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Exchange Rate Pass Through In India

Abhishek Kumar

ABSTRACT :*This paper investigates exchange rate pass through in India using VAR framework. The finding suggests that energy prices affects domestic prices significantly. The exchange rate pass through is not significant*

I. INTRODUCTION

Interest rate is a crucial macro-economic variable. It affects output and price both. Exchange rate is another important variable that affects output and prices. Normally if a currency depreciates the imported product become costlier in terms domestic currency and thus domestic price level rises and this phenomenon is called exchange rate pass through. A depreciation of currency boost exports and vice versa. In country like India exchange rate plays a key role in determination of macro-economic variable. Our objective in this chapter is to bring exchange rate and foreign exchange management of RBI in a unified framework of monetary policy transmission (Kim 2003) and to look whether the results have improved in comparison to the model considering only conventional monetary policy. We are estimating (SVAR) model. Section 1 analyzes the literature on the need of exchange rate transmission in case of developing countries and section: 2 provide theoretical idea of exchange rate pass through. Section: 3 provide evidence on exchange rate pass through. We discuss the need to use exchange rate in monetary transmission in case of country like India. In section 4 we have explained the dataset used in analysis, the identifying restriction of SVAR and our basic Model. Section 5 gives the methodology. This is followed by results and analysis and ends with conclusion.

II. WHY EXCHANGE RATE CHANNEL?

While emerging economies are increasingly integrated with the world economy through trade and financial flows, there are unique policy challenges in monetary policy primarily owing to underdeveloped financial markets and institutions (Hammond et al., 2009). With a well functioning financial system, changes in the policy rate have a substantial impact upon aggregate demand and thus on the price level (Gerlash and Smets, 1995; Ramaswami and Slok, 1998; Mojon and Peersman, 2001; Smets and Wouters, 2002; Ganev et al., 2002; Norris and Floerkemeir, 2006) and since a well developed financial system is not present in case of developing countries we expect the interest rate channel to be weak and exchange rate channel may add to our understanding of monetary transmission. While there is substantial variation in financial development across developing countries (Dorrucci et al., 2009), three features are often found. The first is an underdeveloped bond market. Through this, the transmission of changes in the short-term policy rate to other points on the yield curve tends to be weak (Moreno, 2008). Transmission of interest rate from low end of the spectrum to high end is crucial for monetary transmission as it's the long-term rates that matters for real economic activity. We have found in earlier chapters that pass through to long-term rates decreases as the period increases and the pass through is time varying.

The second issue is that of the banking system. Low levels of competition, resource pre- emption for deficit financing, and public sector ownership inhibit the extent to which changes in the policy rate rapidly affect deposit rates and lending rates. Stickiness of deposit rates is common in the case of India. High costs of information processing, evaluating projects and monitoring borrowers induce banks to maintain persistently high levels of bank reserves (Agenor and Aynaoui, 2010). This leads to less proportionate Bank lending in developing countries. Small values for the stock of bank lending to the private sector, relative to GDP, imply that even when bank-lending rates do change, the impact upon aggregate demand is small. Third, In addition to the small formal financial system there is the large informal sector in most developing countries. The size of this sector, and the nature of its linkages with the formal financial system, has important consequences for monetary policy transmission. When the central bank raises rates, the monetary policy transmission tends to be weak because this does not directly affect informal finance, and also because on the margin there are borrowers who switch to borrowing from the informal system in response to higher interest rates in the formal financial system. This kind of informal lending may weaken the traditional interest rate channel in case of developing economies.In India where the economy is dependent on imported oil, we expect the exchange rate channel to be quite important, as depreciation of exchange rate will lead to higher oil prices in terms of domestic currency. With the economic reform Indian economy has become interlinked with the global economy and in last twenty years the economy has changed from inward-looking economy to outward looking economy and because of that we expect exchange rate channel to be one of the important channel of monetary transmission.

III. THEORETICAL IDEA ON EXTENT OF PASS THROUGH

Economists have traditionally made the simplifying assumption that the prices of tradable goods once expressed in the same currency – are equalized across countries, i.e. that the purchasing power parity condition (PPP) holds. Empirically, however, this assumption has found in general little support, at least in the case of small samples and in the short to medium run. In line with this evidence, the theoretical literature developed over the past two decades has provided different explanations why the ERPT is incomplete. In his seminal paper, Dornbusch (1987) justifies incomplete pass-through as arising from firms that operate in a market characterized by imperfect competition and adjust their mark-up (and not only prices) in response to an exchange rate shock. Burstein et al. (2003) instead emphasize the role of (non-traded) domestic inputs in the chain of distribution of tradable goods. Burstein et al. (2005) point to the measurement problems in CPI, which ignores the quality adjustment of tradable goods large adjustment in the exchange rate. Corroborating these various theoretical approaches, the empirical literature for both advanced and emerging economies has found evidence of incomplete ERPT. These studies also find evidence of considerable differences across countries, leading naturally to the question of what are the underlying determinants of pass-through. Taylor (2000) in particular has put forward the hypothesis that the responsiveness of prices to exchange rate fluctuations depends positively on inflation. The rationale for this involves a positive correlation between the level and persistence of inflation, coupled with a link between inflation persistence and pass-through. The latter link can be expressed as follows: The more persistent inflation is, the less exchange rate movements are perceived to be transitory and the more firms might respond via price-adjustments. The evidence across different studies appears overall supportive of the Taylor hypothesis. The positive relationship between the degree of pass-through anThe evidence across different studies appears overall supportive of the Taylor hypothesis. The Another important determinant of ERPT, from a theoretical standpoint is the degree of trade openness of a country. The most immediate connection between the two variables is positive: the more a country is open, the more movements in exchange rates are transmitted via import prices into CPI changes. However, the picture becomes more complex once we take into account that inflation could be negatively correlated with openness, as empirically found by Romer (1993). This gives rise to an indirect channel, whereby openness is negatively correlated with inflation and, taking into account Taylor's hypothesis, the degree of pass-through. The direct and indirect channels go in opposite directions and the overall sign of the correlation between pass-through and openness can thus be either positive or negative.

IV. EVIDENCE ON PASS THROUGH

Over the past two decades a large economic literature on exchange rate pass-through (ERPT) has developed. Starting from different standpoints, the empirical literature examines the role played by ERPT in small and large economies. Studies conducted for the case of developed countries include Anderton (2003), Campa and Goldberg (2004), Campa et al. (2005), Gagnon and Ihrig (2004), Hahn (2003), Ihrig et al. (2006) and McCarthy (2000). There is also a burgeoning literature applied to emerging market economies, including cross-country comparisons as in Choudhri and Hakura (2006), Frankel et al. (2005) and Mihaljek et al. (2000).

