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Abstract

There are strong a priori reasons to believe that monetary transmission may be weaker and less reliable in low- than in high-income countries. This is as true in India as it is elsewhere. While its floating exchange rate gives the RBI monetary autonomy, the country's limited degree of integration with world financial markets and RBI's interventions in the foreign exchange markets limit the strength of the exchange rate channel of monetary transmission. The country lacks large and liquid secondary markets for debt instruments, as well as a well-functioning stock market. This means that monetary policy effects on aggregate demand would tend to operate primarily through the bank-lending channel. Yet the formal banking sector is small, and does not intermediate for a large share of the economy. Moreover, there is evidence both that the costs of financial intermediation are high and that the banking system may not be very competitive. The presence of all of these factors should tend to weaken the process of monetary transmission in India.

This paper examines what the empirical evidence has to say about the strength of monetary transmission in India, using the structural vector autoregression (SVAR) methods that have been applied broadly to investigate this issue in many countries, including high-,middle-, and low-income ones. We estimate a monthly VAR with data from April 2001 to December 2014. Applying a variety of methods to identify exogenous movements in the policy rate in the data, we find consistently that positive shocks to the policy rate result in statistically significant effects (at least at confidence levels typically used in such applications) on the bank-lending rate in the direction predicted by theory. Specifically, a tightening of monetary policy is associated with an increase in bank lending rates, consistent with evidence for the first stage of transmission in the bank-lending channel. While pass-through from the policy rate to bank lending rates is in the right (theoretically-expected) direction, the passthrough is incomplete. When the monetary policy variable is ordered first, effects on the real effective exchange rate are also in the theoretically expected direction on impact, but are extremely weak and not statistically significant, even at the 90 percent confidence level, for any of the four monetary policy variants that we investigate. Finally, we are unable to uncover evidence for any effect of monetary policy shocks on aggregate demand, as recorded either in the industrial production (IIP) gap or the inflation rate. None of these effects is estimated with strong precision, which may reflect either instability in monetary transmission or the limitations of the empirical methodology. Overall, the empirical tests yield a mixed message on the effectiveness of monetary policy in India, but perhaps one that is more favourable than is typical of many countries at similar income levels.

Keywords: monetary policy, bank lending, exchange rate, interest rate, institutions

JEL Code: E5, E4, F4

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Monetary Transmission in Developing Countries: Evidence from India[1]

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ABSTRACT

There are strong *a priori* reasons to believe that monetary transmission may be weaker and less reliable in low- than in high-income countries. This is as true in India as it is elsewhere. While its floating exchange rate gives the RBI monetary autonomy, the country's limited degree of integration with world financial markets and RBI's interventions in the foreign exchange markets limit the strength of the exchange rate channel of monetary transmission. The country lacks large and liquid secondary markets for debt instruments, as well as a well-functioning stock market. This means that monetary policy effects on aggregate demand would tend to operate primarily through the bank-lending channel. Yet the formal banking sector is small, and does not intermediate for a large share of the economy. Moreover, there is evidence both that the costs of financial intermediation are high and that the banking system may not be very competitive. The presence of all of these factors should tend to weaken the process of monetary transmission in India.

This paper examines what the empirical evidence has to say about the strength of monetary transmission in India, using the structural vector autoregression (SVAR) methods that have been applied broadly to investigate this issue in many countries, including high-, middle-, and low-income ones. We estimate a monthly VAR with data from April 2001 to December 2014. Applying a variety of methods to identify exogenous movements in the policy rate in the data, we find consistently that positive shocks to the policy rate result in statistically significant effects (at least at confidence levels typically used in such applications) on the bank-lending rate in the direction predicted by theory. Specifically, a tightening of monetary policy is associated with an increase in bank lending rates, consistent with evidence for the first stage of transmission in the bank-lending channel. While pass-through from the policy rate to bank lending rates is in the right (theoretically-expected) direction, the pass-through is incomplete. When the monetary policy variable is ordered first, effects on the real effective exchange rate are also in the theoretically expected direction on impact, but are extremely weak and not statistically significant, even at the 90 percent confidence level, for any of the four monetary policy variants that we investigate. Finally, we are unable to uncover evidence for any effect of monetary policy shocks on aggregate demand, as recorded either in the industrial production (IIP) gap or the inflation rate. None of these effects is estimated with strong precision, which may reflect either instability in monetary transmission or the limitations of the empirical methodology. Overall, the empirical tests yield a mixed message on the effectiveness of monetary policy in India, but perhaps one that is more favourable than is typical of many countries at similar income levels.

I. Introduction

Monetary policy is the most actively used tool for macroeconomic stabilization in countries with independent currencies. Yet, as the Global Financial Crisis (GFC) has made manifest, the effectiveness of monetary policy in influencing aggregate demand varies with circumstances. This is as true from one country to another as it is at different times for the same country. To be effective, therefore, central banks pursuing an activist monetary policy (as would be true, for example, for any central bank that pursues some version of the Taylor Rule) therefore require at least an approximate – quantitative as well as qualitative -- understanding of the effectiveness of monetary transmission in the specific country and under the specific circumstances in which they operate.

Cross-country differences in the effectiveness of monetary transmission are likely to be important. As is well understood, the channels through which monetary policy affects aggregate demand depend on a country's financial structure. Relevant factors include the extent of the country's links with external financial markets, its exchange rate regime, the size and composition of its formal financial sector, the degree of development of its money, bond, and stock markets, the liquidity of its markets for real assets such as housing, and both the costs to its banks of doing business as well as the competitive environment in its banking sector. These characteristics differ significantly among countries.

These differences become especially dramatic when comparing high-income and low-income countries. As a consequence, there is no reason to expect that mechanisms of monetary transmission in low-income countries would be similar to those that have been found to operate in high-income ones. Indeed, in contrast with results for high-income countries, careful studies of the effectiveness of monetary transmission in low-income countries have often found monetary policy effects that are counterintuitive, weak, and/or unreliable.[2]

[2] See, for example, Mishra and Montiel (2013).

These issues are quite relevant for the case of India. Despite its size and relative economic success over the past two decades, India remains a lower middle-income country (by the World Bank's classification) with an institutional environment and domestic financial system not dissimilar from that of many countries at comparable income levels. Moreover, the Reserve Bank of India (RBI) recently implemented an inflation-targeting regime that requires it to hit publicly announced inflation targets. Effective monetary transmission is potentially crucial to the success of this regime. In the absence of effective and reliable links between the policy instruments controlled by the RBI and aggregate demand in the Indian economy the public may lack confidence that the RBI is able to deliver on its announced inflation target, making the target more difficult (and costly) to achieve.

The objective of this paper is to explore the effectiveness of these links in the Indian context, using the structural VAR methodology that has commonly been applied to investigate monetary policy effectiveness not only in advanced and emerging economies, but also in many low-income ones. A brief survey of the existing literature on India is provided in the Appendix. This paper focuses on the bank lending channel of monetary transmission, which is relatively less studied in the literature on India. Das (2015) is a recent study which also provides evidence on the bank lending channel of monetary policy transmission in India, though it focuses only on the first stage of the transmission process from monetary policy to lending rates, whereas we look at the transmission of monetary policy not only to lending rates, but also to ultimate target variables such as output and inflation.

We estimate a monthly VAR with data from April 2001 to December 2014. Applying a variety of methods to identify exogenous movements in the policy rate in the data, we find consistently that positive shocks to the policy rate result in statistically significant effects (at least at confidence levels typically used in such applications) on the bank-lending rate in the direction predicted by theory. Specifically, a tightening of monetary policy is associated with an increase in bank lending rates, consistent with evidence for the first stage of transmission in the bank-lending channel. While pass-through from the policy rate to bank lending rates is in the right (theoretically-expected) direction, pass-through is incomplete. When the monetary policy variable is ordered first, effects on the real effective

exchange rate are also in the theoretically expected direction on impact, but are extremely weak and not statistically significant, even at the 90 percent confidence level, for any of the four measures of monetary policy that we investigate. Finally, we are unable to uncover evidence for any effect of monetary policy shocks on aggregate demand, as recorded either in the industrial production (IIP) gap or the inflation rate. None of these effects are estimated with strong precision, which may reflect either instability in monetary transmission or the limitations of the empirical methodology.

The rest of the paper is organized as follows. Section II reviews India's financial architecture, with the objective of identifying key components of that architecture that are likely to affect the monetary transmission mechanism. As indicated above, such components include the strength of linkages between the domestic and foreign financial markets and the evolution of the country's exchange rate regime, as well as the size and composition of the formal financial sector. These characteristics of the Indian economy constitute the context in which monetary transmission operates in the country. Section III describes the evolution of monetary policy in India. The purpose of the discussion in this section is to provide guidance in the selection of monetary policy instruments to be used in the empirical work, as well as to indicate the types of variables to which the RBI has responded in setting the values of that instrument (RBI's reaction function). Section IV discusses the empirical methodology, and the variety of issues concerning the specification of the VAR from which the dynamic responses of several macroeconomic variables to monetary policy shocks will be estimated. Section V presents the estimation results in the form of impulse responses. Section VI concludes. An appendix presents a brief review of the literature on India.

II. Capital Account Regime, Exchange Rate Regime, and Domestic financial Structure

As indicated above, the effectiveness of monetary transmission in any country depends on a variety of characteristics of its economy. These are usefully classified into macroeconomic and microeconomic factors. Macroeconomic factors include the economy's degree of

integration with external financial markets as well as its exchange rate regime, and microeconomic factors refer specifically to the structure of its financial system. This section describes the roles of both factors in the Indian economy.

Macroeconomic factors

A standard approach in macroeconomic modeling --- at least until the current international financial crisis – has been to assume away financial frictions in the domestic economy, so that returns on all domestic interest-bearing assets (that is, on all assets but money) are assumed to be perfectly arbitraged – i.e., risk-adjusted returns are equalized among all domestic nonmonetary assets. Under these circumstances, all nonmonetary assets can be treated as perfect substitutes. In this case, the effectiveness of monetary transmission depends only on macroeconomic factors, in the form of the degree of integration between domestic and foreign financial markets and the exchange rate regime.

The "impossible trinity" of Mundell provides the main result: with fixed exchange rates, the effectiveness of monetary policy *decreases* as the degree of integration between domestic and foreign financial assets increases. In the limit, with perfect integration, monetary policy has no effect on aggregate demand. Under floating rates, on the other hand, monetary policy is transmitted to aggregate demand through two channels: through domestic interest rates (which affect the overall level of absorption) and through the exchange rate, which affects the composition of absorption between domestic and foreign goods. In this case, as the degree of financial integration increases, the power of monetary policy to affect aggregate demand *increases* with it. The reason is that increased integration implies a reduced scope for monetary policy to create rate-of-return differentials between domestic and foreign assets. This means that a given policy-induced change in the domestic interest rate must create a larger offsetting expected change in the exchange rate (i.e., an expected depreciation of the domestic currency in response to an increase in the domestic interest rate, and an expected appreciation in response to a decrease) the greater the degree of financial integration. Holding the expected future exchange rate constant, the exchange rate must depreciate today in order to create the expectation of an appreciation tomorrow,

and it must appreciate today in order to create the expectation of depreciation tomorrow. Since increases in domestic interest rates are therefore associated with exchange rate appreciations, while decreases are associated with depreciations, these exchange rate changes reinforce the effects of policy-induced interest rate changes on aggregate demand. The upshot is that the higher the degree of financial integration, the greater the extent to which exchange rate changes reinforce the effects of interest rate changes on aggregate demand, and therefore the stronger the monetary transmission mechanism.

To form an *ex ante* expectation of the strength of monetary transmission in India, we therefore begin by considering its economy's degree of financial integration with the rest of the world, as well as its exchange rate regime.

International Financial Integration

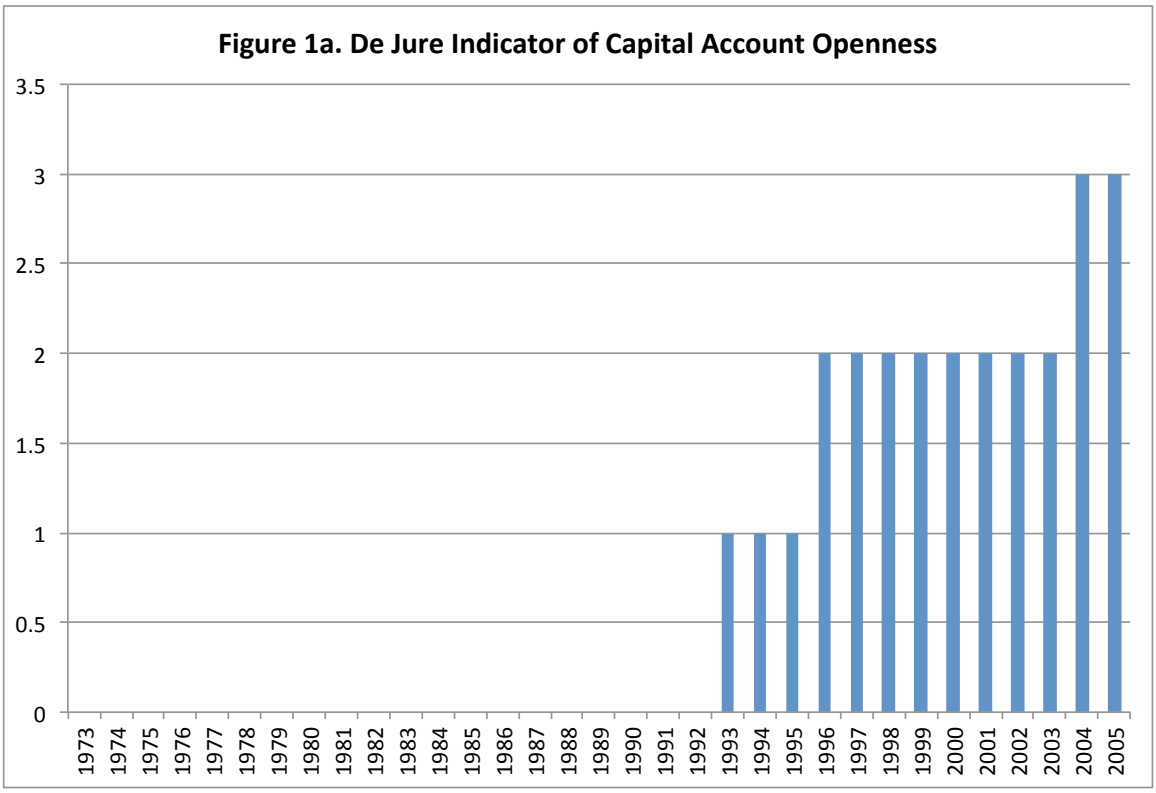
Capital account liberalization in India has taken place in a gradual and calibrated manner. It has been a continuous process rather than a one off event (Sen Gupta and Sengupta, 2014). India prioritized certain kinds of flows in the liberalization process (Reddy, 2008 and Mohan and Kapur, 2009). In particular, the liberalization process favoured non debt flows such as FDI and portfolio investment over debt flows. Currently, barring a few sectors, FDI is universally allowed. Some of the sensitive sectors such as banking and insurance are subject to caps.

Portfolio flows have also witnessed significant liberalization, although there exist separate investment caps on sub accounts of foreign institutional investors (FIIs), individual FII and aggregate FII investment in a company. In contrast, debt flows are subject to numerous restrictions including borrowers and lenders having to satisfy eligibility conditions, minimum maturity period, cap on all-in-cost payments made by corporates as well as end-use restrictions.

The calibrated approach towards liberalization is reflected in the steady increase in India's extent of financial integration with the rest of the world. Yet India has not kept pace with other emerging markets. The extent of capital account liberalization has been primarily

determined using two kinds of measures. The first set of measures looks at the *de jure* openness, and focuses on laws governing the movement of capital in and out of the country.

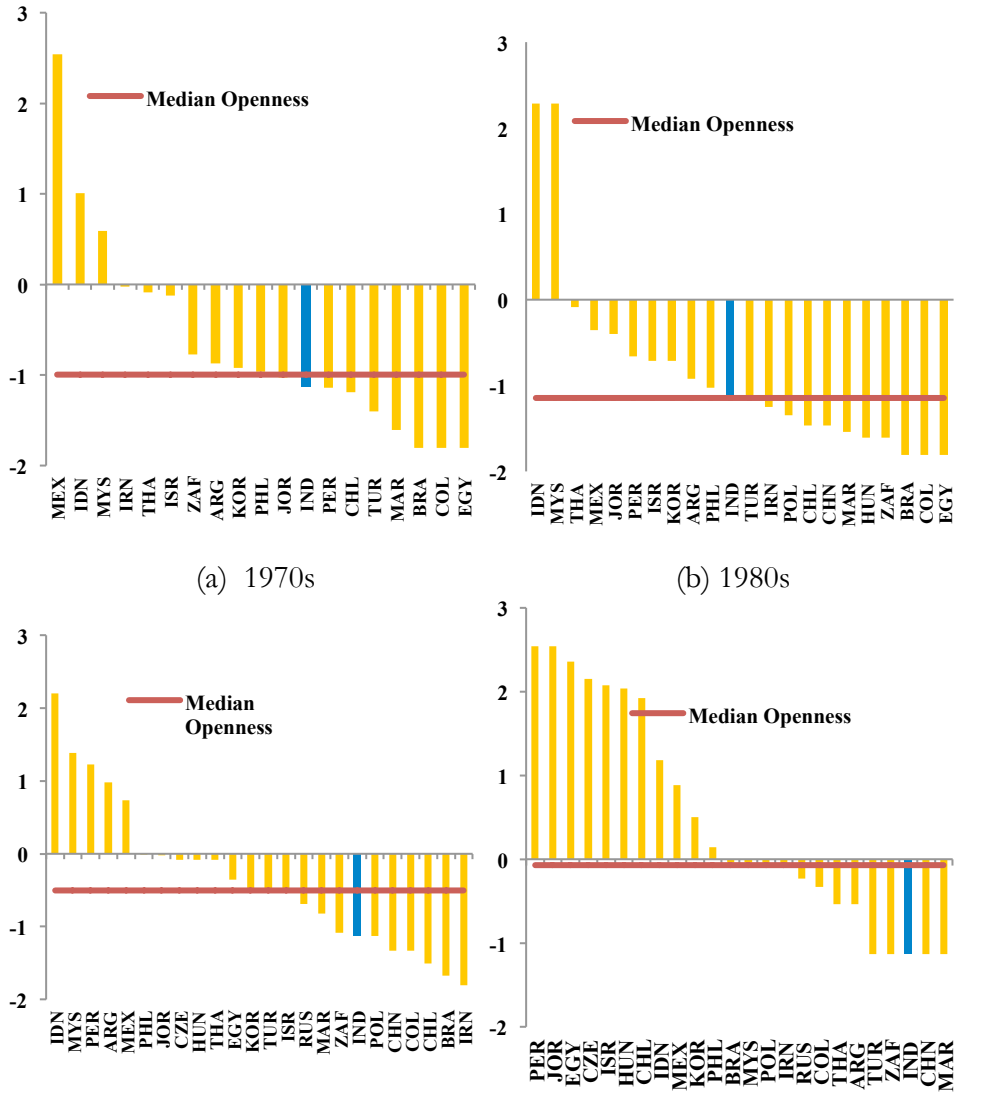
A well-known index of *de jure* capital account restrictions was constructed by Abiad and others (2008) and is presented for India in Figure 1a. The index is constructed on the basis of information in the IMF's *Annual Report on Exchange Rate Arrangements and Exchange Restrictions,* and increases as the capital account becomes more liberalized. The index finds a step change in India's capital account regime in 1993, followed by another step change in 1996; and another one in 2004.



