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The Macroeconomic Effects of Uncertainty Shocks in India

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Abstract

The macroeconomic response to uncertainty for India is studied in a structural model that decomposes uncertainty into negative and positive contributions. The results show that uncertainty shocks reduce industrial production, lead to an exchange rate depreciation, lowers prices and increases interest rates. Conversely, a reduction in uncertainty (or an increase in negative uncertainty) increases industrial production, reduces prices, leads to an exchange rate appreciation and slightly increases interest rates. The results, however, reveal that the response to uncertainty is insignificant - this implies that the short run duration and sign could be different.

Keywords: Uncertainty, Macroeconomic Variables, SVECM, India

JEL classifications: E10, C32

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1 Introduction

Since the recent financial crisis of 2008, a large literature has originated which examines the macroeconomic effects of uncertainty (see for example, Bloom, 2009; Bloom et al., 2009; Gilchrist et al., 2010; Panousi and Papanikolaou, 2012; Colombo, 2013; Dendy et al., 2013; Jones and Olson, 2013; Mumtaz and Zanetti, 2013; Kang et al., 2014; Theodoridis and Mumtaz, 2014; Jurado et al., forthcoming and references cited there in for earlier studies). However, all these studies have been primarily based on the US economy, with some of them concentrating on the Euro area and the UK. Though there exists a couple of studies (Kang et al., forthcoming; Li et al., forthcoming) that have concentrated on the relationship between uncertainty and financial markets (stock returns) for China and India, to the best of our knowledge there is no study to date hat analyses the impact of uncertainty shocks on key macroeconomic variables of an emerging economy. One disagreement in the current literature is concerned with the appropriate measure of uncertainty. In this regard, Baker et al. (2013) recently addressed this by developing a news-based economic policy-related uncertainty index for major economies around the world.

Against this backdrop, the objective of this paper is to analyse the impact of economic policy uncertainty (EPU) shocks on key macroeconomic variables (output, consumer price index (CPI), interest rate and the dollar-based exchange rate) of an emerging economy, namely India, using a structural vector error correction model (SVECM) covering the monthly period of 2003:1-2014:12.

The SVECM allows us to analyse the impact of EPU shocks on non-stationary data that are likely to be cointegrated, by imposing theory-based short- and long-run restrictions – something that has not been done in the literature involving uncertainty and macroeconomic variables. In addition, we also decompose the EPU shocks into their positive and negative components, following the hidden cointegration idea of Granger and Yoon (2002), to analyse the asymmetric impact of these shocks on the Indian macroeconomy – again something done for the first time in this literature. In this regard it is assumed that negative and positive uncertainty is related to different news; with negative uncertainty indicating a decrease in economic uncertainty and positive uncertainty indicating an increase in economic uncertainty. Note this is mostly due to the fact that the methodology of Granger and Yoon (2002) used to decompose a series into its positive and negative components requires the underlying series to be a random walk (further details are in the methodology segment), which is not generally the case for uncertainty indices around the world, barring that of India. This technical reason is why we choose India over other economies, including two other emerging economies, namely China and Russia. Further, there are other data issues involving China and Russia, especially in terms of the flexibility of their exchange rates, as well as, the fact that the uncertainty index for China and Russia are based on one newspaper (The South China Morning Post from Hong Kong and Kommersant (in Russian) respectively) only, unlike that of India, which involves seven English-based newspapers (for further details, see the data segment), and hence, is likely to provide a more robust measure of the EPU.

It is worth noting the results of some of the literature regarding uncertainty shocks and economic activity. Colombo (2013) uses a structural VAR, with short run restrictions, to study the impact of a U.S. uncertainty shock on the Euro area. Colombo (2013) shows that there are significant spill-over effects: a one standard deviation shock in the U.S. reduces industrial production by approximately 0.12 percent and inflation by about 0.06 percent, while monetary policy responds by decreasing interest rates. One of the reasons for the fall in output and prices is due to precautionary savings where investment and consumptions decisions are postponed (Colombo, 2013).

