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[Abstract]

We study the impact of monetary policy announcements on stock returns in India using an event study (ES) and "identification through heteroscedasticity" (IH) methodology with daily data over the 10-year period 2004-2014.This relatively recent IH technique controls for possible feedback relationships between asset prices and monetary policy changes.While the impact is in the expected direction ., monetary tightening leads to a decline in stock returns, the results from IH are statistically insignificant, which is also confirmed by the ES approach. However, unanticipated policy announcements seem to have weakly significant impact on the stock index, especially banking stocks. Robustness checks substantiate that policy announcements has little impact on the Indian stock market, unlike several advanced and some emerging economies. Factors such as (a) the dominance of the banking channel; (b) dominance of foreign institutional investors; and (c) relative ineffectiveness of the asset price channel in monetary transmissioncould have contributed to this non-confirmative result.

Keywords: India, Stock Market, Monetary Policy Announcements, Event Study, Identification through Heteroscedasticity

: E44, E52,E58, G14

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1. Introduction

Among various policies that are regularly announced in the national economic landscape, changes in monetary policy are perhaps most widely deliberated upon and discussed. Any perceptible shift in monetary policy stance usually necessitates a number of discrete changes in key policy rates of small magnitude. Premised on the rational behavior of the stock market, movement in stock prices are deemed to encapsulate all the "news and noise" emanating from policy announcements, release of macroeconomic data and geo-political developments.[1]On the other hand, if one believesthat stock market behavior exhibits irrational exuberance, then there is no guarantee that stock price movements reflect all such information.

Even if torn between the rational behavior of the market and a possible streak of irrationality, financial analysts often tend to emphasize the role of monetary policy in explaining stock price movements,given the more frequent nature of such announcements. Barring the hype associated with policy meetings,[2] it is useful to examine what would be the temporal sequence of the impact of policy changes on the stock market in the context of an emerging economy like India.

From an eclectic sense, monetary policy, as an arm of economic stabilization policy, seeks to influence the course of key macroeconomic indicators ., output, inflation and unemployment. Unlike fiscal policy, however, the impact of monetary policy on these variables is largely indirect. The propagation of monetary policy shocks work through financial markets in influencing real economic activity. In this regard, theinitial impact of monetary policy is expected to be on short term interest rates which influencetrading volume and asset

[1]Berg (2012) notes that

pricesbydirectly affecting systemic liquidity. Moreover,policy signalsalso trigger market expectations about evolving asset price dynamics.

Specifically, how does monetary policy affect stock prices? Several channels have been emphasized in the literature. First, an increase in interest rate would lower the present value of future earning flows and depress equity markets Tobin's q - the market value of a firm's assets relative to their replacement costs (Tobin, 1978; Ehrmann and Fratzscher, 2004). Second, higher real interest rates make investments other than stocks, such as bonds, more attractivewhich would then necessitate an increase inthe required return on stocks thereby reducing its price. Third, as stocks are viewed as relatively risky investments, investors generally demand anequity premium for holding stocks. Therefore,the expected yield on stocks can rise only through a decline in the current stock price(Bernanke, 2003).Cumulatively, the price and return on stocks significantly affect individual consumption and investment behavior through the wealth effectwhich, at a macro level, have an impacton overall economic activity(Bernanke and Kuttner, 2005).

There are, however, two major empirical difficulties in delineatingthe relationship between stock prices and monetary policy in the empirical literature. First, the simultaneity or endogeneity problem arise from the joint determination of monetary policy and stock prices, as the former can instantaneously react to changes in the latter. Second, the problem of omitted variable could occur as stock returns and monetary policy may jointly react to some other variables, including economic news, which would cause a bias even if there is no endogeneity problem. Together, these two factors could complicate the identification of the responsiveness of stock prices to monetary policy (Rigobon and Sack, 2004).

In the empirical literature, there are three broad strands in discerning the stock market - monetary policy relationship. First, the relationship is studied in a vector autoregression (VAR) framework comprising some monetary policy indicator, stock prices and related variables. Second, event-based studies look for a temporal pattern of stock price movements to monetary policy announcements. Third, the response of stock prices to policy announcements is explained in terms of the heteroscedasticity of monetary policy shocks in the recent literature (Rigobon and Sack, 2004).