However, another commonly used index of capital account openness is the Chinn-Ito index –is static for India between 1970 and 2012, with a value of -1.18 and does not capture any capital account liberalization that took place since the early 1990s. For comparison, the index takes a value of 2.54 for the US over the entire period. Figure 1b looks at the degree of *de jure* capital account openness index developed in Chinn and Ito (2008) across emerging markets. It is evident that over the last 40 years, on average, there has been an increase in the extent of capital account openness, reflected in the upward shift of the median line. However, India has not liberalized at the same pace as the average emerging

market, as a result of which it has shifted from being in the middle of the distribution of countries, ranked according to their openness, during the 1970s and 1980s, towards the more restrictive end of the spectrum in the last two decades (Sen Gupta and Sengupta, 2014).

Figure 1b: Cross Country Comparison of De Jure Openness



(a) 1970s (b) 1980s

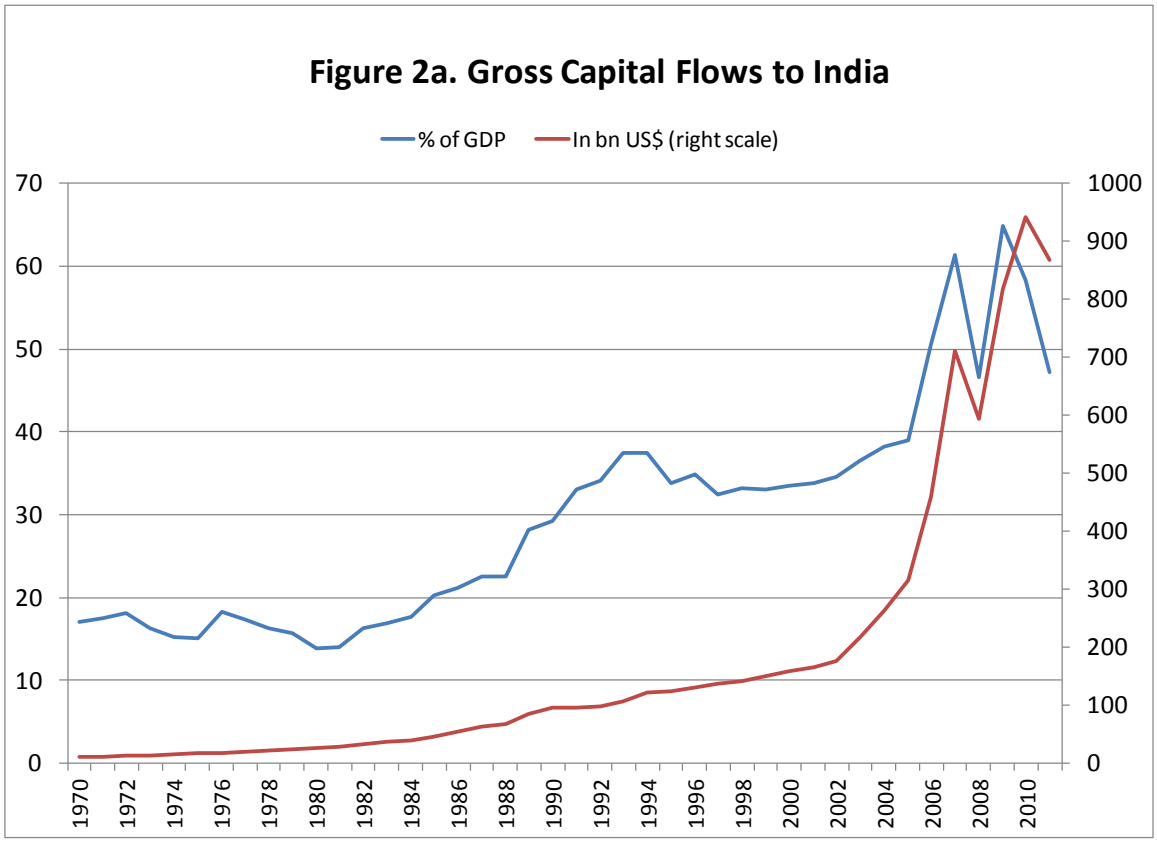
(c) 1990s (d) 2000s

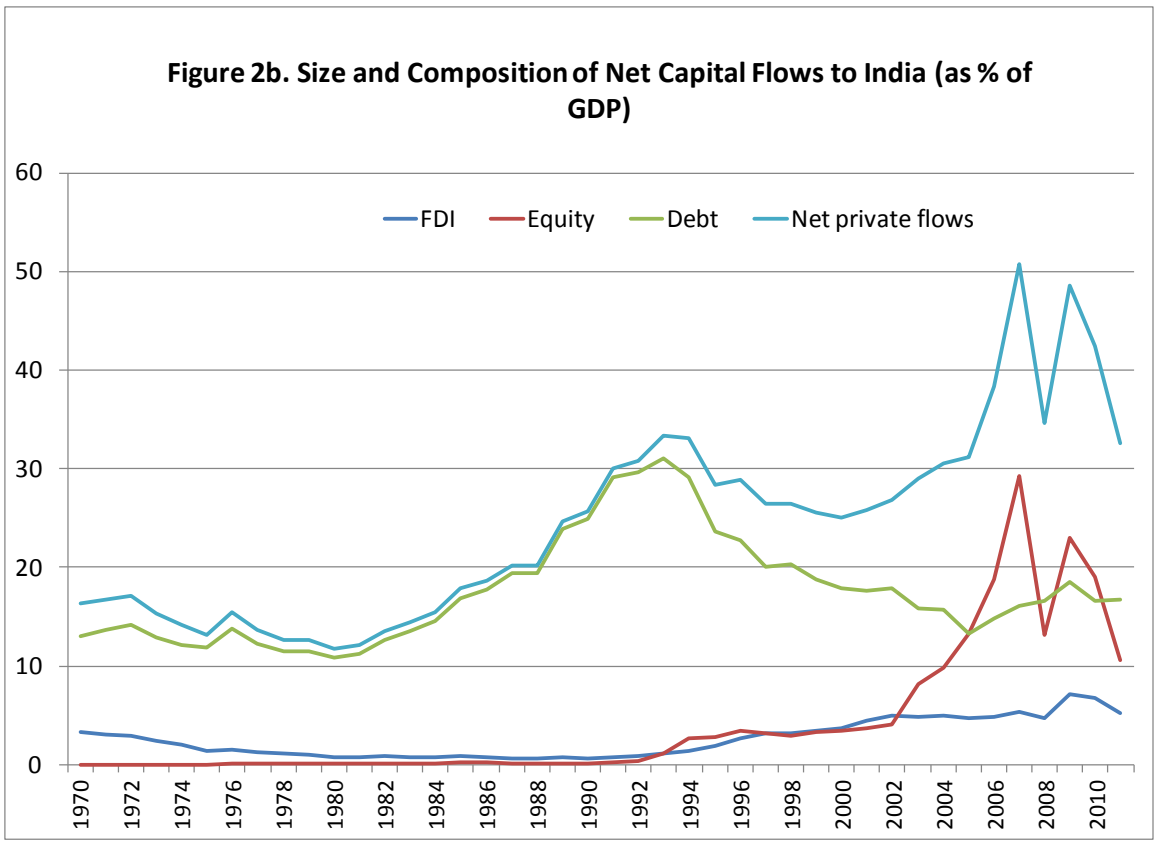
Source: Chinn and Ito (2008)

However, financial integration requires more than the absence of *de jure* restrictions on capital movements. The existence of *de jure* regulations often does not accurately capture the actual level of financial integration as they depend critically on the effectiveness of the

enforcement and macroeconomic fundamentals. A country with strict controls but lax enforcement can experience large private capital flows. Alternately, a country with an extremely liberal capital account regime can witness limited flows due to limited opportunities for economic returns. Therefore it is important to look at de facto, or outcome-based measures of financial integration, which are calculated as the sum of gross flows or gross stocks of foreign assets and liabilities as a ratio of GDP.

Figures 2a and 2b examine the size and composition of capital flows into the country. The evolution of gross capital flows over the last five decades is shown in Figure 2a. It increased 81 times between 1970 and 2011. The real takeoff in value terms seems to have taken place in the early 2000s. As a percent of GDP, gross flows increased from 17 percent in 1970 to more than 60 percent before the global financial crisis, falling to 47 percent in 2011. Capital flows increased substantially in net terms as well. While debt flows decreased, equity flows increased as a percent of GDP since the early 1990s. FDI flows have also increased though at a much slower pace than equity.



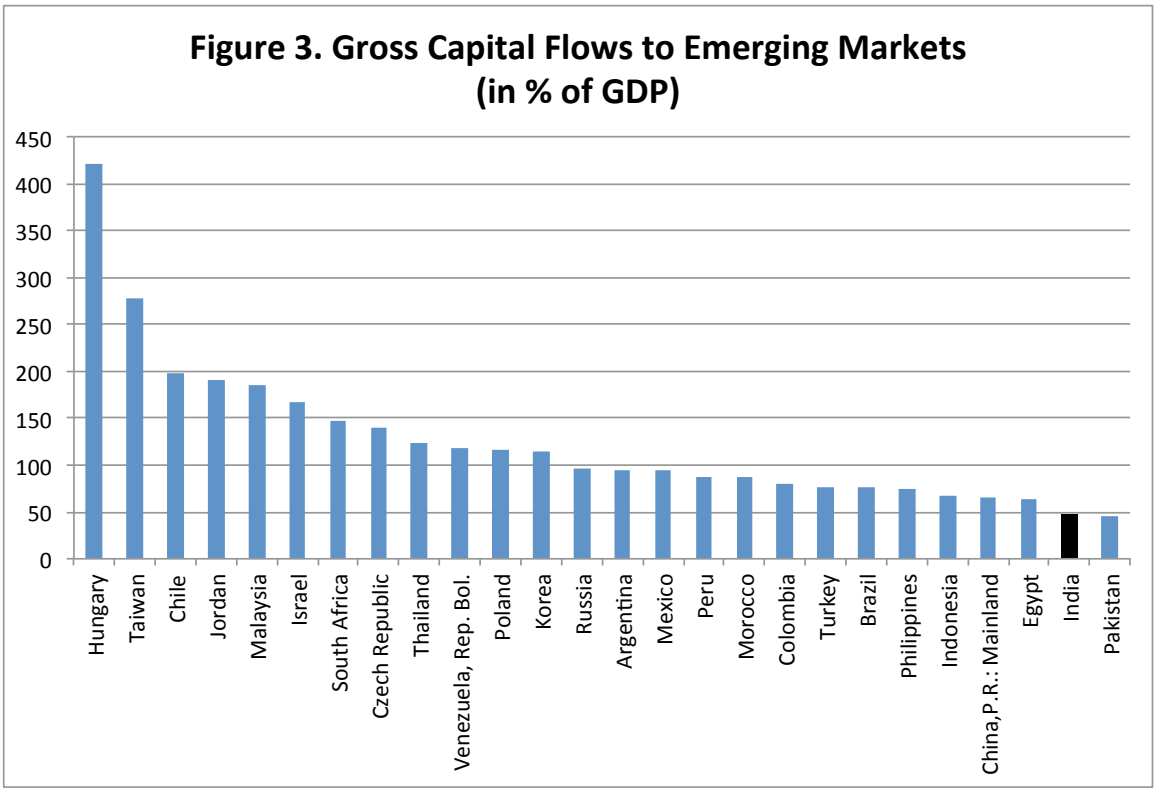


Despite the sharp increase in capital flows over the last five decades, India still has a relatively closed capital account in *de facto* terms, compared to other emerging markets. In all, gross capital flows to India in 2011 were 47% of GDP. As can be seen in Figure 3a, this is substantially lower than in most emerging markets, with the exception of Pakistan.[3]

Overall, therefore, while India has progressively liberalized the de jure restrictions on its capital account since 1991 and while de facto indicators also suggest increased financial openness – especially on the equity side – both in de-jure and in de facto terms India still enjoys only a limited degree of integration with international financial markets compared to other emerging economies.[4]

[3] Emerging market economies are those that are included in the Morgan Stanley Capital International (MSCI) index. As pointed out by an anonymous referee, scaling gross capital flows by GDP may not be ideal as GDP is affected by business cycles. In order to address this issue, we look at the measure averaged over 5 years and get a similar picture.

[4] This finding is also consistent with other work on India such as Ghosh, Qureshi, and Jang (2016). They argue that "India's capital account restrictions-which are mostly quantitative



Notes. Figures 3 is for 2011.

Exchange rate regime

India's de jure exchange rate regime has been classified as "managed floating" in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions since 2009. Effective February 2, 2009, the classification of the de facto exchange rate arrangement was changed from "managed floating with no predetermined path for the exchange rate" to "floating", retroactively to April 30, 2008, due to a revision of the classification methodology.[5]

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rather than price based-appear to have been largely effective in limiting both inward and outward flows."

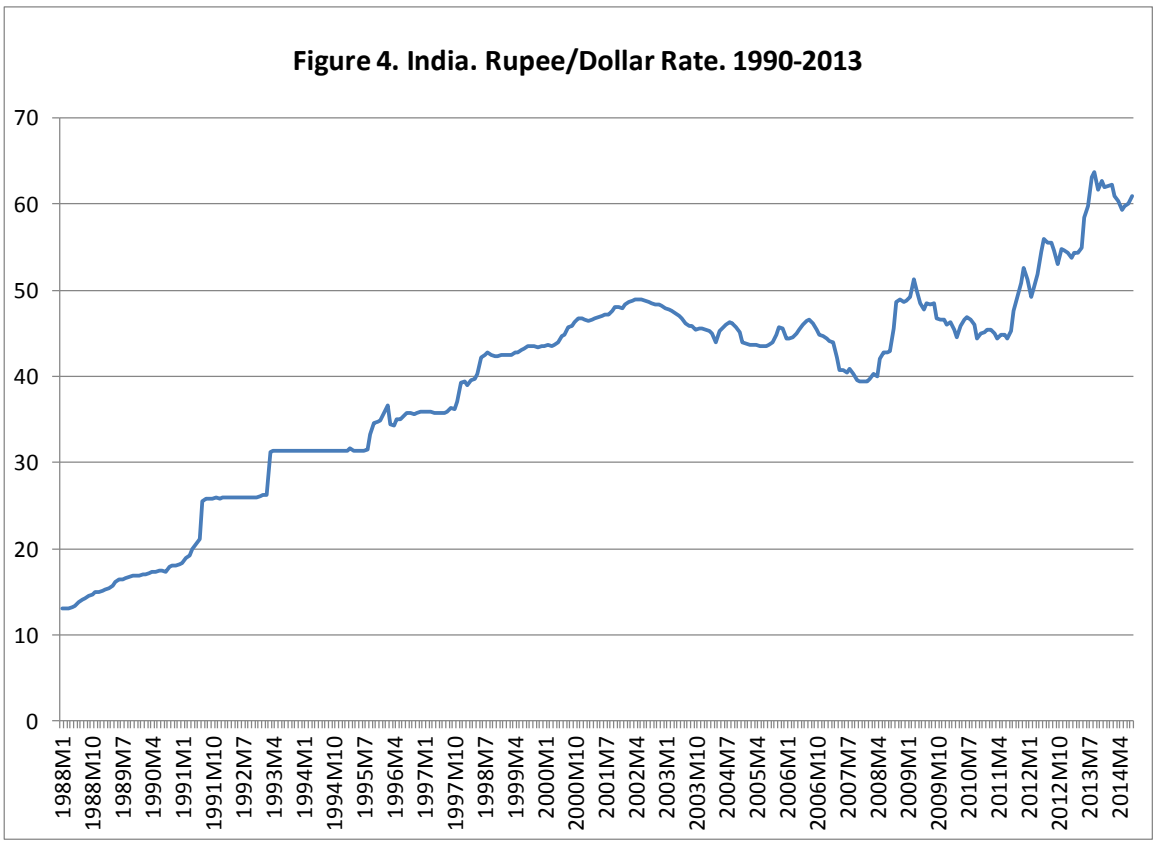
[5] The change reflects only a methodological modification and does not imply a judgment that there has been a substantive alteration in the country's exchange arrangement or other policies.

The exchange rate of the rupee is determined in the interbank market. Though the RBI periodically intervenes in that market, buying and selling both spot and forward dollars at the market exchange rate, its interventions are designed to reduce volatility in the market rather than to target any specific exchange rate. As shown in Figure 4 below, the rupee-dollar rate has displayed substantial volatility since 2008, when the exchange rate was classified as floating. in short, the behaviour of the rupee-dollar rate passes a simple eye-ball test as a floating rate.[6]

Thus, the evidence suggests that the effectiveness of monetary transmission has not been undermined by a loss of monetary autonomy in India. While *de jure* capital account restrictions have been relaxed since early 1990s and capital flows have indeed grown, both gross and net capital flows remain small relative to other emerging markets. Using other emerging markets as a benchmark, therefore, India still appears to exhibit a limited degree of integration with international financial markets. Coupled with evidence that the country has maintained a floating exchange rate regime, we conclude that macroeconomic factors have not undermined monetary autonomy in India.

However, this does not necessarily imply that macroeconomic factors favour strong monetary transmission in India. Given the country's floating exchange rate, its limited degree of integration with international financial markets would tend to weaken the exchange rate channel of monetary transmission that typically supplements the interest rate channel under floating exchange rates.

[6] Sen Gupta and Sengupta (2014) use the methodology introduced by Frankel and Wei (1994) to create an index of exchange rate stability for India. They also find that exchange rate felxibility went up significantly since the global financial crisis.



This suggests that, relative to other emerging economies more of the burden of monetary transmission is likely to fall on the interest rate channel in India. This naturally raises the question of whether the structure of the Indian financial system is consistent with effective monetary transmission through interest rate effects.

Structure of the domestic financial system

The key issues are three (Mishra, Montiel, and Spilimbergo, 2012)

- The size and reach of the system.