Bloom et al. (2014) provide further details regarding the co-movement of uncertainty and business cycle movements. First, they find that uncertainty shocks are not driven by first moment shocks and that recessions being amplified and prolonged due to uncertainty shocks.

2 Data and Methodology

We use monthly data from January 2003 until December 2014 for our analysis, which provides us with 144 observations, with the sample being purely driven by data availability at the time of writing this paper. Our macro variables include India's consumer price index (CPI), the rupee-US dollar exchange rate (FX), industrial production (LIP), the money market rate (INT) as a proxy for the central bank rate and three measures of economic policy uncertainty(EPU), i.e., the EPU itself and its positive and negative components, based on the positive and negative cumulative sums respectively, of the growth rate of the EPU (discussed below). All the measures are in log form except for the interest rate, and the positive and negative measures of uncertainty. The Indian macroeconomic variables are all obtained from the IHS Global Insight database. The uncertainty measure, which we decompose into negative and positive contributions, is sourced from (http://www.policyuncertainty.com/india_monthly.html). Baker et al., (2012) construct the news-based Indian EPU index following the same approach as used for American newspapers in their monthly US EPU Index. They include 7 Indian newspapers: The Economic Times, the Times of India, the Hindustan Times, the Hindu, the Statesman, the Indian Express, and the Financial Express. For each paper, they count the number of news articles containing at least one term from each of three term sets. The first set is uncertain, uncertainties, or uncertainty. The second set is economic or economy. The third set consists of policy relevant terms such as 'regulation', 'central bank', 'monetary policy', 'policymakers', 'deficit', 'legislation', and 'fiscal policy'.

We use Granger and Yoon (2002) to disaggregate the uncertainty index into positive and negative changes. We begin by defining EPU as a random walk:

$$EPU_t = EPU_{t-1} + u_{1t} = EPU_0 + \sum_{i=1}^{t} u_{1i} = EPU_0 + \sum_{i=1}^{t} u_{1i}^{+} + \sum_{i=1}^{t} u_{1i}^{-} \quad (1)$$

where $t = 1,2,\dots,T$. EPU_0 is a constant representing the initial value of economic policy uncertainty, u_{1i} is a white noise error term, which is defined as the sum of positive and negative shocks, i.e., $u_{1i} = u_{1i}^{+} + u_{1i}^{-}$, where $u_{1i}^{+} = \max(u_{1i}, 0)$ and $u_{1i}^{-} = \min(u_{1i}, 0)$. The cumulative form of *EPU* when it is positive is: $U^{+} + \sum_{i=1}^{t} u_{1i}^{+}$, and when *EPU* is negative, is: $EPU^{-} + \sum_{i=1}^{t} u_{1i}^{-}$.

If we rely on the more powerful Ng-Perron unit root test, all the variables are a mixture of I(1), which motivates the use of a model that explores the cointegrating relationship among variables too. Table 1 summarises the results of the ADF, Ng-Perron and KPSS unit root tests.

We include 1 lag in the model as given by the Schwarz and Akaike information criterion. Furthermore, the Johansen trace and maximum eigenvalue statistics indicate between 2 and three cointegrating vectors.[1]

Table 1: Unit root tests

	LIP	**FX**	**INT**	**CPI**	**Uncertainty**
Level					
ADF:					
Constant	(-2.95)*	(-0.45)	(-2.69)	(2.43)	(-1.96)
Trend	(-1.04)	(-2.09)	(-3.24)	(-3.31)*	(-2.66)
Ng-Perron:					
Constant	(0.95)	(-1.44)	(-4.67)	(0.37)	(-6.52)
Trend	(-0.74)	(-4.91)	(-11.13	(-0.57)	(-9.78)
KPSS:					
Constant	(1.28)***	(0.97)***	(0.12)	(1.37)	(0.95)***
Trend	(0.36)**	(0.28)***	(0.10)	(0.32)	(0.13)*
First difference					
ADF:					

[1] Results available upon request.

