Oil Price, Exchange Rate and the Indian Macroeconomy

Ghosh, Taniya

IGIDR

1 October 2016

Oil Price, Exchange Rate and the Indian Macro Economy

Taniya Ghosh[i]

April 1, 2016

Abstract

The general discussions on the Indian macro economy have centered on two things in the recent past: how will the economy be impacted by falling value (depreciation) of rupee and the effects of falling world oil prices. However the exact impact of a depreciation of rupee or fall in oil prices on different macroeconomic variables of the Indian economy is still open to debates. The paper investigates the dynamic relationship between movements in oil prices and exchange rates with macroeconomic variables like price, output, interest rate and money by using structural vector auto regression (SVAR) approach. Additionally, a comparative analysis is done to show how each of these structural shocks historically has affected price, output and exchange rate.

The results are in favor of a strong link among these variables. Three results have important policy implications: first, the world price of oil has a great potential to impact India's output. Second, targeting depreciation of Indian rupee to expand output may not be an effective policy tool for the RBI. Third, variation in rupee's value can have medium to long term impact on world price of oil that the world should care about.

Keywords: Monetary Policy; Structural VAR; Oil Price, Exchange Rate; Output, Inflation, Depreciation

Section 1: Introduction

Among the numerous issues India has been grappling with in the last decade, there are two recent developments which are the most talked about. First is there any tangible gain (if at all) from the falling oil prices in the Indian context. Second is there any problem with falling rupee and why RBI should be concerned with it. The evaluation of such effects is imperative for the government and the private sector to help design the future course of action. It is important to understand how and to what extent these two variables affect the Indian macro economy. In this paper we study the effect of shocks to exchange rate and shocks to oil prices on variables like price, output, interest rate and money thereby explore if such shocks have a delayed and gradual effect on the price levels, small and temporary or a substantive and permanent effect on the output etc.

The first part of the present work is to study how variations in oil prices affect the Indian macro economy (price, output, interest rate, exchange rate). India is the fourth largest oil importer in the world after US, Japan and China. Its demand for oil is expected to rise very fast in the future with the projected growth rate of GDP to stay above 7%**.** As the GDP growth and industrial development is highly correlated to the availability of oil, our economy is, hence, extremely, vulnerable to oil price variations. There are many studies on the relationship among oil prices and real economic activities especially for the developed country originated by Darby (1982) and Hamilton (1983). Bjornland (2009) examined effect of oil price shocks for oil exporting country like Norway and in a different paper Bjornland (2000) examined the role of oil price shocks on GDP and employment for Germany, Norway, UK and the US using a SVAR model. Hamilton (1996) and others extended their work to model asymmetric responses of positive and negative oil price shocks to the macro economy. While majority of the studies are based on developed economy, there are few studies examining the role of oil prices for developing countries like India. However the results remain ambiguous. To quote a few, Hidhayathulla et al (2014) found that oil prices significantly affect the Indian exchange rates whereas Kaushik et al (2014) find that there is no detectable effect of oil price change on the real exchange rate between the Indian rupee and the USD.

The second part of the present work is to study how innovations in exchange rates affect the Indian macro economy (price, output, interest rate, exchange rate). There is still no consensus on appropriate exchange rate policy for developing countries given its unpredictable impact on the macro economy. The variations in exchange rate determine the economic performance of a nation mainly through its effect on exports, imports, prices, output and interest rates. The actual effects on output and inflation will be decided by the relative impacts of demand and supply channels, that is, change in value of imports and exports respectively. Evaluation of such effects will be necessary to design an appropriate exchange rate policy for India.

When rupee depreciates against major foreign currencies, we will expect Indian exports to increase, as Indian produced goods become cheaper abroad. However depreciation increases the cost of imports, so that the volume of imports may decline with the possibility that domestic goods and services are substituted for imports in response to the increase in the relative cost of imports. In such a scenario, a depreciation of rupee will lead to an improvement in net exports and hence, an increase in GDP. According to Guitian (1976) and Dornbusch (1988) the prerequisite for a currency devaluation to improve trade balance depends on switching the demand in the right direction and magnitude, and on the capacity of home economy to meet the additional demand. In other words, when Marshall-Lerner condition (sum of price elasticity of exports and imports in absolute value must exceed 1) is satisfied, a rupee devaluation will improve trade balance and output will expand. India in the past several years has witnessed severe supply side bottlenecks due to shortages notably in energy, power, mining sectors etc. This coupled with relatively low global demand has dampened the price elasticity of exports. Also as developing alternative form of energies is not a priority yet, India's high dependence on

oil, with oil being the major component of India's total imports, could affect the price elasticity of imports unfavorably. This opens the possibility of currency devaluation leading to contractionary effects on output as found in works of Kamin and Rogers (1997), Agenor (1991) etc.

To explore the effects of innovations to oil prices and exchange rate on the Indian macro economy, we use a small open economy structural vector auto-regression (SVAR) model (from Barnett et al.). This is based on Kim and Roubini (2000) and is modified to fit the Indian economy. The model from Barnett et al is shown to fit the Indian economy well as it is able to identify all the shocks correctly. For example a monetary policy shock in the model gives puzzles free results for India. In other words, the model exhibits no exchange rate puzzle, no output puzzle, no liquidity puzzle and no price puzzle. We do impulse response analysis to assess the quality of the model in terms of identifying different shocks. Having done that this also gives us precise estimates of the impacts of each shocks on prices, output, interest rate and money. We perform variance decomposition analysis to see how much of the oil price and exchange rate can explain the fluctuations in the prices, output, interest rate and money. Lastly using the historical decomposition analysis we attribute the role of each shock in explaining variations in prices, output and exchange rate.