Specifically, how important is the formal financial system in the Indian economy – i.e., how much financial intermediation in India actually occurs through the formal financial system? Since monetary policy operates through the terms on which the financial system conducts formal intermediation, the larger the system and the more it dominates the process

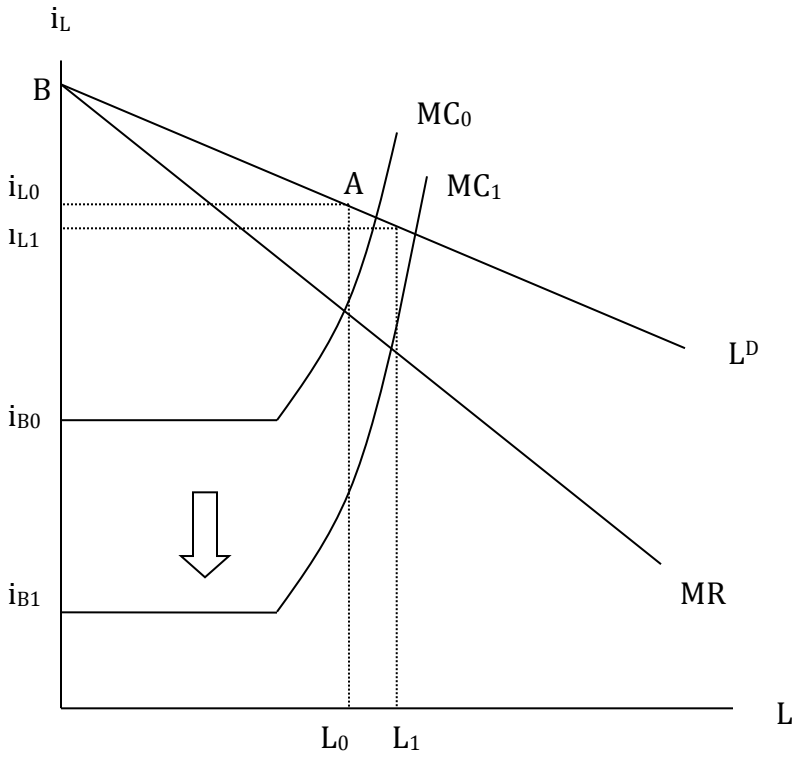
of financial intermediation in India, the larger the impact that monetary policy is likely to have on the Indian economy.

- The magnitude of financial frictions.

Financial intermediation is a costly activity because of the importance of asymmetric information and costly contract enforcement in financial transactions. These frictions require financial intermediaries to incur a variety of costs (loan evaluation costs, monitoring costs, and contract enforcement costs). The magnitude of those costs depend on the quality of the domestic institutional environment (the security of property rights, the quality and enforcement of its accounting and disclosure standards as well as of its bankruptcy laws, and the efficiency of the domestic legal system), as well as on the characteristics of domestic borrowers (specifically their collateralizable net worth and opacity).

These considerations have implications for the shape of the marginal cost of lending for financial intermediaries in low-income countries. The production structure in many developing countries tends to be dualistic, with the economy consisting of a small number of large and transparent firms with significant collateralizable net worth and a large number of small, opaque enterprises with little collateralizable net worth. Under these conditions, the marginal cost of lending tends to be relatively flat over the range of lending to large firms and then to quickly become very steep when lending is extended to smaller firms. Figure 5 illustrates this situation. The figure depicts a profit-maximizing equilibrium for a financial intermediary possessing some monopoly power and operating in a low income-type environment. Its marginal cost curve MC_0 has a flat range corresponding to loans extended to large, relatively transparent firms, but then a sharply rising range when the intermediary extends its lending to small and opaque borrowers. When the marginal cost curve has this shape, changes in the opportunity cost of funds to financial intermediaries, such as those caused by monetary policy, may shift the marginal cost curve vertically (e.g., in the case of a monetary expansion, to MC_1 in Figure 5), but have little effect on the total supply of funds and therefore on the terms offered by financial intermediaries, weakening the power of monetary policy to affect the economy.

Figure 5. Financial Frictions, Monopoly Power, and Monetary Transmission



- The degree of competition in the formal financial sector.

For a given shape of the marginal cost of lending curve for each financial institution, the less competitive the financial sector (the steeper the demand curve facing each individual financial intermediary), the less responsive the supply of funds will be to changes in monetary policy. The reason is that steep demand curves are associated with steep marginal revenue curves, and since firms with monopoly power maximize profits by setting marginal revenue equal to marginal cost, the steeper the marginal revenue curve facing an individual financial intermediary, the less responsive its supply of lending to the private sector will be to a change in its marginal cost of lending caused by a change in monetary policy.

To see this, imagine rotating the loan demand curve L^D in a clockwise direction around the point A in Figure 5. Doing so makes the loan demand curve steeper, decreasing its elasticity and increasing the bank's degree of monopoly power. As L^D become steeper, the point B moves vertically upward along the vertical axis, and MR becomes steeper as well.

Consequently, the profit-maximizing points of intersection between marginal revenue and marginal cost move to the southwest along their respective marginal cost curves MC_0 and MC_1. The effect is to narrow the horizontal distance between those points, thereby reducing the expansion of the bank's loans for a given reduction in its opportunity cost of funds.

How relevant might these considerations be for India? As mentioned previously, the institutional environment in which financial intermediaries operate – the security of property rights, the efficiency and impartiality of the legal system, the adequacy of accounting and disclosure standards – has strong effects on the costs of overcoming financial frictions, especially for lending to smaller and more opaque borrowers. Direct measures of these factors are not available, but since they are all particular aspects of a country's general institutional environment for the conduct of economic activity, more general indicators of such institutional quality are likely to be correlated with them. Table 1 reveals where India ranks compared to other countries in terms of such indicators.

Table 1. India: Indicators of Institutional Quality

Indicator	Percentile rank
Rule of Law	52.61
Government Effectiveness	47.37
Regulatory Quality	33.97
Control of Corruption	34.93
Voice and Accountability	58.29
Political Stability and Absence of Violence/Terrorism	11.85

Notes: These figures are for 2012.

While not all of the indicators listed in the table are of equal relevance for the costs of doing financial business in India, the key point that emerges from the table is that India does not rank significantly above the median on most of the indicators listed. Particularly worrisome is India's low ranking in the areas of regulatory quality and control of corruption, where it ranks at the 33rd percentile. This suggests that the types of government-provided public goods on which the financial system depends (enforcement of property rights, of accounting and disclosure standards, of legal contracts) may not be as readily available in India as in

some other countries. The relative scarcity of such public goods would tend to make financial intermediation a costly activity.

There are two implications of high-cost intermediation for the likely effectiveness of monetary transmission. The first is based on the resulting small size of the formal financial sector. To the extent that monetary policy actions affect only the share of the economy that is served by the formal financial sector, the small size of that sector limits the reach of monetary policy, thus reducing its impact on the economy. The second is that costly intermediation likely implies a sharply rising marginal cost of intermediation as banks try to serve smaller and more opaque borrowers, so even for the share of the economy that is served by the formal financial sector, central bank actions may have weak effects on the supply of bank lending.

Is this borne out by the structure of India's financial system? Some of the relevant data are presented in Table 2, which compares some characteristics of the Indian financial system with those in high, middle, and low-income countries.

Table 2. India. Indicators of Financial Development

	Advanced	Emerging	Low-income	India
Deposit money bank assets to GDP (%)	149.8	76.1	41.2	64.0
Non-bank financial institutions assets to GDP (%)	140.5	36.2	14.4	0.0
Private credit by deposit money banks and other financial institutions to GDP	138.5	67.7	33.8	46.3
Bank branches per 100,000 adults (commercial banks)	36.4	21.2	13.1	10.6
Stock market capitalization to GDP (%)	90.3	82.4	26.8	58.5
Number of listed companies per 10,000 people	34.7	21.4	24.1	4.2
Stock market turnover ratio (value traded/capitalization) (%)	68.6	60.5	7.1	57.4

Source. Mishra, Montiel and Spilimbergo (2012), and Global Financial Development Database. All figures are for 2011, except stock market capitalization, which is for 2005.

A first important observation is that, as shown by the last three rows of Table 2, the stock market plays a relatively limited role in India, particularly compared to advanced economies. While the market appears to be relatively liquid compared to other low-income countries (the turnover ratio in the Indian market is much higher than LICs, and comparable to emerging economies), very few companies are listed in the market, and total market capitalization is significantly lower than that in both advanced and emerging economies. Note that the number of listed companies per 10,000 people in India is not only significantly lower than in high-income countries, but at 4.2 it is even lower than the average for all LICs

(23.3). This has the important implication that the asset channel of monetary transmission, which operates through monetary policy effects on the price of marketable financial (and real) assets, is unlikely to be strong in India.[7]

This means that if changes in policy interest rates are to have important effects on aggregate demand in India, those effects are likely to have to operate through the lending rates charged to their customers by formal financial intermediaries. But how important is the role of such intermediaries in the Indian economy? Consistent with financial intermediation being a costly activity in India, the reach of the formal financial system appears to be significantly less extensive than that in emerging and advanced economies. In total size as measured by conventional indicators, (such as the ratio of deposit bank assets and the assets of nonbank financial institutions to GDP, the ratio of private credit from formal financial institutions to GDP, the number of bank branches scaled by population, or the fraction of adults with accounts at formal financial institutions) the formal financial system is relatively small in India.[8] In terms of the reach of its formal financial sector, it is therefore clear that India operates in a very different domestic financial environment than that which tends to characterize advanced and emerging economies.

While the small size of the formal financial sector in India should be expected to weaken the links between lending rates in that sector and total Indian aggregate demand, limited competition in the banking sector may in turn weaken the links between policy rates and formal sector lending rates, as shown in Figure 5. There are several indications that the banking sector in India is highly concentrated. First, a striking feature of the Indian financial

[7] India also lags behind advanced and emerging economies in developing its long-term corporate debt market. Bank finance, equity markets and external borrowings are the preferred funding sources for companies. The size of the corporate debt market is very small. In 2000-01, banks in India accounted for 14.4% of the financing of large firms and this increased to 17.8% in 2010-11. On the other hand, bond market financing accounted for only 3.5% of the source of funds of large Indian companies in 2000-01, and this increased only marginally to 3.9% a decade later (Banerji et al, 2012). The long-term debt market in India consists largely of government securities. In 2011, the size of the Indian corporate bond market in terms of outstanding issuances was INR 8,895 billion, only 31% of government securities (SEBI, 2012; Anand and Sengupta, 2014).

[8] See also Banerjee et. al. (2003), and Burgess and Pande (2005), who establish that the formal reach of bank finance is limited in India. In a similar vein, Allen et. al. (2009) show that most Indian firms rely on financing by friends or family members and the extent of avoiding formal financial markets is even more prevalent than Chinese or other counterparts in emerging market economies.

system is that it is dominated by public sector banks. Based on IMF (2013), public sector banking assets constitute close to three-quarters of the total banking sector assets, and 43 percent of total financial sector assets. Second, banks' net interest margin is quite high in India. This may in part be due to the high costs of financial intermediation in the country. That this may not be the sole reason for the high spreads, however, is suggested by the fact that returns to equity in the Indian banking sector are high, not only by the standards of high-income countries, but also by those of LICs.[9]

In short, microeconomic factors pertaining to the structure of the country's domestic financial system suggest that a) a relatively small share of the Indian economy may be affected by the impacts of monetary policy on the formal financial system, and b) those impacts may themselves be limited by sharply rising costs of lending to the private sector at the margin, as well as by imperfect competition in the banking sector.

III. Monetary policy instruments in India

While these considerations create *ex ante* reasons to suspect that the power of monetary transmission may be limited in India, the issue is ultimately an empirical one. A key step in any empirical investigation of this issue is to identify monetary policy shocks (exogenous changes in monetary policy) in the data, in order to examine their effects. To do so, we need both to determine which monetary policy variable the RBI has been controlling as well as to separate out endogenous movements in this variable from exogenous ones.

A complicating factor in this regard is that the evolution of monetary policy in India has historically been characterized by the use of multiple instruments. Two broad groups of instruments have been used by to conduct monetary policy: (i) price-based instruments that affect the cost of funds for banks, in the form of the: repo rate and the reverse repo rate, and (ii) quantity based instruments, which directly affect the volume of lending by banks, in the form of the cash reserve ratio (CRR) and the statutory liquidity ratio (SLR).

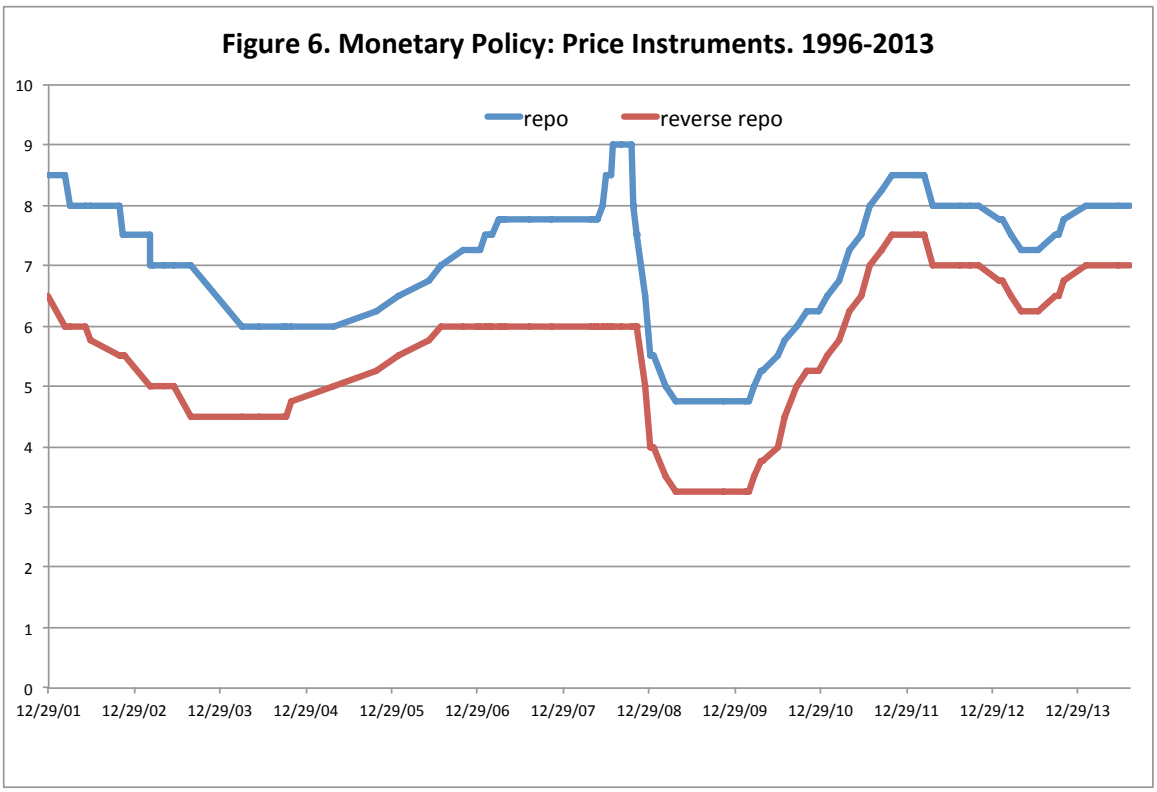
Price based instruments: Repo and reverse repo

[9] Note that the financial sector in India also includes Non-Bank Financial Companies (NBFCs). Based on IMF (2013), there are 578 NBFCs, much larger than the number of banks, but they comprise only 6.5% of total financial sector assets, and 8.7% of GDP. The NBFCs are therefore more likely to be competitive than the banking sector.

Since 2001, the RBI has conducted monetary policy through the Liquidity Adjustment Facility (LAF), which allows banks to borrow money through repurchase agreements. LAF consists of repo and reverse repo operations. Repo (for "repurchase option") is essentially collateralized lending to banks -- i.e., banks borrow money from the RBI to meet short-term needs by selling securities to RBI with an agreement to repurchase the same at a (higher) predetermined price at a specified future date. The rate charged by RBI for this transaction, implied by the difference between the repurchase and selling prices, is called the repo rate. Repo operations therefore inject liquidity into the system. An increase in the repo rate raises the rate RBI charges for lending to banks, reduces liquidity (or the rate of injection of liquidity) in the system, and therefore constitutes tightening of monetary policy. A reverse repo operation occurs when the opposite transaction takes place: the RBI borrows money from banks by lending securities, and therefore absorbs liquidity from the system. The interest rate paid by RBI is in this case is called the reverse repo rate. An increase in the reverse repo rate increases the incentives for banks to park funds with the RBI, and represents a tightening of monetary policy. The collateral used for repo and reverse repo operations takes the form of Government of India securities.

Repo and reverse repo rates were announced separately until May 2011. Since then, the reverse repo rate is not announced separately, but is linked to the repo rate. The liquidity adjustment facility corridor -- that is, the excess of repo rate over reverse repo -- has varied between 100 to 300 basis points. This corridor is used to contain volatility in short-term interest rates.

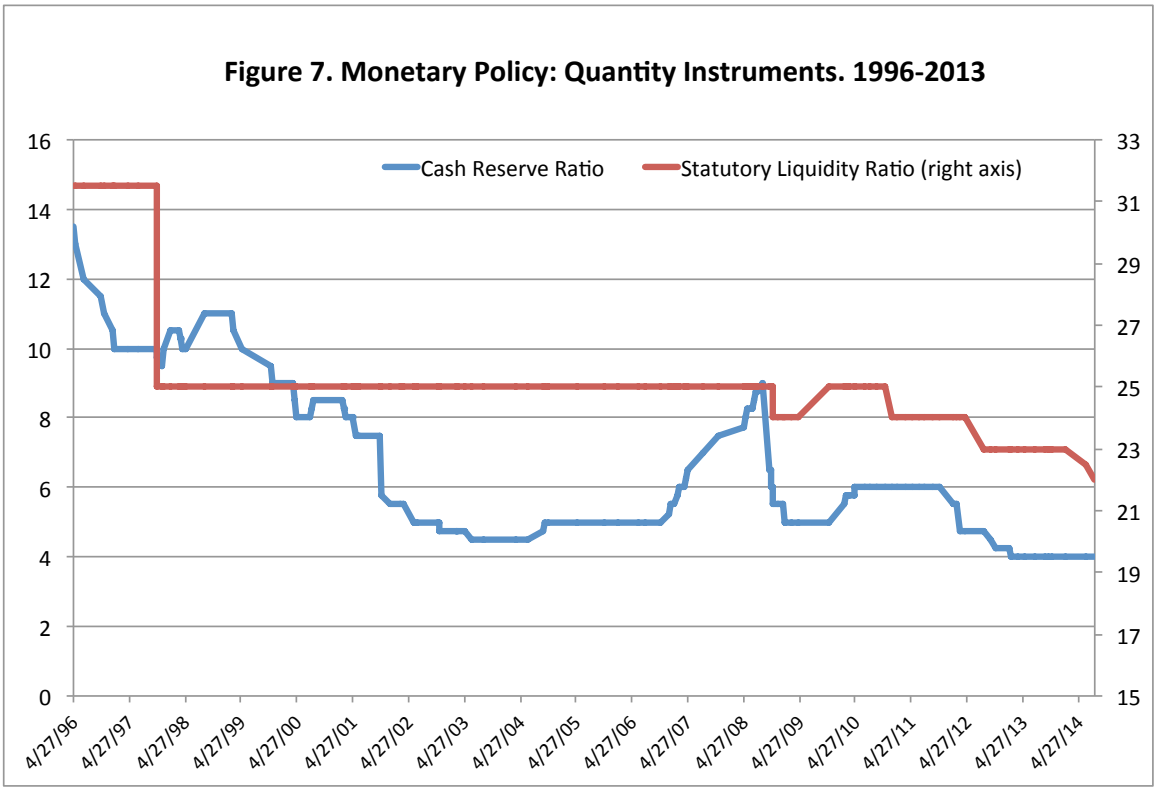
Currently, the width of the corridor is 100 basis points. The evolution of repo and reverse repo rates since 2001 is shown in Figure 6. Both have typically moved in the same direction, indicating that they have effectively functioned as a single instrument over most of the sample, establishing a corridor for short-term interest rates. Importantly, there exists significant variation in the repo and reverse repo rates over time, which allows us to identify the effect of monetary policy on bank lending.



