Oskooee (1985), Bahmani-Oskooee and Alse (1994), Gylfason and Risager (1984) and Himarios (1989) support the view that the trade balance improves with a devaluation. On the other hand, studies by Bahmani-Oskooee (1991), Haynes and Stone (1982) and Miles (1979) find that the relation between the two variables holds only for certain countries and time periods.

<sup>88</sup> The countries studied are Cyprus, the Czech Republic, Hungary, Poland, Slovakia, Bulgaria, Croatia, Romania, Turkey, Russia, and Ukraine.

and an ARDL model on bilateral real exchange rate (with an increase indicating depreciation of the domestic currency), he finds that real exchange rate does not impact the trade balance (measured as exports-imports in domestic currency units) for any of the countries studied except for Korean trade with U.S. Contrasting results were obtained by Lal and Lowinger (2002), who find evidence of a J-curve for all the countries studied except for Japan (Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, and Thailand). They use cointegration analysis, error correction model, and impulse response functions for their analysis on quarterly data over the period 1980Q1 and 1998Q4. They also emphasize that the duration and extent of the J-curve differs across countries. They use the REER as the exchange rate and the ratio of exports to imports as the trade balance for these countries. For instance, studies of Japan find evidence of the J-curve using both nominal and real variables under varying exchange rate regimes and over different time periods (Backus, 1993; Gupta-Kapoor & Ramakrishnan, 1999; Noland, 1989;). Ahmad and Yang (2004) estimate the J-curve effect for China in its bilateral trade with the G-7 countries using annual data over the period 1974-94. Using cointegration and causality tests, they do not find evidence of a J-curve, but do find a positive long run effect of exchange rate on the trade balance.

The J-curve effect is also related to the exchange rate pass through (ERPT) phenomenon. If the ERPT of a currency devaluation is delayed, it delays or negates the J-curve pattern as well. (Bahmani-Oskooee & Ratha, 2004). This occurs because when ERPT is incomplete, import prices do not rise by as much as the exchange rate depreciation, and therefore the trade balance does not witness an immediate deterioration

of the same magnitude as the exchange rate change, hence delaying the J-curve effect (Rosensweig & Koch, 1988). Wassink and Carbaugh (1989) studied this effect for the U.S. using the dollar-yen exchange rate on U.S. trade balance for the period 1978-1988 and found that there is evidence of incomplete ERPT leading to a delayed J-curve effect for U.S.

The choice of currency invoicing has also been found to explain the across-country differences in the impact of exchange rates on the trade balance in the short run. This distinction is important because if imports are invoiced in a foreign currency, the domestic currency value of import contracts will increase following a devaluation and lead to a worsening of the trade balance in the short run, thus leading to a J-curve effect. Using bilateral trade data between 14 OECD countries for 14 industries over the period 1980-83, Melvin and Sultan (1990) find that countries where exports are invoiced in domestic currency and imports in foreign currency experience a deterioration in the trade balance following a depreciation of the currency. They also find that countries where both exports and imports are invoiced in the domestic currency do not experience any change in the trade balance following a depreciation. They examine the correlations between importer resale price, exchange rate, and production costs to arrive at these results. The fact that domestic currency invoicing of imports and exports does not affect the trade balance has also been proved for the U.S., which had not been experiencing an improvement in its trade balance despite a depreciation of the USD. Using data over the period 1975-2003 and previously estimated ERPT coefficients to study the impact of a 10 percent depreciation of the USD, Goldberg and Dillion (2007) find that the depreciation

lowers U.S. export prices by seven percent and raises import prices by only four percent, thus contributing to the persistent trade deficits.

#### **4.3.2 Disaggregated Studies: Bilateral and Sectoral**

The main problem with the earlier studies was their use of the aggregate data. Using aggregated trade data could cause an “aggregation bias,” which implies that a significant price elasticity with one trading partner could be more than offset by an insignificant elasticity with another trade partner—in other words there could be a loss of information. Besides, there are problems of finding the appropriate proxies for the rest of the world income and exchange rates. With this realization, studies started focusing on the bilateral trade between countries. However, the disaggregated studies also provided mixed results, with some studies finding that Marshall-Lerner condition holds for their countries of study (Arora et al, 2003; Halicioglu, 2007; Nagpal, 2010; Shirvani & Wilbratte, 1997).

One of the pioneering studies at the disaggregated data was by Rose and Yellen (1989). The authors study the aggregated as well as the disaggregated data for the U.S. trade with six of its trading partners (Japan, Canada, UK, France, Germany, and Italy) using instrumental variables regressions on real exchange rate and trade balance over the period 1960Q1 to 1985Q4. Even though they find evidence of a relation between the two variables for U.S. trade with Germany and Italy, the impact was not robust to alternative specifications. They did not find any “statistically reliable evidence” of a relation between the exchange rate and the trade balance for any lag length. To compare their

results with the literature, the authors also undertook the analysis at the aggregate level and found the same result--no reliable evidence of any relation.

Using the Johansen-Juselius cointegration approach and the error correction method on monthly data from May 1973 to August 1990 for the bilateral trade of U.S. with six of the other G7 countries, Shirvani and Wilbratte (1997) find a reversed L-curve effect instead of a J-curve. The reverse L-curve implies that for the first six months following real devaluation there is no significant effect on the trade balance, whereas in the longer run the trade balance improved any time within the next 18 months.

Meade (1988) investigated the impact of a devaluation on sectoral trade balance for the U.S. using a partial equilibrium model on annual data over the period 1978-1988 and found that for the non-oil industrial supplies, the negative impact of a devaluation on the trade balance is short-lived and the improvement in the trade balance sets in soon. On the other hand, capital goods did not appear to have any negative impact of exchange rate changes, while consumer goods are found to be unresponsive to exchange rate changes.

Using the Pesaran bounds testing and error correction modeling on annual data for the period 1962-2003 between the U.S. and UK, Bahmani-Oskooee and Kovyryalova (2008) find the presence of a J-curve effect in 66 industries, following Rose and Yellen's (1989) definition of the J-curve, i.e., a short-run deterioration followed by long-run improvement. For 107 industries of the 177 studied, there is a short-run effect (either positive or negative) of a real depreciation on the trade balance; however, only in 13 industries do they observe negative coefficients followed by positive ones for the J-curve effect. Bahmani-Oskooee and Hajilee (2012) conduct a similar analysis (using the same

methodology as above) on the SITC 3-digit level data for trade between Germany and U.S. for 131 industries using annual data over the period 1971-2009 and find that for 91 industries there is a short-run impact (positive or negative) of real depreciation of the Euro on trade balance while the J-curve pattern was observed for 31 industries. In an attempt to see if the response of the goods sector is different to that of the services sector to an exchange rate change, Wijeweera and Dollery (2012) examine quarterly Australian data over the period 1988-2011. Using the bounds testing approach and error correction modeling they find that the services sector displays a J-curve effect; the goods sector witnesses an improvement in the short run but experiences a weak negative response in the long run.

Another factor which has been somewhat less studied is the impact of the exchange rate change on the trade balance is production sharing. As the share of network trade rises, the impact of exchange rate change on the trade balance reduces. Typically, an exchange rate appreciation raises demand for imports and reduces demand for exports from the domestic country. But with production sharing, along with an increase in the demand for imports, the demand for exports might also rise when the domestic country exports are used for production in the foreign country. Therefore, an appreciation of the domestic currency can also raise the demand for the country's exports. This was empirically proven for the U.S.-Mexico trade using the vector error correction (VEC) model on data over the period 1989Q1 to 2002Q4 by Arndt and Huemer (2006). Thorbecke (2009) obtained similar results when analyzing the East Asian computer industry over the period 1990-2006 using panel data for four East Asian countries that

process and export computers and 28 importing nations. He uses a dynamic OLS model to suggest that an appreciation in the component supplying countries to these East Asian economies hurts computer exports, while appreciation of the currency of these four countries does not curtail exports.

### **4.3.3 J-curve Effects for India**

There have been a handful of studies on this issue for India (Annex 4.1 summarizes studies on India). Studies that used aggregate data did not find evidence of the J-curve in India, nor did they find any impact of the depreciation of the INR on the trade balance in the long run. In a study using the cointegration and error correction models, Rose (1990) found that there was no strong relation between the REER and the trade balance using three-stage least squares regression on the annual and quarterly data for 30 developing countries including India for the period 1970-1988. Similarly, Singh (2004) did not find the presence of a J-curve in the relation between the exchange rate devaluation (using both trade based and export based REER) and trade balance for India in his analysis of quarterly data from 1972 Q2 to 1996 Q3 using an error correction model. The innovation in his study is the use of the GARCH model for the estimates of the REER. He suggests using this approach for the volatility of the exchange rate, as this method provides a time-varying and conditional measure of volatility, unlike conventional measures such as the standard deviation or the variance.

Bahmani-Oskooee (1985, 1989) studies the impact of the real exchange rate on the trade balance (measured as index of the INR value of export –imports) for Greece, India, Thailand, and Korea for the period 1973–1980, using quarterly data. The

constructed real exchange rate indicates a depreciation of the rupee with an increase in the exchange rate. He finds that India exhibits “the inverse J-curve effect” in that there is an improvement in the trade balance initially before it deteriorates at the distributed lags of the exchange rate. He also finds that in the long run as well, there is a deterioration in the Indian trade balance. In his study of 27 countries using OLS regression on annual data over the period 1953-73 and quarterly data over the period 1975Q1: 1984:Q4, Himarios (1989) looks at India’s trade balance in USD. He finds a positive impact of the depreciation of the real exchange rate (defined as INR per unit of USD representing a depreciation with an increase in the real exchange rate) on the trade balance in the short and long runs.

To do away with the unit of measurement, Bahmani-Oskooee and Malixi (1992) measured trade balance as the ratio of the exports over imports and found that the REER (units of domestic currency per foreign currency indicating a depreciation with an increase) improves the trade balance in the long run. They conduct this study for 13 less-developed countries. For India, they observe negative coefficients of the exchange rate at lower lags and a positive coefficient at higher lags, suggesting the presence of a J-curve effect. They used a distributed lag model and imposed Almon lag structure on the exchange rate over the period 1973 Q1: 1985 Q4. However, they do not obtain similar results for all the countries studied, and therefore conclude that the short-run effect of the exchange rate on the trade balance may not follow a set pattern, whereas a favorable impact of the J-curve holds in the long run, suggesting that devaluation can be used as a policy to improve trade balance in the less-developed countries.

There have been only a few disaggregated studies for the country. Arora et al (2003) examined the bilateral trade data for India with seven of its major trading partners (Australia, France, Germany, Italy, Japan, the UK and the U.S.) for the period from 1977 Q1 to 1998 Q4. They used the autoregressive distributed lag (ARDL) approach for their study and found no evidence of a J-curve, but found that in the long run, the real bilateral exchange rate (increase representing depreciation) improves the trade balance for India's trade with Australia, Germany, Italy, and Japan. Mustafa and Rahman (2008) examined the effect of the U.S. bilateral nominal exchange rate changes (measured as foreign currency per unit of USD indicating a depreciation of USD with a decline in the exchange rate) on trade with India, Japan, Malaysia, South Korea, and Thailand using monthly data for the period from January 1985 and May 2005. Utilizing the Johansen-Juselius cointegration procedure and the error-correction model, they find a long run relationship between the exchange rate and trade balance, but no evidence of a J-curve effect.

Napgal (2010) examined India's bilateral trade the U.S., UK and Japan using monthly data from 1992-2009 and cointegration tests, impulse response function and VAR/VEC models. Like many of the previous studies for India, he too does not find the J-curve effect for India but does find evidence of a positive long-run relationship in India's trade with the U.S. A study by Tiwari and Shahbaz (2011) appears to be the first to find support for the J-curve effect at a disaggregated level for India's trade with the U.S. They use an ARDL bounds-testing approach to cointegration as well as the impulse response functions and variance decompositions for the period 1965-2008 to confirm

these results. However, like most of the other studies, they do not appropriately control for the demand for Indian exports.

Using quarterly bilateral trade data between India and 15 of her trading partners, Dhasmana (2012) finds that there is a positive relation between real exchange rate and trade balance in the long run.<sup>89</sup> Dhasmana uses the REER as the exchange rate and the ratio of exports to imports as trade balance to run the Pesaran bounds testing approach as well as a pooled mean group estimator test to estimate the long-run relation between the variables. Her results also indicate that there is no evidence of a J-curve effect in India's trade with any of the 15 partners. However, she does find that real depreciation of the rupee improves trade balance against eight of the 15 countries (Belgium, France, Germany, Hong Kong, Japan, the Philippines, South Korea and the U.S.). Estimates from the pooled mean group estimation also support the results obtained from the bounds testing approach.<sup>90</sup>

Suggesting that the lack of any relation between the exchange rate and trade balance between India and the U.S. in the study by Arora et al. (2003) could be due to an aggregation bias, Bahmani-Oskooee and Mitra (2009) disaggregate data at the industry level and study this relation for 38 industries that are part of the trade between these two countries. They investigate this relation at the industry level using annual data from 1962-2006 and follow Pesaran et al.'s (2001) bounds testing approach to cointegration and

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<sup>89</sup> She also finds that real exchange rate volatility has a negative correlation with the trade balance in the long run.

<sup>90</sup> However, since the REER is constructed to indicate an appreciation with a rise in the exchange rate, a positive coefficient would indicate a deterioration of the trade balance in the long run, unless the REER has been modified to reflect a depreciation with an increase of the REER.

error correction modeling. Using the INR-USD bilateral exchange rate (an increase indicating a depreciation), they find evidence of the J-curve pattern in only eight industries (3 industries by looking at higher lags of the exchange rate and 5 industries by following Rose and Yellen's definition), while in 22 industries they found short-run effects, in that a devaluation of the exchange rate leads to a deterioration in the trade balance for these industries.

#### **4.4. Research Question**

Overall, the empirical studies on the J-curve have provided mixed results for India, with the majority of the studies generally not finding any empirical support for the J-curve.<sup>91</sup> Similarly, results are also not conclusive regarding the short-run and long-run impact of an exchange rate change on the trade balance, with some studies finding a deterioration (for instance, Bahmani-Oskooee, (1985, 1989), while others finding an improvement in the short and long run (Himarios, 1989). There do not appear to be any studies to date that estimate the long-run impact of the exchange rate on the trade balance at the aggregate sectoral level for India. The inconclusive results on the relation between the exchange rate and trade balance as well as of the J-curve effect for India motivate the revisiting of the issue at the aggregate level as well as at a detailed industry-wide level for the country. This chapter therefore addresses the following research question:

*Research Question:* Does the J-curve phenomenon hold for India at the aggregated and disaggregated country as well as sectoral levels?

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<sup>91</sup> Exceptions being Bahmani-Oskooee and Malixi (1992), Bahmani-Oskooee and Mitra (2009), and Tiwari and Shahbaz (2011) for India's trade with U.S. in a few sectors.

## 4.5. Methodology and Data

### 4.5.1 Theoretical Model

Following, Rose and Yellen (1989), Shirvani and Wilbratte (1997) and assuming a two-country model, the imports and exports of the domestic and the foreign country can be expressed as follows:

$$M_d = M_d(p_m, Y) \quad (1)$$

$$M_d^* = M_d^*(p_m^*, Y^*) \quad (2)$$

where  $M_d$  is the demand for imports in the home country and  $M_d^*$  is the demand for imports in the foreign country,  $p_m$  ( $p_m^*$ ) is the relative price of imports to domestically produced goods in the home (foreign) country measured in the home currency and  $Y$  ( $Y^*$ ) is the income level in the home (foreign) country. This form of representing the equations conforms to the Marshallian demand equation, where the price elasticity of demand is negative and the income elasticity is positive.

The relative price of imports can be expressed as follows:

$$p_m = E \frac{P_x^*}{P} \quad (3)$$

where  $E$  is the nominal exchange rate defined as the domestic price of foreign currency.

The right hand side of the equation can be written as follows:

$$E \frac{P_x^*}{P} = E \left( \frac{P_x^*}{P} \right) \left( \frac{P^*}{P^*} \right) \Rightarrow E \left( \frac{P_x^*}{P^*} \right) \left( \frac{P^*}{P} \right) \Rightarrow \left( \frac{1}{q} \right) p_x^* \quad (4)$$

where  $q$  – real exchange rate defined as the relative price of domestic to foreign goods,  $P_x^*$  is the foreign currency price of foreign exports, and  $P$  and  $P^*$  are the overall price indices of the home and foreign country respectively. The real exchange rate thus defined ( $q = P/(E.P^*)$ ) indicates a devaluation of the domestic currency with a decrease in the value of  $q$ .

Substituting equations (4) into (3), we get:

$$p_m = \left( \frac{1}{q} \right) p_x^* \quad (5)$$

$$\text{Similarly, } p_m^* = p_x q \quad (6)$$

Substituting equation (5) in (1) we obtain the following:

$$M_d = M_d \left( \left( \frac{1}{q} \right) p_x^*, Y \right) \quad (7)$$

Similarly, the foreign country demand for imports can be expressed as follows:

$$M_d^* = M_d^* (p_x q, Y^*) \quad (8)$$

Assuming a perfectly competitive market for the supply of exports, they can be expressed as a function of the relative price of exports as follows:

$$X_s = X_s(p_x) \quad \text{and} \quad X_s^* = X_s^*(p_x^*) \quad (9)$$

where  $X_s$  ( $X_s^*$ ) is the supply of exportables of the home (foreign) country.