The mainstream strategy for analyzing exchange rate pass-through is a multivariate time-series analysis of six variables: output, oil price, import price, domestic price, exchange rate and short-term nominal interest rate (McCarthy, 1999; Smets and Wouters, 2002; Ito and Sato, 2008). In such analyses, emerging markets are treated as small open economies where domestic variables are endogenous to the system and are affected by exogenous world variables, but not vice versa. ECB working paper (2007) analysed the ERPT with a six variable structural VAR consisting of first difference of oil prices, output, exchange rate, Import prices, consumer prices and interest rates for a set of countries. For most countries their results appear generally plausible both in terms of CPI and import prices. ERPT is found to decline along the pricing chain, i.e. it is higher for import prices than for consumer prices.RBI working paper analysed the pass through with a vector error correction model comprising of six variables including domestic prices (LWPI), import prices or unit value index (LMUV), Indian Rupee-US dollar exchange rate (LEXR) and GDP at factor cost at constant prices in natural logarithm scale, and interest rate (call money rate) and capital flows, defined as the current account deficit plus capital account surplus to GDP ratio (XBOPRS) to investigate as to how import prices affect domestic prices. Domestic inflation rate for fuel group and growth of agricultural production were used as exogenous variable to account for domestic and external supply shocks. The economic intuition is that capital flows would depend upon macroeconomic fundamentals such as the growth and inflation condition, apart from gains from the movement in exchange rates. The VECM model used annual data for the period 1950-2007, since import prices data were available annually. Based on non-parametric estimation, import price inflation could contribute to domestic inflation on average ranging between 1 and 2 percentage points. The vector error correction model suggested that every percentage point increase in import prices in domestic currency could affect domestic inflation upward by 20 to 30 basis points; alternatively, every five percentage point increase in import price inflation would be associated with one percentage point increase in domestic price inflation. Import prices, capital flows and exchange rate had statistically significant positive association with domestic inflation in the long run. The interest rate variable had a negative association with domestic prices in the long run, though its statistical significance was not as strong as other variables.Bhattacharya et. al. (2008) analysed the ERPT with a four variable structural VAR consisting of first difference of oil prices, output, exchange rate, and consumer prices for India. They also considered a VECM model with adding M3 before consumer prices in the ordering of the variable.They found that exchange rate pass-through into domestic prices in India is moderate. The long run pass through elasticity for CPI is 3.7-17%, while that for WPI is 28.6%. Bhattacharya et. al. (2011) estimated a Structural VECM of exchange rate, interest rate, output and consumer prices and included US price index and interest rate as exogenous variable. In India they found evidence of incomplete, but statistically significant, exchange rate pass though.

V. DATA AND MODEL

4.1 Data

The data vector is monthly [oil prices proxied by energy price index obtained from World Bank commodity Price Index, output IIP, exchange rate Rupee/USD, CPI interest rate i.e. call money rate (MMR)], from 1995M6-2013M2 based on the model developed by ECB for emerging market and McCarthy (1999). We couldn’t take import prices as for import prices only annual series is available. We replaced CPI with WPI and estimated another model. MMR is the call money rate, CPI is the consumer price index and WPI is wholesale price index.. CPI and IIP have been obtained from IMF database. All other variables have been taken from RBI website. First differences of the variables have been used except MMR. IIP has been seasonally adjusted. In Appendix A.1 (Figure: 1,2,3,4, 5, 6) have shown the data being used in analysis.

4.2 The Model

The ordering of variables in the exchange rate pass-through and monetary policy literature is subject to the characteristics of the country/region under consideration and the problem explored. For example, Kim and Roubini (2000) present an open economy model for industrialized countries in a non-recursive structural framework. In their model, the policy rate, which is ordered first, is affected contemporaneously by shocks to money demand, the world price of oil and the exchange rate. The exchange rate is ordered last in the list, which responds instantaneously to all other shocks. These shocks are ordered as following: Monetary aggregate, CPI, IIP, world price of oil and U.S. Federal Funds Rate. This model captures the characteristics of a large open economy with fully floating exchange rates where authorities have independence over monetary policy. Incorporating world variables in the endogenous system implies that although, these variables are not affected by shocks to the home country variables contemporaneously; they are affected with a lag. For a model of an emerging economy like India, which is a small open economy (in the sense that it can not affect prices in the world market), world variables are incorporated in the set exogenous variables.In contrast to Kim and Roubini (2000), the pass-through literature dominated by McCarthy (1999) and its downstream literature follows recursive structural VAR models with Choleski orthogonalisation. The order of the variables in these models is the following: oil price inflation, output gap, exchange rate, import price inflation, wholesale and consumer price inflation. This formulation again captures the floating nature of the exchange rate, which immediately responds to supply and demand side shocks to the economy**. Our ordering of the variable in the VAR model is in the line of McCarthy (1999) considering a floating exchange rate regime in India.**

VI. METHODOLOGY

Structural VAR modeling with contemporaneous restrictions

We assume the economy is described by a structural form equation

$A(L)\,Y_t = E_t$ (1)

Where A (L) is a matrix polynomial in the lag operator L, Y_t is an n*1 data vector, and E_t is an n*1 structural disturbance vector. E_t is serially uncorrelated and variance (E_t) =Matrix B. B is a diagonal matrix where diagonal elements are the variances of structural disturbances, so structural disturbances are assumed to be mutually uncorrelated.We can estimate a reduced form equation (VAR)

$Y_t = B(L)\,Y_{t-1} + u_t$ (2)

where B(L) is a matrix polynomial in lag operator L and variance (u_t)=Σ

There are several ways of recovering the parameters in the structural form equation from the estimated parameters in the reduced form equation. Some methods give restrictions on only contemporaneous structural parameters. A popular and convenient method is to orthogonalize the reduced form disturbances (u_t) by the Cholesky decomposition (as in Sims, 1980). However, in this approach we can assume only a recursive structure, that is, a Wold-causal chain. Blanchard and Watson (1986), Bernanke (1986) and Sims (1986) suggested a generalized method in which non-recursive structures are allowed while still giving restrictions only on contemporaneous structural parameters.