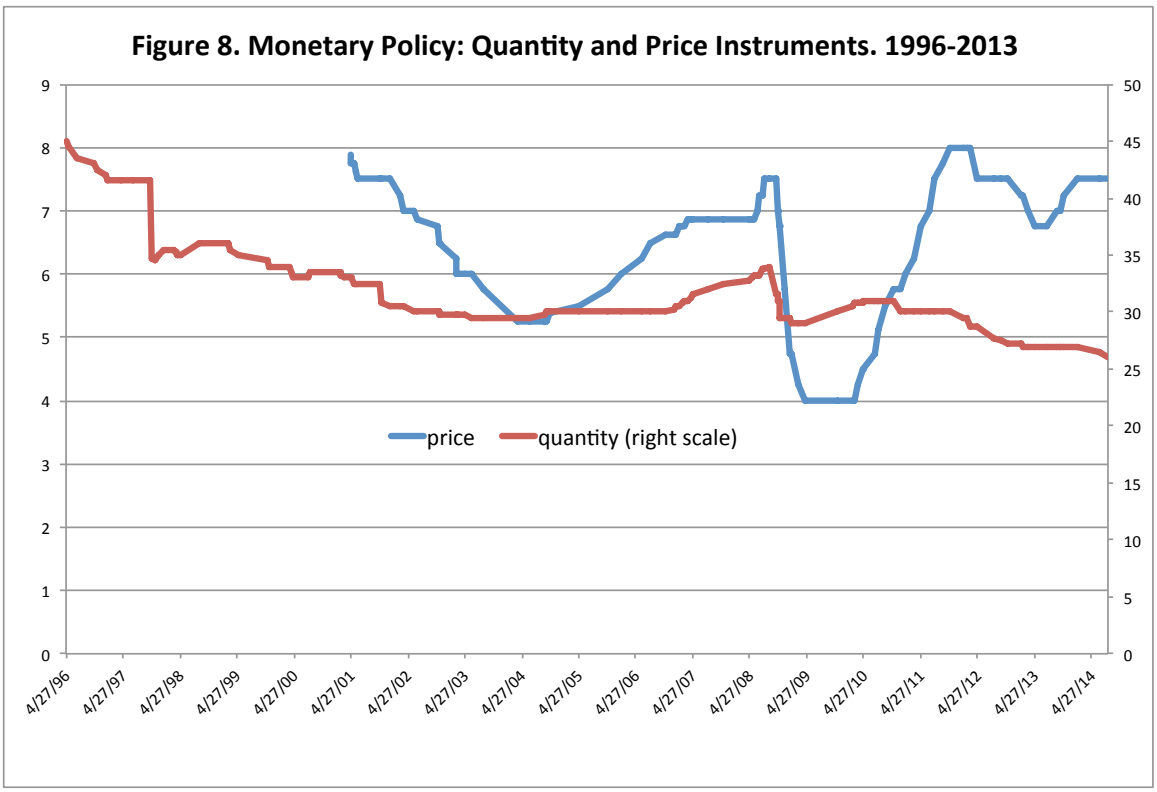
Quantity based instruments: CRR and SLR

CRR is a certain fraction of bank deposits which banks are required to keep with RBI in the form of reserve balances. An increase in CRR directly reduces the volume of resources that banks have available to lend, and therefore constitutes a tightening of monetary policy. In addition to CRR, at each point in time every bank has to maintain a certain quantity of liquid assets expressed as a fraction of their net time and demand liabilities. These assets can be maintained in the form of cash, gold, or as unencumbered "approved" securities. In practice, they are predominantly held in the form of government securities. The ratio of these liquid assets to time and demand liabilities is called the Statutory Liquidity Ratio (SLR). A reduction in SLR, for example, increases the resources that banks have available to lend, and therefore constitutes "loosening" of monetary policy. SLR declined sharply from 31.5% to 22% between 1996 and 2013 (Figure 7). There was a sharp decline in SLR to 25% in 1997; and then it stayed flat till 2008, before beginning to decline again. CRR has exhibited more fluctuations, but has also declined from 14% to 4% between 1996 and 2013. Combining

both CRR and SLR, about half of commercial banks' liabilities were withheld from lending to the private sector in 1996; this figure has reduced to a quarter in 2013.

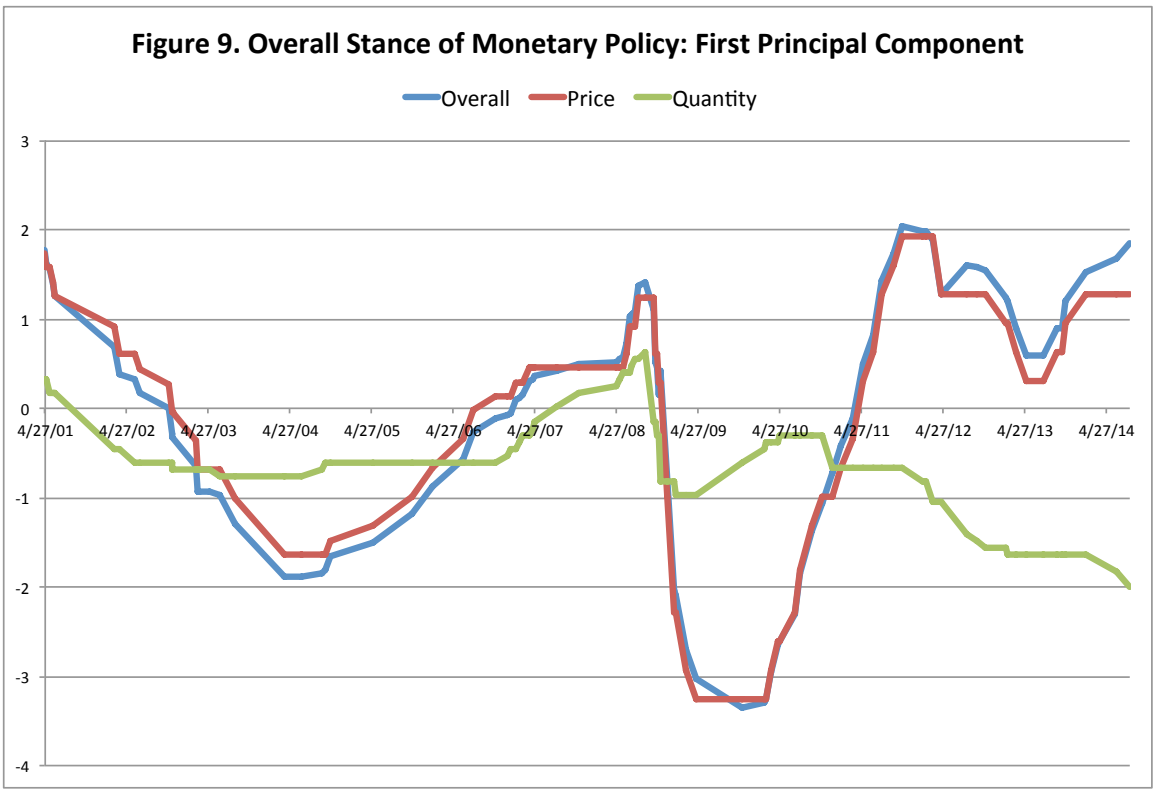


It is possible, of course, that the RBI has conducted monetary policy solely through the repo (and reverse repo) rate, and that the CRR and SLR have been adjusted with other goals in mind (e.g., as a component of financial liberalization). But because the CRR and SLR have effects on the supply of banks' loanable funds, it is also possible that the repo rate, CRR and SLR would all have been used by the RBI as instruments of monetary policy. To examine this issue, following Das, Mishra, and Prabhala (2015), we create composite measures for price and quantity instruments and examine their co-movements. The price instrument is specified as a simple average of repo and reverse repo rates. The quantity instrument, on the other hand, is the sum of CRR and SLR. As shown in Figure 8, price and quantity instruments have generally moved in the same direction during our sample period. The exception is between 2011 and 2012, when sharp increases in the policy rates suggested a tightening of monetary policy while the quantity indicator continued to move in a loosening direction. This suggests that for most of our sample period the RBI has indeed treated the CRR and SLR as instruments of monetary policy.



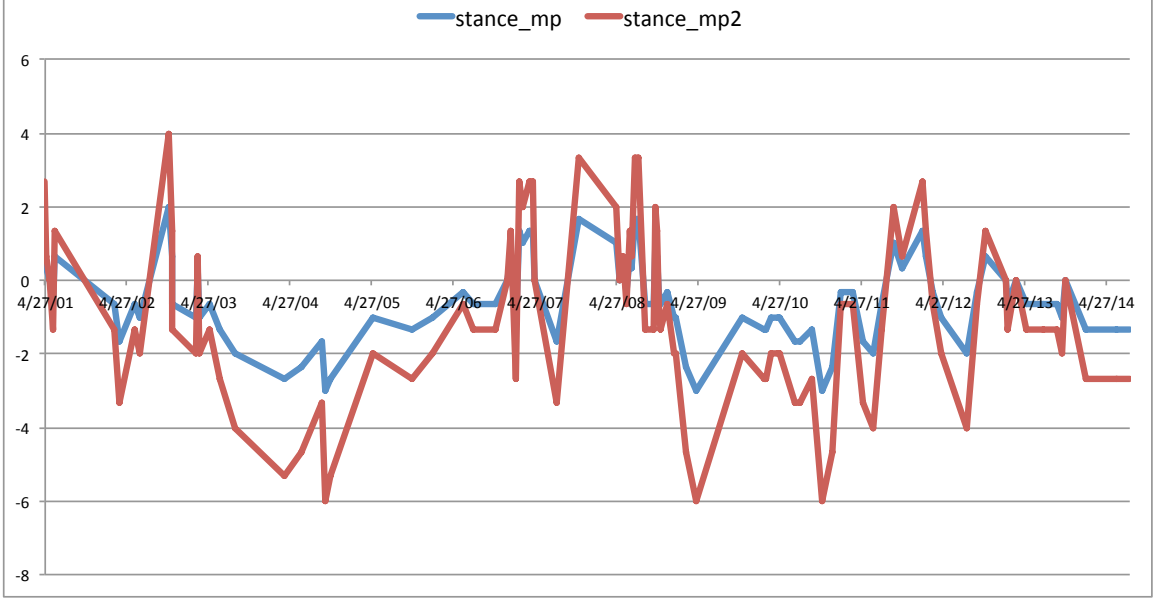
Alternative measures of stance of monetary policy

To address this complication, we construct three alternative measures of the overall stance of monetary policy. First, we extract the first principal component from the repo and reverse repo rates, as well as the CRR and SLR. The first principal component explains about 50 percent of the total variance in the four variables; and mirrors closely the evolution of the first principal component based only on the repo and reverse repo rates (Figure 9), reflecting the strong co-movement in these rates caused by the "corridor" approach and the use of the quantity instruments as complements to the price instruments.



Following Das, Mishra, and Prabhala (2015), we construct two other measures of the overall stance of monetary policy based on assigning scores to quarterly changes in the instruments. Scores of 0, +1, -1, are respectively assigned if there is no change, an increase, or a decrease in the values of individual instruments. In an alternative measure, we assign different scores based on the magnitudes of the changes. Scores of 0,+1,+2,-1,-2 are assigned respectively to each instrument. A score of zero is assigned for no change. A score of +1, and +2 are respectively assigned for quarterly increases of less than 25 basis points, and between 25-50 basis points. A score of -1, and -2 are assigned for quarterly decreases of less than 25 basis points, and between 25-50 basis points respectively. The overall stance of monetary policy is calculated by taking an unweighted sum of the scores for the individual instruments. Figure 10 shows the evolution of the two score-based measures of the overall stance of monetary policy. Based on either of these measures, monetary policy was loose following the global financial crisis, but has tightened since then.

Figure 10. Overall Stance of Monetary Policy: Score Based Methodology
(3-month moving averages)



IV. Empirical Methodology

To explore monetary transmission, we will use a structural vector autoregression (SVAR) approach. This approach has been widely implemented in a variety of settings – including OECD, emerging and low-income countries -- to explore the effectiveness of monetary transmission. In this section we describe the approach in general terms. In subsequent sections we implement it for the case of India.

In the SVAR methodology, the dynamic behavior of endogenous macroeconomic variables is assumed to be determined by a structural model of the form:

$$A_0 x_t = A(L) x_{t-1} + \varepsilon_t. \quad (1)$$

where x_t is a column vector containing observations on n endogenous variables at time t, A_0 is an nxn matrix that captures the contemporaneous interactions among these variables, $A(L)$ is an nxn matrix of polynomials in the lag operator L, and ε_t is a column vector of

structural shocks. In order to define these shocks unambiguously, the elements of $\boldsymbol{\varepsilon_t}$ are assumed to be *i.i.d.* and mutually uncorrelated. They can be normalized without loss of generality to have unit variances, so that ($\boldsymbol{E[\varepsilon_t \varepsilon_t']} = \boldsymbol{I}$). What the researcher is ultimately interested in are the dynamic effects of specific structural shocks (in our case, of a monetary policy shock) on the endogenous variables. These effects can be traced out from the reduced-form representation of this system. As long as $\boldsymbol{A_0}$ is invertible, the reduced form can be obtained by pre-multiplying equation (1) by $\boldsymbol{A_0^{-1}}$. This yields:

$$x_t = \boldsymbol{B}(L)x_{t-1} + u_t, \tag{2}$$

where $\boldsymbol{B(L)} = \boldsymbol{A_0^{-1}A(L)}$ and $\boldsymbol{u_t} = \boldsymbol{A_0^{-1}\varepsilon_t}$. Since this equation expresses the vector of endogenous variables as an autoregression, it constitutes the VAR representation of the system. Notice that the random shocks in (2) behave very differently from those in (1): since every element of u_t is a linear combination of the elements of ε_t, the elements of u_t will in general be contemporaneously correlated, but serially uncorrelated.

Conveniently, the elements of the matrix *B(L)* can be estimated consistently by OLS. However, estimation of (2) is not sufficient to allow us to describe the dynamic effects of specific structural shocks on the endogenous variables. To do so, we need to determine how the structural shocks in (1) affect the reduced-form shocks in (2). As indicated above, this relationship is given by $\boldsymbol{u_t} = \boldsymbol{A_0^{-1}\varepsilon_t}$. It follows that to determine how structural shocks affect the dynamic responses of the endogenous variables in the system we require an estimate of the elements of A_0.

Estimation of the VAR is helpful in estimating the elements of A_0, since it yields some useful restrictions that the elements of A_0 must satisfy. Specifically, since $\boldsymbol{u_t} = \boldsymbol{A_0^{-1}\varepsilon_t}$, the variance-covariance matrix of the VAR residuals is given by:

$$\Omega = \boldsymbol{E}_t\, u_t u'_t = \boldsymbol{E}_t\, (A_0^{-1}\varepsilon_t \varepsilon'_t A_0^{-1'}) = \boldsymbol{A_0^{-1}A_0^{-1'}}.$$

The estimate $\widehat{\boldsymbol{\Omega}}$ of the variance-covariance matrix of the reduced-form residuals thus provides a set of restrictions on the elements of A_0. Since $\widehat{\boldsymbol{\Omega}}$ is an nxn symmetric matrix, it contains n(n + 1)/2 distinct elements, which provide an equal number of restrictions on the

n^2 elements of A_0. Thus an additional $n^2 - n(n+1)/2 = n(n-1)/2$ restrictions are required to estimate all of the elements of A_0. This identification challenge is most commonly met by using theoretical reasoning to impose $n(n-1)/2$ additional restrictions on the contemporaneous interactions among the endogenous variables (referred to as short-run restrictions). These usually take the form of setting $n(n-1)/2$ of the elements of A_0 equal to zero, on the grounds that information and/or response lags prevent some endogenous variables from reacting contemporaneously to changes in others.

IV.1. VAR estimation

Implementing this methodology for the purpose of examining the effectiveness of monetary transmission in India requires several steps:

i. Specification of the VAR

The first step in implementing the approach described above is to determine the specification of the VAR – i.e., to choose the variables that will appear in the VAR. We will motivate that choice by drawing on the family of small New Keynesian structural models that are used for monetary policy analysis by many central banks around the world. Though there is a wide variety of such models, we will focus on a version that contains little more than the specific elements that tend to be common across all such models. The reason is that the limited sample period that is available for India and the large number of lags typically required to produce well-behaved residuals in estimated VARs suggest that degrees of freedom are likely to be at a particular premium in this case. Accordingly, the set of variables to be included in the VAR should be chosen as parsimoniously as possible.

The specific model that we will use to motivate our choice of endogenous variables in the VAR is a slightly modified version of the simple open-economy New Keynesian model developed by Adam et. al. (2015). The model is presented below. It consists of an IS equation (3), a New Keynesian Phillips curve (4), an uncovered interest parity condition (5), an interest rate pass-through equation (6), and a Taylor-type monetary policy rule (7):

$$\tilde{y}_t = \alpha_1 \cdot E_t[\tilde{y}_{t+1}|I_t] + (1 - \alpha_1) \cdot \tilde{y}_{t-1} - \alpha_2 \cdot [\alpha_3 \cdot \left(i_t^L - E_t[\pi_{t+1}|I_t] - \bar{r}\right) + (1 - \alpha_3) \cdot \tilde{e}_t] + \varepsilon_t^y, \quad (3)$$

$$\pi_t = \beta_1 \cdot E_t[\pi_{t+1}|I_t] + (1 - \beta_1) \cdot \pi_{t-1} + \beta_2 \cdot \tilde{y}_t - \beta_3 \cdot \tilde{e}_t + \varepsilon_t^{\pi}, \quad (4)$$

$$\tilde{e}_t = E_t[\tilde{e}_{t+1}|I_t] - (1/4) \cdot [i_t^L - E_t[\pi_{t+1}|I_t] - \bar{r}^*] + \varepsilon_t^e, \quad (5)$$

$$i_t^L = \gamma_1 \cdot i_t + \varepsilon_t^L, \quad (6)$$

$$i_t = \tau_1 \cdot \left(\bar{r} + 1.4 \cdot E_t[\pi_t|I_{t-1}] + \tau_2 \cdot E_t[\tilde{y}_t|I_{t-1}]\right) + \tau_3 \cdot i_{t-1} + \varepsilon_t^i. \quad (7)$$

This model contains five observable macroeconomic variables: the GDP gap $\tilde{y}_t$, the inflation rate π_t, the real exchange rate gap $\tilde{e}_t$ (the deviation of the real exchange rate from its long-run equilibrium value), the commercial bank lending rate i_t^L, and the central bank policy rate i_t. The symbol $E_t\,[x_{t+i}|I_{t+j}]$ is an expectations operator denoting expectations formed at time *t* for a variable *x* to be observed at time *t* + *I* conditional on information available at time *t* + *j*, Greek letters denote positive structural parameters, and the ε_t's are the unobservable random structural shocks.[10]

Consistent with this model, we will estimate a VAR for India that contains the five endogenous variables contained in the model. Thus the column vector x_t will be assumed to be given by $x_t = (\tilde{y}_t, \pi_t, \tilde{e}_t, i_t^L, i_t)'$. As it stands, however, the model described above treats all supply shocks as unobservable to the econometrician. They are captured by the random term ε_t^{π} in equation (4). Contrary to this assumption, shocks to world food and energy prices may exert important effects on inflation in India, and since these variables are observable, they should in principle be identified separately in equation (4). Since India is less likely to affect world food and energy prices, these prices measured in US dollars can be considered to be exogenous to developments in India, and we will accordingly include these as exogenous variables in some versions of the estimated VARs.[11] Doing so is particularly

[10] For discussion of the individual equations, see Li et. al. (2015).