Constant	(-19.98)***	(-8.35)***	(-15.12)***	(-10.17)***	(-15.79)***
Trend	(-19.62)***	(-8.48)***	(-15.07_***	(-10.61)***	(-15.73)***
Ng-Perron:					
Constant	(-19.56)***	(-60.15)***	(-140.44)***	(-2.71)	(-1.92)
Trend	(-54.10)***	(-62.82)***	(-141.60)***	(-67.35)***	(-129.98***
KPSS:					
Constant	(0.68)**	(0.31)		(0.79)***	(0.08)
Trend	(0.06)	(0.04)		(0.30)***	(0.08)

*, ** and *** denote rejection of the null hypothesis at 1%, 5% and 10% level of significance, respectively

We assume that the economy can be described by the following VAR(p) model:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + u_t \tag{2}$$

where A_i is a $k \times k$ matrix of coefficients and y_t is a vector of observable variables. We assume that the error term has a normal distribution $u_t \sim (0, \Sigma_u)$. We can write (2) as a VECM (assuming that most of the variables are difference stationary):

$$\beta_0 \Delta y_t = \Pi^* y_{t-1} + \Gamma_1^* \Delta y_{t-2} + \cdots + \Gamma_{p-1}^* \Delta y_{t-p+1} + \varepsilon_t \tag{3}$$

The Γ is a $k \times k$ matrix of short run coefficients, ε_t is a $k \times 1$ matrix that contains the structural innovations and is assumed to have a zero mean and covariance matrix I_k, Π^* is the structural cointegrating matrix. β_0 is a $k \times k$ matrix of contemporaneous relations. Assuming that β_0 is invertible we can re-write (2) as

$$\Delta y_t = \Pi y_{t-1} + \Gamma_1 \Delta y_{t-2} + \cdots + \Gamma_{p-1} \Delta y_{t-p+1} + u_t \tag{4}$$

where $\Gamma = \beta_0^{-1}\Gamma^* = -(A_{i+1} + \cdots + A_p)$ is a $k \times k$ matrix that measure the transitory impact of shocks, $u_t = \beta_0^{-1}\varepsilon_t$ is a $k \times 1$ matrix that relates the reduced form errors to the structural innovations and is $u_t \sim N(0, \Sigma_u)$, $\Pi = \beta_0^{-1}\Pi^* = \alpha\beta^T = -(I - A_1 - \cdots - A_p)$ is the structural cointegrating matrix. α is the loading matrix where the coefficients of the long run relationships are contained in β^T. The dimensions of $\alpha\beta^T$ is $k \times r$, where r is the cointegrating rank.

We need to impose some restrictions on the error matrix to identify the structural innovations given that u_t is in reduced form. To identify the structural shocks we can multiply the error term to yield $\beta_0 u_t = \varepsilon_t$ or $\Sigma = \beta_0^{-1}\Sigma_\varepsilon \beta_0'$. We need $\frac{k^2-k}{2}$ additional restrictions on β_0^{-1} to exact identifyΣ_ε.

We may write (4) in terms of the following Beveridge-Nelson moving average representation:

$$y_t = \Xi \sum_{i=1}^{t} u_i + \sum_{j=0}^{\infty} \Xi_j^* u_{t-j} + y_0^* \quad (5)$$

y_t can be decomposed into both parts that integrated of order 1 or 0. y_0^* contains the initial values, $\Xi = \beta_\perp \left(\alpha_\perp' \left(I_n - \sum_{i=1}^{p-1} \Gamma_i\right)\beta_\perp\right)^{-1}$, while Ξ_j^* contains an infinite order polynomial of coefficients going to zero as $j \to \infty$ and contains transitory effects. $\Xi \sum_{i=1}^{t} u_i$ captures the common stochastic trends where the loadings are given by $\beta_\perp \left(\alpha_\perp' \left(I_n - \sum_{i=1}^{p-1} \Gamma_i\right)\beta_\perp\right)^{-1}$ and the common driving trends as $\alpha_\perp' \sum_{i=1}^{t} u_i$. We can replace u_t by its structural equivalent and rewrite (4) as:

$$y_t = \Xi \sum_{i=1}^{t} \beta_0^{-1}\varepsilon_i + \sum_{j=0}^{\infty} \Xi_j^* \beta_0^{-1}\varepsilon_{t-j} + y_0^* \quad (6)$$