Using a novel approach of identification heteroscedasticity,

3. Data and Methodology

3.1

Before proceeding with the empirical exercise, a few caveats on the variables are in order. First, while most studies on the US use federal funds futures datafor extracting the unanticipated component of policy announcements, there is no similar information available for India.[4]Given this constraint, we use the91-day Treasury bill rate as a proxy for capturing the surprise effect of monetary policy actions (Duran 2012; Rezessy,2005). Anticipated changes in monetary policy actions are already factored inby the market in Treasury bill yields and any change after the policy announcement reflects the unanticipated component of policy.[5]Moreover, the 91-day Treasury bill rate is most liquid atthe short end of the money market and are also least influenced by the uncertainty regarding the timing of policy decisions.[6]While another alternative could have been the inter-bank call money rate, it is largelyinfluenced by the daily liquidity flows under the liquidity adjustment facility (LAF) and may not fully reflect market expectations on thefuture plannedpolicy dates eight in a year. There were, however, instances of intermittent policy announcements between scheduled meetings, particularly during the peak of the global financial crisis and subsequent to the “taper tantrum” episode of May 2013. During the sampleperiod, there were 72 policy announcements of which 20 were made on non-scheduled policy dates (Table 1).[9] These days are considered as policy days while the previous market day is considered as a non-policy day.

Table 1: Monetary Policy Announcements (April 2004 – March 2014)					
Policy Dates	Observations	Direction	Observations	Timing	Observations
Scheduled	52	Tightening	36	Within market hours	58
Non-scheduled	20	Easing	18	After market hours	14
		No Change	18		
Total	72		72		72

3.2 Event Study (ES) and Identification through Heteroscedasticity (IH)[10]

Since monetary policy changes affect the stock market and vice versa, following Rigobon and Sack (2004), the relationship can be described by two simultaneous equations

$$\Delta i_t = \beta \Delta s_t + \gamma z_t + \varepsilon_t \quad (1)$$

$$\Delta s_t = \alpha \Delta i_t + z_t + \eta_t \quad (2)$$

Here, Equation (1) is the monetary policy reaction function whereby the changes in the monetary policy or short-term interest rate (i) respond to the stock market index and a set of variables z, where z can be observed or omitted variables. Equation 2 is the asset price equation and models the variation in the stock market indices as a function of changes in the short-term interest rate and the variable z. The shock to monetary policy is denoted by ε_t and the shock to the stock market is denoted by η_t.

[9]Non-scheduled policy announcements nearly always take financial markets by surprise and are often followed by dramatic swings in asset prices.

[10]For the detailed methodology, please see Rigobon and Sack (2004).

3.2.1

The difference in the covariance matrix between the policy day (P) and the non-policy days (NP) then can be shown as:

From the above equation (5), we can estimate the desired parameter α using instrumental variables (IV) approach as well as by the generalized-method-of-moments (GMM) method. In this study, we use both the approaches to estimate the impact of monetary policy announcements on stock prices. Since ES method has strong assumptions such as variance of the monetary policy shock to be infinitely large, we test the validity of ES estimates using the Hausmanspecification test.

3.2.3

First, we group the changes in the two variables in the two subsamples ., policy days (P) and non-policy days (NP) into one vector with dimension of 2Tx1, where T is the number of policy days in the subsample. Since the number of observation is same for policy days and non-policy days, by combining them, the total observation becomes 2T. The new vectors Δi and Δs are given by

′ ′ ,

It is neither correlated with nor η because the positive and negative correlation cancels each other out (Foley-Fisher 2013).

Given the two instruments, α which measures the impact of monetary policy on the stock market can be estimated by either of the following equations:

$$' \quad ' \quad \text{or}$$

$$' \quad '$$

3.2.4

Equation (5) can also be estimated using the GMM technique which gives an efficient estimate as it considers all the three moment conditions simultaneously.Rigobon and Sack (2004) showed that the estimate can be obtained by minimizing the following loss function:

The two-step GMM model is estimated first by using the identity weighting matrix and, in the second step,by the optimal weighting matrix , which is the inverse of the estimated covariance matrix of the moment conditions

4. Empirical Results and Implications

4.1.1

We estimated the impact of policy announcementson the stock market indices through equation 10 and equation 12. Table 2 reports the preconditions for applying the IH method, .,