[11] In the baseline version of the VAR, we include several lags of world food and energy price inflation as exogenous variables. The choice of lag length for these two variables was somewhat arbitrary, and we will consider alternative choices in section V.

important in the present context, because to the extent that shocks to either of these variables may help predict future headline CPI inflation in India, by equation (7) excluding them from the model would tend to undermine the identification of monetary policy shocks in India.

ii. Sample period

As already indicated, the sample period is April 2001 to December 2014 – i.e., the period during which monthly data on industrial production are available, and before the new flexible inflation targeting regime was put in place. The RBI formally announced an inflation target only in 2015.[12] The reason for restricting attention to this period is that macroeconomic theory (including in the form of the model above) suggests that the effectiveness of monetary transmission depends critically on the effects that monetary policy shocks have on expectations of future interest rates (see, for example, Woodford 2001), and the effects of current shocks on such expectations in turn depend on the monetary policy regime that is in place. Thus, if the change in India's monetary policy regime in January 2014 was a credible one, we should expect monetary transmission in India to be quite different post-January 2014 from what it was pre-January 2014. Including the data post the regime change would therefore result in unstable VAR parameters and unreliable inference about the nature of monetary transmission in India under IT.

iii. Data

An exploration of the effectiveness of monetary transmission requires estimating the effects of a shock to the monetary policy instrument on aggregate demand. Based on the discussion in section III, the RBI has used multiple instruments historically to conduct monetary policy. We consider the effects of four instruments in the empirical analysis: (i) the repo rate, (ii) the average of repo and reverse repo rates, (iii) the sum of CRR and SLR, and (iv) the composite score-based indicator of monetary policy stance described above.

The second issue is how to measure the effects of monetary policy on aggregate demand. In principle one wants to use both an indicator of real economic activity and the

[12] See http://finmin.nic.in/reports/MPFAgreement28022015.pdf on agreement between Government of India and Reserve Bank of India on new monetary policy framework.

price level, because using just one or the other risks biasing the exercise against a finding of effective monetary transmission by making the results depend on the shape of the economy's aggregate supply curve. For example, if the price level is used as the sole indicator of aggregate demand and the economy's aggregate supply curve is very flat, then a monetary policy shock that has a strong impact on aggregate demand would nevertheless have little impact on prices, and the finding of minimal effects on the price level would be erroneously interpreted as weak monetary transmission. We therefore include both the price level (in the form of the CPI) and an indicator of aggregate economic activity in the VAR.

Unfortunately, the latter presents a problem. The obvious indicator to choose is real GDP. However, real GDP numbers are available only on a quarterly basis, starting from 1996. For reasons explained in the next sub-section, we have opted to use monthly data. We use the index of industrial production (IIP) as a proxy for real economic activity, as it is the only indicator for which monthly data are available. The drawback of using IIP, however, is that it is partial, and covers only the manufacturing sector. The results on transmission to output should, therefore, be interpreted with adequate caution.

We first seasonally adjusted the series using the Census Bureau's X-12 routine and then computed a monthly IIP gap as the deviation of the log of this series from a smoothed version computed using a two-sided HP filter. For the measure of the aggregate price level we used the headline CPI (from the Central Statistical Organization of India). The measure of inflation used in the VAR was seasonally adjusted (using the same procedure as for economic activity), and the monthly percentage change in this series was expressed as an annual rate. The real effective exchange rate (REER) is taken from the RBI, and the REER gap is calculated as the deviation of the log of this series from a smoothed version constructed, as with the IIP gap, using a two-sided HP filter.

Finally, the commercial bank lending rate data are taken directly from the *IFS*. It refers to the "benchmark prime lending rate" till June 2010, and to the "base rate" thereafter. The benchmark prime lending rate (BPLR) regulated all interest rates charged by the commercial banks on various categories of loans. Till 2010 most of the variable rate loans, like home loans and some of the term loans etc. were pegged against the PLR. Beginning in July 2010, BPLR was replaced by the average base rate charged by India's five

largest commercial banks. The base rate is fixed on the basis of the average cost of funds of the banks, and is the minimum rate for all commercial loans, with banks not being permitted to resort to any rate below it.

iv. Estimating the VAR

The first decision in estimating the VAR is whether to do so in level, first difference, or vector error-correction form. The answer depends on the time series properties of the included endogenous variables. The first step, therefore, was to check the time series properties of the endogenous variables. The results of standard Augmented Dickey-Fuller and Phillips-Perron tests for all the variables are reported in Table 3. The null hypothesis for these tests is that the variables in question contain a unit root. As can be seen from the table, this hypothesis is rejected for the IIP gap, inflation, and the real exchange rate gap, but not for the policy repo and bank lending rates.

Table 3. Unit Root Tests for Endogenous Variables

	ADF		**Phillips-Perron**	
	Statistic	**P-value**	**Statistic**	**P-value**
IIP gap	-3.150	0.099*	-7.202	0.01***
Inflation	-6.693	0.01***	-17.662	0.01***
Real exchange rate gap	-3.109	0.114*	-3.339	0.0671*
Bank lending rate	-2.177	0.502	-2.384	0.416
Policy repo rate	-3.528	0.356	-2.150	0.514

*** Significance at 1 % level; ** Significance at 5% level; * Significance at 10 % level

In principle, therefore, a VAR estimated in these five variables over the relevant sample period would be unbalanced in a time series sense. However, a Johansen cointegrating test

indicates that the policy repo rate and the bank lending rate are cointegrated, so estimating the VAR in levels can be expected to yield statistically valid results.[13]

The next step in estimation is to determine the appropriate lag length for the VAR.[14] Appropriateness is determined in this case by the requirement that sufficient lags are included in the VAR so as to render its residuals serially uncorrelated. We began with 12 lags and applied the full set of information criteria provided by Eviews to determine the appropriate lag length for the VAR. None of the five relevant criteria suggested more than [6] lags. Joint lag exclusion tests rejected the null of zero coefficients for lags 1, 5, 6, and 11. Guided by these results, we decided to include six lags in the baseline estimation. Lagrange multiplier (LM) tests suggested that the resulting residuals are serially uncorrelated.

IV.2. Identification

As indicated above, the VAR captures the full dynamic interactions among the variables included in the model, so given a shock to the policy rate it is possible to trace out the empirical response of all five variables to that shock period by period. But this cannot be done by simply shocking the residual in the reduced-form equation for the policy rate, because a structural shock to the policy rate (in the form of ε_t^i) may affect the residuals in at least some of the other equations in the VAR at the same time, as given by the relationship $u_t = A_0^{-1}\varepsilon_t$. The residuals from the estimated VAR represent the innovations in the autoregressive representation of each variable in the VAR, but they cannot be interpreted as the orthogonal structural shocks in the underlying data-generating process (DGP) unless they are contemporaneously uncorrelated (i.e., unless the A_0 matrix is diagonal), since the structural shocks may appear in more than one of the reduced-form equations of the underlying DGP represented by the VAR.

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[13] Both the trace and maximum-eigenvalue statistics reject the absence of a cointegrating vector with a P-value of less than 1 percent.

[14] Note that equation (1) is simply a generalized version of the model given by equations (3)-(7) in state-space representation. It is generalized in the sense that it allows for longer lags than the state-space representation of the model of the last section would generate in the presence of serially uncorrelated shocks. Taken literally, the state-space representation of that model would contain a single lag arising from the setting of monetary policy based on time $t-1$ information, and the estimated VAR should contain a single lag as well.

However, the import of this observation depends on the strength of the contemporaneous correlation among the VAR residuals. The weaker such correlations, the less the extent to which the VAR residuals will represent an amalgam of structural shocks. We find that the innovations in the policy rate are only weakly correlated with the innovations in the other equations. This suggests that the impulse responses should not be overly sensitive to the identification strategy chosen.

As mentioned previously, the most common way to impose identifying restrictions on the A_0 matrix is to restrict the contemporaneous interactions among the endogenous variables in the model, typically by sprinkling the required number of zeros ($n(n-1)/2$ of them) among the elements of the matrix. Access to this identification strategy is what makes the use of monthly data desirable in this case. It is plausible to assume that the central bank cannot observe the variables that enter its monetary policy reaction function contemporaneously within the month, so that contemporaneous shocks to the other endogenous variables in the model would not affect the current policy rate, enabling all of the non-policy rate elements in one row of the A_0 matrix to be set equal to zero. But it is less plausible to assume that they cannot do so within the quarter, and even less that they cannot do so within the year, so the same restrictions could not be imposed with equal confidence in the context of lower-frequency data. Similarly, it is plausible to assume that monetary policy actions do not affect some subset of macroeconomic variables within the month, enabling the non-policy rate elements of the column of the A_0 matrix corresponding to the policy rate to be set equal to zero, but as the relevant unit of time becomes longer, this procedure becomes less and less justifiable. In short, the assumption that the central bank cannot observe all of the variables that enter its reaction function within the month yields exclusion restrictions on shocks to nonmonetary variables in the equation linking nonmonetary structural shocks to innovations in the policy rate, while the assumption that structural shocks in the policy rate do not affect specific other variables within the month yields exclusion restrictions in the equations linking innovations in those other variables to monetary policy shocks. This is the rationale for using monthly observations in this exercise.

However, while the use of monthly data makes a plausible case for a variety of exclusion restrictions based on information and reaction lags, thereby facilitating the process of identification, it may not be necessary to impose all of the available restrictions for

present purposes. Specifically, Christiano, Eichenbaum and Evans (1999) have shown that estimating all of the elements of the A_0 matrix is not required in order to recover the impulse responses to monetary-policy shocks. Instead, the responses can be recovered from the reduced form VAR under the much weaker condition that A_0 is block-lower-triangular, with the monetary policy instrument (the policy interest rate in this case) occupying its own diagonal block. The intuition is straightforward: as long as this condition is met, variables that contemporaneously affect the policy rate will not be affected contemporaneously by it, and variables that the policy rate affects contemporaneously will not simultaneously affect it. What this means is that the contemporaneous effects of a monetary policy shock on the first set of variables must be zero, while that on the second set of variables can simply be estimated by running OLS regressions on VAR residuals.[15]

Our identification strategy will actually be somewhat simpler than allowed for by the Christiano, Eichenbaum and Evans analysis. It is based on a timing convention for the implementation of monetary policy. We assume that the central bank sets the systematic part of its policy interest rate at the beginning of each period *t*, before shocks specific to that period arrive. Thus, the bank's policy rate is based on information dated $t - 1$. The implication is that the policy rate is not affected by *any* contemporaneous shock. This places the policy rate in the top left-hand corner of the A_0 matrix, with all other elements in that row equal to zero. This immediately satisfies the Christiano, Eichenbaum and Evans conditions, no matter how many zeros arise in the remaining rows of the A_0 matrix – i.e., the matrix is lower block-triangular whether its remaining elements are fully identified or not.

Note that the identification strategy would be satisfied by a Choleski decomposition with the interest rate ordered first, but it is more general than a Choleski decomposition, since in the present case it requires only four zeros along the top row of the A_0 matrix, rather than 10 zeros above the diagonal. Nonetheless, since the only structural shocks that we are interested in are those to monetary policy, with all others set to zero, we can most

[15] The monetary policy shock can be extracted from the residual in the VAR policy rate equation by regressing that residual on the residuals of the equations corresponding to the first set of variables. The monetary policy shock is the OLS residual from that regression. In turn, the contemporaneous effects of the monetary policy shocks on the remaining set of variables can be estimated from OLS regressions of the VAR residuals of the equations for those variables on the monetary policy shock estimated in the first step.

easily implement our identification by imposing it in the form of a Choleski decomposition with the interest rate ordered first. The impulse responses reported below are constructed in that manner.

V. Results

V.1. Main Results

Our results are presented in Figures 11-18. We present results for two alternative identification schemes. One in which the monetary policy variable is ordered first, reflecting the assumption that the RBI does not observe (or does not react to) macroeconomic variables within the month, but macro variables are potentially affected by monetary policy shocks contemporaneously (monetary policy variable ordered first). The bank lending rate, output gap, CPI inflation, and REER gap are ordered after the monetary policy variable in this scheme. For robustness, we also report the results from an alternative identification scheme in which the RBI can respond to macro variables within the month, but those variables in turn can respond to monetary policy only with a lag. The ordering of the other variables remains the same. Four impulse response functions are presented in each case, each using a different definition of the monetary policy variable: the repo rate, the average of the repo and reverse repo rates (the price indicator), the sum of the CRR and SLR (the quantity indicator), and the composite score-based monetary policy indicator based on changes in all four instruments, constructed as described above. Figures 11-14 and Figures 15-18 show the impulse response functions for the identification scheme when the monetary policy variable is ordered first and last respectively.

The results reveal some clear patterns:

First, across both identification schemes and for all four indicators, a tightening of monetary policy is associated with an increase in bank lending rates, consistent with evidence for the first stage of transmission in the bank lending channel. The effect is hump-shaped, with peak effects on bank lending rates appearing between 5-10 months in every case. As is conventional, the confidence bands in Figures 11-18 are at the 90 percent level, so these

effects are estimated somewhat imprecisely: while they are statistically different from zero at the 90 percent confidence level in every case when the monetary policy variable is ordered last, they are only significant at this level in two cases when the policy variable is ordered first.

Second, while pass-through from the policy rate to bank lending rates is in the right (theoretically-expected) direction, pass-through is incomplete. A peak increase of 25 basis points in the repo rate, for example, is associated with a peak increase in the bank lending rate of only about 10 basis points, whether the policy variable is ordered first or last.

Third, when the monetary policy variable is ordered first, effects on the real effective exchange rate are also in the theoretically-expected direction on impact, but are extremely weak and not statistically significant, even at the 90 percent confidence level, for any of the four monetary policy variants. However, when the monetary policy variable is ordered last, effects on the real effective exchange rate are not just very weak, but also in the wrong direction (a contractionary monetary policy shock causes the real effective exchange rate to depreciate). Consistent with out *ex ante* expectation, this suggests a very weak exchange rate channel in India.

Fourth, our results provide no support for any effect of monetary policy shocks on aggregate demand, as recorded either in the IIP gap or the inflation rate. Indeed, our most disturbing finding is a consistent pattern of counterintuitive effects of monetary policy shocks on both the GDP gap and the inflation rate. In all but one of our eight cases, a contractionary monetary policy shock tends to *increase* both the IIP gap and the inflation rate on impact. While both effects are quantitatively negligible in every case, it is surprising that when the monetary policy variable is ordered first the counterintuitive effects on the IIP gap are statistically significant at the 90 percent confidence level for all four of the monetary policy variables considered.

These results admit of an internally-consistent interpretation: the RBI is indeed able to affect bank lending rates in India, but consistent with the analysis in section II, pass-through from the policy rate to bank lending rates is relatively weak. Similarly, India's relatively low degree of financial integration – possibly abetted by RBI intervention in the foreign exchange market to smooth the rupee-dollar rate – has tended to make for a very weak –

possibly nonexistent – exchange rate channel. Finally, the small size of the formal financial sector in India, together with the absence of an exchange rate channel and a muted effect of policy rates on bank lending rates, has implied very weak effects of monetary policy on aggregate demand. In short, consistent with what is suggested by the descriptive evidence for India on the potential roles of both the macroeconomic and microeconomic factors that are suggested by theory as influencing the strength of monetary transmission, our central results do not provide evidence of effective monetary transmission to aggregate demand in India.

Figure 11. Response to Cholesky One S.D. Innovations +/- 1 S.E: Repo Rate (Ordered First)

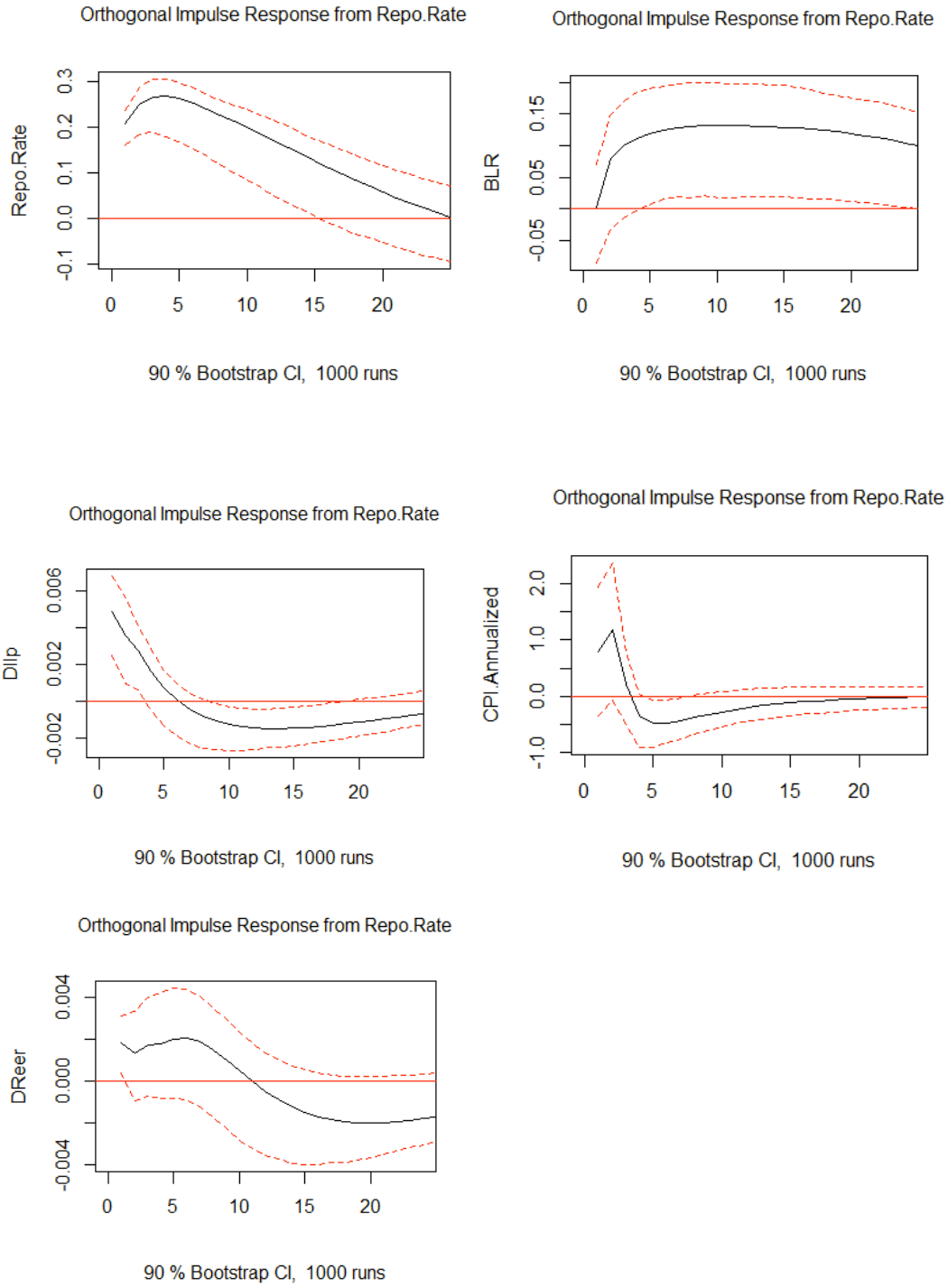


Figure 12. Response to Cholesky One S.D. Innovations +/- 1 S.E: Average of Repo and Reverse Repo Rates (Ordered First)