Section 2: Model

The system of equation representing dynamic structural models can be collected and written in the vector form as

$$B_0 y_t = k + B_1 y_{t-1} + B_2 y_{t-2} + \cdots + B_p y_{t-p} + u_t \qquad (3.1)$$

Where y_t is an $n \times 1$ data vector, k is an $n \times 1$ data vector of constants and u_t is an $n \times 1$ structural disturbances vector. u_t is serially and mutually uncorrelated. p denotes the number of lags. B_s is a $(n \times n)$ matrix whose row i, column j element is given by $B_{ij}^{(s)}$ for s =1, 2... p.

Thus VAR in reduced form of a general dynamic structural model can be derived by pre-multiplying each side of [3.1] by B_0^{-1}. The structural disturbance u_t and reduced form residuals ϵ_t are hence, related by

$$u_t = B_0 \epsilon_t \qquad (3.2)$$

To estimate the parameters from the structural form equations requires restrictions imposed on instantaneous relations between the variables coming from theory and should satisfy the order and rank condition (please refer to Barnett et al).

Identification

We have a 7-variable VAR[ii] that includes the world oil price index (oilp), federal fund rate (rfed), industrial production for India (ip), the level of inflation in the domestic small open economy (π), domestic monetary aggregate (M1), nominal short-term domestic interest rate (rdom) and nominal exchange rate, domestic currency per USD (er). Our identification scheme based on equation (3.3) is given below.

$$\begin{pmatrix} u_t^{oil} \\ u_t^{rfed} \\ u_t^{ip} \\ u_t^{\pi} \\ u_t^{MD} \\ u_t^{MP} \\ u_t^{ER} \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ b21 & 1 & 0 & 0 & 0 & 0 & 0 \\ b31 & 0 & 1 & 0 & 0 & 0 & 0 \\ b41 & 0 & b43 & 1 & 0 & 0 & 0 \\ 0 & b52 & b53 & b54 & 1 & b56 & b57 \\ b61 & 0 & 0 & 0 & b65 & 1 & b67 \\ b71 & b72 & b73 & b74 & b75 & b76 & 1 \end{pmatrix} \begin{pmatrix} \epsilon_t^{oil} \\ \epsilon_t^{rfed} \\ \epsilon_t^{ip} \\ \epsilon_t^{\pi} \\ \epsilon_t^{MD} \\ \epsilon_t^{MP} \\ \epsilon_t^{ER} \end{pmatrix} \qquad (3.3)$$

u is the vector of structural innovations and ϵ is the vector of errors from the reduced form equations where the vector is given by (world price of oil shocks, Fed funds rate shocks, ip shocks, inflation shocks, money demand shocks, monetary policy shocks, and exchange rate shocks). We have a "contemporaneously" exogenous world oil price shock variable. Although none of the domestic variables can affect the world oil price contemporaneously, but it can do so over the time. Similarly, Fed fund rate, the short term interest rate of the U.S. in the small open economy framework is only affected by the world event shocks contemporaneously. A further type of behavioral restriction often imposed is that certain variables respond slowly to movements in financial and policy variables. So, for example, output and prices do not respond instantly to changes in domestic monetary policy variables and exchange rate due to the presence of high adjustment costs to production. However, the industrial production and inflation of the small, open, economy is deeply impacted by the world or outside shocks. Inflation is also affected by the current state of industrial production. We assume that in addition to the real income and the domestic interest rate, the money demand function also depends on the foreign (US) interest rate and the prevailing exchange rates. For an open economy, domestic investor definitely pays heed to the foreign interest rates and the exchange rates in deciding how much currency to hold. Monetary policy equation is assumed to be the reaction function of the monetary authority, which sets the interest rate after observing the current value of money supply, the interest rate and the exchange rate. We believe that the monetary authorities cannot ignore the exchange rate movements; this follows from the small open economy assumption. Also when the monetary authorities set its interest rate, we assume that it keeps an eye on the outside shocks (oil price shock) which have serious repercussion on the small open economy. Finally, we have the nominal exchange rate variable in the model. Exchange rate is one of the most volatile variables in the model and is quick to react to almost all shocks. The interest rate (immediate rates: call money/interbank rate for India) equation is interpreted as the policy

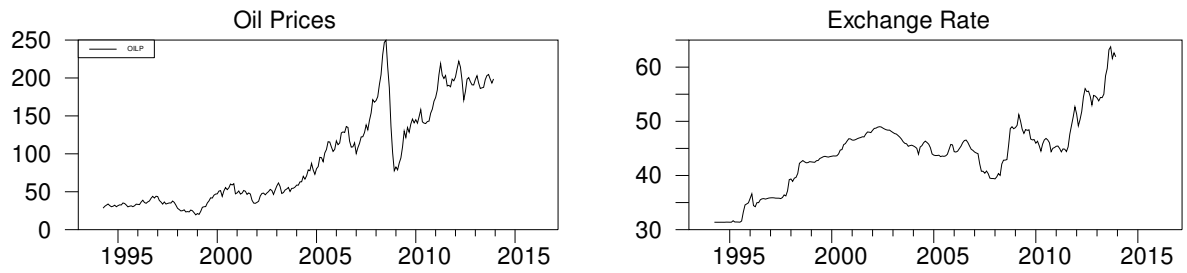
reaction function of the Central bank and the monetary aggregate equation is specified as the standard money demand equation.

On the basis of recommendations of second Narsimham Committee, 1998, an interim Liquidity Adjustment Facility (LAF) was introduced in 1999 to provide a ceiling and the fixed rate repos were continued to provide a floor for money market rates. LAF was introduced for the first time from June 2000 onwards with subsequent revisions. The committee had recommended that RBI's support to the market should be through a LAF operated by way of repo and reverse repo providing a reasonable corridor to market players. Under Repo, the banks borrow money from RBI to meet short term needs by putting government securities as collateral. Under Reverse Repo, RBI borrows money from banks by lending securities. While repo injects liquidity into the system, the Reverse repo absorbs the liquidity from the system. The introduction of the LAF helped to develop interest rate as an instrument of monetary policy transmission. The domestic short-term nominal interest rate closely follows the movement in the repo rate, usually set 1% higher above the repo rate and hence, it is chosen to produce monetary policy shock in our paper. The choice of sample period starting from January 2000 acknowledges the paradigm change in the monetary policy framework of the R.B.I.