Let A_0 be the contemporaneous coefficient matrix in the structural form, and let $A^0(L)$ be the coefficient matrix in A(L) without the contemporaneous coefficient A_0 . That is

$$A(L)= A_0 + A^0(L) \qquad (3)$$

$$B(L)= -A_0^{-1} A^0 (L) \qquad (4)$$

$$E_t = A_0u_t \qquad (5)$$

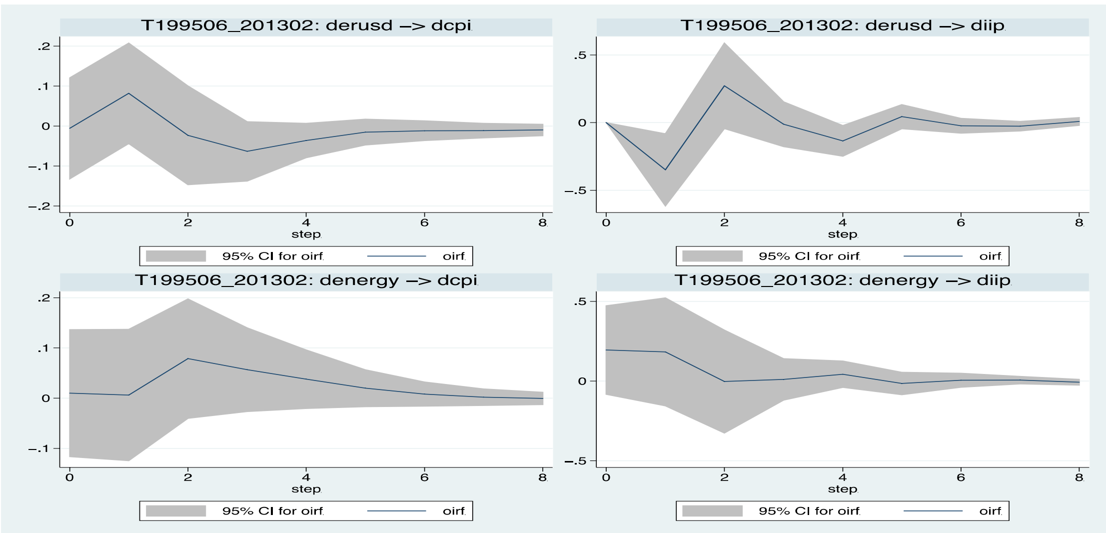
$$\Sigma=A_0^{-1}\wedge A_0^{-1} \qquad (6)$$

Maximum likelihood estimates of ∧ and G can be obtained only through the sample estimate of Σ. The right-hand side of Eq. (6) has n* (n+ 1) free parameters to be estimated. Since Σ contains {n* (n+ 1)} /2 parameters, by normalizing n diagonal elements of A_0 to 1's, we need at least {n* (n- 1)}/2 restrictions on A_0 to achieve identification. In the VAR modeling with Cholesky decomposition, A_0 is assumed to be triangular. However, in the generalized structural VAR approach, A_0 can be any structure (non-recursive).We estimated a SVAR model with Cholesky orthogonalisation in the given order with two lags based on AIC criteria. Our approach is to identify Impulse response function to see w exchange rate pass through and energy price pass through.

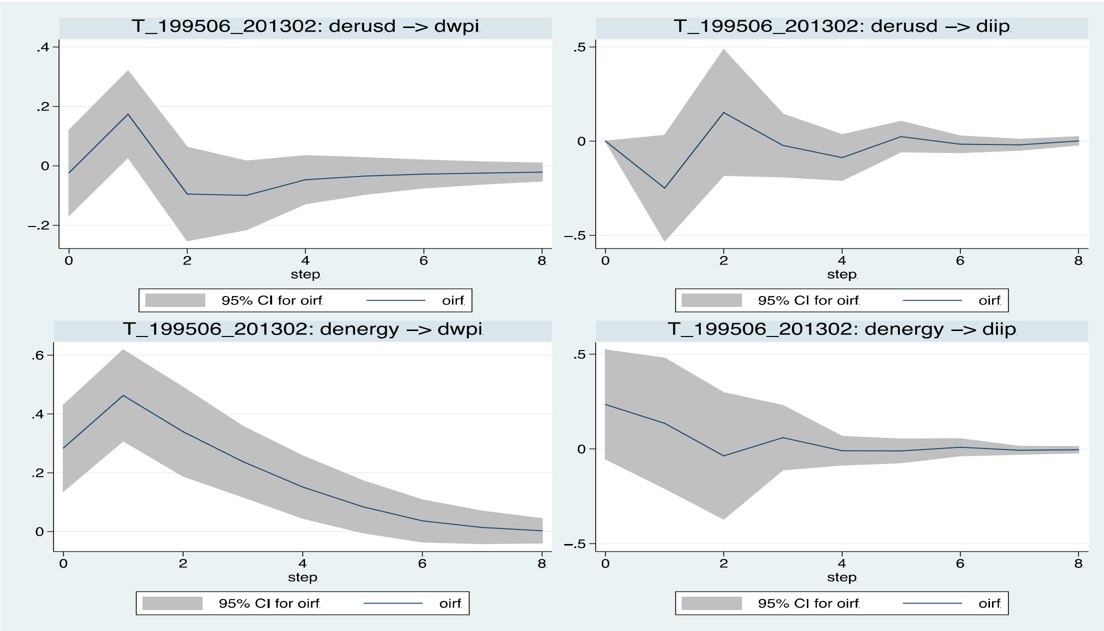
VII. RESULTS AND ANALYSIS

The estimate coefficients have been given in Appendix A.2. The impulse response graph given in graph: 1 and graph: 2 suggests that both consumer price inflation and wholesale price inflation rises with a shock to exchange rate and energy prices. Exchange rate shocks are more prominent for consumer price inflation, whereas in case of wholesale price inflation the shock to energy prices have more impact. Index of industrial production falls with exchange rate depreciation. We normally expect exchange rate depreciation and index of industrial production to be positively related. Our result could be because of causation from worsening of domestic economic condition to depreciation of Rupee.