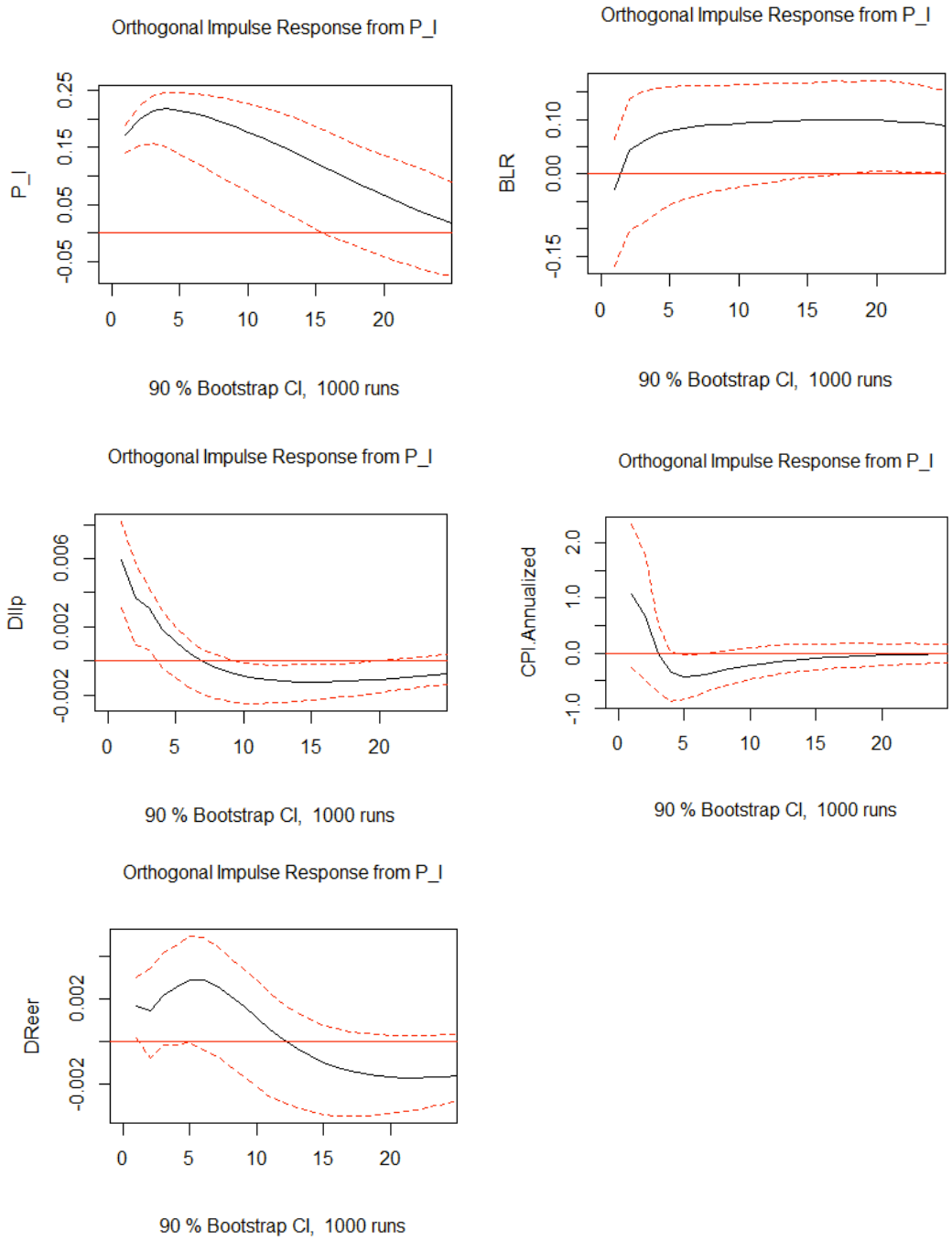


Figure 13. Response to Cholesky One S.D. Innovations +/- 1 S.E: Sum of CRR and SLR (Ordered First)

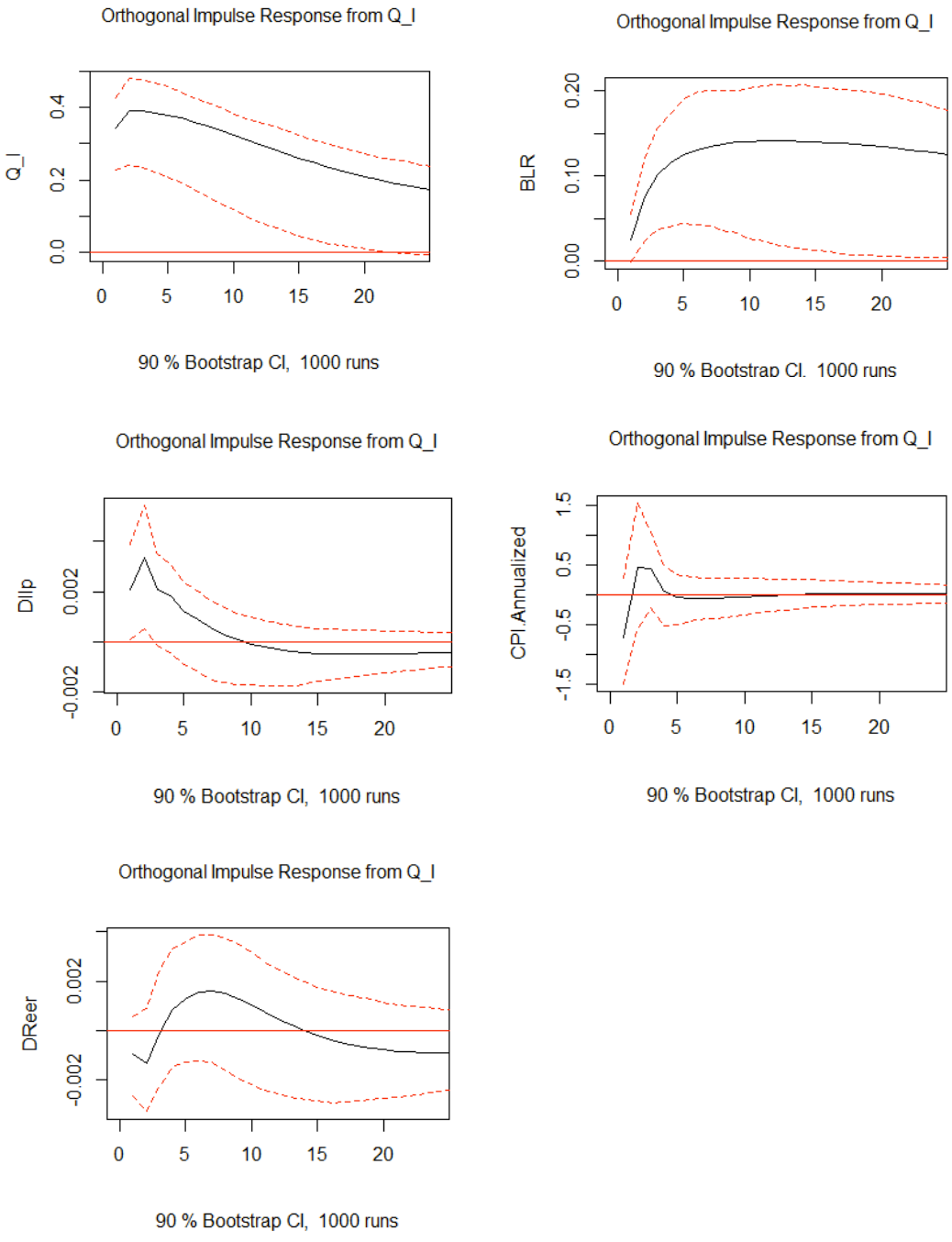


Figure 14. Response to Cholesky One S.D. Innovations +/- 1 S.E: Composite Monetary Policy Stance (Ordered First)

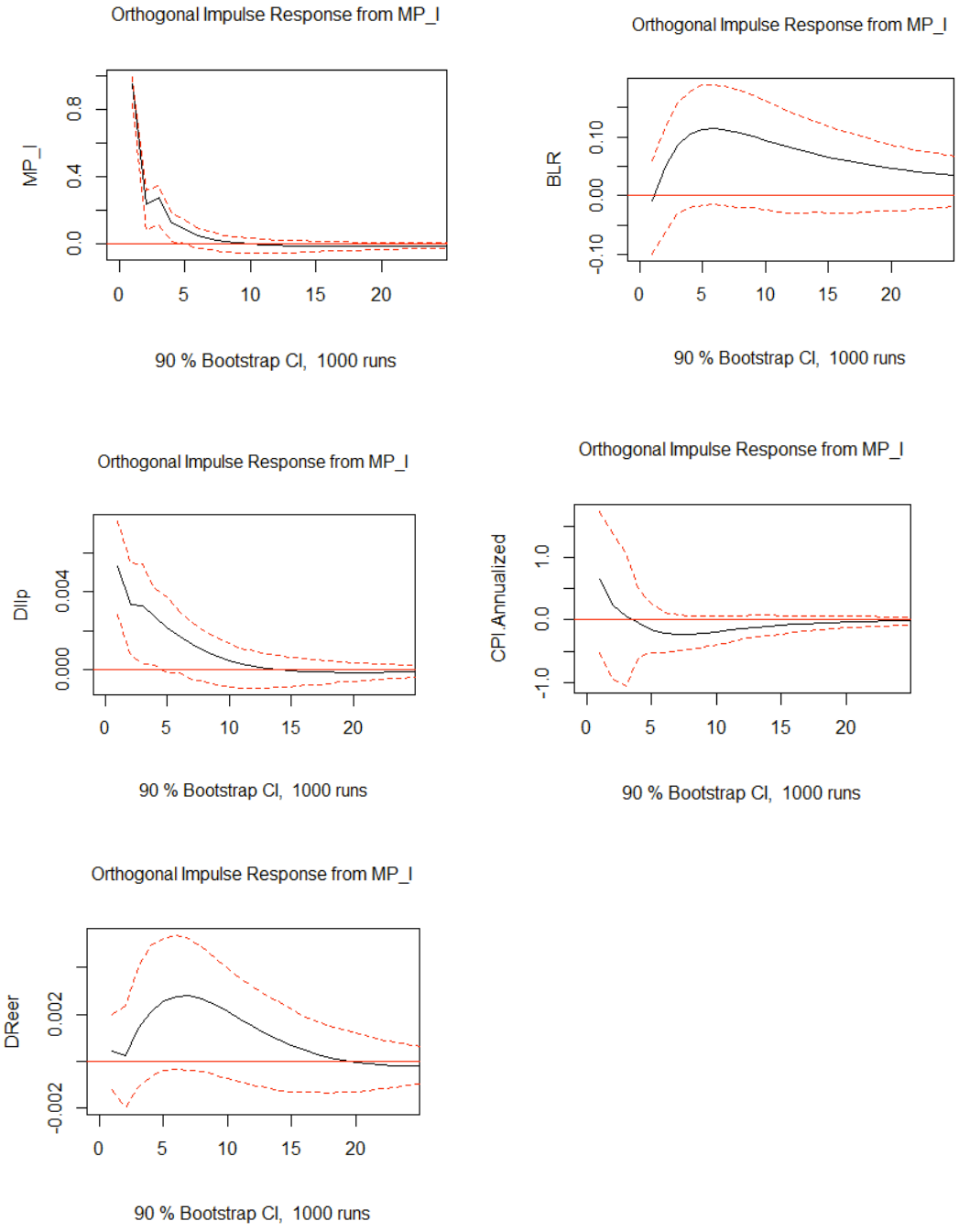


Figure 15. Response to Cholesky One S.D. Innovations +/- 1 S.E: Repo Rate (Ordered Last)

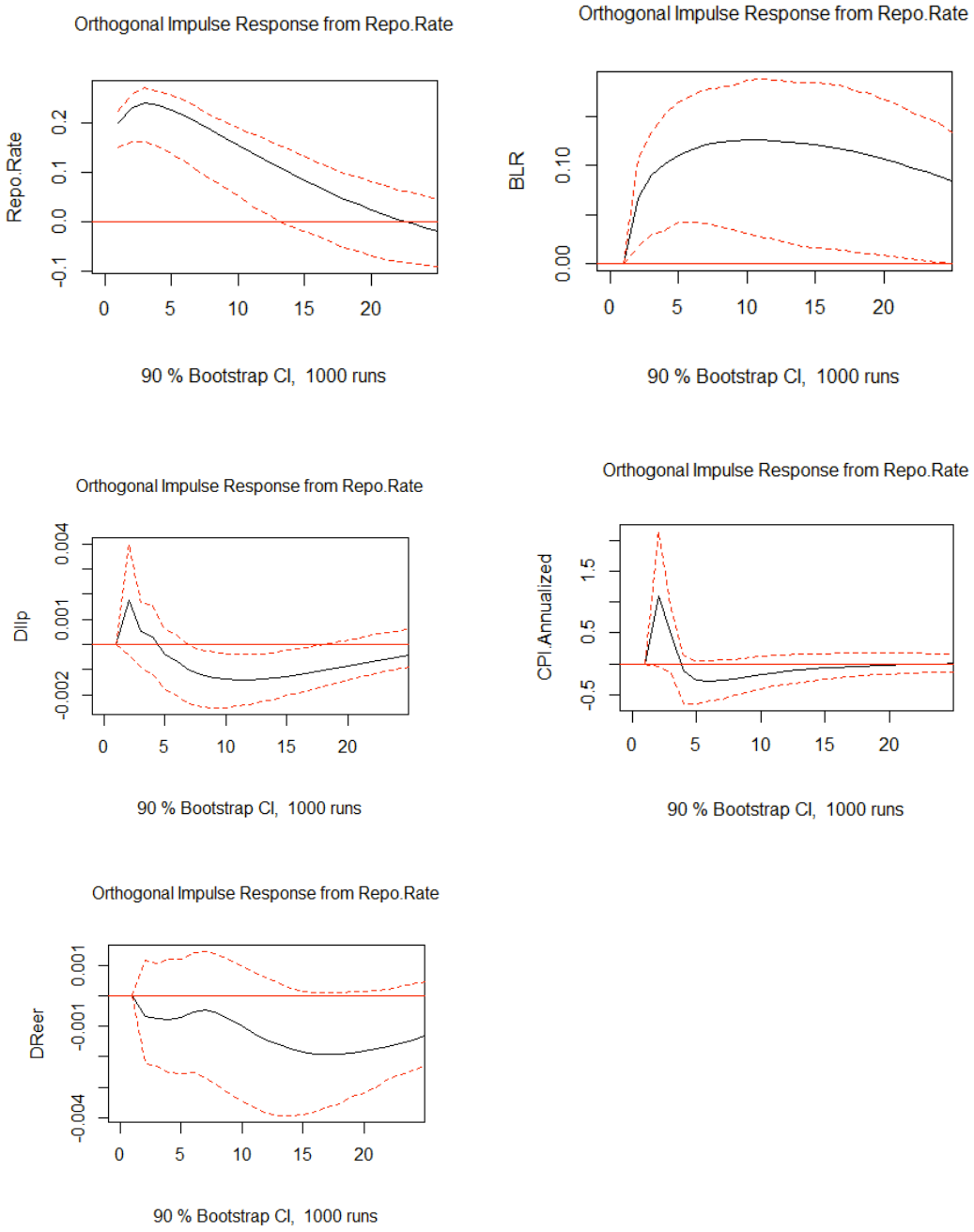
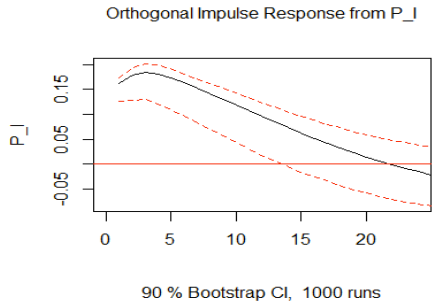
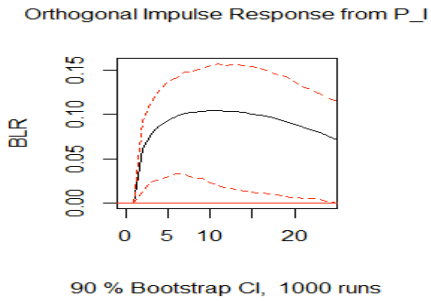
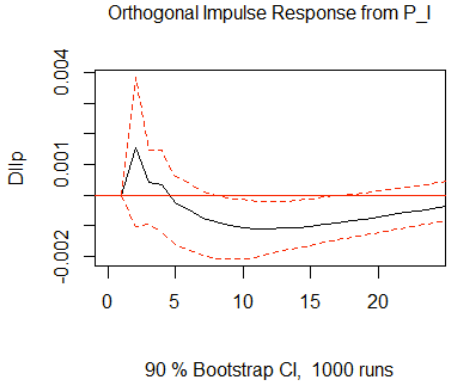
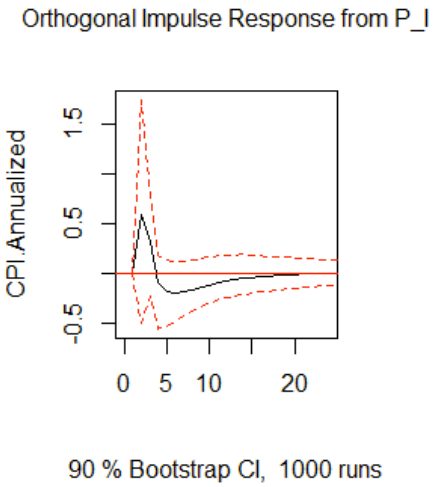


Figure 16. Response to Cholesky One S.D. Innovations +/- 1 S.E: Average of Repo and Reverse Repo Rates (Ordered Last)









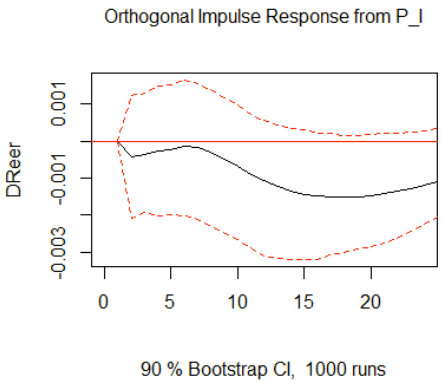


Figure 17. Response to Cholesky One S.D. Innovations +/- 1 S.E: Sum of CRR and SLR (Ordered Last)

