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RBI Autonomy and Performance of Monetary Policy and Macro-economy in India in Post Liberalization Period

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Abstract

The auto regressive distributed lag (ARDL) bound test has been employed to examine the presence of long-run relationship of inflation, exchange rate and stock price with Reserve Bank of India's (RBI) autonomy. The short-run and long-run causal effects of RBI autonomy on these variables have also been captured. Construction of RBI autonomy index suggest that some Governors exercised more autonomy as compared to the others. Results find insignificant negative association between RBI autonomy and inflation in India. RBI autonomy has negative influence on exchange rate and stock price in the long-run and a positive effect on stock prices in the short-run.

Keywords: Central bank autonomy, monetary policy, macroeconomic performance.

1. Introduction

In recent years, considerable importance has been given to the possible benefits of Central Bank independence (CBI) as an institutional mechanism to help control inflationary biases, following which many countries have taken measures to make their central banks more independent. Alesina and Summers (1993) in the past suggested that monetary discipline associated with an independent central bank can bring about predictable changes in macroeconomic performance. In the context of

a transition economy like India, former RBI Governor, C. Rangarajan has pointed out that the Reserve Bank of India (RBI), though not formally independent, has acquired greater degree of operational autonomy during the post-reforms period. Moreover, former RBI Governors, Dr. D. Subbarao and Dr. Raghuram Rajan have conveyed the need for greater independence of the RBI as a prerequisite for implementing an effective monetary policy. In the context of India, the very few research studies available relating to the independence of the Reserve Bank of India are theoretical in nature and provide only a conceptual backdrop. Moreover, there is absence of any kind of measurement for RBI's autonomy index, except for the cross-country study by Cukierman (1992) which attempted to develop an aggregate legal index for four decades in 72 countries. Also, there exists generally cross-country studies which use pre-dominantly panel regression techniques.

The possibility that the extant of autonomy exercised by RBI has increased in the post-liberalization period and is relevant to the performance of monetary policy as well as the performance of the macroeconomy has provided the impetus for our recent study. Against this backdrop, the main objectives of the study are to examine whether RBI Governors exercise certain degree of autonomy in the post liberalization period in India, to examine whether and how RBI autonomy affects the performance of monetary policy and to assess the influence of RBI autonomy on the performance of macro-economic variables.

1.1. Theories on Central Bank Autonomy

In the theoretical literature, three different theories, which are not mutually exclusive, have been advanced in support of autonomy of central banks, viz., dynamic or time inconsistency theory, theory of political business cycle and the theory of public choice. In the context of monetary policy, the time inconsistency problem arises because there are incentives for a politically motivated policymaker to try to exploit the short-run trade-off between employment and inflation. An independent central bank may serve to insulate the economy from political business cycles by preventing pre-election manipulation of monetary policy (Hibbs, 1987; Alesina, 1989). The theory of political business cycle predicts that the business cycle results primarily from the manipulation of policy tools by incumbent governments and may have politically popular consequences in the short-run but unfavorable consequences in the long-run. Since monetary policy affects the economy with long and variable lags, even if the central bank withdraws the fiscal stimulus through monetary tightening, its impact would typically be felt during the post-election period when the incumbents may happen to be back in power. Thus, the public choice theory developed because of political business cycles. After election, measures are needed to calm the economy and for reducing fiscal deficit, the public choice theory suggests a constitutional amendment for a pre-specified stipulation on central bank credit to government. The pre-requisite for this is autonomy of the central bank.

1.2. Overview of RBI Autonomy and Monetary Policy in India

The institutional arrangement for financing the government deficit is of significance for an understanding of the conduct of monetary policy. Before liberalisation, the provision for extending short-term credit (not exceeding three months) to the Central government resulted in a practice of rolling over this facility resulting in automatic monetisation of the Government's deficit. The situation became very serious during the 1980s as the Government's fiscal balance rapidly

deteriorated. During this time, the monetary policy was subservient to fiscal policy. An important turning point came about during the tenure of C. Rangarajan (1993-94 to 1997-98) as the RBI Governor. It has been argued by many that under him, the RBI gained substantial freedom to conduct monetary policy primarily by getting the government to agree to pay market rates of interest for its borrowings and by reducing its right to monetise deficits at will. His tenure saw the introduction of the 'ways and means' advance (WMA). Under the new scheme of WMA, the entire financial needs of the government up to a limited amount, fixed in advance is being met through the WMA system and market borrowing. The discontinuation of the automatic monetisation of central government deficits was a giant step towards fiscal correction as well as giving the RBI functional autonomy in the conduct of monetary policy. B. Jalan's (1998-99 to 2002-03) tenure was also significant because during his tenure the RBI recommended the initiation for separation of Government debt management function from monetary policy. This would enable the RBI to primarily focus on its role as monetary authority and enhance the possibility of a move towards greater autonomy. D. Subbarao (2008-09 to 2012-2013) emphasized that the RBI should move towards setting up a Monetary Policy Committee (MPC) on the lines of the Federal Open Market Committee of the United States, for which a 'legally backed autonomous structure' of the Central Bank is a necessary pre-condition.