The data are in monthly frequency for the sample period January 2000- December 2013. The foreign variables crude oil (petroleum) price index, is simple average of three spot prices; Brent, West Texas Intermediate and Dubai Fateh, obtained from the database of IMF. The Indian variables: industrial production used as a proxy for the real GDP; consumer price index; immediate interest rate (call money\interbank rate); simple-sum monetary aggregate index (M1); nominal exchange rate (Indian rupee per USD), and the US Federal funds rate are obtained from the OECD database. All the series are seasonally adjusted by the official sources except world oil prices which is seasonally adjusted using frequency domain deseasonalization in RATS (see Doan 2013). All variables are in logarithms except the interest rates. Inflation (π) is calculated as the annual change in log of consumer prices. Monthly VAR is estimated using 6 lags (same as done in Barnett et al). The results remain robust to use of different number of lags or different samples

Figure 1 captures the time path of oil price and exchange rate for India. Oil prices have been rising steadily over the past decade with some brief episodes of sharp decline in the latter part of the sample. Similarly, the value of rupee vis-à-vis dollar has been falling with intermittent episodes of currency appreciation.

Figure 1



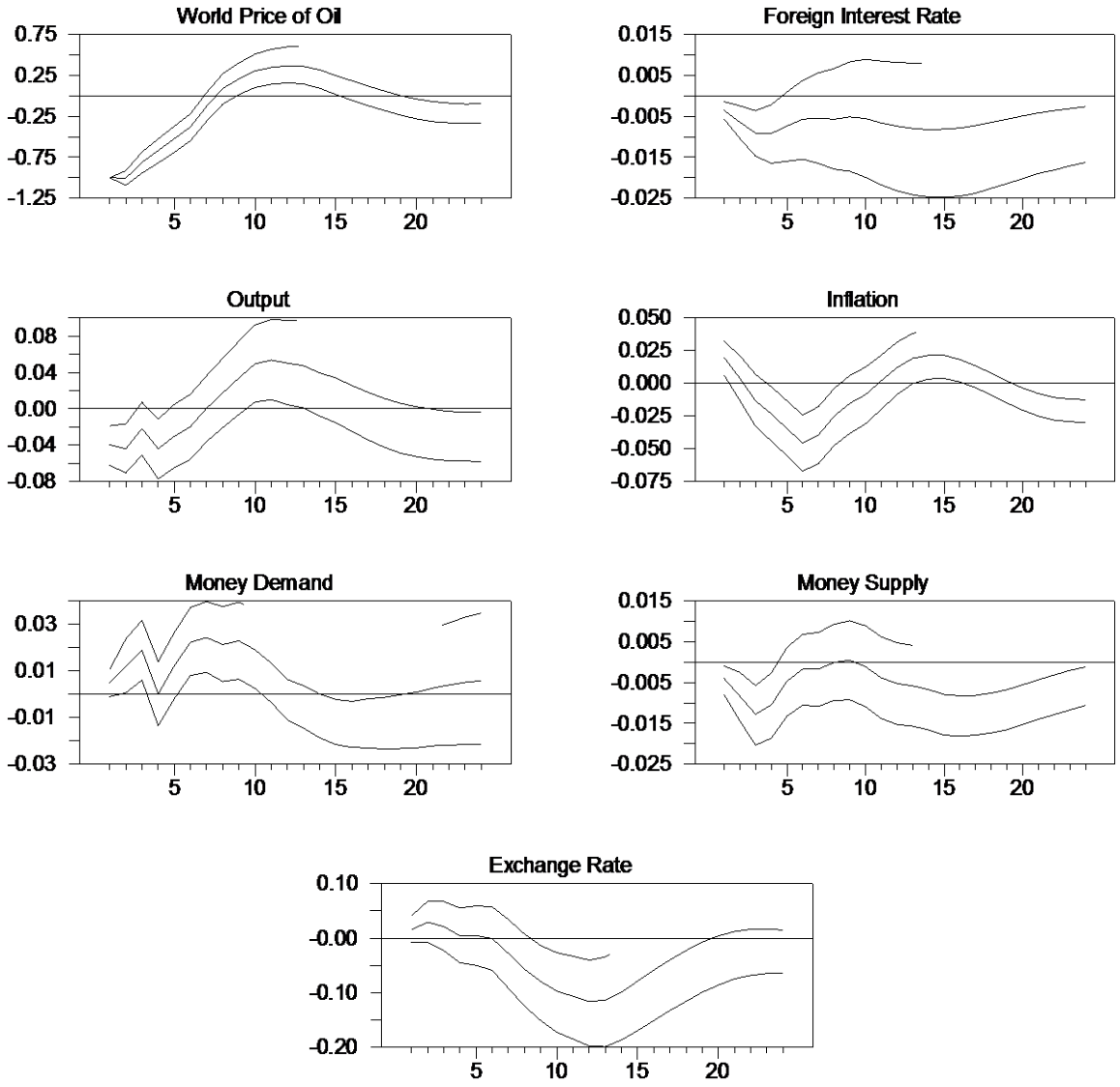
Subsection 2.1: Impulse Response Analysis[iii]

A shock in oil prices is likely to affect the macro economy through different channels. As the Indian economy is in a phase of rapid economic growth, it is heavily depended on imports of oil. This is exacerbated by the fact that India is still not prioritizing on alternative forms of energy to carry out its productions. A positive shock in oil prices discourages production in industries depended on oil as their marginal cost of production goes up. This negatively affects output and employment. As fuel share is a major component in CPI basket, a rise in oil prices will lead to upward movement in prices in general. Also as price of oil increases, amount of money that people want to hold should increase. This can also create inflation if money supply is unchanged. As people demand more money, they invest less, and hence output falls. As oil prices are paid in dollars, a rise in oil prices increase the demand for dollars. This increases the value of dollar vis-a-vis Indian rupee that is, a rise in oil prices leads to depreciation of rupee.