For equilibrium, demand for imports should be equal to the supply of exports in each of the countries, i.e.:

$$M_d = X_s^* \quad \text{and} \quad M_d^* = X_s \quad (10)$$

Based on the above, the domestic balance of trade (TB) can be expressed as follows:

$$TB = X_s / M_d \Rightarrow TB = M_d^* / M_d = \{ M_d^*(p^x q, Y^*) / (M_d((\frac{1}{q})p_x^*, Y)) \}$$

$$TB = (M_d^*(p^x q, Y^*)) / (M_d(p_x^*/q, Y)) \quad (11)$$

Trade balance expressed as a ratio of exports to imports gives us a unit free measure. These equations can be solved for the levels of imports and exports and the relative price ratios as functions of  $q$ ,  $Y$  and  $Y^*$  and therefore, TB can be expressed as a function of  $q$ ,  $Y$  and  $Y^*$  (Rose and Yellen, 1989)

$$TB = TB (q, Y, Y^*) \quad (11)$$

#### 4.5.2 Empirical Model

Equation (11) expresses trade balance as a function of the real exchange rate and the domestic and foreign income. By taking logs on both sides of equation (11) and using a log linear approximation for the right hand side of equation (11), we get the following:

$$\text{LnTB}_{j,t} = \alpha + \beta \text{Ln } Y_{i,t} + \gamma \text{Ln } Y^*_{k,t} + \delta \text{Ln } q_t + \epsilon_t \quad (12)$$

where TB stands for trade balance in industry j at time t, measured as the ratio of industry j's exports over the same industry's imports,  $Y_{i,t}$  is the economic activity in India at time t,  $Y^*_{k,t}$  is the economic activity in trade partner at time t, and  $q_t$  is the bilateral exchange rate between INR and the currency of the trading partner with an increase in the exchange rate denoting appreciation. For the aggregate analysis, the REER has been used as exchange rate, where an increase represents an appreciation of the INR.

However, equation (12) only provides the results for the long run. Many of the studies have computed the short run dynamics by expressing equation (12) in an error correction format as shown in equation (13) (Bahmani-Oskooee & Mitra, 2009; Arora et al., 2003).<sup>92</sup> We specify equation (12) in an ARDL form as shown below:

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<sup>92</sup> The bounds-testing approach by Pesaran et al (2001) also followed by Arora et al (2003), Bahmani-Oskooee and Mitra (2009), Petrović and Gligorić (2010) Tiwari and Shahbaz (2011), is used to compute the short run dynamics. The Pesaran Bounds testing approach is often used to test for a cointegrating relation between the variables in a regression. The advantage of this method is that it does away with the need to test for unit roots as well as allows estimation of the long and short run coefficients simultaneously.

$$\Delta \text{Ln TB}_{j,t} = \alpha + \sum_{l=1}^{n_1} \theta_l \Delta \text{Ln TB}_{j,t-1} + \sum_{l=1}^n \beta_l \Delta \text{Ln Y}_{i,t-1} + \sum_{l=1}^n \lambda_l \Delta \text{Ln Y}_{k,t-1}^* + \sum_{l=1}^n \delta_l \Delta \text{Ln q}_{t-1} + \theta \text{Ln TB}_{t-1} + \beta \text{Ln Y}_{i,t-1} + \lambda \text{Ln Y}_{k,t-1}^* + \delta \text{Ln q}_{t-1} + \mu_t \quad (13)$$

With respect to the expected coefficients, the domestic GDP ought to have a negative coefficient if an increase in the GDP raises imports and worsens the trade balance. Similarly, for foreign GDP, if there is an increase in the demand for Indian imports, then India's exports would increase, leading to an improvement in India's trade balance with a depreciation of the INR. The expected sign of coefficient of the real exchange rate is negative if a depreciation of the INR (in this case a decrease in the exchange rate) leads to an increase in exports and lowers imports.

The basis of a J-curve effect is the fact that quantities take time to adjust as well as the fact that contracts are written out in advance and take time to adjust, whereas import prices change immediately in domestic currency terms (valuation effects), thus affecting the trade balance. Therefore, one would expect that a depreciation, which makes imports expensive in the immediate run, would lead to a deterioration in the trade balance before quantities adjust and improve the trade balance over the medium run as long as prices remain sluggish. In the long run, when quantities start adjusting to the exchange rate change, there is an improvement in the trade balance (Magee, 1973). Thus, for a J-curve to exist there must have been an initial deterioration in the trade balance with an INR depreciation, i.e., the so-called valuation effect, followed by a substantial

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Unlike in the conventional error correction model (ECM), one does not have to ensure that all the variables are I(1) processes. Combination of I(0) and I(1) processes cannot be handled by the ECM models.

improvements, i.e., the so-called competitiveness effect (and fulfillment of the Marshall-Lerner condition).

One reason for the lack of J-curve could be because of the non-existence of initial valuation effects. This could arise if exports are also invoiced in foreign currency terms and the country is starting from a balanced trade or a trade surplus.<sup>93</sup> It could also arise if exports and imports do not respond to real exchange rate changes, either because they are exchange rate-inelastic (in aggregate terms, implying non-fulfillment of Marshall-Lerner condition), or there is a fairly high level of ERPT into domestic prices. At a sectoral level, for instance, this could happen in the case of commodities such as oil (Umoru & Eboreime, 2013) or in the event of high import content of exports due to, for instance, production sharing (Arndt & Huemer, 2006; Thorbecke, 2009).

### **4.5.3 Empirical Methodology**

The first step in the bounds testing approach is to establish cointegration among the variables, which is done by testing if the coefficients  $\theta$ ,  $\beta$ ,  $\lambda$  and  $\delta$  in equation (13) are different from zero.<sup>94</sup> To test for cointegration, the null hypothesis of no long-run relation between the real exchange rate and trade balance and the domestic and foreign income  $H_0: \theta = \beta = \lambda = \delta = 0$  is tested against the alternative:  $H_1: \theta \neq 0, \beta \neq 0, \lambda \neq 0, \delta \neq 0$ . If

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<sup>93</sup> Alternatively, it could also arise if both exports and imports are priced in local currency terms (unlikely for developing countries like India).

<sup>94</sup> For this purpose, equation (13) is run by taking into account symmetric lags for each of the variables involved, which in the case of this paper is 4 for all the variables, as suggested by the Akaike Information Criteria (AIC)

the lagged level variables are jointly significant, they are said to be co-integrated. The relevant test statistic to use here is the F-statistic with the new critical values which have been provided by Pesaran et al. (2001). They tabulate an upper bound by assuming that all the variables are integrated of order one and compute a lower bound by assuming that all the variable are integrated of order 0. The null of no long-run relationship between the dependent and independent variables is rejected if the F statistic is greater than the upper bound, which indicates cointegration. If the calculated F statistic is below the lower bound, then the null cannot be rejected, which indicates lack of cointegration. The results are inconclusive if the F statistic falls within the band. In such a case, an alternate test for cointegration is carried out whereby one period lagged residuals from equation (12) are used to compute an error correction term (ECT). This term is then used in the regression in place of the linear combination of the lagged variables (equation 14). A significant negative coefficient of the lagged error correction term signifies cointegration and also the fact that the variables adjust towards their long run equilibrium<sup>95</sup>.

$$\Delta \text{Ln TB}_{j,t} = \alpha + \sum_{l=1}^n \theta_l \Delta \text{Ln TB}_{j,t-l} + \sum_{l=1}^n \beta_l \Delta \text{Ln Y}_{i,t-l} + \sum_{l=1}^n \lambda_l \Delta \text{Ln Y}^*_{k,t-l} + \sum_{l=0}^{n4} \delta_l \Delta \text{Ln q}_{t-l} + \rho \text{ECT}_{t-1} \quad (14)$$

where  $\text{ECT}_{t-1} = \text{LnTB}_{j,t-1} - \alpha_{t-1} - \beta \text{Ln Y}_{i,t-1} - \gamma \text{Ln Y}^*_{k,t-1} - \delta \text{Ln q}_{t-1}$

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<sup>95</sup> The error correction term here has the same interpretation as in a VEC model. A negative significant coefficient indicates that the variables tend towards their long run equilibrium. However, a positive coefficient indicates that the variables are moving away from the equilibrium.

Once cointegration is established, the next step is to estimate the short run and long run impact of the exchange rate on the trade balance from equation (13). For the purpose of this analysis, the coefficient of the real exchange rate at the first lag is treated as the short-run coefficient, while the long run coefficient is obtained as a sum of the lagged coefficients of the independent variables.<sup>96</sup>

#### **4.5.4 Data and its Sources**

The model specified in equation (13) is first estimated at (i) the aggregate level for the country as a whole; (ii) at the bilateral level for India's trade with five trading partners, viz. Germany, Saudi Arabia, Singapore, Switzerland, and U.S.; and finally (iii) for nine sectors based on the SITC one digit classification for which data are provided by the CSO. Of the countries studied, India has a trade surplus with U.S. and Singapore and a trade deficit with Switzerland, Germany, and Saudi Arabia for almost the entire period of study. Monthly data for the period from April 2001 to March 2013 are used for the analysis.

The trade balance is measured as exports over its imports for India at the aggregate and bilateral level. Data on imports and exports has been obtained from the Foreign Trade Statistics of the Monthly Abstract of Statistics provided by the CSO both at the aggregate as well as bilateral level. With respect to the sectoral analysis, only the import and export unit value indices and import and export quantum indices are provided

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<sup>96</sup> One period lag has usually been considered to be the short run in literature (see Bahmani-Oskooee, 1985; Bahmani-Oskooee and Mitra, 2009; Petrović and Gligorić, 2010). Therefore, we follow the same interpretation here as well.

by the CSO. Considering unit values to be a proxy for the prices, the trade balance for the sectors is constructed as follows:

$$\text{Trade balance} = \frac{UV_X Q_X}{UV_M Q_M} \quad (15)$$

where  $UV_X$  is the export unit value index;  $UV_M$  is the import unit value index;  $Q_X$  and  $Q_M$  are the export and import quantum indices. Unit value index is measured as the ratio of total value of imports (exports) divided by the quantity of imports (exports).

Income levels of the countries being studied were obtained from International Financial Statistics (IFS, 2013) of the International Monetary Fund. Data on the REER for the aggregate analysis is obtained from RBI. The bilateral exchange rate data is obtained from the Pacific Exchange Rate service of the University of British Columbia<sup>97</sup>. These are converted into real terms by multiplying the nominal exchange rate with the ratio of domestic to foreign prices ( $P_{\text{domestic}} * \text{NER} / P_{\text{foreign}}$ ). The real exchange rate is constructed in such a way that an increase represents an appreciation of the Indian rupee to be consistent with the REER. The consumer price indices data, used to convert the nominal bilateral exchange rate to real exchange rates, are also obtained from the IFS.

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<sup>97</sup> Pacific Exchange Rate Service, University of British Columbia (<http://fx.sauder.ubc.ca/data.html>)

## 4.6 Results

### 4.6.1 Aggregate and Bilateral Trade

For India as a whole, using the monthly trade balance and the real exchange rate representing a depreciation with a decrease, the results suggest the existence of a long-run relationship between the variables based on the critical values of the F test suggested by Pesaran et al. (2001). The F-statistic of 7.29 is greater than the upper bound critical value of 4.35. The critical values suggested by Pesaran et al. (2001) are presented in Table 4.2. An F-statistic greater than the critical value suggests that the variables are cointegrated. On the other hand, if the F-statistic lies between the lower and upper bounds, then the result is in the inconclusive zone for which further tests using error correction term are needed. And finally, a value below the lower critical value suggests that the variables are not cointegrated.

**Table 4.2 F-Statistic Critical Values for testing the existence of a long run relationship<sup>98</sup>**

Critical Values	Lower Bound	Upper Bound
1% level	4.29	5.61
5% level	3.23	4.35
10% level	2.72	3.77

Source: Pesaran et al. (2001)

The short-run coefficient at the aggregate level is -1.28, which is in line what that obtained by Singh (2004).<sup>99</sup> The long-run coefficient is also negative (-2.88). At the

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<sup>98</sup> The critical values are taken from Pesaran et al. (2001), unrestricted intercept and no trend with three regressors.

<sup>99</sup> Using REER and the ratio of exports to imports as the trade balance over the period 1975q2 to 1996q3, Singh (2004) obtains a short run coefficient of -1.01 significant at 5% level of significance.

aggregate level, the coefficients on the trade balance in the currency contract phase (when contracts negotiated prior to the change in the exchange rate are due) as well as the pass-through phase (when new contracts are entered into but before quantities have adjusted) are negative, indicating that there is a positive effect of a depreciation of the rupee on the trade balance in the short and long run. This result is also in line with earlier findings in the literature, in that there is an improvement in the trade balance in the short and long run. (Dhasmana, 2012; Himarios, 1989). Possible reasons for this result could be the fact that competitiveness effects kick in sooner than expected and quantities adjust immediately, or that exports are predominantly invoiced in foreign currency. If the exports are invoiced in the foreign currency, then with a depreciation the Indian exporter stands to gain if he does not change the prices in the foreign currency. And in the long run, as both the quantities and prices adjust, there is a positive impact on the trade balance.

**Table 4.3 Short-run and Long-run Coefficients**

1	Short-run coefficients <sup>100</sup>				Long-run Coefficients		
	2	3	4	5	6	7	8
	REER <sub>t-1</sub>	REER <sub>t-2</sub>	REER <sub>t-3</sub>	REER <sub>t-4</sub>	REER	GDP	Foreign GDP
USA	-0.518	1.240	-0.849	-0.759	-0.886	2.154	14.358
Switzerland	-3.692**	2.138	-0.898	2.504	0.052	8.472	-12.338
Saudi Arabia	2.132	0.383	-0.002	-0.416	2.096	6.139	27.399
Germany	-1.604**	0.122	-0.222	-0.770	-2.474	3.170	-2.912
Singapore	-0.229	-1.236	-2.993	-3.582	-8.039	1.002	6.271
Aggregate	-1.284**	-0.025	-0.732	-0.842	-2.882	2.096	17.573

\*\*\* Significant at 1% level; \*\* Significant at 5% level; \* Significant at 10% level

<sup>100</sup> All the coefficients of REER are shown in the table because the long run coefficient is the sum of the short run coefficients.

With respect to India's bilateral trade, the short-run result is significant only for Switzerland and Germany. The short-run coefficient for India's trade with Switzerland is -3.69, indicating that with a depreciation, there is an immediate improvement in the trade balance in the short run. In the long run, there is a deterioration in the trade balance with a positive coefficient of 0.052. For India's trade with Germany, there is an improvement in the trade balance in the short and long run, with coefficients of -1.6 and -2.474 respectively. The results suggest that at the aggregate level as well as in India's trade with Germany, a depreciation improves the trade balance in the long run. The error correction term is significant and negative for all the countries indicating that there exists a long-run relationship between the bilateral real exchange rate and the trade balance and also suggests that the adjustment among the variables in the model is towards their long-run equilibrium (Annex 4.2, col 3).

#### **4.6.1.1 Diagnostic Checks for Aggregate Analysis**

The results of the diagnostic tests are presented in Annex 4.2. At the aggregate level, the F statistic is greater than the critical value suggested by Pesaran et al. (2001) suggesting that there is a long-run relationship between the variables. Of the five countries considered, for Singapore, the F-statistic is below the critical value, indicating that there is no long-run relationship between the variables. Other diagnostic tests such as the Ramsey Reset test to test for the model specification, the Lagrange Multiplier statistic testing for serial correlation as well as the CUSUM and CUSUMSQ<sup>101</sup> test to determine

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<sup>101</sup> The CUSUM test calculates and plots the cumulative sum of the recursive residuals and their squares from the regression. It tests whether the coefficients are constant over the period of study. It plots the lower

stability of the long-run and short-run coefficients were also carried out. Values between the critical lower and upper bound for the CUSUM tests indicate the stability of the model, which has been represented by an “S” in Table 4.3.1. These tests confirm that the model is specified correctly in most of the cases. For those countries, where we are unable to reject the hypothesis that the model does not have any omitted variables, changing the model to include the appropriate lags for each of the variables helps improve the scores for the reset test. However, it does not change the results significantly. (See Annex 4.3 for the results of the model using appropriate lags for the individual variables). The results also confirm that there is no serial autocorrelation and the coefficients are stable in the long and short run.

#### **4.6.2 Sectoral Analysis**

The results of the aggregate study suggest that for India there is an improvement in the trade balance in the short and long run with a depreciation of the INR. This result varies by country, as can be seen from the bilateral country studies. As a next step, and given the possibility of aggregation bias clouding the results, it would be pertinent to understand the behavior of the individual sectors to exchange rate depreciation. With respect to the disaggregate analysis, it is usually found that durable goods are more

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and upper bounds through a 95 percent confidence band. A cumulative sum between the critical values indicates stability of the model. If the model is stable, then we find the recursive estimates stabilizing at some level. On the other hand, if the recursive estimates do not stabilize over time or if there is a sharp break, then the coefficients are unstable.

sensitive to exchange rate changes than non-durable goods. (Burda & Gerlach, 1992).<sup>102</sup> However, Bahmani-Oskooee and Kovyryalova (2008) find that even within industries there are variations in the response to exchange rate changes, which suggests studying data at the commodity level.<sup>103</sup>

Given the lack of appropriate commodity level data for India, this section analyzes the exchange rate effect on trade balance for nine sectors based on the SITC one-digit classification data provided by the CSO. These sectors are food and food articles, beverages and tobacco, crude materials inedible except fuels, mineral fuels and lubricants, animal/vegetable oils and fats and waxes, chemicals and related products, classified manufacturing products, machinery and transport equipment, and miscellaneous manufactured goods (Annex 3.4 provides the commodities included in each sector).