Graph: 1Response of consumer price Index and Index of Industrial Production to one standard Deviation shock to exchange rate and Energy Price

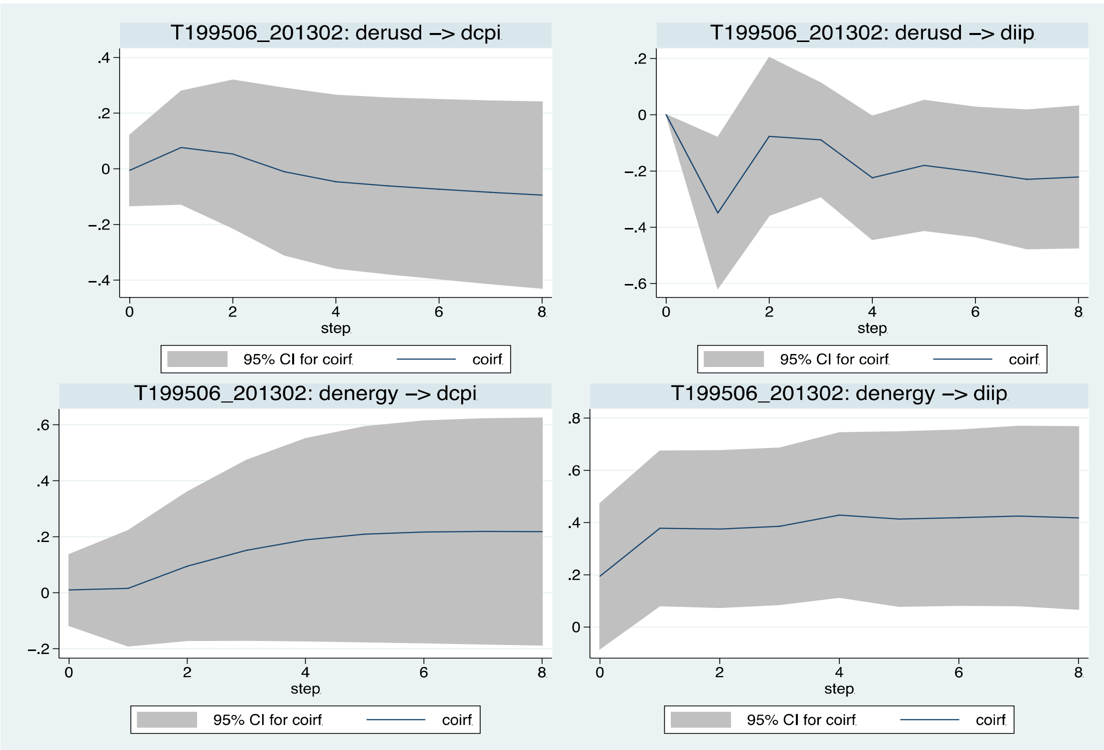


Graph: 2 Response of wholesale price Index and Index of Industrial Production to one standard Deviation shock to exchange rate and Energy Price

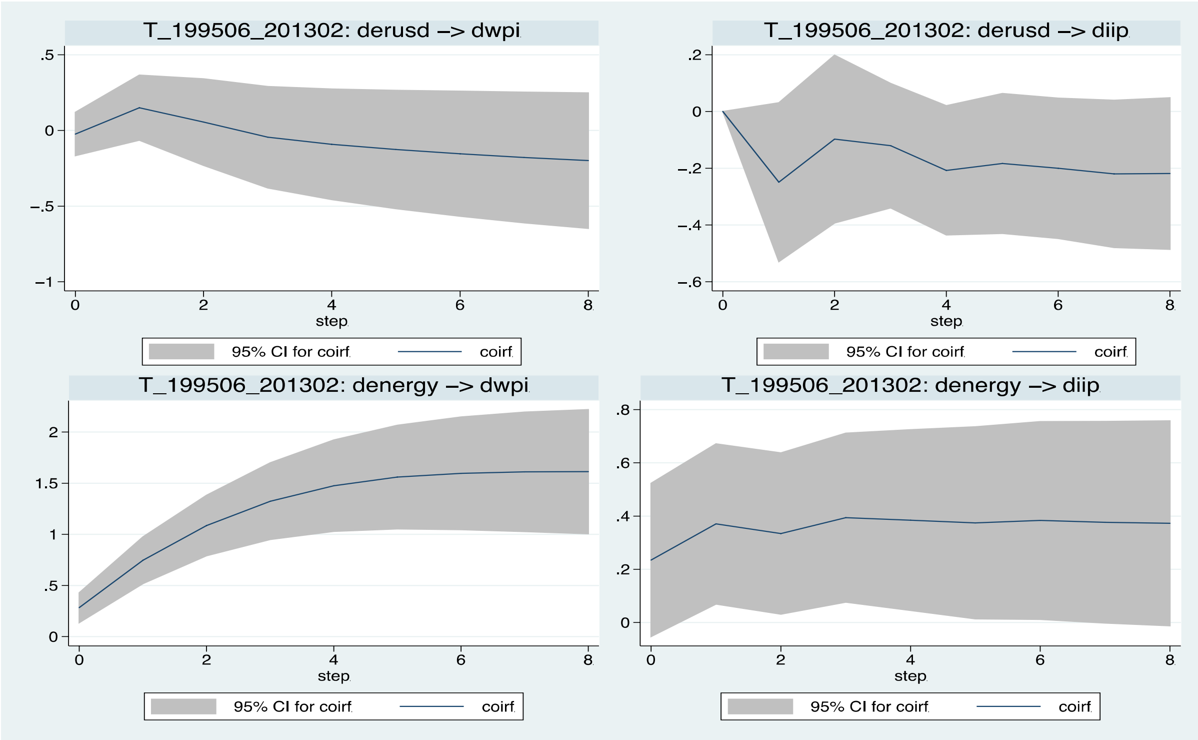


Index of industrial production declines with an initial jump due to energy price shock. The initial jump could be due to the better global economic condition, as energy prices would rise in the case of booming global economy.