By knowing the rank of Π one can induce that at most r of the structural errors can have a transitory impact. The cointegration structure provides *r(k-r)* restrictions on the long-run matrix. The remaining restrictions can be placed on either matrix whereby at least *r(r-1)/2* must be imposed on the contemporaneous matrix directly.

Given that we have identified three cointegrating vectors, we have three zero-column long run restrictions. We assume that uncertainty, interest rates and CPI have no long run impact on any of the variables in our sample. It must be emphasized that uncertainty and its two components enter the VECM in turn, and not together. In addition to our long-run restrictions we impose four contemporaneous restrictions which render the system just-identified. We assume that uncertainty has no contemporaneous effects on industrial production and CPI. We also assume that interest rates have a zero contemporaneous impact on industrial production while industrial production has a zero contemporaneous impact on CPI.

3 Results

We analyse the results of the actual uncertainty index, positive and negative uncertainty on the macro economy. Figure 1 summarises the impulse responses. We have multiplied the negative uncertainty shock by (-1) to make the discussion on the size of the impact comparable to the normal uncertainty shock and the positive uncertainty shock. A priori one would expect that an increase in uncertainty would lead to a reduction in output, a decrease in prices and lower interest rates. If one were to make a link between uncertainty and risk in a consumer optimisation problem with a CRRA-type utility function then a risk averse consumer would spend less and save more. The lack in aggregate demand would reduce prices and an inflation targeting central bank would reduce prices in line with a fall in aggregated demand and a decline in inflation. One could also make the argument that an increase in uncertainty leads to less confident price adjustments by firms - i.e. the frequency in which prices change becomes less certain, which could affect upward or downward price adjustments differently. However, the very fact that uncertainty shocks hit the economy makes it difficult to pin down exactly how the economy responds. These results shed some light on these responses to uncertainty.

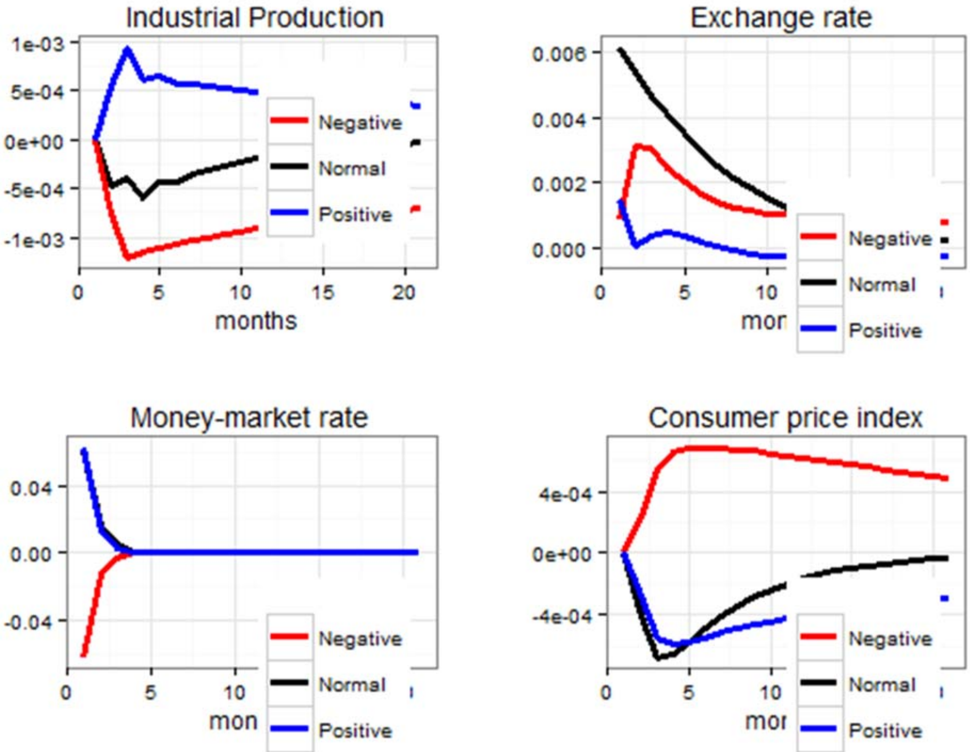
An increase in uncertainty reduces industrial production. The duration of the response in industrial production to the uncertainty shock lasts for approximately 13 months before returning to equilibrium. The benefits to lower political uncertainty are big: A decrease in uncertainty (an increase in negative uncertainty) increases industrial production (Figure 1 shows that it decreases because it is multiplied by (-1)) by a magnitude larger than an increase in uncertainty. The duration of the response in industrial production lasts for a little longer than 2 years.