As noted in section 4.2, the trade balance for food and live animals, beverages and tobacco, miscellaneous manufactured goods, and manufactured goods has been negative from April 2001 to March 2013. For crude materials inedible except fuels, India witnessed a deficit until 2007-08, after which there has been a surplus in the trade account of this sector. Machinery and transportation equipment has been in surplus throughout the period of study.

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<sup>102</sup> Burda and Gerlach (1992) define durable goods as capital goods, automobiles, consumer durables and durable industrial supplies.

<sup>103</sup> They find that within durable and non-durable goods there are variations in the impact of the exchange rate on the trade balance. For example, within non-durable goods, they find that fish and fish preparations witness a positive impact of the exchange rate depreciation on the trade balance in the long run, while for dairy products and eggs, they do not find a positive impact of the depreciation. Similarly, within durable goods, iron and steel castings has a positive impact of the depreciation on the trade balance while silver and platinum group metals does not.

The short-run and long-run coefficients of the estimation at the sectoral level are presented in Table 4.4. The short-run coefficients are significant only for crude and miscellaneous manufactured products, the only two sectors for which there has been a trade surplus. For crude, there is an initial improvement in the trade balance of the sector with a depreciation, and it remains so in the long run as well. On the other hand, for miscellaneous manufactured products there is a deterioration in the trade balance both in the short and long runs. For all the sectors, the negative and highly significant error correction term suggests that there is a long-run relation between REER and the trade balance and also that the adjustment among the variables of the model is towards their long-run equilibrium (Annex 4.4; col 3).

**Table 4.4 Sectoral Short-run and Long-run Coefficients using REER**

1	Short-run coefficients				Long-run coefficients		
	2	3	4	5	6	7	8
	REER t-1	REER t-2	REER t-3	REER t-4	REER	GDP	Foreign GDP
Food	-1.13	-1.45	-0.29	-2.26	-5.13	1.10	-11.81
Crude	-3.01***	-1.63	-1.01	-1.82	-7.48	2.05	-55.11
Mineral Fuels	1.79	0.82	-2.52	0.05	0.14	-4.13	-37.83
Animal and Vegetable Oils	-2.42	-2.17	-2.15	-2.07	-8.80	6.31	63.14
Chemicals	-0.26	-0.30	-0.81	-0.90	-2.25	8.74	103.52
Manufacturing	-0.60	-0.21	-2.66	-1.45	-4.92	3.08	42.55
Machinery & Transportation	-0.33	1.73**	-0.69	-1.22	-0.51	-2.04	-7.69
Miscellaneous Manufactured	5.18***	-5.35***	1.78	-0.83	0.77	-0.58	16.63

\*\*\* Significant at 1% level; \*\* Significant at 5% level; \* Significant at 10% level

#### **4.6.2.1 Diagnostic Checks for Sectoral Analysis**

The diagnostic tests are shown in Annex 4.4. The F statistics is greater than the critical value for most of the sectors, except for beverages and tobacco and animal and vegetable oils. For beverages and tobacco, the F statistic is below the 10 percent lower critical value as well, indicating that there is no cointegration among the variables for this sector. For animal and vegetable oils, the F-statistic is in the inconclusive zone. However, the lagged error term is negative and significant (0.191\*\*\*), suggesting cointegration and also justifying the inclusion of the lagged level variables in the model for this sector as well. Thus, the results are robust to the alternative specification. There is no serial correlation among the variables and the model is generally stable for all the sectors. However, for a few sectors we do observe that there is a specification issue which gets resolved when we change the lag structure, as was the case with the aggregate and bilateral country analysis.

#### **4.6.2.2 US Dollar Invoicing**

Since around 88 percent of India's exports and imports are invoiced in USD, as a robustness check, we compare the impact of the USD-INR bilateral exchange rate on the trade balance of the sectors.<sup>104</sup> Using the bilateral real USD-INR exchange rate, indicating an appreciation with an increase, we find that the coefficient of mineral fuels, 3.125, is significant at the 10 percent level of significance (Table 4.5). This implies that

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<sup>104</sup> As mentioned earlier in chapter 3, almost 90 percent of Indian imports and 86 percent of Indian exports are invoiced in USD, followed by Euro (6.5 and 7.6 respectively). Only around 1 % of Indian exports are invoiced in INR with none of the imports invoiced in INR as of 2005-06 (Arabi, ND).

with a depreciation there is a deterioration in the trade balance of mineral fuels both in the short and long runs. Mineral fuels include petroleum and petroleum products, coal and coke, as well as natural and manufactured gas (Annex 3.4). Petroleum products constitute more than one-third of the total imports of India, and the demand for these products is inelastic (Goyal, 2013d). The invoicing of the exports and imports of this sector is also in USD, which explains the deterioration of the trade balance for this sector. The results of the diagnostic tests are presented in Annex 4.5. The results also indicate that there is a long run relation between the USD-INR real exchange rate and the trade balance for these sectors based on the negative and significant coefficient of the error correction term.

**Table 4.5 Short-run and Long-run coefficients using USD-INR**

	Short-run coefficients				Long-run coefficients		
	USD-INR t-1	USD-INR t-2	USD-INR t-3	USD-INR t-4	Ln RER	Ln GDP	Ln Foreign GDP
Food	-0.727	-0.356	-0.593	-1.009	-2.684	1.228	-21.366
Crude	-0.664	0.653	-0.631	0.592	-0.051	2.078	-48.018
Mineral Fuels	3.125*	1.317	-1.555	2.171	5.058	-4.366	-48.651
Chemicals	-0.415	1.259	-1.313	-0.488	-0.957	9.275	119.367
Manufacturing	-0.530	0.286	-1.122	-0.677	-2.043	2.717	24.082
Machinery & Transportation	-0.659	0.709	-1.562	-2.196	-3.708	-1.471	-7.322
Miscellaneous Manufactured	1.621	-	1.563	2.652*	-2.597	-0.450	19.054

\*\*\* Significant at 1% level; \*\* Significant at 5% level; \* Significant at 10% level

#### **4.7. Conclusion and Policy Recommendations**

The purpose of this chapter is to examine the impact of an exchange rate depreciation on the trade balance. The results of this chapter suggest that there is an immediate positive impact of a depreciation on the trade balance at the aggregate trade level, which continues into the long run as well. These results indicate that in India, export quantities adjust fairly quickly as compared to imports in the short run, leading to an improvement on the trade account even in the short run. The results obtained are in contrast to some of the other studies on India, which did not find any impact of the real exchange rate depreciation on the trade balance.

Improvement in the trade balance with a depreciation in the short run takes place in India's trade at the aggregate level as well as in India's trade with Germany and Switzerland. Even though this improvement continues into the long run in trade with Germany, there is a deterioration in the long run for Switzerland. There is a long-run relationship between the trade balance and the real bilateral exchange rate for all the countries studied; however, there is no evidence of a J-curve effect in India's trade with any of the countries. Similarly, at the sectoral level, using REER, there exists a long run relation between the sectoral trade balance and the REER but observe the J-curve effect for none of the sectors. For crude, there is a significant positive impact of a depreciation in the short and long run, whereas for miscellaneous manufactured goods, there is a deterioration in the trade balance both in the short and long runs. Using the USD-INR exchange rate given the high share of USD invoicing in India trade, mineral fuels experience a deterioration in the trade balance in the short and long runs.

The findings in this chapter suggest some potentially important policy implications. First, given that there exists a long run relation between the real exchange rate and the trade balance for all the countries and sectors studied, the Indian government can rely on real exchange rate changes to help improve its trade balance and thereby the income flows in the country. Second, the study identifies which sectors respond favorably to a depreciation and which do not. This in turn may help formulate policy to improve the trade balance of the country (through targeted subsidy/tax policies) instead of relying on an overall depreciation to make Indian exports competitive and improve the trade balance for all the sectors. For instance, for the mineral fuels sector (which includes petroleum products), depreciation has a deteriorating impact both in the short and long runs, which suggests that the government cannot rely on depreciation to expect an improvement in the trade balance for this sector, which constitutes about one-third of Indian imports.

One issue that is relevant but has not been addressed in this chapter is the direction of causality for the Indian trade data. Do changes in the exchange rate cause the change in the trade balance or the other way round? This is an area of further research that is beyond the scope of this chapter.

## ANNEX

### Annex 1.1: Cointegration analysis of savings and investment

The cointegration between gross savings and gross investment is computed in this Annex. Gross investment is measured as the gross domestic capital formation (GDCF). Both the series are obtained at current prices and are divided by the nominal GDP at market prices. Annual data from 1950-51 to 2011-12, which are used for the analysis, have been obtained from the Handbook of Statistics on the Indian economy of the RBI (2013). The first step of the analysis is to test the stationarity of both the series.

**Table 1.1.1 Unit Root Tests of Stationarity**

Test	Test Statistic	Gross Domestic Saving (GDS)		Gross Domestic Capital Formation (GDCF)	
		Level I(0)	First Difference I(1)	Level I(0)	First Difference I(1)
ADF Test	t-statistic	-0.894	-6.573***	-0.782	-6.897***
PP Test	Adj t-stat	-0.854	-6.547***	-0.684	-6.864***
Critical Values					
ADF Test		1 %	-3.709	5%	-2.983
PP Test		1 %	-3.565	5%	-2.921

\*\*\* Significant at the 1% level

The unit root tests suggests that GDS and GDCF are non-stationary in levels, but stationary in first differences, i.e., integrated of the first order, I(1). Engel Granger cointegration tests can be applied to test for the short-run and long-run relationship between the variables as they are integrated in the same order. The test involves running an OLS regression between the two variables and then a unit root test on the residuals. If the residual is I (0), then GDS and GDCF are said to be cointegrated. A simple regression of the following form is undertaken:

$$\text{GDCF} = \alpha + \beta \text{GDS} + \varepsilon_t.$$

Regression of this equation gives the following results:

$$\text{GDGF} = 0.0008 + 1.045 \text{ GDS}$$

$$R^2 = 76.78$$

Taking the residual from this regression ( $\epsilon_t = \text{GDGF} - \alpha - \beta \text{GDS}$ ) and running the ADF test gives the following result: ADF test statistic for residual: -10.194\* (\* Significant at the 1% level).

These tests suggest that savings and investment are cointegrated as the residual is stationary in levels and that a long-run relationship exists between the two in the country. Given that these two are cointegrated, any policy that impacts the savings ratio in the country will also have an effect on the investment. The results indicate that for every unit increase in savings, investment increases by more than one unit, which suggests that the difference between investment and savings is met by capital inflows from abroad.

The next step is to run Granger causality tests to check the causation between savings and investment. The results of the Granger causality support the fact that savings Granger cause investment and that investment Granger causes savings.

**Table 1.1.2 Results of Granger Causality Tests**

Null Hypothesis	Chi-2 Statistic	Probability	Causal Relation
GDGF does not Granger cause GDS	9.531	0.002	GDGF → GDS
GDS does not Granger cause GDGF	7.022	0.008	GDS → GDGF

The above table suggests that both investment and savings granger cause each other. The next step is to investigate the relation between the two in the short run and the time it takes for the series to come back to a steady state path. To estimate the short-run relation, the following Engel-Granger error correction model is used:

$$\Delta \text{GDGF} = a + b \Delta \text{GDS} + c (\text{GDGF}_{t-1} - \alpha_{t-1} - \beta \text{GDS}_{t-1}) + \mu_t$$

where  $\Delta$  represents the first difference of the variables.

$b$  captures the short run impact of the GDS on the GDGF

$c$  is adjustment effect which shows how much of the effect is corrected each period.

$(\text{GDCF}_{t-1} - \alpha_{t-1} - \beta \text{GDS}_{t-1})$  is the error correction term.

OLS can be applied to this equation as the first differences of GDS and GDCF are stationary from the earlier unit root tests and the residual is also stationary. OLS regression gives the following result:

$$\text{GDCF} = 0.001 + 1.01\text{GDS} - 0.302 \varepsilon_{t-1}$$

$$R^2 = 78.4$$

The result suggests that in the short run, a one percent change in the savings leads to a one percent change in the investment. The negative sign of the speed of adjustment suggests that there is convergence taking place towards the long-run equilibrium. The coefficient -0.302 suggests that about 30 percent of the adjustment towards the long-run equilibrium takes place every year. And the other relation with the GDS as the dependent variable gives the following:

$$\text{GDS} = 0.003 + 0.756\text{GDCF} + 0.148 \varepsilon_{t-1}$$

The result suggests that in the short run, a one unit change in the investment leads to a 0.75 percent change in savings.

## Annex 1.2 Definition of the macroeconomic variables

<b>Variable</b>	<b>Definition</b>
Cash Reserve Ratio (CRR)	Cash Reserve Ratio is the proportion of the total deposits that banks are required to hold with the RBI.
Open Market Operations (OMO)	OMOs are the market operations conducted by the RBI through the sale and purchase of government securities to influence the rupee liquidity conditions in the market on a durable basis. When the RBI feels there is excess liquidity in the market, it resorts to sale of securities thereby sucking out the rupee liquidity. Similarly, when the liquidity conditions are tight, the RBI will buy securities from the market, thereby releasing liquidity into the market.
Statutory Liquidity Ratio (SLR)	The statutory liquidity ratio is the amount of the total demand and time liabilities that the banks are required to hold as liquid assets. The liquid assets can be in the form of cash, gold, or government and other approved securities.
Liquidity Adjustment Facility (LAF)	LAF is a facility extended by the Reserve Bank of India to the scheduled commercial banks (excluding RRBs) and primary dealers to avail of liquidity in case of requirement or park excess funds with the RBI in case of excess liquidity on an overnight basis against the collateral of government securities including state government securities.
Repo Rate	Repo or ready forward contract is an instrument for borrowing funds by selling securities with an agreement to repurchase the said securities on a mutually agreed future date at an agreed price that includes interest for the funds borrowed.
Reverse Repo Rate	The reverse of the repo transaction is called 'reverse repo,' which is lending of funds against buying of securities with an agreement to resell the said securities on a mutually agreed future date at an agreed price which includes interest for the funds lent.
91-day Treasury Bill	Treasury Bills are short-term debt obligations of the treasury/government, with maturities of one year or less. They are instruments issued at a discount to the face value and form an integral part of the money market. The 91-day Treasury Bill has a maturity of 91 days.
Weighted average call money rate	Call money rate is a rate at which scheduled commercial banks and primary dealers borrow and lend from each other in the call money market. The call money market is the market for uncollateralized lending and borrowing of funds and is predominantly overnight and open for participation only to scheduled commercial banks and the primary dealers.