In the recent time, we have been witnessing falling oil prices and an enduring debate that how favorable will this be for the Indian economy. Using similar analogy we can expect the impacts of a negative oil price shocks to the macro economy. A negative oil prices will increase output and reduce inflation. As firms input cost lowers, they start producing more. Also people have more disposable incomes due to lower inflation to carry out investment purchases. The fall in oil prices improves India's current account balance and reduces government's fuel subsidy burden. However, we should not expect symmetrically opposite effect of a negative oil price shock compared to a positive oil price shock. A nonlinear model can capture the asymmetric dynamics. However VAR model is linear and will be unable to capture the extent of asymmetry. But our model does give strong evidence of a negative oil price shock affecting the Indian economy favorably.

The impulse responses to a negative shock in world price of oil is presented in figure 2. Although output falls on impact but rises steadily after the initial fall and the impact becomes positive from 7^{th} month onwards. A percentage point reduction in world price of oil can lead to a peak increase in output of around 0.05% with the positive effect lasting till the 20^{th} month after the initial impact. Inflation reduces up to 0.045% and the effect lasts till the 11 months prices start going up again.

Figure 2: Impulse Responses to Negative Oil Price Shocks



A fall in oil prices reduces the demand for dollars appreciating[iv] the value of Indian rupee vs dollar to a peak of 0.12% in the 12th month. Negative innovation in oil price cause the Indian central bank to significantly reduce the domestic interest rate to 0.012% as a response to mitigate the effects of falling prices and appreciation of rupee. Fed responds by reducing the interest rates (foreign interest rate) to a negative innovation in oil price to stabilize the dollar as oil prices are denominated in dollar. The impact response of money demand to oil price shock is insignificant on impact but shows an increase later on. Theory predicts money demand should fall. This is against the theory and can be attributed to the problems in the measurement of M1 money. Instruments like credit cards or debit cards etc. also provide liquid money but are not part of M1 measure reflecting inadequacy of M1 to capture the actual money demand. Overall we get correct impulse responses. However we see a lagged effects in the response of all the variables due to the fact that change in world oil prices do not transpire in to the domestic economy

instantly as the transactions are usually done through contracts written a priori or many a times, the government intervenes to smoothen the price variability so that the burden is not passed on instantly to the people.

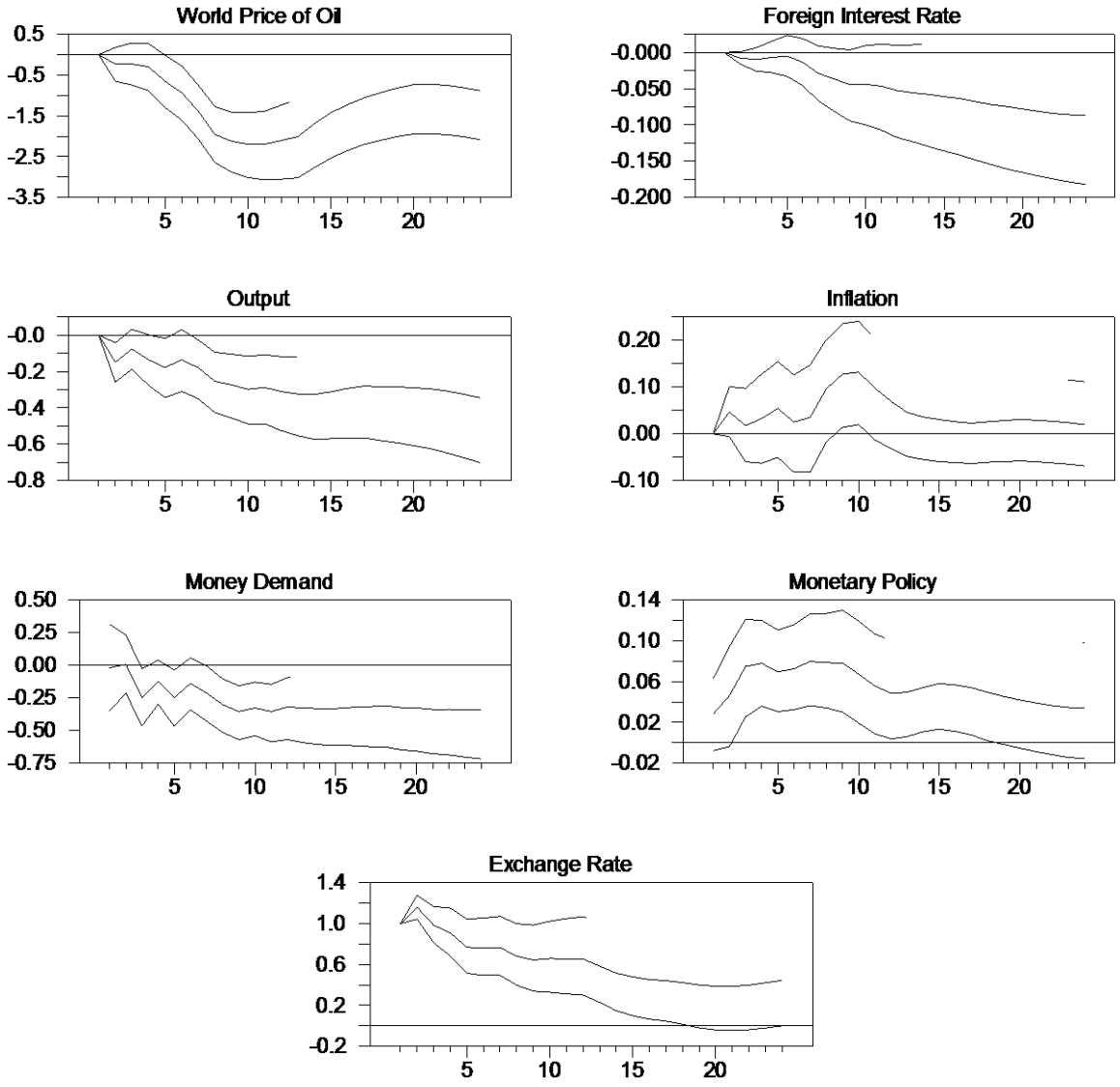
We present impulse responses for exchange rate shocks in figure 3. The direct channel through which exchange rates shocks affect the economy is through the country's net exports. A depreciation of exchange rate makes foreign goods more expensive compared to domestic goods for the natives and foreign goods cheaper compared to domestic goods for the foreigners. A weaker rupee vis-à-vis dollar encourages more exports and less imports such that net exports rise. Hence currency devaluation should cause a rise in output produced domestically as producers cater to larger domestic consumer base as well as larger foreign consumer base. However India' exports have been sluggish in last decade due to severe supply side bottlenecks. Also many industries depend on imported intermediate inputs whose cost has gone up due to currency devaluation affecting productions sharply. Depreciation of rupee may increase inflation as for example imports like oil are more expensive now. This prompts curbing the amount of imports like crude oil which can also affect the economy adversely. A one percentage devaluation of rupee vis-à-vis dollar had contractionary effect on industrial production. Industrial production significantly and permanently reduces with a peak reduction of around 0.3% in the 14th month after the shock.