The exchange rate depreciates given a rise in uncertainty, but appreciates as uncertainty decreases. Interestingly the interest rates increase for both uncertainty measures. For negative uncertainty this makes sense if it leads to both an increase in output and inflation. The interest rate response for an increase in uncertainty deserves more thought. It is possible that the central bank raises interest rates in response to possible capital outflows that causes a depreciation in the currency. Although the Reserve Bank of India does not target the exchange rate, it does reserve the right to intervene on occasions to reduce excessive volatility.[2] The positive uncertainty shocks tend to increase industrial production, lead to an exchange rate depreciation, lower consumer prices and higher interest rates. It would be interesting to analyse, in a laboratory-type environment, how individuals, firms and governments would react to persistent increases in uncertainty. If agents view uncertainty as persistent they might discount the shocks, hence reducing the effects of uncertainty.

Finally, it should be noted that the short run responses are all insignificant (see appendix). While the signs of each impulse response are robust to different structural restrictions, it continues to be insignificant.

Figure 1: Impulse response of the macro economy to a 1 sd uncertainty shock

[2] See http://www.rbi.org.in/scripts/BS_PressReleaseDisplay.aspx?prid=33372.



4 Conclusion

We analyse the effects of uncertainty shocks on India's macro economy using a structural VECM. We decompose uncertainty into positive and negative contributions. The results show that an increase in uncertainty reduces industrial production, causes a depreciation in the rupee-dollar exchange rate, leads to declining prices and an increase in monetary policy. A reduction in uncertainty (an increase in negative uncertainty) leads to an increase in output, an appreciation in the currency, lower prices and an increase in interest rates. Uncertainty shocks, however, do not have a significant bearing on the economy in the short run. In this sense uncertainty shocks do not have a predefined influence on the path that an economy takes - ironically the very definition of uncertainty. This result calls for a time-varying analysis in the future. Since, as indicated by Li et al., (forthcoming), while analyzing the impact of EPU on the Indian stock returns, on average there is no significant impact on stock returns due to EPU, however, there are specific periods where EPU does have predictive content for the Indian stock market movements. This could also be the case for the macroeconomic variables as well.