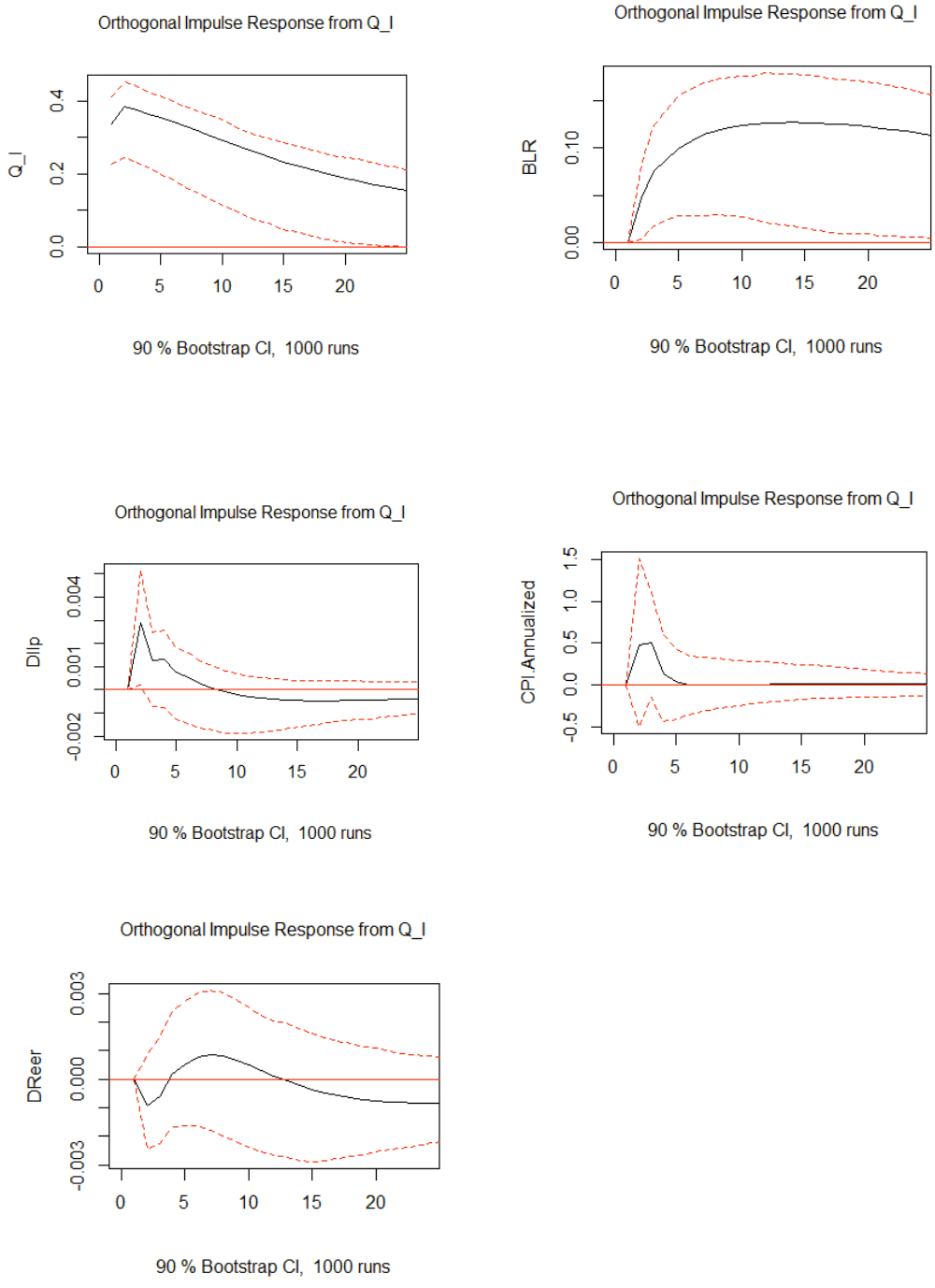
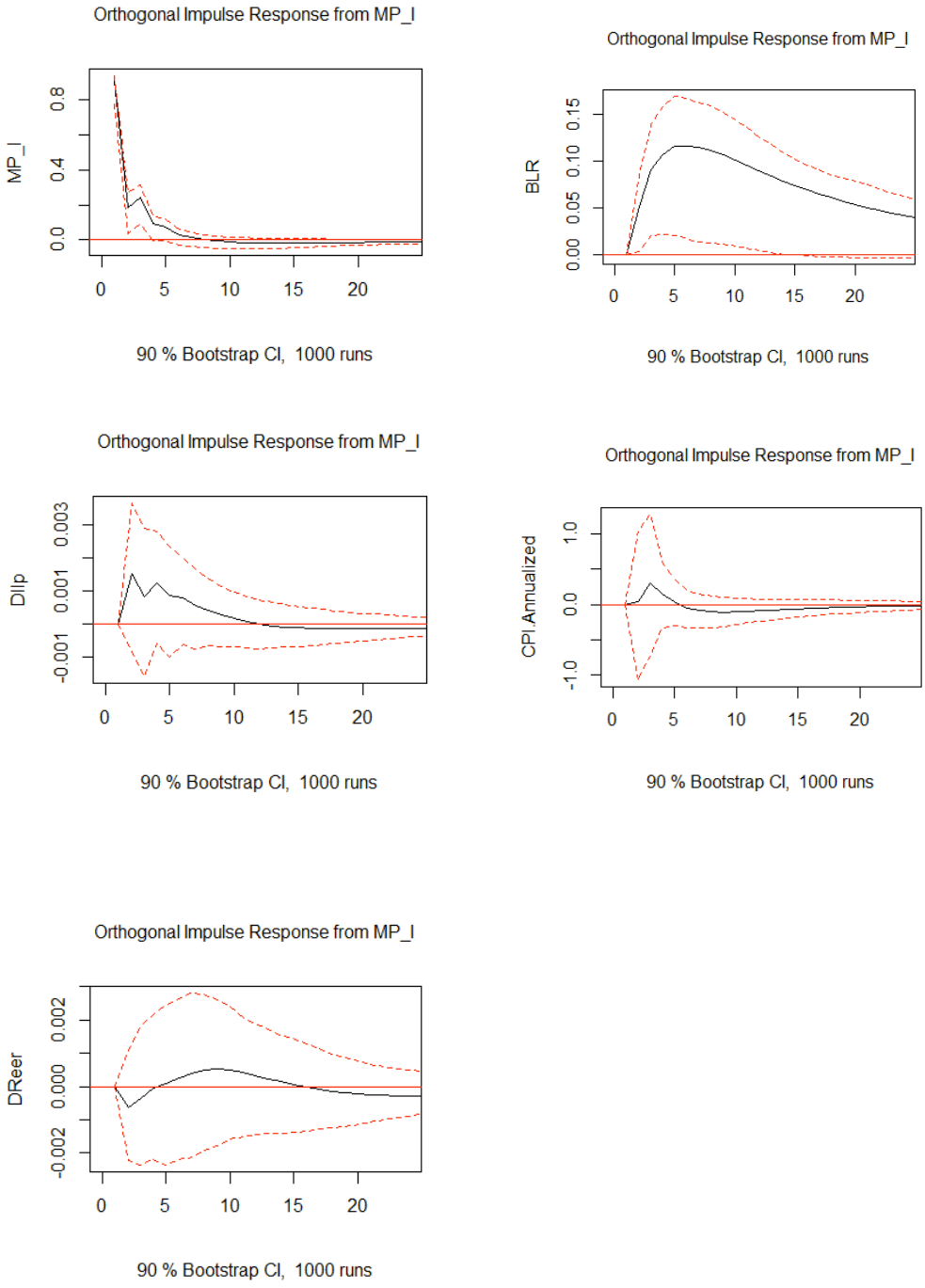


Figure 18. Response to Cholesky One S.D. Innovations +/- 1 S.E: Composite Monetary Policy Stance (Ordered Last)



V.2. Robustness Checks

In this section, we examine the robustness of the previous results to alternative specifications. First, we repeat the estimations by dropping the exogenous variables – world food and energy price inflation. The impulse response functions (not shown) are effectively the same as before.

Second, we tried a variant of the second identification scheme presented in Figures 15-18, where the RBI can respond to macro variables – output gap, inflation, and REER gap - within the month, but those variables in turn can respond to monetary policy only with a lag. RBI, however, does not observe (or does not react to) bank lending rate within the month, but the bank lending rate is potentially affected by monetary policy shocks contemporaneously (monetary policy variable ordered before the bank lending rate). The model has exogenous variables ordered first, as in the impulse responses shown in the previous sub-section. The impulse responses for this alternative identification scheme are shown in the Appendix Figures A1-A4. The results are qualitatively similar. A tightening of monetary policy is associated with an increase in bank lending rates. The pass-through from the policy rate to bank lending rates is in the right (theoretically-expected) direction, but the pass-through is incomplete. Our results provide no support for any effect of monetary policy shocks on aggregate demand as recorded either in the IIP gap or the inflation rate.

VI. Conclusions

This paper explores the bank lending channel of monetary transmission in the Indian context, using a structural VAR methodology that has commonly been applied to investigate monetary policy effectiveness not only in advanced and emerging economies, but also in many low-income ones. If we think of monetary transmission through the bank lending channel in two steps – from policy rates to bank lending rates and from bank lending rates to aggregate demand – there is some evidence that the first step is operative in India, unlike in many other developing countries (see Mishra et. al. 2013). While pass-through from policy rates to bank lending rates is incomplete, there is some evidence that such pass-through exists. Our results, however, provide no support for the second step of monetary

transmission, or any effect of monetary policy shocks on aggregate demand, as recorded either in the IIP gap or the inflation rate.[16]

A second channel of transmission that one might be expect to be important in India, given its floating exchange rate regime – the exchange rate channel – also does not receive much support from our results. The response of the exchange rate to monetary policy shocks is in right direction but the magnitude is very small. The implication is that any effects of monetary policy on aggregate demand in India are more likely to operate through the trade balance than through interest-sensitive components of aggregate of aggregate demand, but any such effects are likely to be weak. There are at least two possible reasons. One is that India remained characterized by a low degree of *de facto* capital mobility during the sample period, at least when compared to other emerging markets. This may explain a weak exchange rate response. A second possibility is that the RBI's intervention in the foreign exchange market has tended to mute the exchange rate response to monetary policy.

The question is how to interpret these results. As suggested by Egert and Macdonald (2009) (for the case of transition economies in central and Eastern Europe), it is likely to reflect some combination of the facts on the ground and shortcomings in the empirical methods that have been applied to this issue. For the reasons we indicated in the introduction, it is vitally important to determine the contributions of each of these factors. There is no doubt that shortcomings in both data and methodology are many. For example, IIP is only a partial indicator of overall economic activity. Importantly, the identification assumptions for the VAR are non-testable. Based on the descriptive evidence on the characteristics of the Indian economy that are likely to influence the effectiveness of monetary transmission, however, we suspect that "facts on the ground" may also be an important part of the story. For example, India's relatively low degree of financial integration, possibly abetted by RBI intervention in the foreign exchange market to smooth the rupee-dollar rate, would tend to make for a very weak, possibly nonexistent, exchange rate channel. On the other hand the small size of the formal financial sector in India would tend to undermine the effects on bank lending rates

[16] Our results therefore do not provide a basis, for example, for assessing the optimal relative weights on inflation and the output gap in a monetary policy rule such as specified in (6) in the case of India.

on aggregate demand. Since these are the two main channels through which, *ex ante*, we would expect monetary policy to affect aggregate demand in India, it may not be surprising that such effects are hard to detect in the data.

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Appendix: Brief Review of the Literature on Monetary Transmission in India		
Paper Details & Time period	**Method, Variables used & Related details**	**Results & Summary**
Das (2015): "Monetary Policy in India: Transmission to Bank Interest Rates" IMF WP; End-March 2002 to end-October 2014; Each observation is a two week period.	Bank Lending Channel, through lending and deposit rates; Stepwise estimation of VECM models. Estimates the pass-through from monetary policy changes to bank interest rates in two steps: (i) from the monetary policy rate to the interbank market rate (that is the operating target of the framework); (ii) from the target rate to bank interest rates (deposit and lending rates). Daily data on interest rates and LAF transactions are averaged over two week periods, and the bank balance-sheet data is available on a bi-weekly basis. The monetary policy rates considered are the reverse repo rate and the repo rate. Market interest rate targeted by the monetary policy framework is the weighted average call money rate and the two main bank interest	Significant, albeit slow, pass-through of policy rate changes to bank interest rates in India. The extent of pass-through to the deposit rate is larger than that to the lending rate, and the deposit rate adjusts more quickly to changes in the policy rate. Evidence of asymmetric adjustment to monetary policy: the lending rate adjusts more quickly to monetary tightening than to loosening. Deposit rates do not adjust upwards in response to monetary tightening, but do adjust downwards to loosening; The speed of adjustment of both deposit and lending rates to changes in the policy rate has increased in recent years.

	rates considered are the rate on 3-month certificates of deposits and the prime lending rate (the average of five major banks). Although banks now price loans from the base rate, they still report PLRs. In practice, the prime lending rate and base rate of banks move together.	
Sengupta (2014): "Changes in Transmission Channels of Monetary Policy in India," Economic and Political Weekly; Monthly data; April 1993 to March 2012.	VAR Introduction of LAF as an operating procedure for monetary policy in the post-reform period is a landmark event for monetary policy. This paper looks for a structural break in the post-reform period corresponding to the introduction of LAF in 2000. Assesses the changing importance of various transmission channels of monetary policy in the pre-LAF and post-LAF periods. Divides sample into two periods- pre LAF (before 2000) and post LAF (post 2000) and sees whether the transmission has changed in the transition.	Finds a structural break in transmission corresponding to the introduction of LAF in 2000. Bank lending channel remains an important means of transmission of monetary policy in India, but it has weakened in the post-LAF period. The interest rate and asset price channels have become stronger and the exchange rate channel, although weak, shows a mild improvement in the post-LAF period.
Khundrakpam & Jain (2012): "Monetary transmission mechanism in India:A Quarterly Model" RBI DEPR WP; Quarterly data; 1996-97Q1 to	4 channels of monetary transmission: interest rate channel, credit channel, asset price channel and exchange rate channel. Structural VAR model with external vars as exogenous vars;	2 baseline estimates- with and without external vars; **Interest rate channel-** Hike in policy rate leads to a decline in GDP growth on impact (magnitude: 0 to - 0.0015) that dissipates slowly showing a V shaped response whereas WPI inflation on impact goes up (0 to 0.0008), declines in about 2 qrtrs (to - 0.0018) and its peak impact is felt with a lag of 1 qrtr from the corresponding peak impact on GDP growth. **Credit channel**- Shock to interest rate leads to decline in credit

2011-12Q2	**Endogenous vars:** Real GDP growth, WPI inflation, Call money market rate (policy rate) in that order and then the channel specific variable. **Exogenous vars**: OECD GDP and gross portfolio inflows; **Transmission channel specific vars:** Interest rate channel-CMR Credit channel- non food credit and total credit; Asset price channel- BSE SENSEX; Exchange rate channel- REER & NEER; SVAR estimates in first difference (except interest rate variables), owing to presence of unit root (co-integration check not mentioned) Don't have confidence interval bands around IRFs.	growth from 2nd qrtr; GDP growth also declines on impact and negative impact on inflation (which goes up on impact) occurs 1 qrtr after the GDP decline. **Asset price channel-** Equity price index goes up on impact and declines in 2nd qrtr, GDP growth declines on impact and peaks in 2nd qrtr, and impact on inflation (goes up on impact) is more muted relative to other 2 channels. **Exchange rate channel**- Immediate REER appreciation followed by depreciation; GDP response is very little and inflation shows a negative impact. **Summary:** Inclusion of external variables prolongs the impact of MP shocks on GDP growth and inflation. Interest rate, asset price and credit channel are important while exchange rate channel is weak. Interest rate channel accounts for about half of the total impact of monetary shock to GDP growth and about one third of total impact on inflation, indicating it is the most important channel in India.
Mohanty (2012): "Evidence on interest rate channel of monetary policy transmission in India", paper presented at the Second International Research Conference at the Reserve Bank of	Structural VAR Interest rate channel; Studies policy rate changes through to their effects on output and inflation.	Provides evidence that policy rate increases have a negative effect on output growth with a lag of two quarters and a moderating impact on inflation with a lag of three quarters, with both effects persisting for eight to ten quarters. Results underline the importance of interest rate as a potent monetary policy tool.

India; Quarterly data (Paper not found)		
Khundrakpam (2011): "Credit channel of monetary transmission in India - how effective and long is the lag?" RBI DEPR WP; Monthly data 2001:3 to 2011:3	Examines the operation of credit channel of monetary policy transmission in India through change in policy rate. Two reduced form equations, one with nominal bank credit as the dep. var. and the other with real bank credit, are estimated. Estimates the regressions for the two models in first difference or growth form. Monetary policy variable: Weighted call money rate (Because in India the effective policy rate had alternated between repo and reverse repo rate depending upon the deficit or surplus liquidity conditions) Other variables: IIP, WPI, NEER, REER Nominal bank credit: the total non-food credit of scheduled commercial banks. Real bank credit: real deposit and real money supply- the corresponding nominal series deflated by WPI. All variables in log.	Credit channel of monetary transmission is significant and robust in the post-LAF period. The transmission of policy rate to nominal or real bank credit growth takes about 7 months over the full sample period as well as across various sub-sample periods. Over the full sample period, 100 basis points increase in policy rate was found to reduce the annualised growth in nominal and real bank credit by 2.78 per cent and 2.17 per cent, respectively. However, a decline in the magnitude of the impact of policy interest rate on bank credit has been observed during the post global financial crisis period.