The depreciation of currency is expected to increase the inflation through various channels. One possible channel would be the price of imported goods (oil, gold etc.) goes up as consumers now have to pay more for the foreign goods in terms of weaker rupee. A percentage point innovation in exchange rate (rupee devaluation) causes inflation to rise by 0.13% in the 10^{th} month. Demand for money balances is inversely related to depreciation of domestic currency as people would like to hold foreign assets. As rupee depreciates people want to hold less Indian currency and the money demand significantly reduces by almost 0.35%.

A weakening rupee can also posit other problems for the economy. The weak rupee repels the foreign investors in investing in rupee and also encourages domestic investors to invest abroad. Moreover it swells country's debt which is usually denominated in dollar as the government has to pay a higher amount in terms of the devalued rupee. To offset such negative impacts Central Banks take steps to strengthen the rupee in case rupee is hit by such a devaluating shock. One such measure could be to increase the domestic interest rates. Theory predicts that an increase in the domestic interest rates should lead to on impact appreciation of the exchange rate from Dornbusch's theory of exchange rate overshooting. Higher return on investments due to increase in interest rates in the domestic economy leads to a higher demand for domestic currency, appreciating the domestic currency vis-à-vis the foreign currency. We see that RBI has increased the interest rates (monetary policy) up to 0.8% points with a long term effects due to a positive shock in exchange rate (rupee devaluation). A shock to Indian exchange rate vis-à-vis dollar implies US dollar has appreciated. In response to that the Fed reduces its interest rate

(represented by foreign interest rate) up to 0.9 percentage points, however, the effects are not significant. Lastly, importing oil becomes more expensive with rupee devaluation, India being a major importer of oil prices adversely affect the aggregate demand for oil putting a downward pressure on its prices. One percentage point positive shock to the exchange rate (such that the rupee depreciates vis-à-vis dollar) reduces the world price of oil by 2.25%, an amount that the world should care about.

Figure 3: Impulse Responses to Exchange Rate Shocks



Subsection 2.2: Variance Decomposition

Table 1 offers the variance decomposition for all the variables in the model due to oil price shocks. One step ahead, the oil price shock does not have considerable contribution in

explaining any of the domestic variables. However, 2 steps ahead, we can see the increased role of oil price shocks in explaining monetary policy (2.3%) and output (3.2%) which keeps increasing further as we proceed in to the horizon.

Exchange rate shocks also play a key role in the recession post 2002 till 2004. Although output's own shock adds initially to the negative output shock, we see that it's almost the sole component explaining the negative output shocks from 2006 to 2007. We observe that inflation shocks made very small contribution during the entire recession phase. The contribution of oil price shocks though not immense but cannot be ignored.

Table 1: Decomposition of Variance for Oil Price Shocks

Steps	Oil Prices	Fed Funds Rate	Output	Inflation	Money Demand	Money Supply	Exchange Rate
1	100.0	1.9	1.8	1.2	0.0	1.5	0.1
2	94.6	2.3	3.2	0.7	0.6	2.3	0.1
4	84.9	2.6	3.0	1.0	0.6	4.4	0.2
8	61.9	0.9	3.1	5.0	3.2	4.5	2.3
12	41.4	0.5	9.7	4.3	4.1	5.0	9.5
18	33.7	0.4	10.7	5.1	5.0	7.8	13.5
24	30.0	0.3	8.5	5.5	6.3	7.5	11.3

18 steps ahead, oil price shocks explain 10.7% of output shocks and 7.8% of monetary policy shock. Also exchange rate shocks are affected significantly as we move further in to the horizon with 13.5% of exchange rate shocks explained by oil prices at the 18th step. Thus, oil price shocks can have long term effect to the economy. However oil price shock does not contribute immensely to the cpi inflation in our model. Its effect will be slightly more pronounced in models with wpi inflation as research has shown that wpi is more sensitive to oil price changes. But the major interpretation from the model will remain unchanged to use of cpi or wpi.