Graph: 3 Cumulative responses ofconsumer price Index and Index of Industrial Production to one standard Deviation shock to exchange rate and Energy Price

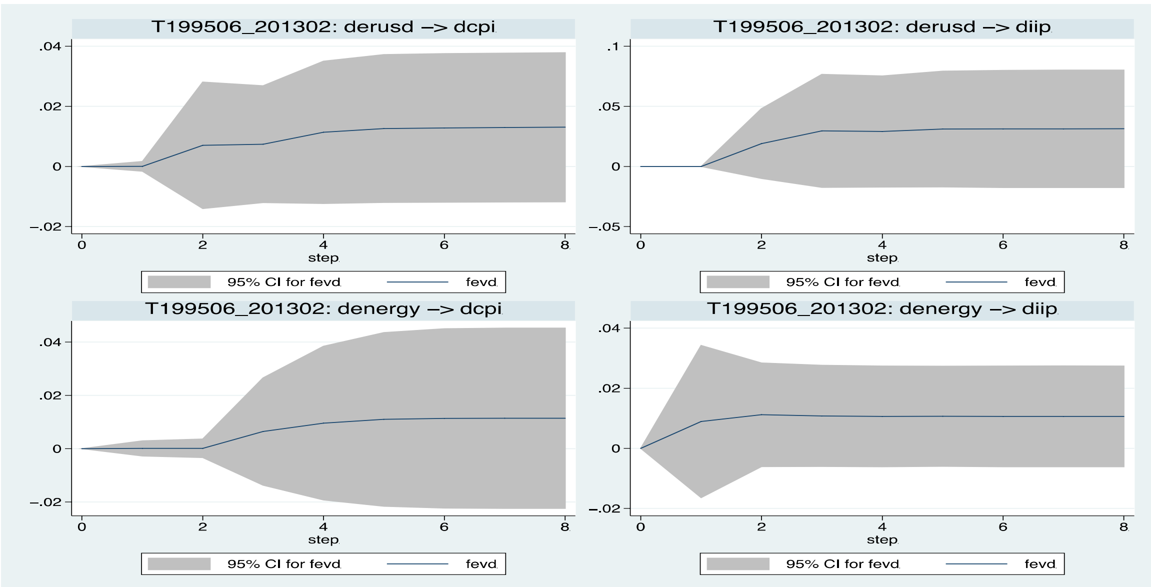


Graph: 4 Cumulative responses ofwholesale price Index and Index of Industrial Production to one standard Deviation shock to exchange rate and Energy Price

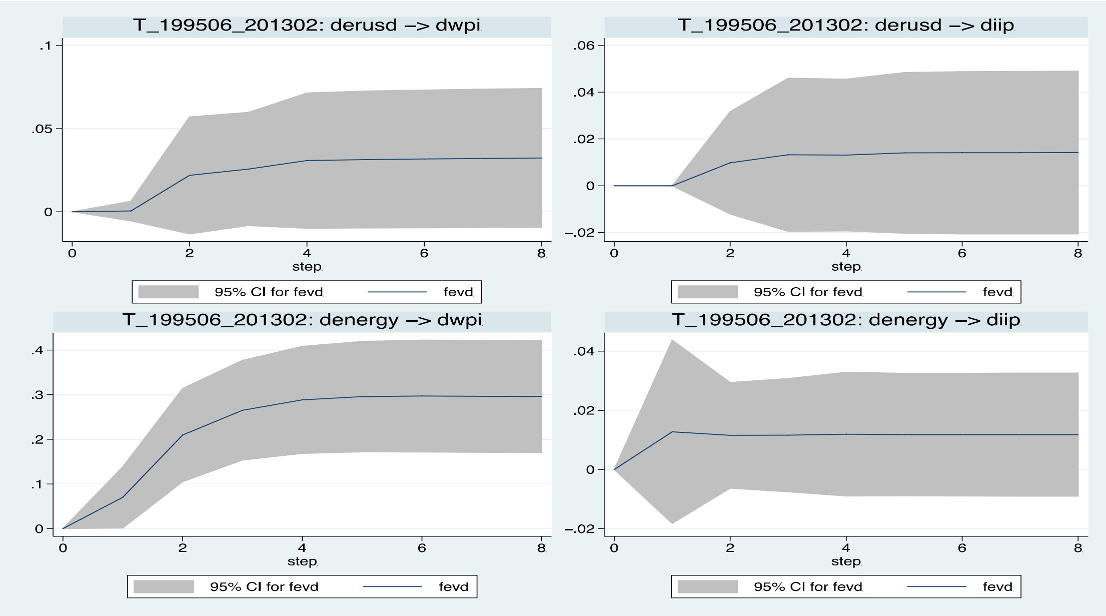


Cumulative impulse response graph: 3 and graph: 4 suggests that it's mainly the energy price which leads to higher consumer price inflation and wholesale price inflation with the substantial higher impact on wholesale price inflation. Cumulative response of index of industrial production with a shock to exchange rate is negative and this is in line with argument raised above that is the causation may be from worsening of domestic activities to exchange rate depreciation. Cumulative response of index of industrial production with a shock to energy prices is positive and this is because energy prices rise with strong global economy and that have positive impact on our index of industrial production. Forecast error variance decomposition graph: 5 and graph: 6 suggests that both exchange rate and energy pries explains less than 20% variation in consumer price inflation. In case of wholesale price inflation energy prices explains around 30% of the variation up to 8 months whereas exchange rate explains less than 5%.

Graph: 5 Forecast error variance ofconsumer price Index and Index of Industrial Production to one standard Deviation shock to exchange rate and Energy Price



Graph: 6 Forecast error variance ofwholesale price Index and Index of Industrial Production to one standard Deviation shock to exchange rate and Energy Price