Source: RBI Glossary of Important terms (<http://www.rbi.org.in/scripts/FAQView.aspx?Id=79#A5>)

### Annex 2.1: Studies on Interest rate pass-through for India

Paper Title	Author	Period of study	Countries Studied	Methodology	Results
The Emerging BRIC Economies: Evidence from the Interest Rate Transmission Mechanism	Karagiannis, Stelios, Yannis Panagopoulos and Prodromos Vlamis (2009)	1998: M1 to 2007: M9	BRICS	Disaggregated GETS model using a Non-linear least squares model	Complete pass-through in the long run; Only policy rate decreases are transmitted to the loan rates
The Interest Rate Channel of Monetary Transmission Mechanism in India: An Empirical Study	Pattnaik and Ramanathan (2007)	1997 Q1-2005 Q4	India		
Monetary Transmission in Asia: Is It Working	Guimarães and Ruiz-Arranz (2009)	2001-09	Australia, Indonesia, India, Japan, Korea, Malaysia, New Zealand, Philippines and Thailand	ARDL	Long run PT: 0.3; Time taken for complete PT: 1.2 months
South Asia and the Global Financial Crisis	Hattari et al. (2011)	Jan 2001-Oct 2009	India, Pakistan, Bangladesh and Sri Lanka	ARDL	Short run PT: 0.0 Long run PT: 0.3 Time taken for complete PT: 1.2 months

## Annex 2.2 First and second stage pass-through with TB Rate

### First Stage Pass-through with TB rate

(1)	(2)	(3)
Model	$\Delta 91\text{dayTB}_t = \alpha \Delta \text{repo}_t + \varepsilon$	$\Delta 91\text{dayTB}_t = \alpha \Delta \text{repo}_t + \gamma \Delta \text{crr}_t + \theta \Delta \text{repo} * \Delta \text{crr}_t + \varepsilon$
$\Delta \text{repo}$	0.714*** (0.238)	0.636** (0.262)
$\Delta \text{crr}_t$		0.564** (0.248)
$\Delta \text{repo} * \Delta \text{crr}$		0.542*** (0.324)
constant	0.004 (0.059)	-0.007 (0.059)
N	115	115
$R^2$	0.0734	0.1147

\*\* Significant at 5% level of significance

\*\*\* Significant at 1% level of significance

### Second Stage Pass-through with TB rate

(1)	(2)	(3)
Model	$\Delta r_t = \alpha \Delta 91\text{dayTB}_{t-1} + \varepsilon$	$\Delta r_t = \alpha \Delta 91\text{dayTB}_{t-1} + \beta \Delta \text{diffrr} + \varepsilon$
$\Delta \text{repo}$	0.045 (0.056)	0.035** (0.055)
$\Delta \text{diffrr}$		0.447** (0.248)
Constant	-0.029 (0.036)	-0.026 (0.036)
N	114	114
$R^2$	0.0058	0.053

\*\* Significant at 5% level of significance

## Annex 2.3 Unit root tests and Lag selection criteria

### a. ADF and Zivot Andrews Test for Factors Affecting Pass-through

<i>Variable</i>	<i>ADF</i>		<i>Zivot-Andrews<sup>#</sup></i>	
	<i>Levels</i>	<i>First Difference</i>	<i>Levels</i>	<i>First Difference</i>
GDP growth	-1.251	-20.41***	-4.698	-6.704*** #
Inflation Rate	-1.583	-9.341***	-3.352	-9.443***
Credit-deposit ratio	0.7671	-11.705***	-3.836	-5.229**
Bank deposit-GDP	-2.279	-3.992*** #	-3.317	-7.320*** #
Bank Concentration	5.056	-5.119*** #	-2.032	-4.940**
Cost to Income ratio	-5.240***		-4.317*	
Portfolio diversification	-0.568	-2.856** #	-5.186**	-7.678*** #
Non-performing assets	-7.856***		-2.468	-5.866***
Private credit to GDP	-1.544	-4.341***	-3.651	-4.925**
Bank Ownership	-6.140***		-6.676***	
<b>Critical Values</b>				
1% level	-3.505		-5.43	
5% level	-2.889		-4.80	

# Stationary at a higher difference than the first difference

\*\*\* Significant at 1%; \*\* Significant at 5%; \* Significant at 10%.

## b. Lag Order Selection

LL: log likelihood; LR: Likelihood ratio; AIC: Akaike's information criterion;  
SBIC: Schwarz's Bayesian information criterion; HQIC: Hannan and Quinn information criterion

### *GDP growth*

Lag	LL	LR	AIC	HQIC	SBIC
0	-247.75		4.44	4.45	4.47
1	-13.51	468.49	0.28	0.3	0.33
2	214.66	456.33	-3.78	-3.75	-3.71
3	400.49	371.67	-7.08	-7.04	-6.98
4	451.77	102.55*	-7.97*	-7.92*	-7.85*

### *Inflation rate*

Lag	LL	LR	AIC	HQIC	SBIC
0	-511.16		9.15	9.16	9.17
1	-162.07	698.17*	2.92*	2.94*	2.97*
2	-161.11	1.93	2.93	2.96	3.00
3	-161.07	0.07	2.95	2.99	3.04
4	-160.91	0.33	2.96	3.01	3.08

### *Credit-deposit Ratio*

Lag	LL	LR	AIC	HQIC	SBIC
0	-392.58		7.03	7.04	7.05
1	-165.01	455.15	2.98	3.00	3.03
2	-163.86	2.30	2.98	3.01	3.05
3	-163.41	0.90	2.99	3.03	3.09
4	-157.16	12.488*	2.89*	2.94*	3.01*

### *Bank deposit to GDP*

Lag	LL	LR	AIC	HQIC	SBIC
0	-330.31		5.92	5.93	5.94
1	33.49	727.60	-0.56	-0.54	-0.51
2	283.30	499.62	-5.01	-4.98	-4.93
3	494.88	423.15	-8.77	-8.73	-8.67
4	524.45	59.14*	-9.27*	-9.22*	-9.15*

*Bank concentration*

Lag	LL	LR	AIC	HQIC	SBIC
0	-199.22		3.58	3.59	3.60
1	126.55	651.54	-2.22	-2.20	-2.18
2	339.63	426.15	-6.01	-5.98	-5.94
3	549.72	420.2*	-9.75	-9.70*	-9.64*
4	550.90	2.36	-9.74*	-9.70	-9.63

*Cost to income ratio*

Lag	LL	LR	AIC	HQIC	SBIC
0	-315.01		5.64	5.65	5.67
1	-10.46	609.11	0.22	0.24	0.27
2	244.25	509.42	-4.31	-4.28	-4.24
3	423.07	357.63	-7.48	-7.44	-7.39
4	481.90	117.67*	-8.51*	-8.46*	-8.39*

*Portfolio diversification*

Lag	LL	LR	AIC	HQIC	SBIC
0	-292.48		5.24	5.25	5.27
1	-27.19	530.58	0.52	0.54	0.57
2	223.79	501.97	-3.94	-3.91	-3.87
3	394.39	341.19	-6.97	-6.93	-6.87
4	475.99	163.2*	-8.41*	-8.36*	-8.28*

*Non-performing assets*

Lag	LL	LR	AIC	HQIC	SBIC
0	-294.50		5.28	5.29	5.30
1	-56.98	475.03*	1.05*	1.07*	1.10*
2	-56.88	0.19	1.07	1.10	1.14
3	-56.78	0.21	1.09	1.12	1.18
4	-56.67	0.23	1.10	1.15	1.22

*Bank Ownership*

Lag	LL	LR	AIC	HQIC	SBIC
0	-208.86		3.75	3.76	3.77
1	76.45	570.61	-1.33	-1.31	-1.28
2	301.05	449.21	-5.32	-5.29	-5.25
3	473.95	345.79	-8.39	-8.35	-8.29
4	509.04	70.188*	-9.00*	-8.95*	-8.87*

*Private credit to GDP*

Lag	LL	LR	AIC	HQIC	SBIC
0	-360.27		6.45	6.46	6.48
1	80.13	880.80	-1.40	-1.38	-1.35
2	307.31	454.36	-5.43	-5.40	-5.36
3	523.74	432.86	-9.28	-9.24	-9.18
4	540.55	33.61*	-9.56*	-9.51*	-9.44*

## **Annex 2.4: Case studies: Korea and Thailand**

### **Korea government bond market development (Based on Government Bond Market Development: The Korean Experience)<sup>105</sup>**

The development of Korean bond market was influenced by the financial repression carried out by the government, whereby the banks were forced to hold government bonds at the administered interest rates. Until the Asian Financial Crisis (AFC), the issuance of government bonds in Korea was a form of a taxing mechanism rather than borrowing from the market. Even though this way of forcing the banks to hold government bonds provided low-cost resources to the government, it did not help the development of the bond market and distorted the interest rate structure. Development of this market was limited, and it could not play any role in the financial market development or in the macroeconomic policies.

Recognizing the need for the development of the government bond market for the overall financial market development, the Korean government initiated a series of reforms even prior to the AFC in the early 1990s. Steps were undertaken to improve the primary and the secondary markets along with the institutional and structural infrastructure. There was a move towards a market-determined interest rate structure from an administered interest rate structure. And there were also efforts to increase the liquidity and depth of the government bond market. New instruments were introduced along with the primary dealer system, the electronic trading and settlement infrastructure. These efforts transformed the government bond market in Korea and elevated it to a par with the financial markets of some of the more-developed countries.

Some of the important lessons that developing countries can draw from the Korean experience are as follows: the government bond market has to be in line with the economic development process. This is because the demand for the government bonds changes along with the level of economic development. The Korean experience also suggests that a country needs some prerequisites to developing the government bond market which include, but are not limited to, sound fiscal and monetary policies,

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<sup>105</sup> Based on Rhee (2013)

developed financial systems, and an effective regulatory infrastructure. Another important lesson is the role for the government in the bond market development. The Korean government issued new bonds along with activating and monitoring the market transactions as well as integrating wide ranging policies into an organized framework to modernize the government bond market.

**Thailand Bond Market Development (Based on Development of the Thai Bond market)<sup>106</sup>:**

Unlike in the Korean case, where the government bonds were held even prior to the AFC, the bond markets--both government and corporate--were relatively underdeveloped in Thailand. Prior to the AFC, the commercial banks were responsible for most of the financial intermediation. There was a limited supply of government bonds, which prevented the development of a risk-free benchmark for the market and issuers to price corporate bonds. The AFC brought these problems to the fore, particularly through the liquidity crunch the countries faced during the crisis, as banks were wary of lending money, which led to an increase in the share of non-performing loans. This had an impact on businesses in Thailand, which lost their regular channels of finance, thereby aggravating the economic slowdown caused by the AFC.

The impact of the crisis led the authorities to undertake extensive steps to improve the financial system of the country. The focus mostly was on improving the bond market, “partly because of the necessity of funding the financial sector restructuring and partly as an alternative funding source to reduce reliance on bank intermediation. In addition to the efficiency gain expected from increased competition for funding, a more developed bond market would also provide the economy with a more balanced financial infrastructure, thereby diversifying the risk of intermediation across a large number of

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<sup>106</sup> Based on Chabchitichaidol, Akkharaphol, and O. Permpoon (2002)

institutions and market players.(Chabchitrchaidol & Permpoon, 2002, p. 190)

Within the bond markets, the focus was on the government bond market for the development of the overall bond market. One of the first things the Thai government did was to build the government bond yield curve and enhance the secondary market liquidity. With the improvement in the government bond market along with increased activity in the secondary market, the government bond yield curve became an indicator of the financial market conditions and market sentiment. Developing bond markets helped the Bank of Thailand (BOT) move away from direct instruments of operations (such as reserve requirements, interest rate ceilings, and credit controls) towards the use of market-based instruments such as open-market operations. With well-developed (deeper and more liquid) capital markets, the development of a repo market facilitated the use of more indirect instruments of monetary policy. In addition, the credibility of monetary policy operations was also enhanced by the development of the bond markets. This is because bond yields respond more rapidly to changes in the policy rate, improving the signaling effect of monetary policy.

Another important effect of bond market development, which draws from the other effects mentioned above, is the improvement in the monetary policy transmission through the interest rate channel. With development of the bond markets, the central bank can improve monetary policy efficiency in the country particularly under an inflation targeting regime by imposing an initial margin as well as marking collateral to market. And as additional sources of finance become available with the market developments, the corporate sector can also maintain access to funds even if the banking sector is impaired.

**Annex 3.1: Percentage share in Indian exports**

	<b>2000-01</b>	<b>2009-10</b>	<b>2010-11</b>	<b>2011-12</b>	<b>2012-13 (Apr-Nov)</b>
I Primary products	16	14.9	13.2	15.2	16
(a) Agri. & allied products	14	10	9.7	12.4	14
(b) Ores and minerals	2	4.9	3.4	2.8	2
II Manufactured goods	78.8	67.2	69	66.1	64.5
(a) Textiles incl. RMG	23.6	10.5	9.1	8.7	8.7
(b) Gems & jewelry	16.6	16.2	16.1	14.7	15.4
(c) Engineering goods	15.7	18.2	19.8	19.2	19.3
(d) Chemicals and related products	10.4	12.8	11.5	12.2	13.7
(e) Leather & leather manufactures	4.4	1.9	1.6	1.6	1.7
(f) Handicrafts including carpet handmade	2.8	0.5	0.5	0.4	0.4
III Petroleum, crude and products	4.3	15.8	16.5	18.3	18.6
Total exports	100	100	100	100	100

Source: Economic Survey of India 2012-13

### Annex 3.2 Summary of studies on ERPT for India

Title of Study	Authors	Details of study	Methodology	Major Conclusion
How high is exchange rate pass-through in India? Has it changed over time?	Ghosh and Rajan (2007b)	ERPT into CPI (1980-2005)	Error Correction Model	EPRT into India's CPI: between 40-45 %; bilateral USD-INR movements more impact than NEER on pass-through
Exchange rate pass-through in India	Bhattacharya et al. (2008)	ERPT into CPI and WPI. (1997m9 – 2007m10)	VAR	10% change in exchange rate: CPI: 1-1.1 % short run 0.3-1.% long run WPI: 1.36 % short run 2.86% long run
Exchange rate pass-through and its impact on inflation: A comparative study for Australia, China and India with disaggregated data	Saha and Zhang (2012)	ERPT into import prices, CPI and WPI. (1990m1 – 2011m3)	VAR	Depreciation of Indian rupee reduces import prices but raises CPI.
Economic reforms and exchange rate pass-through to domestic prices in India	Khundrakpam (2007)	ERPT into WPI (1991m8: 2005m3)		Pass-through to WPI: Short run: 0.063 Long run: 0.09
Exchange rate pass-through in India – An exploration with sectoral import prices	Pyne and Roy (2008)	ERPT into import prices (1991-92 to 2005-06)	Panel regressions	Incomplete pass-through to import prices at 65%; Significant coefficient only for chemicals
Exchange rate pass-through: How much do exchange rate changes affect the prices of Indian exports	Dash and Narsimham (2011)	ERPT into import and export prices (1993Q2: 2004Q3)	Error Correction Model	More than complete pass-through to import prices. (Coefficient: 1.7) Incomplete pass-through by Indian exporters.

and imports				
Exchange rate pass-through and volatility: Impact on Indian foreign trade	Dholakia and Raveendra (2000)	ERPT into import and export prices; (1980-1996)	Partial adjustment model (special case of ARDL)	Complete pass-through to import prices; Complete pass-through by Indian exporters only after 1991.
Sectoral exchange rate pass-through: testing the impact of policy reforms in India	Mallick and Marques (2006)	PTM in Indian export and import prices; (1980-2001)	Panel estimation and Seemingly Unrelated Regressions	Pass-through to import prices declined in 1990s while that to export prices increased; sectors exhibiting ERPT to export prices increased to 6 in 1990s from 3 in 1980s.
Pass-through of exchange rate and tariffs into import prices of India: currency depreciation versus import liberalization	Mallick and Marques (2008c)	ERPT and tariff rate pass-through into import prices (1990-2001)	Feasible generalized least squares (FGLS)	ERPT significant and complete in 12 of 38 industries; TRPT significant in six industries. Sectoral differences due to sector's share in total imports and the sector's effective protection rate
Exchange Rate transmission into industry-level export prices: A tale of two policy regimes in India	Mallick and Marques (2008a)	PTM in export prices (1980-2001)	FGLS	Pass-through to export prices increased in 1990s compared to 1980s.
Exchange rate pass-through in India's exports to developed and emerging markets	Mallick and Marques (2008b)	PTM in export prices (1992-2005); G3 and BRIC countries	FGLS	Incomplete ERPT to export prices from India for G3 countries (USA, Japan & UK) and BRIC economies. Pass-through to export prices: 18 percent for all countries, 30 percent for developed and zero for emerging markets.