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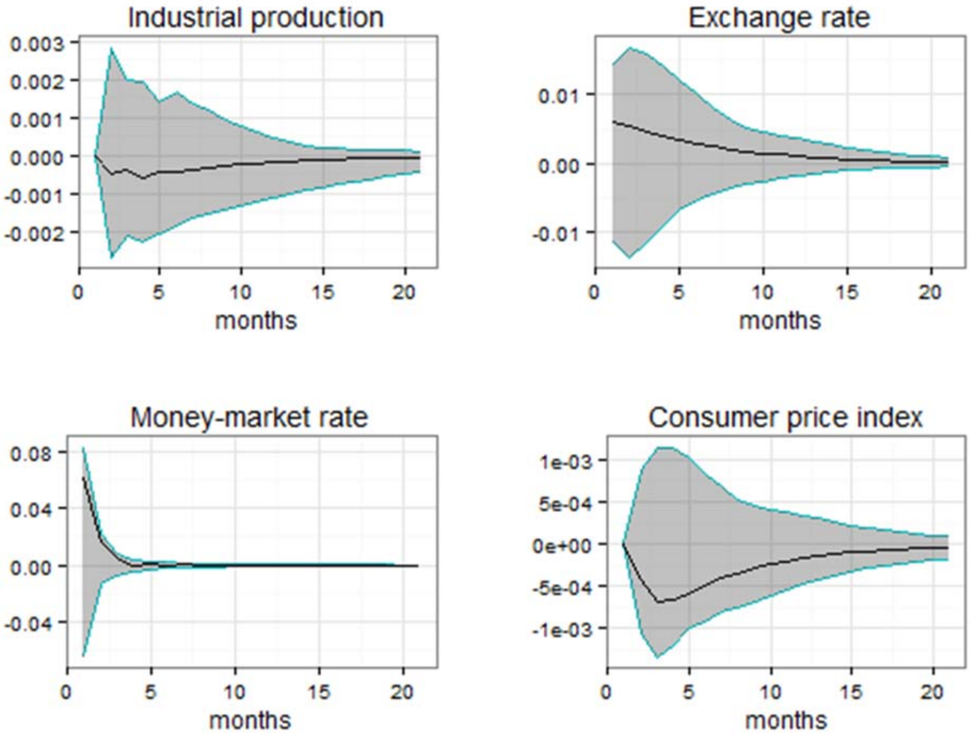
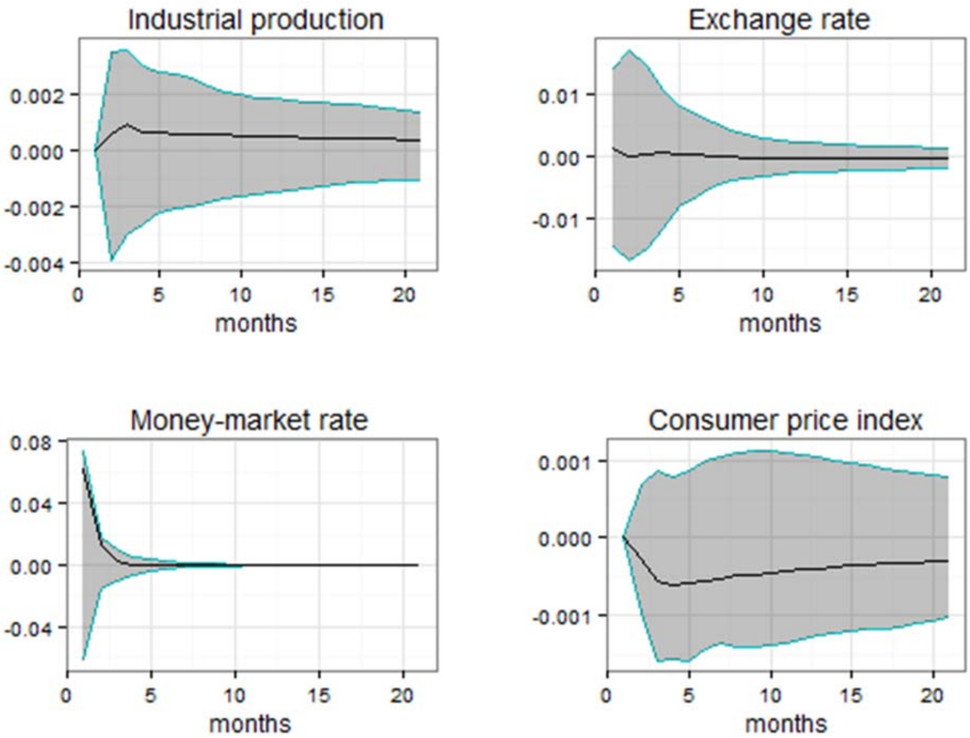
Appendix

Normal uncertainty



Positive uncertainty



Negative uncertainty