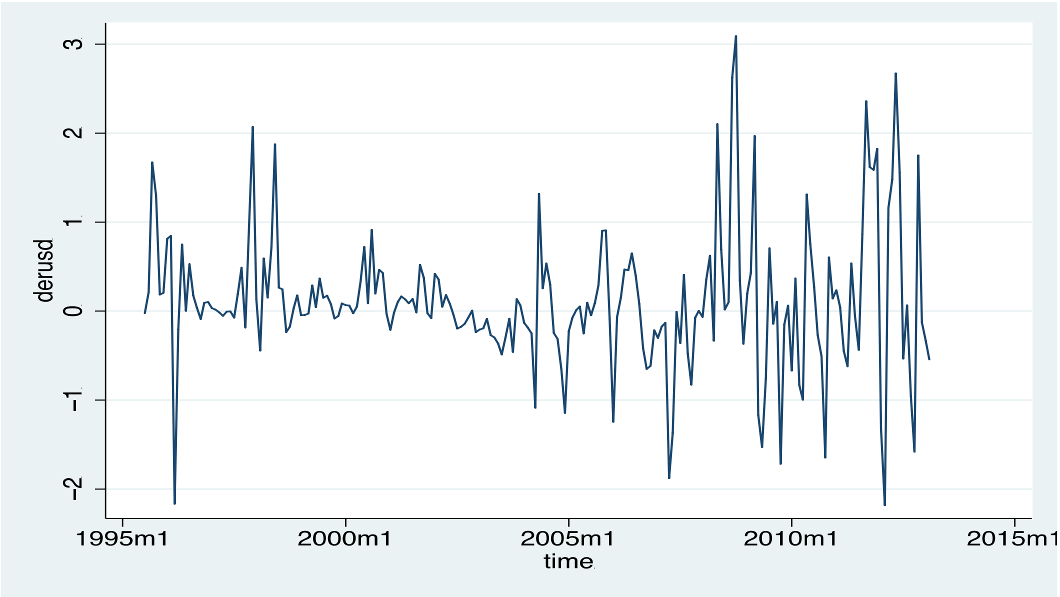


VIII. CONCLUSION

The sign of coefficient is as expected. **The exchange rate pass through is not significant but global commodity prices significantly affect the domestic price level through wholesale price inflation.** Index of industrial production falls with exchange rate depreciation. We normally expect exchange rate depreciation and index of industrial production to be positively related. Our result could be because of causation from worsening of domestic economic condition to depreciation of Rupee. Index of industrial production declines with an initial jump due to energy price shock but is always positive. This could be due to the fact that as energy prices would rise in the case of booming global economy and thus leading to a favorable impact on index of industrial production.