Data frequency and exchange rate pass-through: Evidence from India's exports	Mallick and Marques (2010)	PTM in export prices; (1992-2006 for annual and 1996-2001 for monthly data)	Dynamic fixed effects model.	Higher frequency data more likely to find incomplete pass-through in the short run. Long run: incomplete pass-through in few industries at both frequencies
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### Annex 3.3 Lag length selection

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	503.061				2.70E-09	-8.387	-8.349	-8.294
1	1171.67	1337.2	16	0.000	4.60E-14	-19.355	-19.16	-18.888*
2	1202.11	60.873	16	0.000	3.60E-14	-19.598	-19.25	-18.757
3	1224.19	44.153	16	0.000	3.30E-14	-19.700	-19.20	-18.486
4	1259.93	71.494*	16	0.000	2.4e-14*	-20.032*	-19.38*	-18.444

LL: log likelihood; LR: Likelihood ratio

AIC: Akaike's information criterion; SBIC: Schwarz's Bayesian information criterion

HQIC: Hannan and Quinn information criterion

### Annex 3.4: Sectors for computation of ERPT

S.No.	Sector	Industries included
1	Food & food products	<ul style="list-style-type: none"> <li>• Live animals other than animals of division 03</li> <li>• Meat and meat preparations</li> <li>• Dairy products and birds' eggs</li> <li>• Fish (not marine mammals), crustaceans, molluscs and aquatic invertebrates, and preparations thereof</li> <li>• Cereals and cereal preparations</li> <li>• Vegetables and fruit</li> <li>• Sugars, sugar preparations and honey</li> <li>• Coffee, tea, cocoa, spices, and manufactures thereof</li> <li>• Feeding stuff for animals (not including un-milled cereals)</li> <li>• Miscellaneous edible products and preparations</li> </ul>
2	Beverages & Tobacco	<ul style="list-style-type: none"> <li>• Beverages</li> <li>• Tobacco and tobacco manufactures</li> </ul>
3	Crude Materials inedible except fuels	<ul style="list-style-type: none"> <li>• Hides, skins and furskins, raw</li> <li>• Oil-seeds and oleaginous fruits</li> <li>• Crude rubber (including synthetic and reclaimed)</li> <li>• Cork and wood</li> <li>• Pulp and waste paper</li> <li>• Textile fibres (other than wool tops and other combed wool) and their wastes (not manufactured into yarn or fabric)</li> <li>• Crude fertilizers, other than those of division 56, and crude minerals (excluding coal, petroleum and precious stones)</li> <li>• Metalliferous ores and metal scrap</li> <li>• Crude animal and vegetable materials, n.e.s</li> </ul>
4	Mineral fuels & lubricants	<ul style="list-style-type: none"> <li>• Coal, coke and briquettes</li> <li>• Petroleum, petroleum products and related materials</li> <li>• Gas, natural and manufactured</li> <li>• Electric current</li> </ul>
5	Animal/vegetable oils & fats & waxes	<ul style="list-style-type: none"> <li>• Animal oils and fats</li> <li>• Fixed vegetable fats and oils, crude, refined or fractionated</li> <li>• Animal or vegetable fats and oils, processed; waxes of animal or vegetable origin; inedible mixtures or preparations of animal or vegetable fats or oils, n.e.s.</li> </ul>
6	Chemicals & related products	<ul style="list-style-type: none"> <li>• Organic chemicals</li> <li>• Inorganic chemicals</li> <li>• Dyeing, tanning and colouring materials</li> <li>• Medicinal and pharmaceutical products</li> </ul>

		<ul style="list-style-type: none"> <li>• Essential oils and resinoids and perfume materials; toilet, polishing and cleansing preparations</li> <li>• Fertilizers (other than those of group 272)</li> <li>• Plastics in primary forms</li> <li>• Plastics in non-primary forms</li> <li>• Chemical materials and products, n.e.s.</li> </ul>
7.	Classified manufactured goods	<ul style="list-style-type: none"> <li>• Leather, leather manufactures, n.e.s., and dressed furskins</li> <li>• Rubber manufactures, n.e.s.</li> <li>• Cork and wood manufactures (excluding furniture)</li> <li>• Paper, paperboard and articles of paper pulp, of paper or of paperboard</li> <li>• Textile yarn, fabrics, made-up articles, n.e.s., and related products</li> <li>• Non-metallic mineral manufactures, n.e.s.</li> <li>• Iron and steel</li> <li>• Non-ferrous metals</li> <li>• Manufactures of metals, n.e.s.</li> </ul>
8.	Machinery & transport equipment	<ul style="list-style-type: none"> <li>• Power-generating machinery and equipment</li> <li>• Machinery specialized for particular industries</li> <li>• Metalworking machinery</li> <li>• General industrial machinery and equipment, n.e.s., and machine parts, n.e.s.</li> <li>• Office machines and automatic data-processing machines</li> <li>• Telecommunications and sound-recording and reproducing apparatus and equipment</li> <li>• Electrical machinery, apparatus and appliances, n.e.s., and electrical parts thereof (including non-electrical counterparts, n.e.s., of electrical household-type equipment)</li> <li>• Road vehicles (including air-cushion vehicles)</li> <li>• Other transport equipment</li> </ul>
9.	Miscellaneous manufactured goods	<ul style="list-style-type: none"> <li>• Prefabricated buildings; sanitary, plumbing, heating and lighting fixtures and fittings, n.e.s.</li> <li>• Furniture, and parts thereof; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings</li> <li>• Travel goods, handbags and similar containers</li> <li>• Articles of apparel and clothing accessories</li> <li>• Footwear</li> <li>• Professional, scientific and controlling instruments and apparatus, n.e.s.</li> <li>• Photographic apparatus, equipment and supplies and optical goods, n.e.s.; watches and clocks</li> <li>• Miscellaneous manufactured articles, n.e.s.</li> </ul>

**Annex 3.5 Unit root results for sectors**

	<b>Level</b>	<b>First difference</b>
Food and Live Animals	-1.433	-16.244
Beverages and Tobacco	-0.767	-3.447
Crude	-4.648	-16.066
Mineral Fuels	-2.195	-9.399
Animal and Vegetable Oils	-0.332	-9.439
Chemicals and Related Products	-0.815	-6.574
Manufactured Goods	-2.972	-8.816
Machinery and Transportation	-0.689	-9.273
Miscellaneous Manufactured Goods	-2.243	-11.566
<b>Critical Values</b>		
1%	-3.503	
5%	-2.889	

#### Annex 4.1 J-curve studies on India

Paper Title	Author	Period of study	Countries Studied	Methodology	Results
Exchange rates and the trade balance: Some evidence from developing countries	Rose (1990)	1970-88: annual and quarterly data	30 developing countries	Error correction models	No relation between exchange rate and trade balance
Testing J-Curve hypothesis and analyzing the effect of exchange rate volatility on the balance of trade in India	Singh (2004)	1972 Q2 to 1996 Q3	India	Error correction models/ GARCH	No J-curve
Do devaluations improve the trade balance? The evidence revisited	Himarios (1989)	1953-73 annual data; 1975Q1: 1984:Q4	Colombia, Costa Rica, Ecuador, Finland, France, Ghana, Iceland, India, Israel, Korea, Peru, Philippines, Spain, Sri Lanka, UK Indonesia, Italy, Mexico, Norway, South Africa, Sudan, Thailand, Zambia	OLS and two-stage least squares	Positive impact of depreciation on the trade balance
Bilateral J-curve between India and her trading partners	Arora et al (2003)	1977 Q1 to 1998 Q4	India with 7 trade partners (Australia, Germany, Italy, Japan, US	ARDL	No Short run impact of exchange rate on trade balance; Long run

					impact for Australia, Germany, Italy, Japan but not for US.
Devaluation and the J-curve: Some evidence from LDCs	Bahmani-Oskooee (1985)	1973–1980	Greece, India, Thailand and Korea	Distributed lag model imposing Almon lag structure on the exchange rate	Deterioration in the short run and positive impact on trade balance in long run.
More evidence on the J-curve from LDCs	Bahmani-Oskooee and Malixi (1992)	1973 Q1 – 1985 Q4	Brazil, India, Greece, Pakistan, Egypt, Korea, Mexico, Philippines, Peru, Portugal, Thailand, Turkey Dominican republic	Distributed lag model imposing Almon lag structure on the exchange rate	Short run effect may not follow a set pattern but favorable impact in the long run
US bilateral nominal trade balance with India, Japan, Malaysia, S. Korea and Thailand, and bilateral nominal exchange rate dynamics: Evidence on J-curve?	Mustafa and Rahman (2008)	Jan 1985 - May 2005	US, India, Japan, Malaysia, South Korea and Thailand	Error correction model	No short run impact for India; Long run impact present
The J-curve phenomenon: myth or reality? – An analysis for India	Napgal (2010)	1992-2009 monthly data	India with US, UK and Japan	Cointegration tests, impulse response function and VAR/VEC models	No J – curve for India. Positive long run relation in India’s trade with

					US
India's trade with USA and her trade balance: An empirical analysis.	Tiwari and Shahbaz (2011)	1965-2008	India trade with US	Cointegration tests, impulse response function and variance decomposition	J-curve effect at a disaggregated level for India's trade with the US
The J-curve at the industry level: Evidence from U.S.-India trade	Bahmani-Oskooee and Mitra (2009)	1962-2006	India trade with US; 34 industries	Pesaran et al. (2001) bounds testing approach	J-curve effect for 8 industries; for 22 industries short run deteriorating impact of exchange rate on trade balance.

**Annex 4.2 Diagnostic tests on aggregate and bilateral trade using REER**

1	2	3	4	5	6	7
	F stat	ECM Statistic	RESET (H0: Model has no omitted variables)	LM test <sup>#</sup>	CUSUM	CUSUMSQ
Aggregate	7.26	-.760***	1.09	0.056	S	S
Germany <sup>#</sup>	4.56	-.545***	5.52***	2.765*	S	U
Saudi Arabia <sup>#</sup>	4.32	-.225***	11.75***	0.074	S	S
Singapore	2.42	-.313***	0.26	1.024	S	S
Switzerland	6.32	-.848***	1.92	5.144**	S	S
USA	3.28	-.474***	1.00	0.713	S	S

\*\*\* Significant at 1% level; \*\* Significant at 5% level; \* Significant at 10% level

### Annex 4.3 Analysis using asymmetric lag lengths

**Table 4.3.1 Short-run and Long-run coefficients**

		USA	Switzer-land	Saudi Arabia	Germany	Singapore	Aggregate
Short run coefficients	$\Delta \text{Lnrrer}_{t-1}$	-0.172	-3.478*	1.558	-1.083**	0.550	-1.39***
	$\Delta \text{Lnrrer}_{t-2}$	1.150		-0.568	-0.485	-1.783	-0.092
	$\Delta \text{Lnrrer}_{t-3}$	-0.225		0.673		-3.251	-0.355
	$\Delta \text{Lnrrer}_{t-4}$	-0.044		-1.246		-3.609*	0.099
	$\Delta \text{Lnrrer}_{t-5}$	0.391		1.118			0.294
	$\Delta \text{Lnrrer}_{t-6}$	-0.649		-2.759			0.549
	$\Delta \text{Lnrrer}_{t-7}$	0.669		-1.154			0.545
	$\Delta \text{Lnrrer}_{t-8}$						1.171*
	$\Delta \text{Lnrrer}_{t-9}$						-0.168
Long run coefficients	REER	0.709	-3.478	0.417	-1.568	-8.094	-1.741
	GDP	-7.463	-12.969	26.578	6.988	17.490	-4.879
	WGDP	47.111	-9.351	-9.142	-14.073	3.747	27.144
	Constant	69.33***	-8.811	-75.07*	-8.642	-7.165	67.337*

\*\*\* Significant at 1% level; \*\* Significant at 5% level; \* Significant at 10% level

**Table 4.3.2 Diagnostic Tests for Asymmetric Lag length Regressions**

	F stat	ECM Statistic	RESET (H0: Model has no omitted variables)	LM test <sup>#</sup>	CUSUM	CUSUMSQ
Aggregate	3.76	-.755***	0.34	4.938**	S	S
Germany	5.82	-.494***	0.72	0.348	S	U
Saudi Arabia	3.08	-.188**	13.01***	0.133	S	S
Singapore	3.20	-.429***	0.10	0.510	S	S
Switzerland	13.41	-.864***	0.90	9.78***	S	S
USA	3.87	-.865***	0.47	2.951	S	S

\*\*\* Significant at 1% level; \*\* Significant at 5% level; \* Significant at 10% level

#### Annex 4.4 Diagnostics: Sectoral trade using REER

1	2	3	4	5	6	7
	F stat	ECM Statistic	RESET (H0: Model has no omitted variables)	LM test <sup>#</sup>	CUSUM	CUSUMSQ
Food	9.52	-.607***	0.56	0.139	S	S
Beverages	2.23	-.116***	19.16***	0.457	S	S
Crude	8.38	-.451***	0.34	0.000	S	S
Mineral Fuels	5.90	-.750***	37.23***	0.053	S	U
Animal and vegetable Oils	3.05	-.191***	0.39	0.685	S	S
Chemicals	3.98	-.138**	18.87***	1.780	S	U
Manufacturing	6.22	-.636***	2.41*	0.000	S	S
Machinery and Transportation	5.24	-.407***	11.22***	0.469	S	S
Miscellaneous Manufactured	4.32	-.404***	53.63***	0.000	S	U

\*\*\* Significant at 1% level; \*\* Significant at 5% level; \* Significant at 10% level

#### Annex 4.5 Diagnostics for the sectoral estimation using USD-INR

1	2	3	4	5	6	7
	F stat	ECM Statistic	RESET (H0: Model has no omitted variables)	LM test <sup>#</sup>	CUSUM	CUSUMSQ
Food	9.68	-.663***	0.61	2.962*	S	S
Beverages	2.48	-.145***	19.45***	0.906	S	S
Crude	5.72	-.417***	0.10	0.444	S	S
Mineral Fuels	6.83	-.810***	55.78***	0.014	S	U
Animal and vegetable Oils	1.87	-.154***	1.19	3.372*	S	S
Chemicals	5.42	-.209***	20.73***	1.048	S	U
Manufacturing	4.13	-.554***	3.18**	0.03	S	S
Machinery and Transportation	7.23	-.524***	14.89***	0.445	S	S
Miscellaneous Manufactured	4.48	-.544***	33.27***	0.077	S	U

\*\*\* Significant at 1% level; \*\* Significant at 5% level; \* Significant at 10% level

## REFERENCES

- Acharya, N. (2013). "India's Current Account Deficit Narrows." *The Wall Street Journal*. Accessed on December 17, 2012.
- Ahmad, J. and J. Yang, (2004). "Estimation of the J-curve in China." East-West Center Working Papers, Economic Series No. 67. East-West Center.
- Annunziata, M. (2013). "India and the Emerging Market crisis." Voxeu. (<http://www.voxeu.org/article/india-and-emerging-market-crisis>)
- Ansari, J. (2013). "A Theoretical and Empirical Analysis of Interest rate pass-through in India with Regulatory Requirements." *Beykent University Journal of Social Sciences*. Vol. 6. Issue 2. pp 83-104.
- Apostoaie, M. C. (2012). "The Interest Rate Pass-Through from Policy Rates to Interbank Interest Rates in the Romanian Financial System." ([http://www.bursedoctorale.ro/public/documente/conferinte/1345715554\\_articol\\_Articol\\_conf\\_Apostoaie\\_Marius\\_SD\\_FEAA\\_Martie2012.pdf](http://www.bursedoctorale.ro/public/documente/conferinte/1345715554_articol_Articol_conf_Apostoaie_Marius_SD_FEAA_Martie2012.pdf))
- Arabi, U. (2008). "Foreign Exchange Market Behavior and its Management in the post-reform period: the Indian experience." IGIDR. Accessed at [http://www.igidr.ac.in/money/mfc\\_10/Arabi%20U\\_submission\\_19.pdf](http://www.igidr.ac.in/money/mfc_10/Arabi%20U_submission_19.pdf)
- Arndt, S.W. (2009). "Fragmentation." in *The Princeton Encyclopedia of the World Economy*, Vol.ume 1 edited by Kenneth A. Reinert & Ramkishen S. Rajan. Princeton University Press. pp 498-502.
- Arndt, S.W. and A. Huemer. (2006). "Trade, Production Networks and the Exchange Rate." Paper presented at the APEA conference. (<http://www.apeaweb.org/confer/sea06/papers/arndt-huemer.pdf>)
- Arora, S., M. Bahmani-Oskooee, and G. Goswami. (2003). "Bilateral J-Curve between India and her Trading Partners." *Applied Economics*. Vol. 35. No 9. pp 1037-1041.
- Athukorala, P., and J. Menon. (1994). "Pricing to Market Behaviour and Exchange Rate Pass-Through in Japanese Exports". *The Economic Journal* 104, No. 423: 271–281.

- Aydin, H. I. (2007). "Interest Rate Pass-Through in Turkey." Research and Monetary Policy Department. The Central Bank of the Republic of Turkey Working Paper No 07/05.
- Backus, D. K. (1993). "Hysteresis in Perspective: A Discussion of Dixit's "Hysteresis and the Durations of the J-Curve." Working Paper No. 93-16. Leonard N. Stern School of Business, Department of Economics. New York University.
- Bahmani-Oskooee, M. (1985). "Devaluation and the J-Curve: Some Evidence from LDCs." *The Review of Economics and Statistics*. Vol. 67, No. 3. pp. 500-504.
- Bahmani-Oskooee, M. (1989). "Devaluation and the J-Curve: Some Evidence for LDCs: Errata." *The Review of Economics and Statistics*. Vol. 71. No. 3. pp 553-54.
- Bahmani-Oskooee, M. and J. Alse. (1994). "Short-Run versus Long-Run Effects of Devaluation: Error-Correction Modeling and Cointegration" *Eastern Economic Journal*. Vol. 20. No. 4. pp 453-464.
- Bahmani-Oskoe, M. and M. Hajilee (2012). "German-US commodity trade: is there a J-curve effect?", *Applied Economics Quarterly*, Vol.58, No.4, pp.327-353.
- Bahmani-Oskooee, M. and A.M. Kutan. (2009). "The J-curve in the emerging economies of Eastern Europe." *Applied Economics*. Vol. 41. Issue 20. pp 2523-2532.
- Bahmani-Oskooee, M. and M. Kovyryalova. (2008). "The J-Curve: Evidence from Industry Trade Data between US and UK." *Economic Issues*. Vol. 13. Part 1. pp 25-44
- Bahmani-Oskooee, M. and M. Malixi. (1992). "More Evidence on the J-Curve from LDCs" *Journal of Policy Modeling*. Vol. 14. No. 5. pp 641-653.
- Bahmani-Oskooee, M. and R. Mitra. (2009). "The J-Curve at the Industry Level: Evidence from U.S.-India Trade." *Economics Bulletin*. Vol. 29. No. 2. pp. 1520-1529.
- Bahmani-Oskooee, M. and A. Ratha. (2004). "The J-Curve: A Literature Review", *Applied Economics*. Vol. 36, No. 12. pp 1377-1398.
- Balakrishnan, P. and M. Parameswaran (2007). "Understanding Economic Growth in India: A Prerequisite." *Economic and Political Weekly*, Vol. 42, No 27/28 pp 2915-2922.
- Baldwin, R. and P. Krugman (1989). "Persistent Trade Effects of Large Exchange Rate Shocks." *Quarterly Journal of Economics*, Vol. 104. No. 4. pp 635-54.
- Baldwin, R. (1988). "Hysteresis in Import Prices: The Beachhead Effect." *American Economic Review*. Vol. 78. No. 4. pp 773-85.