Table 2 offers the variance decomposition for all the variables in the model due to exchange rate shocks. One step ahead, the exchange rate shock does not have any contribution in explaining any of the domestic variables like output, inflation or money demand except the monetary policy whose 2.3% variation is explained by this shock. 10% of monetary policy shocks is already explained by exchange rate shocks 4 step ahead. Until 4 months ahead, exchange rate innovations had inconsequential contribution in explaining the variations in foreign variables, the fed funds rate and the world price of oil. We can see the increased role of exchange rate shocks in explaining oil price variations by 9% in the 8th step, which increases further to 19% in the 12th step. 24th step ahead, the contribution remains substantial 17% implying that the Indian exchange rate shocks affect the world oil prices significantly in the long run. However, shock to

Indian rupee vis-a-vis dollar does not worry the Fed. The variance decomposition of Fed Funds rate shocks remains low for all steps in the future with the maximum of 6% at 24th step.

Table 2: Decomposition of Variance for Exchange Rate Shocks

Steps	Oil Prices	Fed Funds Rate	Output	Inflation	Money Demand	Money Supply	Exchange Rate
1	0.0	0.0	0.0	0.0	0.0	2.3	91.9
2	0.2	0.2	1.5	0.4	0.1	3.3	84.1
4	0.4	0.2	2.3	0.5	4.2	10.0	68.5
8	9.4	0.9	6.2	1.6	8.7	16.6	54.6
12	18.7	2.0	10.6	4.8	14.0	17.2	43.7
18	18.4	3.6	12.2	4.7	14.8	16.9	34.6
24	17.4	6.1	12.2	4.5	14.8	15.5	29.6

Exchange rate shocks starts explaining substantial portion of output variations from 8th step ahead explaining around 11% in the 12th step and further to 12 % till the 24th step. However oil price shock does not contribute immensely to the cpi inflation explaining around 5% in 12th step, 18th step and 24th step ahead. Again its effect shall be more pronounced with wpi inflation. Exchange rate innovations explain 10 % of monetary policy innovations 4 months ahead with its contribution rising to 17% till the 18th step ahead. Its role remains important till the 24th step with a contribution of 16% establishing the fact that exchange rate is an important factor in monetary policy analysis. As expected, exchange rate shocks does significantly explain the variation in money demand with its contribution to about 15% in 18th month lasting till the 24th month.

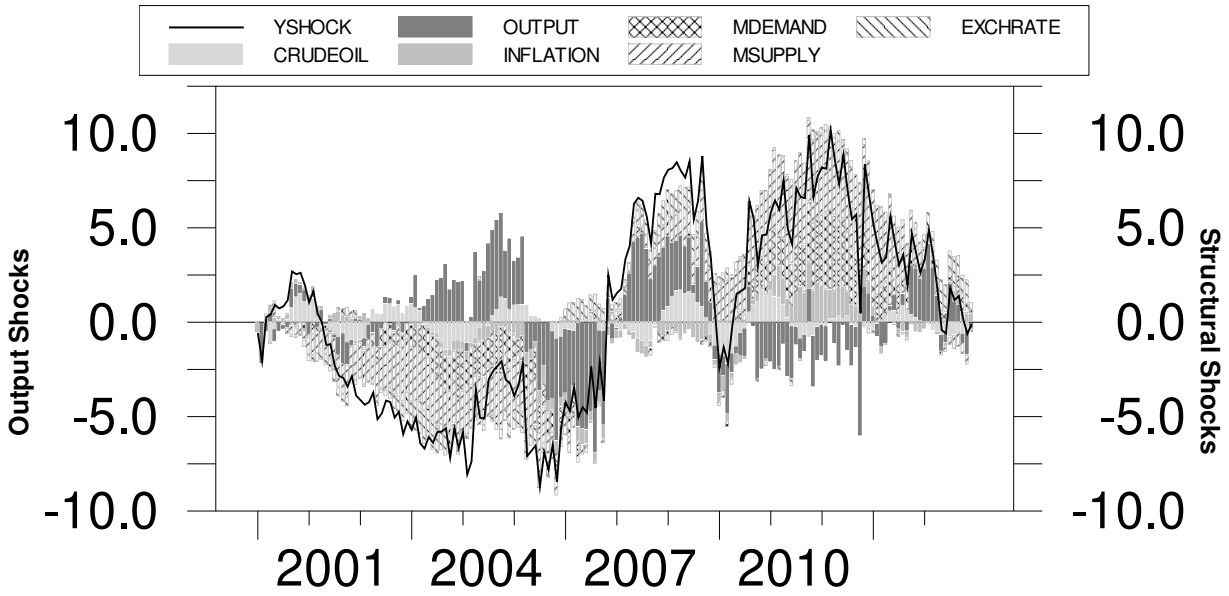
Subsection 2.3: Historical Decomposition

We use historical decomposition to estimate the contribution of each structural shock to the movements in output, inflation and exchange rate for the period 2000 to the end of 2013. This allows us to assess the comparative role of each shocks in the movements of these variables. The historical decomposition of each variable into structural shocks is calculated by using backward substitution and Wald decomposition of equation 3.1 to represent the variables time in terms of its initial values and all the structural shocks of the model.

$$y_t = A^t y_0 + \sum_{k=1}^{t} A^{t-k} u_k$$

Figure 4 captures the historical decomposition of the shocks to output. In 2001 oil price shocks contribute significantly to output. From 2001 to 2007, interest rate shocks (the money supply shocks) followed by M1 money shocks (money demand shocks) are the most significant component of negative shocks to output.

Figure 4: Historical Decomposition of Output



Exchange rate shocks also play a key role in the recession post 2002 till 2004. Although output's own shock adds initially to the negative output shock, we see that it's almost the sole component explaining the negative output shocks from 2006 to 2007. We observe that inflation shocks made very small contribution during the entire recession phase. The contribution of oil price shocks though not huge cannot be ignored.