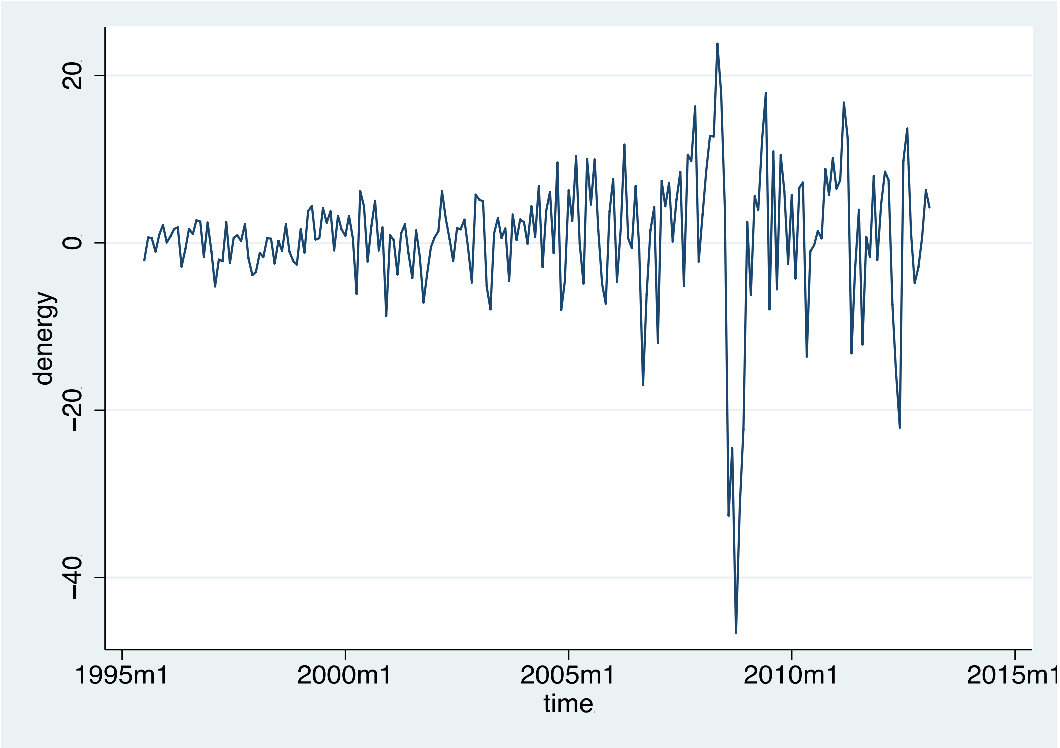
Appendix A.1

Graph: 1 First Difference of Rupee/USD exchange rate



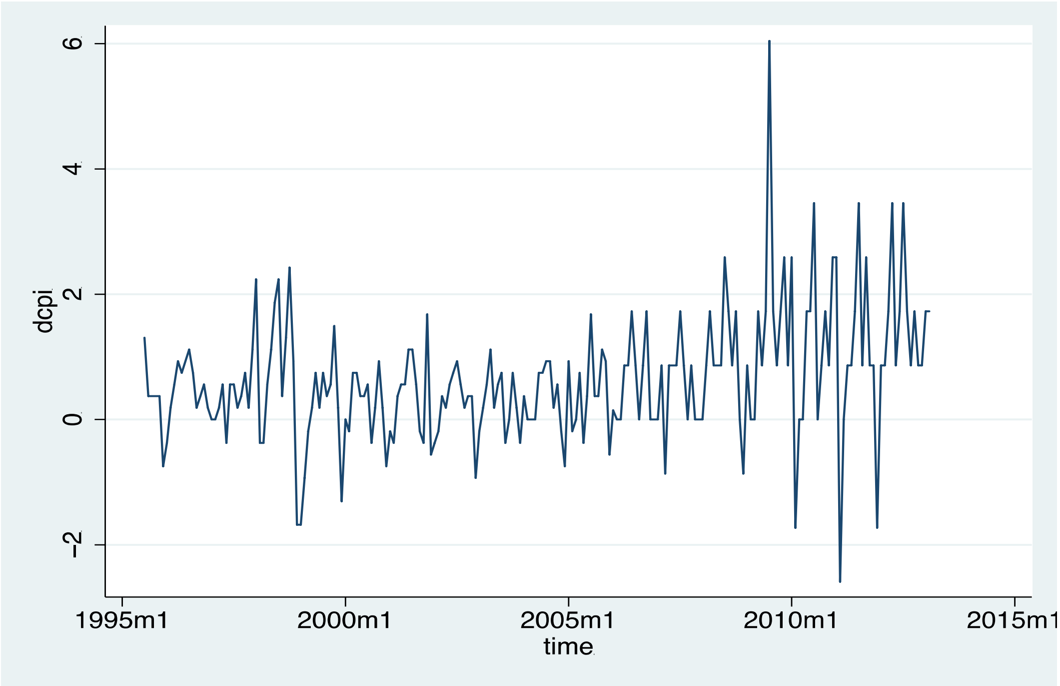
Source RBI Database on Indian Economy

Graph: 2 First Difference of Energy Price Index



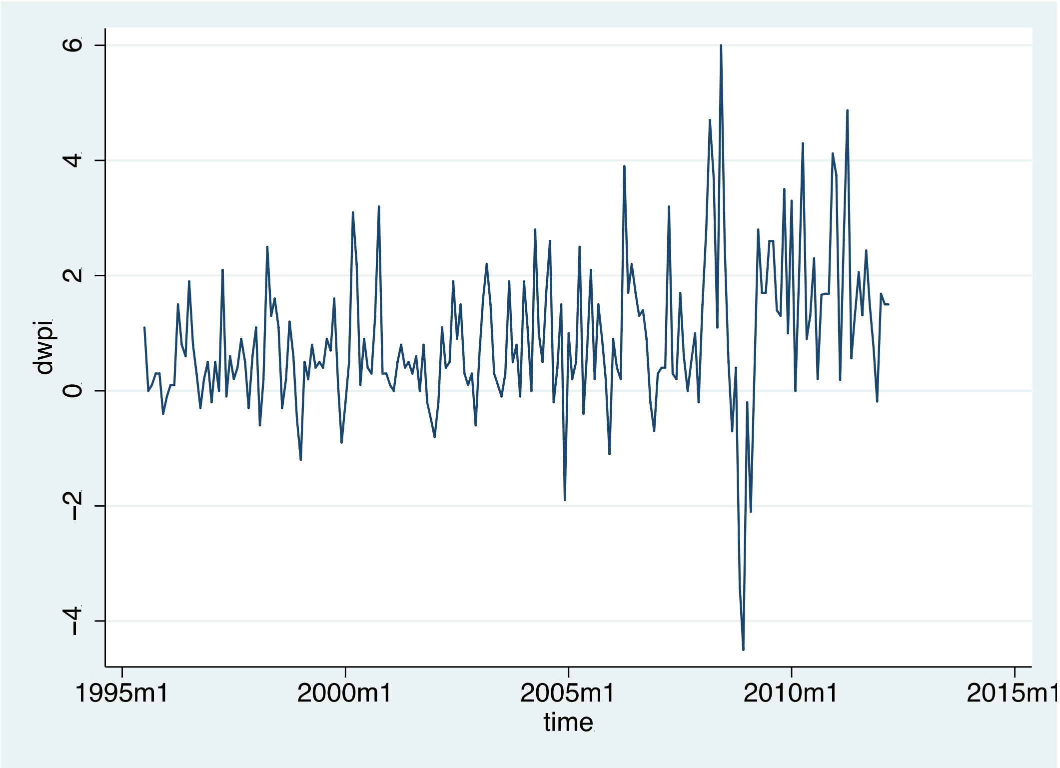
Source Pink Database World Bank

Graph: 3 First Difference of Consumer Price Index



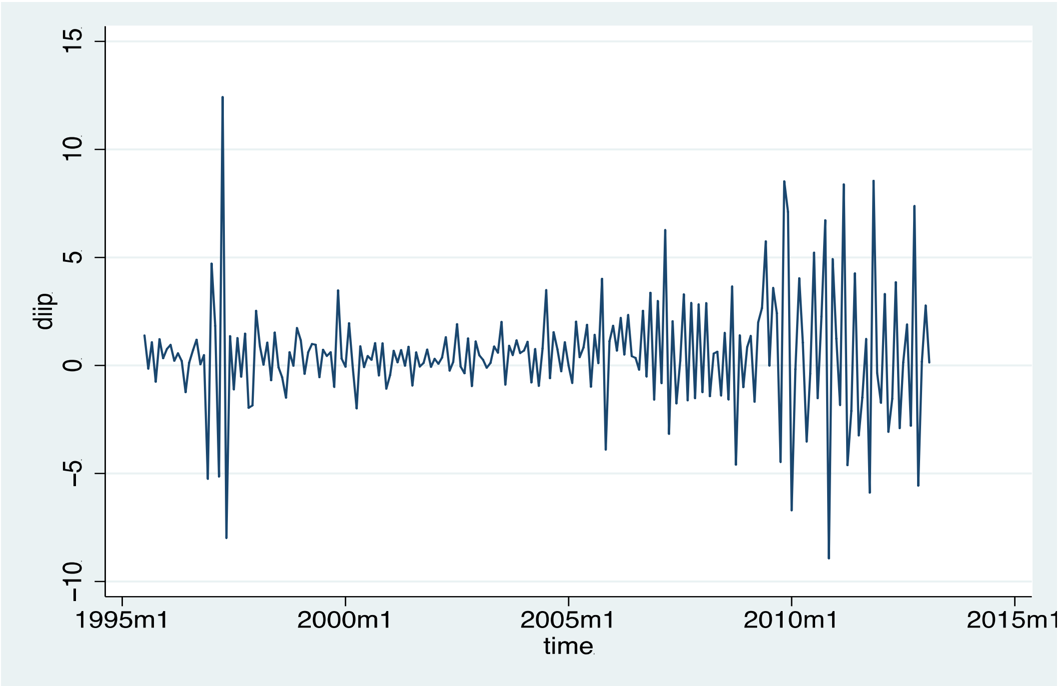
Source RBI Database on Indian Economy

Graph: 4 First Difference of Wholesale Price Index



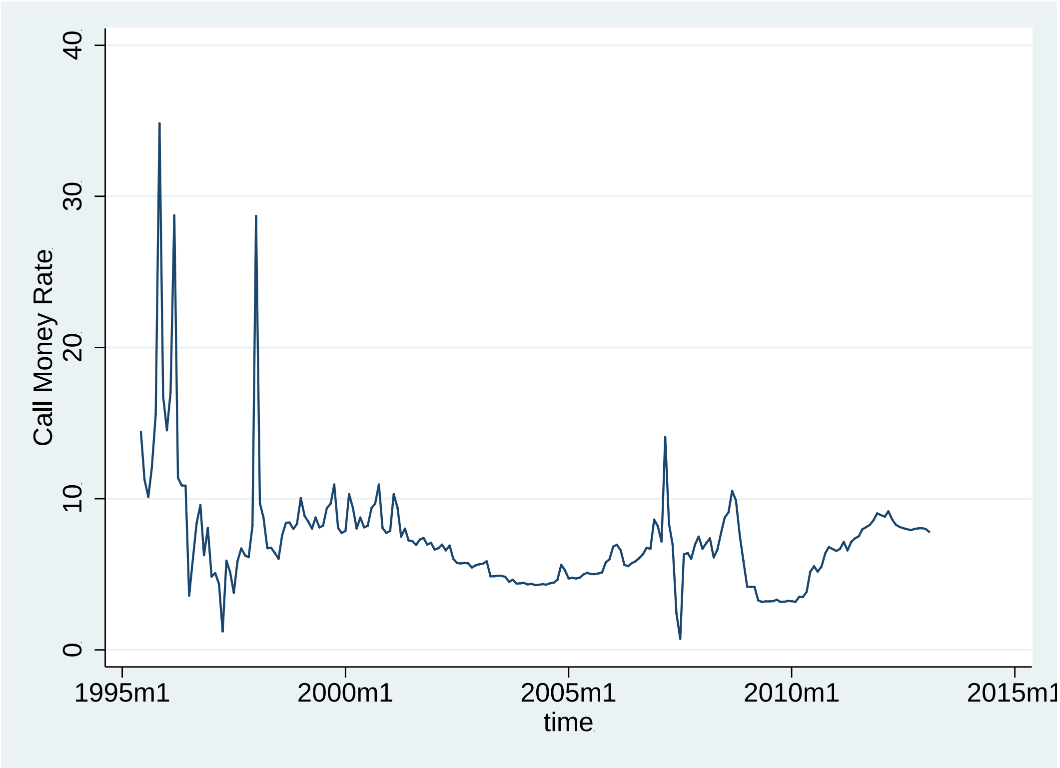
Source RBI Database on Indian Economy

Graph: 5 First Difference of Index of Industrial Production



Source RBI Database on Indian Economy

Figure: 6 Call Money Rate



Source RBI Database on Indian Economy

Appendix A.2 Table 1.

Estimated Coefficient of the VAR Model

	With CPI	With WPI
	denergy	denergy
denergy		
L.denergy	0.367***	0.398***
	-5.19	-5.38
L2.denergy	0.0968	0.243**
	-1.39	-2.98
L.diip	-0.0866	-0.051
	(-0.40)	(-0.23)
L2.diip	-0.152	-0.215
	(-0.70)	(-0.98)
L.derusd	-1.586*	-1.356
	(-2.28)	(-1.88)
L2.derusd	1.103	0.972
	-1.51	-1.21
L.dcpi	-1.011*	
	(-1.98)	
L2.dcpi	0.0176	
	-0.03	
L.mmr	-0.0998	-0.13
	(-0.59)	(-0.77)
L2.mmr	-0.132	-0.0994
	(-0.80)	(-0.62)
L.dwpi		-1.184**
		(-2.59)
L2.dwpi		-0.103
		(-0.25)
_cons	2.885*	3.287*
	-2.26	-2.52

diip		
L.denergy	0.0333	0.0376
	-1.59	-1.65
L2.denergy	0.0152	0.0109
	-0.74	-0.43
L.diip	-0.713***	-0.690***
	(-11.10)	(-10.20)
L2.diip	-0.356***	-0.342***
	(-5.53)	(-5.05)
L.derusd	-0.537**	-0.398
	(-2.62)	(-1.79)
L2.derusd	0.317	0.204
	-1.47	-0.82
L.dcpi	-0.14	
	(-0.92)	
L2.dcpi	0.293	
	-1.92	
L.mmr	-0.0365	-0.0338
	(-0.73)	(-0.65)
L2.mmr	-0.0347	-0.0366
	(-0.71)	(-0.74)
L.dwpi		-0.062