Table 2: Variance, Covariance and Correlation on Policy and Non-Policy Dates						
	Standard deviation of asset prices		Covariance/ Correlation with policy rate			
	Non-policy dates	Policy dates	Non policy dates		Policy dates	
			Covariance	Correlation	Covariance	Correlation
Policy rate (91 day Tbill Rate)	9.96	25.78	-	-	-	-
Sensex	2.83	2.49	3.06	0.11	-1.66	-0.03
Nifty	2.86	2.52	2.58	0.09	-1.06	-0.02
Bankex	3.22	3.47	-0.16	-0.01	-7.72	-0.09

We also use Levene's (1960) test to further confirm the assumption of IH method(Table 3). The test shows that the variance of monetary policy changes increases significantly from non-policy dates to policy dates,while the variance of stock market indices does not change significantly. This shows that the effect of the increase invariance in equation 2 only weakly affects the variance of policy rates(Foley-Fisher 2013).

Table 3:Levene Test of Equal Variance		
	Test Statistic based on Mean	P-value
Policy rate (91 day Tbill Rate)	4.218	0.042
Sensex	0.004	0.952
Nifty	0.029	0.865
Bankex	0.503	0.479

Note**:** Results based on median and 10 per cent trimmed mean for policy rate was significant at 0.055 per cent and other variables were insignificant.

Table 4 reports the results of the impact of monetary policy on stock market from two methods, ., ESand IH.[11]The results indicate that monetary policy have a negative impact on allthree stock index but are statisticallyinsignificant. This finding is in line with those for Germany, Hungary and Poland cited above, as also for the US based on an ESapproach (Rolley and Sellon, 1998; Bomfim and Reinhart, 2000). The IH method using GMM and IV approach provides consistently higher impact than the ES method. Specifically, the bankex index shows the higher impactof monetary policy changes as banks need to manage their balance sheet

[11]The model has been estimated using ivreg2 of Stata (Baum , 2007).

mismatches between interest sensitive assets and liabilities (Kim 2013). Furthermore, the over-identification test statistic of GMM estimate indicates the validity of the instruments used.[12] However, the Hausman test statisticsfails to reject the null hypothesis that policy rate can be treated as exogenous thus supporting ES estimates[13]rather than IH method.

Table 4: Impact of Monetary Policy on Stock Prices: IV versus ES and GMM Results

	IV coefficients	ES coefficients	Test of ES versus IV#	GMM coefficients	Over Identification Test (GMM)*	Test of GMM versus ES
Sensex	-0.008 (0.59)	-0.002 (0.83)				

Table 5: Variance, Covariance and Correlation on Unannounced Policy and Non-Policy Dates						
	Standard deviation of asset prices		Covariance/ Correlation with policy rate			
	Non-policy dates	Policy dates	Non policy dates		Policy dates	
			Covariance	Correlation	Covariance	Correlation
Policy rate (91 day T bill Rate)	12.25	22.65	-	-	-	-
Sensex	4.26	2.75	18.21	0.35	-11.46	-0.18
Nifty	4.14	2.63	17.62	0.35	-10.36	-0.17
Bankex	3.85	3.56	14.38	0.31	-23.48	-0.29

Table 6 reports the results of the impact of non-scheduled policy announcements on stock market from IHand ES. The results indicate that monetary policy have a negative, statisticallyinsignificant impact, for ES and IH using IV method. The Hausman test statistic rejects the null hypothesis at 10% in favor of IH using IV method. In IH method using GMM, we find weakly significantimpact of unanticipated monetary policy announcement on the Sensex and Bankex.[14] As mentioned earlier, the impact on Bankex is higher than the Sensex which further corroborates the dominance of the banking channel in the monetary transmission mechanism. Furthermore, the over-identification test statistic of GMM estimate indicates the validity of the instruments used. However, theHausman test statistics of GMM versus ES was not found to be significant.

Table 6: Impact of Unannounced Monetary Policy on Stock Prices : IV versus ES and GMM Results						
	IV coefficients	ES coefficients	Test of ES versus IH #	GMM coefficients	Over Identification Test (GMM)*	Test of GMM versus ES
Sensex	-0.08 (0.19)	-0.022 (0.40)	0.054	-0.068* (0.09)	0.311	0.105
Nifty	-0.078 (0.20)	-0.020 (0.43)	0.055	-0.065 (0.12)	0.293	0.110
Bankex	-0.103 (0.11)	-0.046 (0.17)	0.074	-0.092* (0.08)	0.553	0.053

Note: #: Hausman Test for validity of the underlying assumptions of the event study (ES) estimator tested against instrumental variable (IV) approach. The standard p-values are given in this column.
* : P-value of Hansen’s J chi square value is given in this column.