Pandit and Vashisht (2011): " Monetary Policy and Credit Demand in India and Some EMEs" ICRIER WP; Monthly data; January 2001 to August 2010; (Not a good paper)	Examining the impact of changes in policy rates on lending rates and deposit rates of commercial banks. Panel framework of 7 EMEs including India Examined the transmission of policy rate viz., repo rate from the perspective of demand for bank credit in India. Monetary Policy Variable: Repo rate	Change in policy interest rate is an important determinant of firm's demand for bank credit. (Not giving more details as this is more focused on a specific pass through rather than complete transmission to real variables)
Singh (2011): "How Asymmetric is the Monetary Policy Transmission to Financial Markets in India"; RBI Occasional Papers; March 2001 to June 2012.	VAR model; Estimates pass-through from the policy rate to a variety of short and long term market interest rates	Significant contemporaneous pass-through under deficit liquidity conditions from policy rates to call money rate as well as significant lagged effects. There is also considerable asymmetry evident in the transmission of monetary policy to financial markets depending on the tight or easy cycles of monetary policy.
Aleem (2010): "Transmission mechanism of monetary policy in India" Journal of Asian Economies; Quarterly seasonally adjusted data; 1996Q4 to 2007Q4.	3 channels of monetary transmission: bank lending channel, asset price channel and exchange rate channel. VAR model to estimate dynamic responses of GDP, prices and interest rates to an unanticipated monetary policy tightening.	**Results from Model 1:** An increase in call money rate leads to a decline in GDP which bottoms out in 3rd quarter and shows a V shaped response. Prices also decline in response to a positive overnight call money rate shock and recovers after 3rd quarter. Prices start declining after the fall in GDP (same as previous study). This effect disappears when exogenous variables are added. And monetary policy shock has temporary effects on the call money rate. Results from Model 2: **Bank Lending channel**- Prime lending rate responds

	Endogenous vars: Log GDP, Log WPI, Overnight call money market rate Channel specific vars: Bank Lending channel- Prime lending rate, Bank loans (bank credit to the commercial sector) Asset price channel- BSE's SENSEX-30 as an index of stock exchange. Exchange rate channel- REER **Ordering Rationale:** They argue that RBI takes into account current stage of GDP and prices. Thus, overnight call money rate responds contemporaneously to shocks to GDP and prices. However, GDP and prices do not respond contemporaneously to overnight call money rate shocks. Likewise GDP, prices and overnight call money rate do not respond contemporaneously to a shock to the transmission channel specific variable but the reverse holds. So variables ordering: -GDP -Prices -Interest rate -Channel specific var. **Exogenous vars:** World commodity price index, Federal funds rate and US GDP. Although some variables appear to	immediately to a call money rate shock. A positive shock creates an initial increase in PLR to 0.24%. After the second quarter, it converges toward the baseline. With bank loans, quantity of bank loans to the commercial sector decreases initially in response to a monetary policy tightening and then recovers after 3rd quarter. Prices and GDP show a similar decline, bottoming out in 3rd quarter. **Asset price channel-** A monetary tightening creates a decline in GDP-bottoms out in 4th qrtr, whereas prices initially fall and then pick up. **Exchange rate channel**: REER initially appreciates and shows a short-lived reaction to a positive overnight call money rate shock. GDP response is also very weak. Prices decline and show a V shaped response. **Summary:** Imposed restrictions on contemporaneous effects of endogenous variables to have an exact identification of benchmark VAR model. 1. The results of the benchmark VAR model suggest that a monetary policy shock has transitory effects on call money rate. The price-puzzle vanished after inclusion of vector of exogenous foreign variables. Prices and GDP decline after a positive call money rate shock. Moreover, prices start declining after a decline in GDP. 2. Results support the importance of bank lending channel in transmission of monetary policy shocks to real sector. 3. Neither asset price nor exchange rate channels are important. (Massive interventions by RBI in foreign exchange market to stabilize the exchange rate weaken the exchange rate channel). 4. Inclusion of foreign exogenous vars reveals that Indian monetary policy is constrained by US Fed's monetary policy. Hence, an analysis of Indian monetary policy requires inclusion of the federal funds rate in the information set of RBI. 5. A proper comprehension of monetary transmission mechanism in India requires analysis not only of response of GDP, but also of response of exchange rate to monetary policy shock.

	be non-stationary, they estimate the VAR model in levels. Model 1: First estimates benchmark VAR model with no channel specific variable, Model 2: Then introduces latter at the end and Model 3: Then exogenizes latter using its lags as exogenous variables and compared (2) and (3) IRFs. (Mostly looking at GDP response) Don't have confidence interval bands around IRFs. They do these as robustness checks, estimating +-2S.E. confidence intervals after blocking off each channel by exogenizing it.	6. Banks play an important role in financial intermediation in the Indian economy, and their strong representation reflects the lack of alternative sources of funding for the private sector.
Bhattacharya, Patnaik and Shah (2010): "Monetary Policy Transmission in an emerging market setting" IMF WP; Monthly data; 1997 to 2009.	Unified treatment of exchange rate pass-through and the monetary policy transmission—assessment of the effectiveness of two alternative paths through which changes in the short rate impact upon the economy. Structural VECM model. **Ordering rationale:** Assume that the exchange rate bears the first impact of external, exogenous shocks such as a change in foreign prices or interest rates. Any shock to the exchange rate contemporaneously affects all other variables, but other variables do not affect it instantaneously. This is followed by the interest rate	Orthogonalized IRFs for 24 months with 95% CI bands for both interest rate and exchange rate shocks. Interest rate hike has no direct impact on output; Exchange rate however appreciates on impact whereas WPI on impact goes up and then declines in 2-3 months bottoming out around month 6-7. Exchange rate shock associated with a rise in prices, no output response and a rise in interest rate. **Summary** Monetary policy transmission mechanism in India, an emerging economy, is weak. Changes in interest rates do not affect aggregate demand implying the absence of inflation-output trade-off.

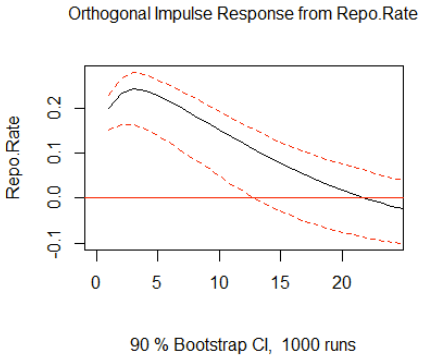
	affecting output and thereby the domestic demand and price but not the exchange rate. Similarly, the next variable, output, affects only the domestic price index contemporaneously while, the domestic price index does not affect any variable instantaneously. The exchange rate can also have an immediate effect on prices via import prices. Thus, domestic prices are ordered last in the model, which contemporaneously respond to all shocks in the system. **Endogenous vars:** IIP, WPI, NER, 91 day TBill rate, **Exogenous vars:** US PPI, 3 month TBill rate of US Fed All the variables, except the interest rate, are in logs. Interest rate is non stationary and one cointegrating relation at 1% significance level	Evidence of incomplete, but statistically significant, exchange rate pass though.
Bhaumik et al (2010): "Implications of bank ownership for the credit channel of monetary policy transmission: evidence from India" Bank level annual data; 2000 to 2007	Question looked at: How bank ownership plays a role in the credit channel of monetary policy transmission; whether the reaction of different types of banks (i.e., private, state and foreign) to monetary policy changes is different in easy and tight policy regimes. Estimates the change in loans in response to changes in PLR at the bank level.	Bank lending channel to be working much more effectively in a tight money period than in an easy money period in India i.e. banks decrease loan supply in response to increases in PLR in tight money periods. Considerable differences in the reactions to monetary policy initiatives of various banks differentiated by ownership pattern. These reactions are also influenced by the surplus or deficit liquidity conditions, with bank lending channel of monetary policy transmission being more effective under deficit condition than under surplus condition.

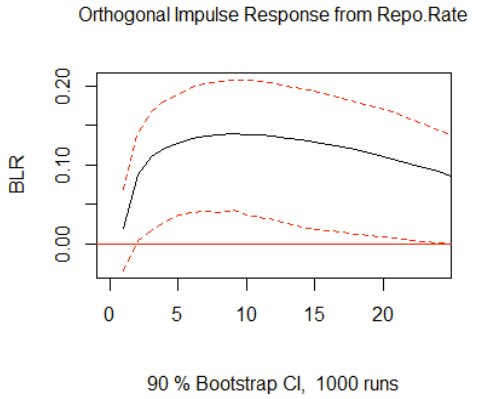
	Regression framework with dependent variable as bank loans and independent variable: Prime lending rate (lagged) Data on 58 banks	(Not giving much details since it is a different research design) Since the authors use the prime lending rate of banks themselves as the indicator of monetary policy, however, they implicitly assume complete and quick pass through of changes in monetary policy to bank lending rates, thus missing a potential price response by banks to monetary policy and looking only for a quantity response.
Mallick (2009): ""Macroeconomic Shocks, Monetary Policy, and Implicit Exchange Rate Targeting in India," Quarterly, 1996:2 to 2009:1	Structural VAR	A contractionary monetary policy shock is associated with a statistically significant reduction in real output, but monetary policy shocks accounted for a small part of the forecast error variance in real output. (Not giving details as not a conventional MP transmission paper)
Singh and Kalirajan (2008): "Monetary transmission in post-reform India: An evaluation". (Paper could not be accessed; found summary from lit review of other papers).		Highlights the significance of interest rate as the major policy variable for conducting monetary policy in post reform India
Pandit et al (2006): "Transmission of monetary policy and the bank lending channel: Analysis and evidence for India"; RBI DRG Study;	Bank Lending Channel (not clear how they incorporate this channel) Structural VAR Model. Panel data analysis of scheduled commercial banks (excluding regional rural banks and foreign	**Shock to CRR:** With an increase in CRR, money supply (LM3) decreases, the market-determined interest rate (CPR) rises and increases for 5 months before the onset of a decline in its growth rate. With a rise in CRR, the price variable initially increases in the first month but starts declining after the second month forming a hump shaped figure. As a result of increasing CRR, output (LIIP) declines.

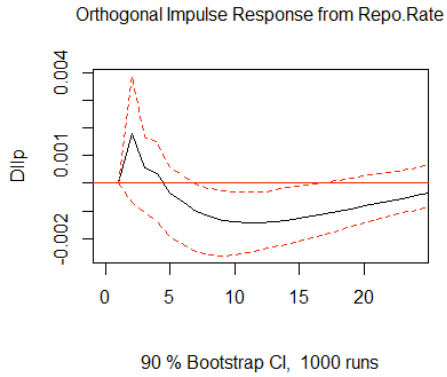
Monthly data; April 1993 to April 2002. (Poorly analyzed and written paper)	banks) – 46 banks in total afer data cleaning. **Endogenous vars:** log IIP, log WPI, log M3, CPR (Commercial Paper Rate) and the chosen policy instrument. Two policy instruments considered are CRR and change in Bank Rate (because their medium-term impact on bank lending can be expected to be direct and fairly quick). Bank balance sheet data: Loans advanced by commercial banks, funds (defined as the aggregate of deposits and borrowings) with commercial banks and commercial banks' investments in government securities—all in logs.	**Shock to Bank Rate:** The money supply decreases and the price variable, after registering an initial drop, increases till the tenth month. There is inconsistency in the behaviour of output and market-determined interest rate. IIP shows practically no effect. They also see the effect of monetary tightening (using both CRR and bank rate) on log NEER, net FII inflows, FX reserves, Trade Balance, and BSE market cap. A fall in CRR is accompanied by a rise in bank credit. There is a shift upwards in the economic activity parameter immediately given by log IIP. **Summary:** 1. On the basis of variance decompositions, there is not much difference as between CRR and bank rate as alternative policy instruments. However, on the basis of plausibility of relationships as given by the impulse response functions, CRR seems to perform relatively better *vis-à-vis* the Bank Rate. 2. The response of advances to a change in the policy variable turns out to be significant at conventional levels, irrespective of whether the price variable (Bank Rate) or the quantity variable (CRR) is considered i.e. banks tend to cut back lending and adjust their funds in response to a policy action. 3. Primarily the public sector banks are more reactive to the policy shocks.
Al-Mashat (2003): "Monetary policy transmission in India: Selected issues and statistical appendix." IMF Country Report Quarterly data	Structural VECM Used the overnight call money rate to capture monetary policy stance in order to examine monetary transmission in the post-reform period.	Interest rate and exchange rate channels strengthen transmission of monetary policy while little evidence of working of bank lending channel due to presence of directed lending to priority sectors. The impact of a monetary policy shock on macroeconomic variables is larger after including the exchange rate in the model.

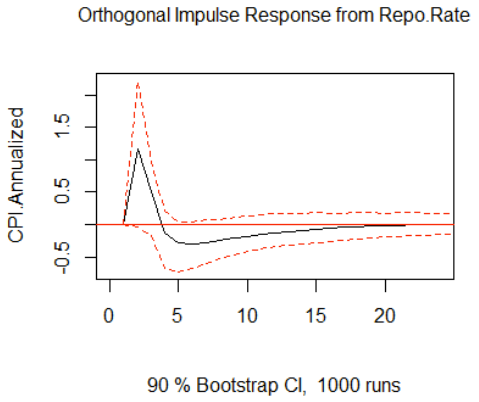
1980Q1 to 2002Q4 (Paper could not be accessed; found summary from lit review of other papers).		

Figure A1. Response to Cholesky One S.D. Innovations +/- 1 S.E: Average of Repo and Reverse Repo Rates (Bank Lending Rate Ordered Last)









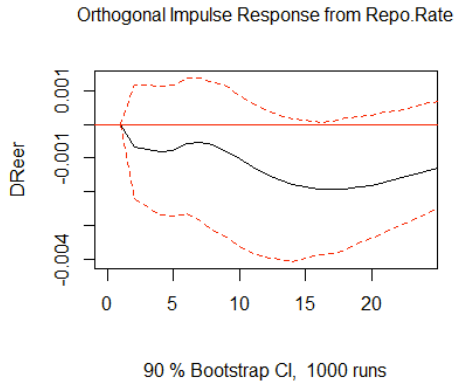
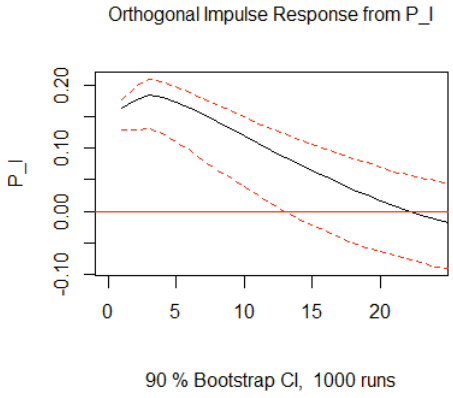
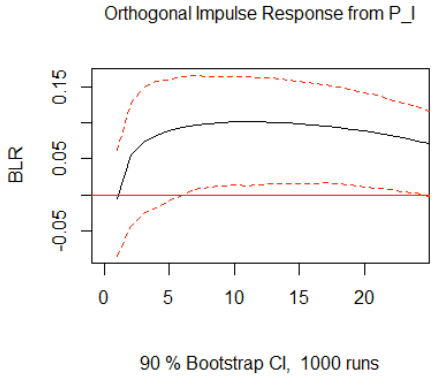
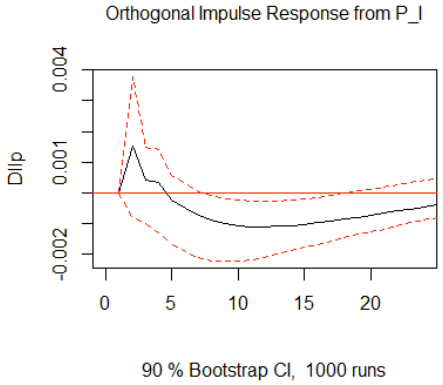
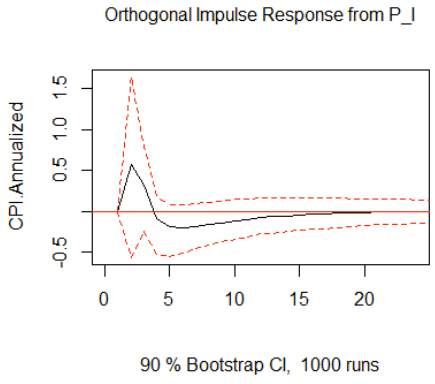


Figure A2. Response to Cholesky One S.D. Innovations +/- 1 S.E: Average of Repo and Reverse Repo Rates (Bank Lending Rate Ordered Last)









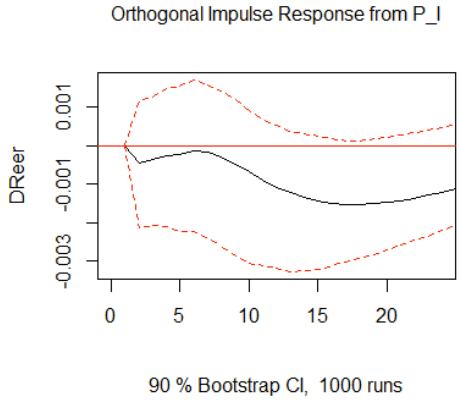


Figure A3. Response to Cholesky One S.D. Innovations +/- 1 S.E: Sum of CRR and SLR (Bank Lending Rate Ordered Last)

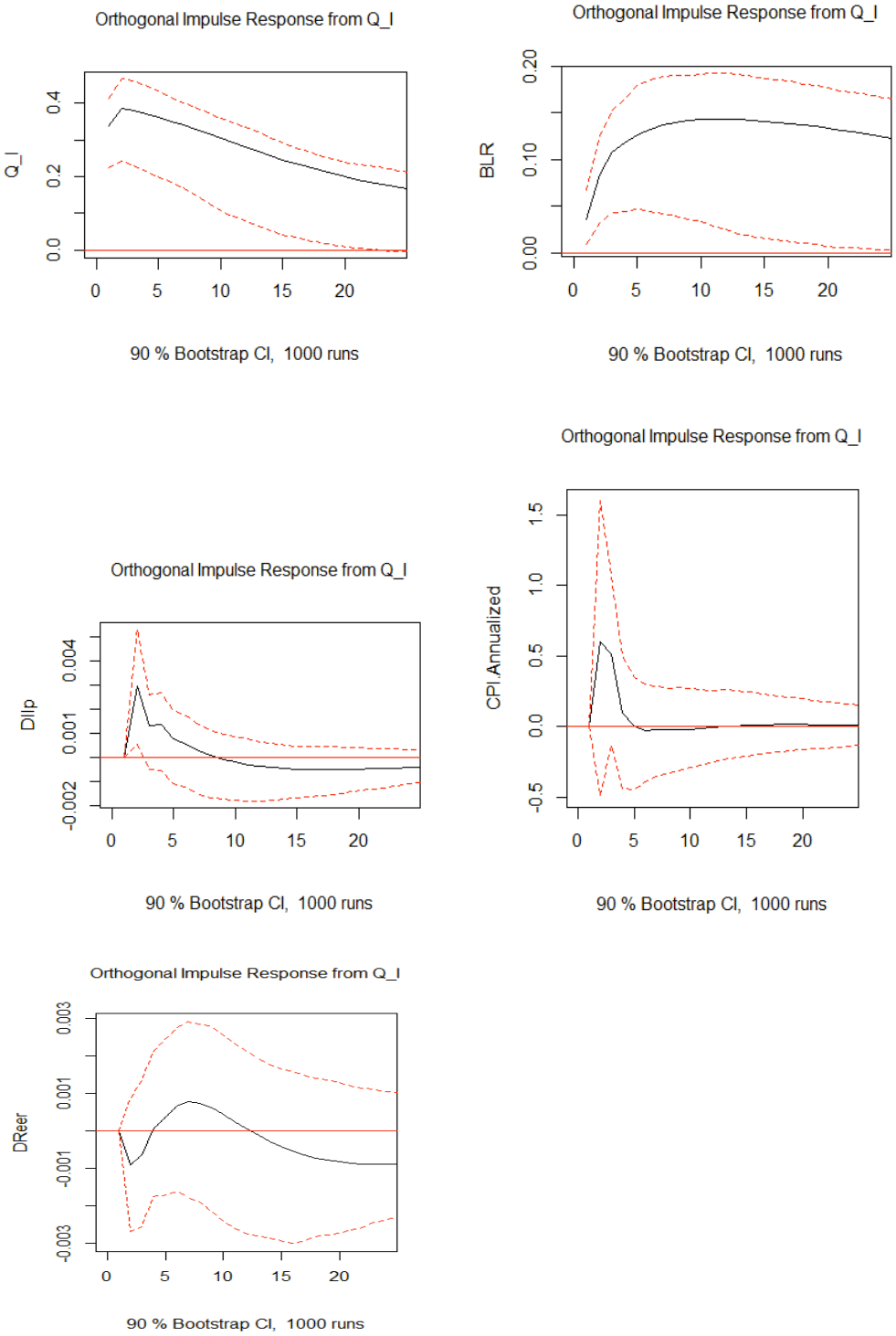


Figure A4. Response to Cholesky One S.D. Innovations +/- 1 S.E: Composite Monetary Policy Stance (Bank Lending Rate Ordered Last)