For the initial phase of recovery, output's reversed its role and played the most important factor adding to positive output shocks with money supply and exchange rate shocks playing a favorable role. While initially dampening the positive effect of output shock, oil price shocks make a substantial positive contribution. A small negative spike in output shocks can be completely explained by oil price shocks in 2009. Money demand and money supply shocks played a major role in the later years in explaining positive shocks to output. Interestingly, inflation shocks did not matter much throughout the sample but were the most significant around 2008-2010 in explaining the positive output shocks.

Figure 5: Historical Decomposition of Inflation

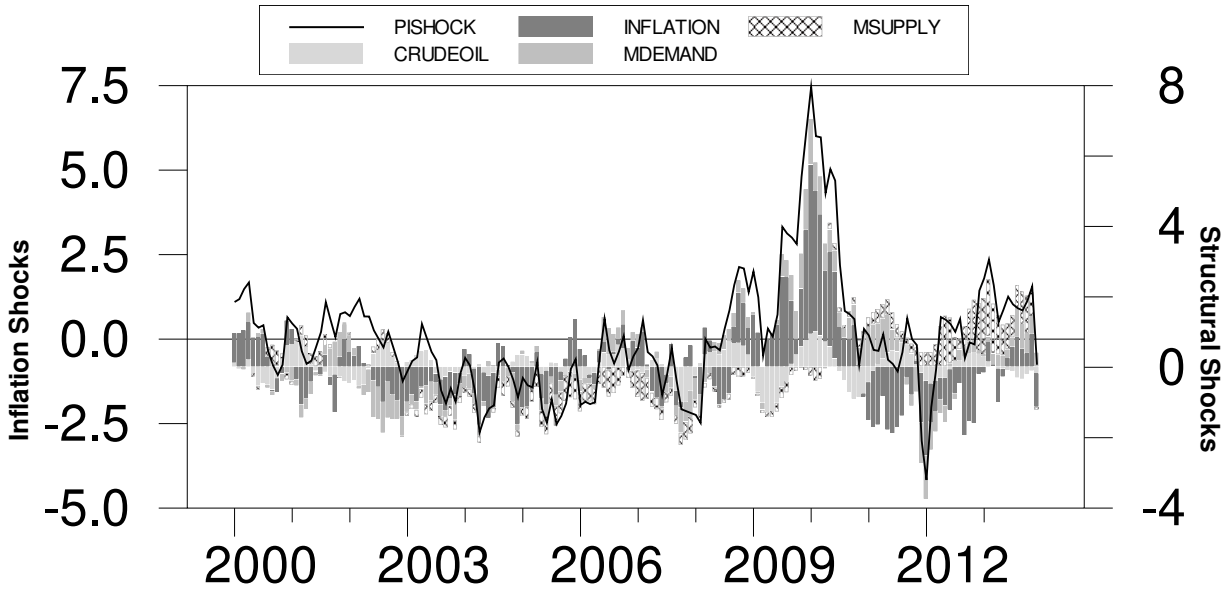
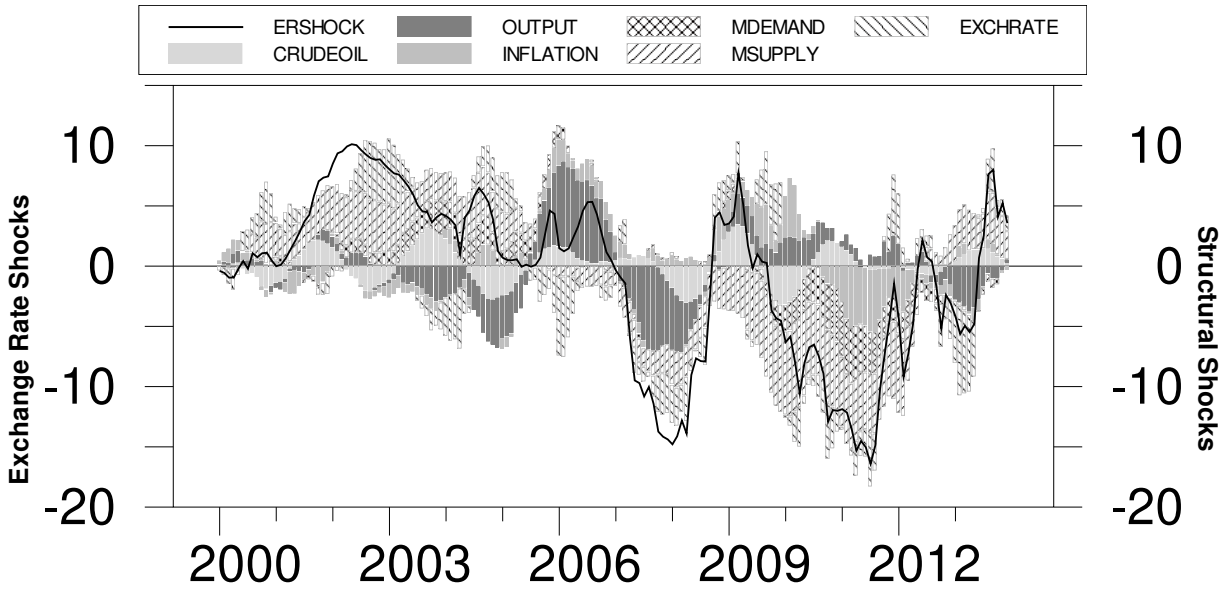


Figure 5 captures the historical decomposition of the shocks to prices. An inflation shock is the most volatile shocks and is explained majorly by its own shocks. Money supply and money demand shocks are also playing a very important role in the last decade. Especially money supply has significant positive contribution to the positive inflation shocks post 2012. Although effect of oil price shocks were not prolonged but have been instrumental some of the years in explaining the inflation shocks. Exchange rate shocks play a minor role and have been suppressed in the graph for the sake of clarity.