[14] Chun-Li (2014) finds stock returns responding significantly to surprise monetary policy shocks based on informative FOMC statements.

4.2

4.2.1

As a robustness check, we also estimated the IH method using a three day data window.[15] In this window also, all the estimators show expected direction of impact ., increase in the short-term interest rates actually lead to a decline instock market indices, but arestatistically insignificant. As in the unanticipated policy announcements, the ES estimates in thethree day window shows significant impact on Bankex at 5% indicating that banking stocks are very sensitive to changes in monetary policy decisions (Table 7). The over-identification test of GMM also validates the instruments used in the estimation.

Table 7: Impact of Monetary Policy on Stock Prices:
IV versus ES and GMM Results(3 day window)

	IV coefficients	ES coefficients	Test of ES versus IH #	GMM coefficients	Over Identification Test (GMM)*	Test of GMM versus ES
Sensex	-0.009 (0.32)	-0.006 (0.32)	0.343	-0.009 (0.38)	0.228	0.546

participants(both banks and primary dealers) and are, therefore, representative of market expectations.

We estimate the IH method using the data on MIBOR instead of T-Bills as the proxy for the policy rate (Table 8).As with T-Bills, the results indicate statisticallyinsignificant but negative impact on stock indices.The IH method using GMM and IV approach provides consistently higher estimated impact than the ES method. The Hausman test statisticshows that the ES estimates are preferable over IH method.

Table 8: Impact of Monetary Policy (MIBOR) on Stock Prices:
IH versus ES and GMM Results

	IV coefficients	ES coefficients	Test of ES versus IH #	GMM coefficients	Over Identification Test (GMM)*	Test of GMM versus ES
Sensex	-0.036 (0.74)	-0.012 (0.48)	0.797	-0.035 (0.75)	0.654	0.821
Nifty	-0.011 (0.92)	-0.008 (0.65)	0.977	-0.015 (0.89)	0.678	0.957
Bankex	-0.027 (0.84)	-0.016 (0.49)	0.909	-0.027 (0.83)	0.726	0.910

Note: #: Hausman Test for validity of the underlying assumptions of the event study (ES) estimator tested against instrumental variable (IV) approach. The standard p-values are given in this column.
* : P-value of Hansen's J chi square value is given in this column.

Thus, most of the results tend to substantiate that domestic monetary policy have little announcement impact on Indian stock indices (similar to Agarwal, 2007), notwithstanding some evidence to the contrary forBankex.

4.3

How do we see the results? We have already indicated earlier that a number of studies reported an insignificant impact of monetary policy on stock markets. While our paper adds to this literature, we do find evidence of weakly significant impact of unexpected policy announcements particularly on banking stocks. We provide some conjectures on the interpretation of the results in the Indian context.

First, the small and medium enterprises (SMEs), which constitute the bulwark of the industrial sector, continue to rely solely on bank finance as they have limited access to the stock market (Bhattacharyya and Sensarma, 2008). Although market capitalization has scaled dizzy heights in recent years, the stock market remains a platform of resource mobilization, mainly for policy actions by the major players in the money market (., banks) and the major players in the stock markets (., FPIs and mutual funds) could be quite different.

Finally, the role of the stock market in capital formation in the country, both directly and indirectly, continues to be less significant. As a result, the impact of changes in stock prices on consumption and investment was found to be much smaller than in economies with market-based financial systems (Ludwig and Slok, 2004). The household sector holds a very small share of its savings in stocks; consequently, the wealth effect is limited. Illustratively, over the 10-year period 2004-14, the household sector had an average share of only 4.6% of its net financial savings in stocks and debentures. Singh (2012) finds that a 10% increase in real stock wealth raises consumption demand by a mere 0.3%, which is consistent with the fact that stock wealth have a relatively low share in the asset portfolio of households. Such wealth effect does not have a large and persistent effect not evident, it could have some impact on a smaller window of about 15-20 minutes immediately after the announcement. Pending the availability of such intensive high-frequency data, any assessment of the impact of monetary policy on financial market behavior would remainimperfectand, at best, partial.

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