Banerjee, A.V., S. Cole and E. Duflo. (2004). "Banking Reform in India." India Policy Forum 2004. Brookings Institute and NCAER.  
([http://www.brookings.edu/~media/research/files/articles/2004/3/india%20policy%20forum/2004\\_banerjee\\_cole\\_duflo.pdf](http://www.brookings.edu/~media/research/files/articles/2004/3/india%20policy%20forum/2004_banerjee_cole_duflo.pdf))

Bhattacharya, R., I. Patnaik, and A. Shah. (2008), "Exchange Rate Pass-through in India." *National Institute of Public Finance and Policy*, New Delhi. March 27, 2008  
([http://macrofinance.nipfp.org.in/PDF/sl\\_0211\\_bhattacharya.pdf](http://macrofinance.nipfp.org.in/PDF/sl_0211_bhattacharya.pdf)).

Bhattacharya, R., I. Patnaik and A. Shah. (2011). "Monetary Policy Transmission in an Emerging Market Setting." IMF Working Paper No. 5.

Bhaumik S.K., V. Dang and A.M. Kutan. (2010), "Implication of Bank Ownership for the Credit Channel of Monetary Policy Transmission: Evidence from India", University of Michigan, William Davidson Institute Working Paper No. 988, May.

Bosworth, B., S.M.Collins and A.Virman. (2006). "Sources of Growth in the Indian Economy." Paper presented at India Policy Forum 2006-07, New Delhi, India.

Burda M. C. and S. Gerlach.(1992). "Intertemporal Prices and the U.S. Trade Balance" *American Economic Review*. Vol. 82. pp. 1234-1253.

Burnstein, A., B. Eichenbaum. and S. Rebelo. (2002). "Why is Inflation so Low After Large Contractionary Devaluations." NBER Working Paper 8748.

Bussière, M. (2007). "Exchange Rate Pass-through to Trade Prices: The Role of Non-linearities and Asymmetries." ECB Working Paper No. 822.

Campa, J.M. and L.S. Goldberg. (2005). "Exchange Rate Pass-through into Import Prices." *The Review of Economics and Statistics*. Vol. 87. No. 4. pp 679-90.

Campa, J.M., J.M. González-Mínguez and M. Sebastián-Barriol. (2006). "Non-linear Adjustment of Import Prices in the European Union." *Banco de España Working Paper* No. 635.

Cas, S.M., A. Carrión-Menéndez and F.Frantischek. (2011). "The Policy Interest-Rate Pass-Through in Central America" *IMF Working Paper* No. 240.

Cavoli, T. and R.S.Rajan. (2013). "South Asian Exchange Rates Regimes: Fixed, Flexible or Something In-between?" *South Asia Economic Journal*. Vol. 14. Issue 1. pp 1-15.

Cerra, V. and S.C. Saxena. (2002). "What Caused the 1991 Currency Crisis in India?", *IMF Staff Papers*, Vol. 49, No. 3 pp 395-425.

Chabchitrchaidol, A and O Permpoon. (2002). "Development of the Thai bond market", in *The development of bond markets in emerging economies*, BIS Papers, no 11 (June), pp 190-199.

Chandavarkar, A. (2005). "Towards an Independent Federal Reserve Bank of India: A Political Economy Agenda for Reconstitution." *Economic and Political Weekly*. Vol. 40 No.35 pp 3837+3839-3845.

Chirleşan, D. and M.C. Apostoaie. (2007). "The Interest Rate Pass-through from Policy Rates to Interbank Interest Rates in the Romanian Financial System." *Forum for Research in Empirical International Trade (FREIT) Working Paper No 411*.

Chowdhury, Mamta B. (2011). "India's Outward Foreign Direct Investment: Closed Doors to Open Souk." MPRA Paper No. 32828. Online at <http://mpra.ub.uni-muenchen.de/32828/>

Columbia Economics. (2010). "How Economists Convert Quarterly Data into Monthly: Cubic Spline Interpolation." (<http://columbiaeconomics.com/2010/01/20/how-economists-convert-quarterly-data-into-monthly-cubic-spline-interpolation/comment-page-1/>)

Cottarelli, C. and A.Kourelis. (1994). "Financial Structure, Bank Lending Rates and the Transmission Mechanism of Monetary Policy." *IMF Staff Papers*, Vol. 41, No. 4, pp. 587-623.

Coulibaly, D. and H. Kempf. (2010). "Does Inflation Targeting decrease Exchange Rate Pass-through in Emerging Countries?" *CES Working paper No. 49*. (<http://hal.archives-ouvertes.fr/docs/00/49/74/46/PDF/10049.pdf>)

CSO. Monthly Abstract of Statistics- Foreign Trade Statistics. Various Issues

Cui L., C. Shu, and J. Chang. (2009). "Exchange Rate Pass-through and Currency Invoicing In China's Exports." *China Economic Issues* Number 2/09, Hong Kong Monetary Authority.

Dasgupta, N. (2012). "India sovereign rating faces risk on fiscal strain-Deutsche Bank", Reuters. Accessed on April 13, 2012.

Dash, A.K. and V. Narasimhan. (2011). "Exchange Rate Pass-through: How Much Do Exchange Rate Changes Affect the Prices of Indian Exports and Imports." *South Asia Economic Journal*. Vol. 12. No. 1. pp 1-23.

- De Bondt, G. (2002). “Retail bank interest rate pass-through: new evidence at the euro area level”, *European Central Bank Working Paper* No. 136.
- De Bondt, G. (2005). “Interest Rate Pass-Through: Empirical Results for the Euro Area.” *German Economic Review*. Vol. 6. pp 37–78.
- Delatte, A. and A. López-Villavicencio. (2012). “Asymmetric Exchange Rate Pass-through: Evidence from Major Economies.” *Journal of Macroeconomics*. Vol. 34. Issue 3. pp. 833-844.
- DGFT (Directorate General of Foreign Trade). (2013). “Export-Import Databank.”
- Dhal, S. (2011). “Industry Effects of Monetary Transmission Mechanism in India: An Empirical Analysis of Use-based industries.” *Reserve Bank of India Occasional Papers*. Vol. 32, No. 2. pp 39-79.
- Dhasmana, A. (2012). “India’s Real Exchange Rate and Trade Balance: Fresh Empirical Evidence.” IIM Bangalore Research Paper No. 373.
- Dholakia, R.H. & S.V. Raveendra. (2000). “Exchange Rate Pass-Through and Volatility: Impact on Indian Foreign Trade.” *Economic and Political Weekly*. Vol. 35. Issue 47. pp 4109–4116.
- DIPP. (2013). “Review of Policy on Foreign Direct Investment (FDI)- Caps and routes in various sectors.” Press note No. 6. Department of Industrial Policy and Promotion, Ministry of Commerce and Industry. Government of India.
- Dixit, A.K. (1989). “Hysteresis, Import Penetration and Exchange Rate Pass-Through.” *Quarterly Journal of Economics*. Vol.104. Issue 2. pp 205-28.
- Dornbusch, R. (1987). “Exchange Rates and Prices.” *American Economic Review*, Vol. 77. Issue 1. pp 93-106.
- Dua, P. and R. Ranjan. (2010). “Exchange Rate Policy and Modelling in India” Development Research Group Study No. 33, Department of Economic Analysis and Policy, RBI.
- Durán-Viquez, R. and M. Esquivel-Monge. (2008). “Policy Rate Pass-Through: Evidence from the Costa Rican Economy.” Banco Central De Costa Rica Research Paper DIE-05-2008-DI.
- Economic Survey of India. (2012-13). “International Trade.” Chapter 7 of report. pps 149-172. (<http://indiabudget.nic.in/es2012-13/echap-07.pdf>).

Égert, B., J. Crespo-Cuaresma and T. Reininger. (2006). “Interest Rate Pass-Through in Central and Eastern Europe: Reborn from Ashes Merely to Pass Away?” William Davidson Institute Working Paper Number 851.

Eichengreen, B. and P. Gupta. (2011). “The Service Sector as India's Road to Economic Growth.” NBER Working Paper no. 16757.

Eichengreen, B. and P. Gupta. (2012). “The Global Financial Crisis and Indian Banks: Survival of the Fittest?” MPRA Paper No. 43365.

Eijffinger, S.C.W and J.D. Haan. (1996). “The Political Economy of Central Bank Independence.” Special Papers in International Economics. No. 19. Princeton University.

ET (2011). “India to be largest receiver of remittances in 2011: World Bank”, The Economic Times, accessed at [http://articles.economictimes.indiatimes.com/2011-12-02/news/30467729\\_1\\_dilip-ratha-remittance-flows-gulf-countries](http://articles.economictimes.indiatimes.com/2011-12-02/news/30467729_1_dilip-ratha-remittance-flows-gulf-countries) on April 13, 2012

Frankel, J.A. (1999). “No Single Currency Regime is Right for All Countries or at All Times.” NBER Working Paper No. 7338.

Froot, K. and P. Klemperer. (1989). “Exchange Rate Pass-through When Market Share Matters.” *American Economic Review*, Vol. 79. Issue 4. pp 637-54.

Gaulier, G., A. Lahrière-Révil and I. Méjean.(2006). “Exchange Rate Pass Through at the Product Level.” CEPII. 2006-02. February.

Ghate, C. and S.Wright. (2008). “The “V-Factor“: Distribution, Timing and Correlates of the Great Indian Growth Turnaround.” Deutsches Institut für Wirtschaftsforschung Discussion Papers 783.

Ghate, C., R. Pandey and I. Patnaik. (2011). “Has India emerged? Business cycle facts from a transitioning economy.” *NIPFP Working Paper* No. 88.

Ghosh, A. (2006). “Pathways Through Financial Crisis: India” *Global Governance*. Vol. 12. pp 413–429

Ghosh, A. and R.S.Rajan. (2007a). “Exchange Rate Pass Through in Asia: What does the Literature tell us?” *Asian Pacific Economic Literature*. Vol. 21. Issue 2. pp 13-28.

Ghosh, A. and R.S.Rajan. (2007b). “How High is Exchange Rate Pass Through in India? Has it Changed over Time?” *Journal of International Trade and Economic Development*. Vol. 16. Issue 3. pp 373 – 82.

Ghosh, A. and R.S. Rajan. (2009). "Exchange Rate Pass-through." in Princeton Encyclopedia of the World Economy, K. Reinert, R. Rajan, A. Glass and Lewis Davis (eds.), Princeton University Press.

Gigineishvili, Nikoloz. (2011). "Determinants of Interest Rate Pass-Through: Do Macroeconomic Conditions and Financial Market Structure Matter?" *IMF Working Paper* No. 176

Goldberg, L. and E.W. Dillon. (2007). "Why a Dollar Depreciation May Not Close the U.S. Trade Deficit." *Current Issues in Economics and Finance*. Federal Reserve Bank of New York. Vol. 13. No 5. pp 1-7.

Goldberg, P. and M. Knetter. (1997). 'Goods Prices and Exchange Rates: What have we Learned?,' *Journal of Economic Literature*. Vol. 35. Issue 3. pp 1243-92.

Goldfajn, I. and S. Werlang (2000). 'The Pass-through from Depreciation to Inflation: A Panel Study', Discussion Paper No.423, Department of Economics, Pontificia Universidad Católica do Rio de Janeiro (PUC-Rio).

Gopinath, G. and R. Rigobon, (2008) "Sticky Borders," *Quarterly Journal of Economics*. Vol. 123. Issue 2. pp. 531-75.

Gopinath, G., O. Itskhoki and R. Rigobon. (2010). "Currency Choice and Exchange Rate Pass-Through." *The American Economic Review*. Vol. 100, Issue 1. pp. 304-336.

Goyal, A. (2002). "Coordinating Monetary and Fiscal Policies: a role for rules?" MPRA Paper No. 29200.

Goyal, A. (2006). "Macroeconomic Policy and the Exchange Rate: Working Together." *MPRA Paper* No. 27768.

Goyal, A. (2011). "History of Monetary Policy in India since Independence." Indira Gandhi Institute of Development Research Working Paper No. 018.

Goyal, A. (2012a). "India's Fiscal and Monetary Framework: Growth in an Opening Economy." *Macroeconomics and Finance in Emerging Market Economies*. Vol. 5. Issue 1.

Goyal, A. (2012b). "Causes and Cures for India's Current Account Deficit." The Hindu Business Line. Accessed on Dec 10, 2013 at <http://www.thehindubusinessline.com/opinion/columns/ashima-goyal/causes-and-cures-for-indias-current-account-deficit/article3742303.ece>

- Goyal, A. (2013a). “Does Monetary Policy Work in India?” The Hindu Business Line. Accessed on Dec 10, 2013 at <http://www.thehindubusinessline.com/opinion/columns/ashima-goyal/does-monetary-policy-work-in-india/article5364666.ece>
- Goyal, A. (2013b). “Price regimes and India’s current account gap” East Asia Forum. Accessed on Dec 10, 2013 at <http://www.eastasiaforum.org/2013/05/08/price-regimes-and-indias-current-account-gap/>
- Goyal, A. (2013c). “India’s growth undershoots: is this a new normal?” Special Feature on 2012 in review and the year ahead, East Asia Forum. (<http://www.eastasiaforum.org/2013/01/02/developments-and-challenges-in-india-a-reversion-to-fundamentals/>).
- Goyal, A. (2013d). “Sliding Rupee, Sloppy methods.” The Hindu Business Line. Accessed on November 29, 2013. (<http://www.thehindubusinessline.com/opinion/columns/ashima-goyal/sliding-rupee-sloppy-methods/article4902143.ece>)
- Goyal, A. (2014). “External shocks”, in S. Mahendra Dev (ed.), India Development Report 2014, New Delhi: IGIDR and Oxford University Press. Forthcoming.
- Goyal, A. and S. Arora. (2010). “The Indian Exchange Rate and Central Bank Action: A GARCH Analysis.” *IGIDR Working Paper* No. 009.
- Guimarães, R. and M. Ruiz-Arranz. (2009). “Monetary Transmission in Asia: Is It Working?” in Asia and Pacific: Regional Economic Outlook, IMF. October.
- Gupta-Kapoor, A. and U. Ramakrishnan. (1999). “Is there a J-curve? A new estimation for Japan.” *International Economic Journal*, Vol. 13. No. 4. pp 71–79.
- Gylfason, T. and O. Risager (1984). “Does devaluation improve the current account?” *European Economic Review*. Vol. 25. No 1. pp 65-68.
- Habermeier, K., A. A. Kokenyne, R. Veyrune, and H. Anderson. (2009). “Revised System for the Classification of Exchange Rate Arrangements.” IMF Working Paper no. WP/09/211.
- Halicioglu, F. (2007) “The J-Curve Dynamics of Turkish Bilateral Trade: A Cointegration Approach” *Journal of Economic Studies*. Vol. 34, Issue. 2. pp103-119.
- Hansen, N. H and P. Welz (2011). “Interest Rate Pass-Through during the Global Financial Crisis: The Case of Sweden.” *OECD Economics Department Working Paper* No. 855.

- Hattari, R., M.S. Islam and R.S. Rajan. (2011) "South Asia and the Global Financial Crisis." In *Monetary Policy and the Global Financial Crisis* in R. Jha (ed) *Handbook of South Asian Economies*, Routledge.
- Hattari, R. and R.Rajan. (2011). "How Different are FDI and FPI Flows?" *Journal of Economic Integration*, Vol. 26. Issue 3. pp.499-525.
- Haynes, S.E. and J.A. Stone, (1982). "Impact of the Terms of Trade on the US Trade Balance: A Reexamination." *Review of Economics and Statistics*. Vol. 64. Issue 4. pp 702–6.
- Himarios, D. (1989) "Do Devaluations Improve the Trade Balance? The Evidence Revisited" *Economic Inquiry*. Vol. 27. pp 143-168.
- Horváth, C., J.Krekó and A. Naszódi. (2004). "Interest Rate Pass-Through: The Case of Hungary." *National Bank of Hungary Working Paper* No.8.
- Hutchison, M., J. Kendall, G. Pasricha and N. Singh (2010), 'Indian Capital Control Liberalization: Evidence From NDF Markets', *UCSC Working Paper* (Santa Cruz, CA:UCSC).
- Hutchison, Michael, Rajeswari Sengupta and Nirvikar Singh. (2012). "India's Trilemma: Financial Liberalisation, Exchange Rates and Monetary Policy." *The World Economy*. Vol. 35 No. 1, pp 3-18.
- IBEF. (2013). "Foreign Institutional Investors (FII) in India." (<http://www.ibef.org/india-at-a-glance/india-diverse-democratic-dynamic/trade-and-external-sector/foreign-institutional-investors.aspx>)
- IFS (2013). "International Financial Statistics." IMF
- Illes, A. and M. Lombardi. (2013). "Interest Rate Pass-through since the financial crisis." *BIS Quarterly Review*.
- IMF (2013). "Understanding IMF Real GDP Growth Forecasts for India." Press Notice of the IMF Resident Representative Office in India. (<http://www.imf.org/external/country/IND/rr/2013/041613.pdf>)
- Inoue, T. (2010). "Effectiveness of the Monetary Policy Framework in Present-day India: Have Financial Variables Functioned as Useful Policy Indicators?" *Institute of Developing Economies Discussion Paper* No. 242.