Figure 6 captures the historical decomposition of the shocks to exchange rates. Monetary policy (money supply) undoubtedly has a remarkable contribution in explaining exchange rates. During first half of 2000s and the last few months of the sample it consistently contributed positively to the positive shocks to exchange rates. During the latter period till 2013 contributed negatively to negative shocks in exchange rate. Only with the exception around 2013 it added positively to a negative shock to exchange rate.

Figure 6: Historical Decomposition of Exchange Rate



Money demand shocks have similar effects but in lesser intensity than money supply shocks. Oil price shocks though transient have not been inconsequential in explaining the exchange rate shocks, for example, for the year 2009-2010, it is the most important source of exchange rate fluctuations.

Section 3: Conclusion

We analyzed the effect of innovations to oil prices and innovations to exchange rate of rupee vis-a-vis dollar on different macroeconomic variables. We get sensible impulse responses due to these innovations in line with the theory. The shocks have consequential impact on the Indian economy also corroborated by the variance decomposition and historical decomposition analysis. The RBI, hence, should acknowledge the important role of these variables in monetary policy analysis. A negative innovation in oil price has a favorable long term effect on output, prices go down temporarily and rupee appreciates in the short term. The central bank adapts an expansionary monetary policy to stabilize the inflation and exchange rate which could lead to further output expansion. The economy responds asymmetrically to positive and negative shocks to oil prices, an issue that need to be studied in further details for the Indian context.

Rupee depreciation causes a medium to long term decline in output, demand for money and world price of oil. It has a small effect on inflation causing it to increase temporarily. RBI in order to rescue the domestic currency adapts a contractionary monetary policy. Variations in rupee has global implications in terms of causing significant variations in world oil prices that the world should not ignore. The variance decomposition analysis strongly supports the view.

The policy of targeting exchange rate at a very competitive level to move the production possibility frontier upwards may not be beneficial one and could be very risky for India. Rather India should focus on structural reforms to resolve supply side bottlenecks especially in resource and energy sectors such as policies to boost exports like optimal resource allocation and allowing private sector participation in the energy sector. Greater investment in research and development is needed for developing alternative energy technologies that will reduce India's dependence on imports of oil.

Lastly we perform historical decomposition analysis to compare the relative roles of each structural shock on output, price and exchange rate innovations. Barring the own shocks, monetary policy shocks followed by money demand shocks have been the most dominant ones in explaining output, price and exchange rate movements. Historically, oil price shock is shown to have a consequential impact in explaining shocks to these variables. Exchange rate shocks, on the other hand, had relatively smaller impact on variations in India's output and inflation historically.

Section 4: References

Agenor, P R (1991): "Output, Devaluation and the Real Exchange Rate in Developing Countries," Weltwirtschaftliches Archiv. Bd. 127, H 1, pp. 18-41

Barnett W. A., Bhadury S. S., Ghosh Taniya (forthcoming): "A SVAR Approach to Evaluation of Monetary Policy in India," with S. Bhadury and William A. Barnett, Carnegie Mellon Working Paper Series in Applied Economics

Darby, Michael R (1982), "The Price of Oil and World Inflation and Recession," American Economic Review, American Economic Association, vol. 72(4), pages 738-51, September.

Doan,T. (2013): RATS Manual, Version 8.3, Estima, Evanston, IL

Doan,T. (2012): RATS Handbook for Bayesian Econometrics, Estima, Evanston, IL

Dornbusch R. (1988): Open Economy Macroeconomics, 2nd Edition, New York

Guitian M. (1976): "The effects of changes in the exchange rate on output, prices and the balance of payments," Journal of International Economics, Volume 6, Issue 1, Pages 65-74

Hamilton, James D. (1983): "Oil and the Macroeconomy since World War II," Journal of Political Economy, University of Chicago Press, vol. 91(2), pages 228-48, April

Hamilton, James D. (1994): Time Series Econometrics, January 11, 1994

Hamilton, James D. (1996): "This is what happened to the oil price-macroeconomy relationship," Journal of Monetary Economics, Elsevier, vol. 38(2), pages 215-220, October

Hidhayathulla A., Mahammad Rafee. B. (2014): "Relationship between crude oil price and Rupee, Dollar Exchange Rate: An Analysis of Preliminary Evidence," IOSR Journal of Economics and Finance, vol3, issue 2, ver. II, pages 01-04

Hilde C. Bjørnland (2009): "Oil Price Shocks and Stock Market Booms in an Oil Exporting Country," Scottish Journal of Political Economy, Scottish Economic Society, vol. 56(2), pages 232-254, 05

Hilde C. Bjørnland (2000): "Effect of Aggregate Demand, Supply and Oil Price Shocks," The Mancheter School, vol. 68(5), pages 578-607, 05

Kamin S. B., Rogers J. J. (1997): "Output and the Real Exchange Rate in Developing Countries: An Application to Mexico," FRB International Finance Discussion Paper No. 580

Kaushik N., Nag R., Upadhyaya K. P. (2014): "Oil Price and Real Exchange Rate: The Case of India," International Business and Economics Research Journal, volume 13, no. 4

Kim S., Roubini N. (2000): Exchange rate anomalies in the industrial countries: A solution with a structural VAR approach, Journal of Monetary Economics, Vol. 45(3), pp.561-586

---

[i] T. Ghosh
Indira Gandhi Institute of Development Research (IGIDR), Mumbai, India

[ii] It is shown that differencing of variables do not provide gain in asymptotic efficiency of the model and may throw away information regarding the co-movements in the data like cointegrating relationship between the variables in a VAR. Hence, we have a VAR in levels.

[iii] The statistical significance of impulse responses are examined using the Bayesian Monte Carlo integration in RATS. Random Walk Metropolis Hastings method is used to draw 10000 replications for the over-identified SVAR model. The 0.16 and 0.84 fractiles corresponds to the upper and lower dashed lines of the probability bands (see Doan, 2013).

[iv] A reduction in value of domestic currency is equivalent to appreciation of the domestic currency relative to foreign currency.