		(-0.44)
L2.dwpi		-0.00452
		(-0.04)
_cons	1.457***	1.608***
	-3.86	-3.99
derusd		
L.denergy	-0.00508	-0.00452
	(-0.73)	(-0.62)
L2.denergy	-0.00252	-0.014
	(-0.37)	(-1.75)
L.diip	-0.00873	-0.0154
	(-0.41)	(-0.71)
L2.diip	-0.0447*	-0.0329
	(-2.08)	(-1.52)
L.derusd	0.323***	0.337***
	-4.71	-4.75
L2.derusd	-0.223**	-0.233**
	(-3.10)	(-2.95)
L.dcpi	0.125*	
	-2.48	
L2.dcpi	0.0788	
	-1.54	
L.mmr	-0.00374	0.000174
	(-0.22)	-0.01
L2.mmr	0.0357*	0.0328*
	-2.2	-2.1
L.dwpi		0.0709
		-1.58
L2.dwpi		0.0915*
		-2.24
_cons	-0.231	-0.251
	(-1.83)	(-1.95)
dcpi		
L.denergy	0.00389	
	-0.41	
L2.denergy	0.00944	
	-1.01	
L.diip	-0.0177	
	(-0.61)	

L2.diip	-0.0179	
	(-0.61)	
L.derusd	0.126	
	-1.35	
L2.derusd	-0.105	
	(-1.07)	
L.dcpi	0.290***	
	-4.24	
L2.dcpi	0.0248	
	-0.36	
L.mmr	-0.0106	
	(-0.47)	
L2.mmr	-0.0148	
	(-0.67)	
_cons	0.627***	
	-3.66	
mmr		
L.denergy	0.0364	0.044
	-1.31	-1.43
L2.denergy	0.0196	0.0455
	-0.71	-1.35
L.diip	-0.0132	-0.0235
	(-0.15)	(-0.26)
L2.diip	-0.0416	-0.0377
	(-0.48)	(-0.41)
L.derusd	1.222***	1.337***
	-4.46	-4.46
L2.derusd	0.321	0.411
	-1.12	-1.23
L.dcpi	-0.0791	
	(-0.39)	
L2.dcpi	-0.279	
	(-1.37)	
L.mmr	0.447***	0.434***
	-6.67	-6.22
L2.mmr	0.204**	0.206**
	-3.14	-3.11
L.dwpi		-0.19
		(-1.00)
L2.dwpi		-0.194
		(-1.12)
_cons	2.536***	2.695***
	-5.03	-4.96
dwpi		
L.denergy		0.0692***
		-5.88

L2.denergy		0.0108
		-0.83
L.diip		0.0235
		-0.67
L2.diip		-0.00606
		(-0.17)
L.derusd		0.277*
		-2.42
L2.derusd		-0.181
		(-1.42)
L.dwpi		0.116
		-1.59
L2.dwpi		0.0824
		-1.24
L.mmr		0.00328
		-0.12
L2.mmr		-0.0328
		(-1.30)
_cons		0.845***
		-4.07
t statistics in parentheses		
="* p<0.05	** p<0.01	*** p<0.001"

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