Inoue, T. & H. Shigeyuki. (2009). "An Empirical Analysis of the Monetary Policy Reaction Function in India." *Institute of Developing Economies Discussion Paper No.* 200.

Islam, S.M. and R.S. Rajan.(2011). "Bank Lending Channel of Monetary Transmission Policy: India and the Global Financial Crisis", *International Journal of Economics and Business Research*, Vol. 3. Issue. 5. pp 557-575.

Ito, T., Y. Sasaki and K.Sato. (2005). "Pass-through of Exchange Rate changes and Macroeconomic Shocks to Domestic Inflation in East Asian Countries", Discussion Paper Series 05-E-020, Research Institute of Economy, Trade and Industry (RIETI), Japan.

Jamilov, R. & B.Égert. (2013). "Interest Rate Pass-Through and Monetary Policy Asymmetry: A Journey into the Caucasian Black Box" *EconomiX Working Papers* 2013-9. University of Paris West - Nanterre la Défense, EconomiX.

Jangili, R. (2011). "Causal Relationship between Saving, Investment and Economic Growth for India – What does the Relation Imply?" *Reserve Bank of India Occasional Papers* Vol. 32, No. 1, pp 25-39.

Jayaram, S., I. Patnaik and A. Shah. (2009). "Examining the Decoupling Hypothesis for India." *Economic and Political Weekly*. Vol. 44. Issue 44. pp 109-116

Jha, R. (2008), "Inflation Targeting in India: Issues and Prospects", *International Review of Applied Economics*, Vol. 22. Issue 2. pp.259-270.

Joshi, V. and S.Sanyal. (2004), "Foreign Inflows and Macroeconomic Policy in India", *India Policy Forum*. Vol. 1. No 1. pp 135-186.

Kalra, A. (2013). "India Insight." Reuters. Accessed on Dec 2, 2013. (<http://blogs.reuters.com/india/2013/06/28/indias-love-for-gold-and-the-governments-efforts-to-curb-it-a-timeline/>)

Kamin, S. and M. Klau. (2003). 'A Multi-country Comparison between Inflation and Exchange Rate Competitiveness', *International Journal of Finance and Economics*. Vol. 8. Issue 2. Pp 167–84.

Kang S. and Y. Wang. (2003) "Fear of Floating: Exchange Rate Pass-Through in East Asia." *Korea Institute of Economic Policy Working Paper No.* 03-06.

Kannan, R. (1999). "Inflation Targeting: Issues and Relevance for India." *Economic and Political Weekly*. Vol. 34. Issue 3-4. pp 115-122.

- Kapur, M. and H. Behara. (2012). "Monetary Transmission Mechanism in India: A Quarterly Model." *RBI Working Paper Series* 9/2012
- Karagiannis, S., Y. Panagopoulos and P. Vlamis. (2009) "The Emerging BRIC Economies: Evidence from the Interest Rate Transmission Mechanism" Oxford Business and Economics Conference Program, St Hugh's College, Oxford University, Oxford, UK.
- Karagiannis, S., Y. Panagopoulos and P. Vlamis. (2010) "Interest Rate Pass-Through in the Eurozone And the USA: Implications For Monetary Policy in the Context of the Recent Financial Crisis" *Journal of Policy Modeling*. Vol. 32, Issue 3. pp 323-338.
- Khundrakpam, J.K. (2007). "Economic Reforms and Exchange Rate Pass-Through to Domestic Prices in India." *BIS Working paper* No. 225.
- Khundrakpam, J.K. (2011). "Credit Channel of Monetary Transmission in India - How Effective and Long is the Lag?" *RBI Working Paper Series* No. 20
- Khundrakpam, J.K. and R.Jain (2012). "Monetary Policy Transmission in India: A Peep Inside the Black Box" *RBI Working Paper Series*. No. 11.
- Knetter, M. 1993. "International Comparisons of Pricing-to-Market Behavior." *American Economic Review*. Vol. 83. Issue 3. pp 473-86.
- Kocchar, K. (2011). "Bringing tears to Indian eyes." *Economist*
- Kotwal, A., B. Ramaswami and W. Wadhwa. (2011). "Economic Liberalization and Indian Economic Growth: What's the Evidence?" *Journal of Economic Literature*. Vol. 49. Issue 4 pp 1152-1199.
- Krugman, P. (1987). "Pricing to Market when the Exchange Rate Changes." in S.W. Arndt and D. Richardson (eds.). *Real Financial Linkages Among Open Economies*. MIT Press. Cambridge: 49-70.
- Lal, A.K. and T.C.Lowinger. "The J-curve: Evidence from East Asia." *Journal of Economic Integration*, Vol. 17, No 2. pp 397-415.
- Leeladhar, V. (2008). "Management of Capital Flows: Indian Experience." Address delivered at the Workshop on Debt, Finance and Emerging Issues in Financial Integration at United Nations Headquarters, New York.
- Leuvensteijn, M. van, C.K. Sørensen, J.A. Bikker and A.A.R.J.M. van Rixtel (2008). "Impact of Bank Competition on the Interest rate Pass-through in the Euro Area." *ECB*

*Working Paper Series* No. 885.

(<http://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp885.pdf>).

Levy-Yeyati, E. and F. Sturzenegger (2007). "Fear of Floating in Reverse: Exchange Rate Policy in the 2000s", World Bank.

Magee, S.P. (1973). "Currency Contracts, Pass Through and Devaluation," *Brookings Papers on Economic Activity*. Vol. 1 pp 303-325.

Mahdavi, S. and A. Sohrabian. (1993). "The exchange value of the dollar and the US trade balance: an empirical investigation based on cointegration and Granger causality tests." *Quarterly Review of Economics and Finance*, Vol. 33. No. 4. pp 343–58.

Mallick, S. and H. Marques. (2006). "Sectoral Exchange Rate Pass-through: Testing the Impact of Policy Reforms in India." *Scottish Journal of Political Economy*. Vol. 53. Issue 2. pp 280-303.

Mallick, S. and H. Marques. (2008a). "Exchange Rate Transmission into Industry-Level Export Prices: A Tale of Two Policy Regimes in India." *IMF Staff Papers*. Vol. 55. Issue 1. pp 83-108

Mallick, S. and H. Marques. (2008b), "Exchange Rate Pass-through in India's Exports to Developed and Emerging Markets." *RIS- Discussion Papers* No.144.

Mallick, S. and H. Marques. (2008c). "Pass-through of Exchange Rate and Tariffs into Import Prices of India: Currency Depreciation versus Import Liberalization." *Review of International Economics*. Vol. 16. Issue 4. pp 765–782.

Mallick, S. and H. Marques. (2010) "Data Frequency and Exchange Rate Pass-Through: Evidence from India's exports." *International Review of Economics and Finance*. Vol. 19. pp 13–22.

Mann, C., (1986). "Prices, Profit Margins, and Exchange Rates." *Federal Reserve Bulletin*, Vol. 72, June, pp 366-379.

Marazzi, M., N. Sheets, R. Vigfusson, and J. Rogers. (2005). "Exchange Rate Pass-through to U.S. Import Prices: Some New Evidence." *International Finance Discussion*, Board of Governors of the Federal Reserve System Papers No.833.

Marston, R.C. (1990). "Pricing to Market in Japanese Manufacturing," *Journal of International Economics*. Vol. 29. Issue 3-4, pp 217-236.

Marwah, K. and L.R. Klein. (1996). "Estimation of J-curves: United States and Canada." *The Canadian Journal of Economics*. Vol. 29. Issue 3. pp 523-539.

- Meade, E.E. (1988). "Exchange rates, Adjustment, and the J-curve." *Federal Reserve Bulletin*. Vol. 74. October. pp 633–44.
- Melvin, M. and J.Sultan. (1990). "The Choice of an Invoicing Currency in International Trade and the Balance of Trade Impact of Currency Depreciation." *Open Economies Review*. Vol. 1. Issue 3 pp 251-268
- Menon, J. (1995). "Exchange Rate Pass-Through." *Journal of Economic Surveys*. Vol.9. Issue 2. pp 197-231.
- Miles, M.A. (1979). "The Effects of Devaluation on the Trade Balance and the Balance of Payments: Some new results." *Journal of Political Economy*, Vol. 87. Issue. 3, pp 600–20.
- Mishra, P. (2012) "Monetary Transmission in Developing Countries." IGC Workshops of Fiscal and Monetary Policy. (<http://www.theigc.org/sites/default/files/Presentation%20by%20P.%20Mishra.pdf>)
- Mishra, P. and C. Rangarajan. (2013). "India's External Sector: Do We Need to Worry?" *Economic and Political Weekly*. Vol. 47. Issue 34. pp 52-59.
- Mishra, P. and P.J. Montiel. (2012). "How Effective Is Monetary Transmission in Low-Income Countries? A Survey of the Empirical Evidence." *IMF Working Paper* No.143.
- Mishra, P., P.J. Montiel, and A. Spilimbergo. (2010). "Monetary Transmission in Low Income Countries." *IMF Working Paper* No. 223.
- Mody, A. (2013). "The Rupee's Wake Up Call." Project-Syndicate. (<http://www.project-syndicate.org/commentary/the-fall-of-the-indian-rupee-by-ashoka-mody>)
- MoF. (2012). "Mid-Year Economic Analysis 2012-2013." Ministry of Finance, Department of Economic Affairs, Government of India.
- Mohan, R. (2006). "Monetary Policy Transmission in India." Paper presented at the Deputy Governor's Meeting on "Transmission Mechanisms for Monetary Policy in Emerging Market Economies - What is New?" at Bank for International Settlements, Basel.
- Mohan, R. (2008). "The Growth Record of the Indian Economy, 1950-2008 – a Story of Sustained Savings and Investment ." *Economic and Political Weekly*. Vol. 43. No. 19 pp 61-71.
- Mohan, R. (2009). "Financial Sector Reforms and Monetary Policy: The Indian Experience." Revised version of paper presented at the Conference on Economic Policy

in Asia at Stanford, organized by Stanford Center for International Development and Stanford Institute for Economic Policy Research, on June 2, 2006.

Mohan, R. and M.Kapur. (2009). "Liberalisation and Regulation of Capital Flows:Lessons for Emerging Market Economies." *Stanford Center for International Development Working Paper* No. 399

Mohanty, D. (2011a). "Lessons for monetary policy from the global financial crisis – an emerging market perspective." Paper presented at the Central Banks Conference of the Bank of Israel, Jerusalem.

Mohanty, D. (2011b). "How does the Reserve Bank of India Conduct its Monetary Policy?" Speech delivered at the Indian Institute of Management (IIM), Lucknow .

Mohanty, Deepak. (2011c). "Changing Contours of Monetary Policy in India?" Speech delivered at the Royal Monetary Authority of Bhutan, Thimphu .

Mohanty, D. (2011d). "Lessons for monetary policy from the global financial crisis – an emerging market perspective" Speech delivered at the Central Banks Conference of the Bank of Israel, Jerusalem.

Mohanty, D. (2012a). "Global Capital Flows and the Indian Economy – Opportunities and Challenges." Speech at Techkriti 2012, the Annual Technical and Entrepreneurship Festival of the Indian Institute of Technology Kanpur (IITK), Kanpur

Mohanty, D. (2012b). "Money Market and Monetary Operations in India." Speech delivered at the Seminar on Issues in Financial Markets, Mumbai, India.

Mojon, B. (2000), "Financial Structure and the Interest Rate Channel of ECB Monetary Policy", *ECB Working Paper* No: 40.

Monetary and Financial Systems Dept.. (2004) "From Fixed to Float: Operational Aspects of Moving Toward Exchange Rate Flexibility." IMF (<http://www.imf.org/external/np/mfd/2004/eng/111904.pdf>)

Mumtaz, H, Ö. Oomen and J.Wang. (2006). "Exchange rate pass-through into UK import prices." *Bank of England Working Paper* No 312.

Mustafa, M. and M. Rahman. (2008). "US Bilateral Nominal Trade Balance with India, Japan, Malaysia, S. Korea and Thailand, and Bilateral Nominal Exchange Rate Dynamics: Evidence on J-Curve?" *Southwestern Economic Review*. Vol. 35. Issue 1. pp 153-162.

- Nagpal, M. (2010). “The J-Curve Phenomenon: Myth or Reality? – An Analysis for India.” IGIDR, Mimeo
- Nayak, G. (2012). “Why Credit Deposit Ratio is a Key Measure.” *Economic Times*. Oct 19. Accessed on Oct 25, 2013. ([http://articles.economictimes.indiatimes.com/2012-10-19/news/34584360\\_1\\_credit-deposit-ratio-credit-deposit-adequacy](http://articles.economictimes.indiatimes.com/2012-10-19/news/34584360_1_credit-deposit-ratio-credit-deposit-adequacy))
- Nogueira J. and P. Reginaldo (2006). “Inflation Targeting, Exchange Rate Pass-Through and “Fear of Floating””. University of Kent Discussion Paper 0602. Department of Economics, University of Kent at Canterbury, Canterbury, Kent.
- Noland, M. (1989). “Japanese trade elasticities and the J-curve.” *Review of Economics and Statistics*. Vol. 71. pp 175–9.
- OEA. Office of the Economic Adviser, various issues
- OECD. (2011). “Import Content of Exports”, in OECD Science, Technology and Industry Scoreboard 2011, OECD Publishing. ([http://dx.doi.org/10.1787/sti\\_scoreboard-2011-61-en](http://dx.doi.org/10.1787/sti_scoreboard-2011-61-en))
- OECD. (ND). “Thailand’s Bond Market Has Grown Strongly for More Than a Decade.” Accessed at <http://www.oecd.org/finance/public-debt/49471944.pdf>
- Olivei, G.P. (2002). “Exchange rates and the prices of manufacturing products imported into the United States.” *New England Economic Review*. First Quarter. pp 3-18.
- Otani, A., S. Shiratuka, and S. Shirato. (2003). ‘The Decline in the Exchange Rate Pass-through: Evidence from Japanese Import Prices’, *Monetary and Economic Studies*, 21, Institute for Monetary and Economic Studies (IMES), Bank of Japan: 53-81.
- Ouyang, A. and R.S.Rajan. (2008). “Reserve Stockpiling and Managing its Monetary Consequences: The Experience of India”, *Macroeconomics and Finance in Emerging Market Economies*, Vol 1. No.1, pp.75-91 .
- Panagariya, A. (2004). “Growth and Reforms during 1980s and 1990s”, *Economic and Political Weekly*, Vol. 39, No 25, pp 2581-94.
- Pandit, B.L., A.Mittal, M. Roy and S. Ghose (2006). “Transmission of Monetary Policy and the Bank Lending Channel: Analysis and Evidence for India.” Reserve Bank of India, Development Research Group Study No. 25.
- Pandit, B.L. and P.Vashisht. (2011). “Monetary Policy and Credit Demand in India and Some EMs”, *ICRIER Working Paper* No.256.

Parsley, D.C., (2004). "Pricing in International Markets: a 'Small-country' Benchmark." *Review of International Economics*. Vol. 12. No. 3. pp 509-524.

Patel, U. R. (2012). "The Gold Effect on Inflation." Brookings Research. Accessed at (<http://www.brookings.edu/research/opinions/2012/11/22-gold-effect-inflation-patel>)

Patnaik, A. and A Ramanathan, (2007). "The Interest Rate Channel of Monetary Transmission Mechanism in India: An Empirical Study." *Artha Vijnana*, Vol. 49, No. 2, pp. 141-156.

Patnaik, I. (2003). "The Consequences of Currency Intervention in India." *ICRIER Working Paper* No. 114

Patnaik, I. (2004). "India's Experience with a Pegged Exchange Rate", *India Policy Forum*. Vol. 1. No 1. pp 1-28.

Patnaik, I. (2007). "India's Currency Regime and its Consequences." *Economic and Political Weekly*. Vol. 42, Issue 11, pp 911-913.

Patnaik, I. (2008). "Central Bank Misrules." *Indian Express*.

Patnaik, I. (2013a). "Looking like a Recovery." *Financial Express*. Accessed on December 21, 2013

Patnaik, I. (2013b). "Inflation Targetting is Critical". *Financial Express*. Accessed on Nov 25, 2013 at (<http://www.financialexpress.com/story-print/1199051>)

Patnaik, I., S.Malik, R. Pandey and Prateek. (2013). "Foreign Investment in the Indian Government Bond Market." *NIPFP Working Paper* No. 126.

Patnaik, I. and A. Shah (2010a). "Why India choked when Lehman Broke." *NIPFP Working Paper* No. 63.

Patnaik, I. and A. Shah (2010b). "India." Elsevier Encyclopaedia of Financial Globalisation

Patnaik, I., A. Shah and G.Veronese. (2011). "How to Measure Inflation in India?" *NIPFP Working Paper* No. 83.

Patra, M.D and M. Kapur. (2010). " A Monetary Policy Model Without Money for India." *IMF Working Paper* No. 183.

- Pesaran, M. Hashem, Yongcheol Shin and Richard J Smith. (2001) “Bounds Testing Approaches to the Analysis of Level Relationships.” *Journal of Applied Econometrics*. Vol. 16. No.3. pp 289–326.
- Petrović, P. and M. Gligorić. (2010) “Exchange rate and trade balance: J-curve effect.” *Panoeconomicus*, Vol. 1, pp, 23-41.
- Planning Commission. (2013). “Central Government : Revenue, Expenditure and Fiscal Deficit (% of GDP at current market prices)” Data tables. ([http://planningcommission.gov.in/data/datatable/1612/table\\_23.pdf](http://planningcommission.gov.in/data/datatable/1612/table_23.pdf))
- Pollard, P.S. and C.C. Coughlin. (2003). “Size Matters: Asymmetric Exchange Rate Pass-through at the Industry Level.” Federal Reserve Bank of St. Louis, Working Paper 2003-029b.
- Pontines, V. and R.S. Rajan. (2011). “Foreign exchange market intervention and reserve accumulation in emerging Asia: Is there evidence of fear of appreciation?” *Economics Letters*. Vol. 111. pp 252-255.
- Pradhan, R. P. (2010). “Globalization in India: With special reference to 1990s.” *Journal of Economics and International Finance*. Vol. 2. No.5, pp. 76-84.
- Przystupa, J. and E. Wróbel. (2011). “Asymmetry of the Exchange Rate Pass-Through: An exercise of Polish Data.” *Eastern European Economics*. Vol. 49. Issue 1 pp30-51.
- PTI. (2013a). “India's current account deficit falls to \$5.2 billion in July-September quarter.” *The Times of India*. Accessed on Dec 2, 2013 at (<http://timesofindia.indiatimes.com/business/india-business/Indias-current-account-deficit-falls-to-5-2-billion-in-July-September-quarter/articleshow/26746231.cms>)
- PTI (2013b). “RBI not to go ‘nutters’ on inflation: Raghuram Rajan.” *The New Indian Express*. Oct 29.
- Pyne, P.K., and S.S. Roy. (2008). “Exchange Rate Pass-Through in India – An Exploration with Sectoral Import Prices.” Paper presented at the International Conference on Empirical Issues in International Trade and Finance organized by Indian Institute of Foreign Trade, Kolkata.
- Rajan, R.G (2009). “A Hundred Small Steps: Report of the Committee on Financial Sector Reforms.” Planning Commission. Government of India.
- Rajan, R.S. (2011). “Exchange Rates and Foreign Direct Investment in Emerging Asia: Selected Issues and Policy Options.” Chapter 2. pp 29-53. Routledge.

Rajan, R.S. and T. Cavoli. (2009). "Should India Adopt an Inflation Targeting Framework?" in Monetary, Investment and Trade Issues in India edited by Ramkishan Rajan. Chapter 2 pp 26-46.

Ramachandran, M and N. Srinivasan. (2007). "Asymmetric Exchange Rate Intervention and International Reserve Accumulation in India." *Economics Letters*. Vol. 94. Issue 2. pp 259-265.

Rangarajan, C. (1996). "Objectives of Monetary Policy and Price stability in relation to the Economy of India." Address at the Second Conference of the Econometric Society's Regional Chapter for India and South Asia in Delhi.  
(<http://www.bis.org/review/r970203b.pdf?frames=0>)

Ratha, D., C. Eigen-Zucchi, S. Plaza, H. Wyss, and S. Yi. (2013). "Migration and Remittance Flows: Recent Trends and Outlook, 2013-2016." Migration and Development Brief. Migration and Remittances Team, Development Prospects Group. The World Bank.

Ray P. and E. Prabhu. (2013). "Financial Development and Monetary Policy Transmission Across Financial Markets: What Do Daily Data tell for India?" *RBI Working Paper series* No.04.

Ray, P. and A. Virmani. (2012). "Calibrated Financial Liberalization in India: Has It Served the Country?" in *Twenty Years of India's Liberalization: Experiences and Lessons*. Edited by Rashmi Banga and Abhijit Das. UNCTAD. pg 43-64  
([http://unctad.org/en/PublicationsLibrary/osg2012d1\\_en.pdf](http://unctad.org/en/PublicationsLibrary/osg2012d1_en.pdf))

Razafimahefa, I. F. (2012). "Exchange Rate Pass-Through in Sub-Saharan African Economies and its Determinants." IMF Working Paper No. 141.

RBI. "Handbook of Statistics on Indian Economy." Various issues.

RBI (1985). "Report of the Committee to Review the Working of the Monetary System." S. Chakravarthy, Chairman.

RBI (1999). "Repurchase Agreements (Repos): Concepts, Mechanics and Uses." RBI.  
(<http://www.rbi.org.in/scripts/PublicationReportDetails.aspx?UrlPage=&ID=34>)

RBI (2003). "Monetary Transmission Mechanism"  
(<http://rbidocs.rbi.org.in/rdocs/Publications/PDFs/59597.pdf>)

RBI. (2005). "Revision of Nominal Effective Exchange Rate (NEER) and Real Effective Exchange Rate (REER) Indices." Prepared jointly in the Division of International

Finance, Department of Economic Analysis and Policy and the Department of External Investments and Operations, Reserve Bank of India.

RBI. (2010). "Guidelines on the Base Rate."  
(<http://www.rbi.org.in/scripts/NotificationUser.aspx?Mode=0&Id=5579>)

RBI. (2011). "Deregulation of Savings Bank Deposit Interest Rate – Guidelines."  
(<http://rbi.org.in/scripts/NotificationUser.aspx?Id=6779&Mode=0>)

RBI. (2012). "Macroeconomic and Monetary Developments – Price Situation."

RBI. (2013). "Developments in India's Balance of Payments during the Fourth Quarter (January-March 2013) of 2012-13."

RBI. (2013a). "Macroeconomic and Monetary Developments." Second Quarter Review 2013-14

RBI. (2013b). "Report of the Working Group to Study the Issues Related to Gold Imports and Gold Loans by NBFCs." January

RBI bulletin. (2006). "Invisibles in India's Balance of Payments." Division of International Finance, Department of Economic Analysis and Policy, RBI  
(<http://rbidocs.rbi.org.in/rdocs/Bulletin/PDFs/74250.pdf>)

Reddy, Y V. (2002). "Issues and challenges in the development of the debt market in India." BIS Papers No. 11. (<http://www.bis.org/publ/bppdf/bispap11j.pdf>)

Reuters. (2012). "RBI's rupee defense gets fresh jolt from S&P." *The Times of India*. Accessed at <http://timesofindia.indiatimes.com/business/india-business/RBIs-rupee-defence-gets-fresh-jolt-from-SP/articleshow/12937087.cms>

Rhee, Yeongseop. (2013). "Government Bond Market Development: The Korean Experience." Ministry of Strategy and Finance (MOSF), Republic of Korea.

Rodrik, D. and A. Subramanian. (2005). "From Hindu Growth to Productivity Surge: The Mystery of the Indian Growth Transition." *IMF Staff Papers*, Vol.ume 52. Issue 2. Pp 193-228.

Roelands, S. (2012) "Asymmetric Interest Rate Pass-Through from Monetary Policy: The Role of Bank Regulation." (September 14, 2012). Available at SSRN: <http://ssrn.com/abstract=2143451>."

Rose, A. K. (1990). "Exchange Rates and the Trade Balance: Some Evidence from Developing Countries" *Economic Letters*. Vol. 34. pp 271-275.

- Rose, A.K. and J.L. Yellen, (1989). "Is There a J-Curve?" *Journal of Monetary Economics*. Vol. 24 pp 53-68.
- Rosensweig, J.A. and P.D. Koch. (1988). "The US dollar and the 'Delayed J-curve'". *Economic Review*, July/August, Federal Reserve of Atlanta.
- Saborowski, C. and S. Weber. (2013). "Assessing the Determinants of Interest Rate Pass Transmission Through Conditional Impulse Response Functions." *IMF Working Paper* No. 23.
- Saha, S. and Z. Zhang. (2012). "Exchange Rate Pass-Through and its Impact on Inflation: A Comparative Study for Australia, China and India with Disaggregated Data." ([http://portal.hss.ntu.edu.sg/egc/seminar/pdf/SSaha-SERPT-ss-zz-NUS-Oct\\_2012.pdf](http://portal.hss.ntu.edu.sg/egc/seminar/pdf/SSaha-SERPT-ss-zz-NUS-Oct_2012.pdf))
- Sander, H. and S. Kleimeier. (2004). "Interest Rate Pass-Through in an Enlarged Europe: The Role of Banking Market Structure for Monetary Policy Transmission in Transition Countries", Maastricht Research School of Economics of Technology and Organization, Research Memoranda, no. 45.
- Saraogi, R. (2006). "Macromanagement and Business Environment: Analysis of the 1991 Indian Economic Crisis." MPRA Paper No. 8030.
- Sasaki, Y. N. (2002). "Pricing-to-Market Behavior: Japanese Exports to the US, Asia, and the EU." *Review of International Economics*. Vol. 10. No. 1. pp 140–150.
- Sen Gupta, A. and R. Sengupta. (2013). "Management of Capital Flows in India: 1990-2011." ADB South Asia Working Paper Series, Vol. 135463, No. 17
- Seshan, A. (2005). "Liberalised Exchange Rate Management System-The story of India's Gulf crisis." *Business Line*. Accessed on April 10, 2012.
- Seth, B. (2011). "Long Run and Short Run Saving-Investment Relationship in India", *RBI Working Paper* No.13
- Shah, A. (2000). "The Soul of the Debt market." Ajay Shah blog (<http://www.mayin.org/ajayshah/MEDIA/2000/rbi-sebi.html>)
- Shah, A. (2008). "Ajay Shah: First steps on building the BCD Nexus." *Business Standard*. Accessed at [http://www.business-standard.com/article/opinion/ajay-shah-first-steps-on-building-the-bcd-nexus-108030101011\\_1.html](http://www.business-standard.com/article/opinion/ajay-shah-first-steps-on-building-the-bcd-nexus-108030101011_1.html)
- Shah, A. (2009). "Having Only a 10-Year Bond Futures is More Useful Than Meets the Eye." *Financial Express*. (<http://www.mayin.org/ajayshah/MEDIA/2009/moreuseful.html>)

Shah, A. (2012). "The Inflation Crisis Has Not Ended." *Citizen Economists*. Accessed on April 13, 2012.

Shah, A. and I. Patnaik, (2007). "India's Experience with Capital Flows: The Elusive Quest for a Sustainable Current Account Deficit" published in *Capital Controls and Capital Flows in Emerging Economies: Policies, Practices and Consequences*. ed by Sebastian Edwards. NBER

Shah, A. and I. Patnaik. (2011). "India's financial globalization." *IMF Working Paper* No.7.

Shetty, M. (2013). "RBI concerned as credit growth outstrips deposit mobilization." *Times of India*. Accessed on Oct 25th 2013.  
(<http://timesofindia.indiatimes.com/business/india-business/RBI-concerned-as-credit-growth-outstrips-deposit-mobilization/articleshow/23877282.cms>)

Shioji, E. (2012). "The Evolution of the Exchange Rate Pass-Through in Japan: A Re-evaluation Based on Time-Varying Parameter VARs." Policy Research Institute, Ministry of Finance, Japan, *Public Policy Review*, Vol.8, No.1, pp 67-92.

Shirvani, H. and B. Wilbratte. (1997). "The Relationship between the Real Exchange Rate and the Trade Balance: An Empirical Reassessment." *International Economic Journal*. Vol. 11, No. 1, pp 39-50

Singh, K. (2006). "Inflation Targeting: International Experience and Prospects for India." *Economic and Political Weekly*, Vol. 41. No. 27-28. pp.2958-2961.

Singh, T. (2004). "Testing J-Curve Hypothesis and Analysing the Effect of Exchange Rate Volatility on the Balance Of Trade in India." *Empirical Economics*. Vol. 29. pp 227-245

Singhal, R. (2010). "Understanding Base Rate." *Business Today*.  
(<http://businesstoday.intoday.in/story/understanding-base-rate/1/8806.html>)

Sinha, A. (2012). "Changing Contours of Global Crisis- Impact on Indian Economy." Address at Finance Summit organized by IIM, Kashipur at Kashipur

Sorensen, C.K. and T.Werner. (2006). "Bank Interest Rate Pass-Through in the Euro Area: A Cross Country Comparison." *ECB Working Paper* No.580.

Srinivasan, N. V. Mahambareb and M. Ramachandran. (2009). "Preference Asymmetry and International Reserve Accretion in India." *Applied Economics Letters*, Vol. 16. Issue 15. pp 1543-1546.

Srinivasan, T. N. (2001). "India's Reform of External Sector Policies and Future Multilateral Trade Negotiations." Center Discussion Paper No. 830. Economic Growth Center. Yale University.

Subbarao, D. (2009). "Impact of the global financial crisis on India – Collateral Damage and Response." Speech at the Symposium on "The Global Economic Crisis and Challenges for the Asian Economy in a Changing World" organized by the Institute for International Monetary Affairs, Tokyo

Subbarao, D. (2010). "Volatility in Capital Flows: Some Perspectives", Speech at the High-level Conference on 'The International Monetary System' jointly organized by the Swiss National Bank and the IMF in Zurich.

Subbarao, D. (2012). "The Challenge of Globalization -Some Reflections from the Reserve Bank Perspective." Address at the 37th Annual Convocation of the IIM Bangalore.

Subramanian, A. (2013). "The Reserve Bank's mission impossible." Business Standard. Accessed on Dec 5, 2013 at [http://www.business-standard.com/article/opinion/arvind-subramanian-the-reserve-bank-s-mission-impossible-113111801026\\_1.html](http://www.business-standard.com/article/opinion/arvind-subramanian-the-reserve-bank-s-mission-impossible-113111801026_1.html)

Sundaresan, S. (2013). "Reforming Government Securities Market in India- A prerequisite for developing active derivative markets on interest rates." Institute for Financial Management Research, Chennai, India.

Tai, P. N., S.K. Sek and W.M.Har. (2012). "Interest Rate Pass-Through and Monetary Transmission in Asia." *International Journal of Economics and Finance*. Vol. 4, No. 2 pp 163-174

Takhtamanova, Y. (2008). "Understanding Changes in Exchange Rate Pass-Through." *Federal Reserve Bank of San Francisco Working paper* No. 2008-13. . (<http://www.frbsf.org/publications/economics/papers/2008/wp08-13bk.pdf>)

Thorbecke, W. (2009). "An Empirical Analysis of East Asian Computer Exports." *ADB Working Paper Series* No. 160.

Tiwari, A. and M. Shahbaz. (2011). "India's Trade with USA and her Trade Balance: An Empirical Analysis." ICFAI University Tripura. MPRA Paper No. 29023.

Umoru, D. and M.I. Eboime. (2013). "The J-Curve Hypothesis and The Nigerian Oil Sector: The ARDL Bounds Testing Approach." *European Scientific Journal*. Vol. 9. No 4.

- Verma, R. (2007). "Savings, Investment and Growth in India: an Application of the ARDL Bounds Testing Approach." *South Asia Economic Journal*. Vol. 8. No. 1 pp 87-98.
- Vigfusson, R.J., N. Sheets, and J. Gagnon. (2009). "Exchange Rate Pass-Through to Export Prices: Assessing Some Cross-Country Evidence." *Review of International Economics*. Vol. 17. No. 1. pp 17-33.
- Virmani, A. (2012). "India: A Potential High Growth Economy (HGE)?" *Review of Market Integration*. Vol. 4. Issue 2. pp 159-195.
- Virmani, A. and D. Hashim. (2011). "J-Curve of Productivity and Growth: Indian Manufacturing Post-Liberalization." IMF Working Paper 163.
- Wassink, D. and R. Carbaugh. (1989). "Dollar-Yen Exchange Rate Effects on Trade," *Revista Internazionale di Scienze Economiche e Commerciali*, Vol. 36, No. 12, pp. 1075-1088.
- WDI. (2013). "World Development Indicators." World Bank database.
- Webber, A. (1999). "Dynamic and Long Run Responses of Import Prices to the Exchange Rate in the Asia-Pacific." *Asian Economic Journal*. Vol. 13. No. 3. pp 303-20.
- Wickremasinghe, G. and P. Silvapulle (2004): "Exchange Rate Pass- Through to Manufactured Import Prices: The Case of Japan," *International Trade*, 0406006.
- Wijeweera, A. and B. Dollery. (2012). "Sectoral J-Curve Effects: Evidence from Australia." Paper presented at the Australian Conference of Economists, Melbourne (<http://ace2012.org.au/ACE2012/Documents/057.pdf>).
- Wilson, P. (2001). "Exchange Rates and the Trade Balance for Dynamic Asian Economies—Does the J-Curve Exist for Singapore, Malaysia, and Korea?" *Open Economies Review* . Vol. 12. Issue 4. pp 389–413.
- World Bank. (2011). "Migration and Remittances- Factbook 2011" Second Edition. The International Bank for Reconstruction and Development.
- Yang, J. (1997). "Exchange Rate Pass-Through into U.S. Manufacturing Industries", *Review of Economics and Statistics*, Vol. 79, pp. 95-104.
- Yang, J. (2007). "Is exchange rate pass-through symmetric? Evidence from US imports." *Applied Economics*. Vol. 39 No. 2. pp 169-178.

Zeileis, A., A. Shah and I. Patnaik. (2007). "Exchange Rate Regime Analysis Using Structural Change Methods." Department of Statistics and Mathematics Research Report No. 56 Wirtschaftsuniversität Wien.

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