Table 1 presents the average monthly growth rate of the economic performance variables vis-à-vis the tenure of each successive Governors under study. The table indicates that the performance variables such as inflation, exchange rate, stock price and RBI autonomy have differed in the tenures of the RBI governors under study. RBI independence index has shown a gradual improvement across the five successive regimes over the study period. It can also be inferred that the particular Governor has been able to make a difference during his tenure implying that the Governors' preferences affected economic performance.

Table 1 Monthly average growth rate of Macroeconomic variables Governor Tenure-wise

Tenure Period	Governor	WPI	EXR	SPI	CBI_RBI	IIP	CMR	BM	TOT
1991-93	S. Venkataramanan	0.91	-1.14	3.52	7.08	0.83	-3.17	1.27	-0.99
1994-98	C. Rangarajan	0.70	-0.03	0.60	7.58	0.48	-1.03	1.32	0.03
1999-03	Bimal Jalan	0.40	0.02	0.25	10.11	0.41	-0.44	1.25	0.11
2004-08	Y. V. Reddy	0.58	-0.02	2.06	10.36	0.89	1.28	1.40	-0.44
2008-13	D. Subbarao	0.53	0.06	0.65	10.86	0.30	-0.41	1.22	0.33

Source: RBI Handbook on Indian Economy, Various Issues

Note: 1. WPI=wholesale price index; EXR=real effective exchange rate (INR vis-à-vis USD); SPI=stock price index; CBI_RBI= central bank independence index for RBI; IIP=index of industrial production; CMR=weighted average of call money rate; BM=broad money; NRCG=net RBI credit to government; TOT= terms of trade.

Against this backdrop, this study attempts to provide conceptual backdrop and present empirical evidence, so as to construct a CBI index and adopt an appropriate framework for investigating the extent of autonomy exercised by the RBI Governors in the post liberalized period. RBI independence index has been constructed based on Cukierman et al's (2002) criteria list and construction of CBI index. The purpose of this paper is also to whether the RBI's autonomy affects macroeconomic performance of the country.

The rest of the paper is organized as follows. Section 2 provides an overview of the literature review relating to CBI and macroeconomic performance. Section 3 presents the data source, methodology and variables. Section 4 presents the analysis and discussion of results. Section 5 concludes the paper.

2. Literature Review

This section consists of a review of the empirical literature on the construction and measurement of the CBI index and effects of CBI on macroeconomic performance. Our hypotheses regarding CBI and macroeconomic performance based on the empirical literature are discussed below.

2.1. Measuring Central Bank Independence

This section considers theoretical and empirical literature on the construction and measurement of the CBI index. The earliest work on the CBI measurement was conducted by Bade and Parkin (1984). All the subsequent work (Alesina, 1989; Grilli, Masciandaro, and Tabellini-GMT (1991), Cukierman (1992), Alesina and Summers (1993), Eijffinger and Schaling (1993), Banaian, Burdekin, and Willet (1995), Loungani and Sheets (1995) and De Haan and Kooi (1997) departed from the Bade-Parkin approach of classifying and ranking central banks and constructed a CBI index with cardinal properties. These different measurements of CBI have generally focused primarily on legal independence, mostly in the industrialised countries. Legal measures are constructed of attributes from several groups relating to a central bank's governor, policy formulation, policy objectives, ability of government to borrow from the central bank and external monetary relations of the central bank. Despite the same methodology, the various indices differ in the choice of central bank attributes and their weights, and sometimes in the final degree of CBI. Cukierman (1992) provided turnover ratio (TOR) of central bank governors, based on the presumption that, at least above some threshold level, a higher turnover of central bank governors indicates a lower level of independence. The most widely employed index of central bank independence is that of Cukierman, Webb, and Neyapti (1991).

2.2. Interrelationship between Central Bank Independence (CBI) and Performance of Monetary Policy

Theoretically, if the Central Bank has the autonomy to set the interest rate, it can support price stability, otherwise it can create unfavourable results. Cukierman et al (1992) states that the causality from central bank independence to lower inflation is not clear, and several studies have found conflicting results about the relationship. Alesina et al (1993), Grilli et al. (1991), Oatley (1997), Loungani and Sheets (1997), Lybek (1999) and Debelle and Fischer (1995) using regression analysis find that inflation performance is likely to be better if the central bank has monetary autonomy. Cukierman (1992), Cukierman and Webb (1995), de Haan and Siermann (1996), Cukierman et al (2002), Neyapti (2003), Crowe and Meade (2007, 2008) find that TOR of central bank governors is positively related with inflation, particularly for developing countries. However, Berger and Kibmer's (2013) results suggest that the more independent central bankers are, the more they refrain from monetary tightening to maintain low inflation. Hutchison and Pasricha (2015) stated that greater monetary autonomy has not delivered lower inflation rates in India.

2.3. Interrelationship between Central Bank Independence (CBI) and Macroeconomic Performance

Moser and Dreher (2007) and Velutin and Zhu (2010) investigated the reaction of exchange rates, bond yields and stock prices to the announcement of governor appointments and found that markets do react to who chairs the central bank. Moser and Dreher (2007) found that the exchange rate depreciates to central bank governor changes or governor resignation. Bodea and Hicks (2015) using logit model and a lagged 5 year CBI average, find evidence that CBI affects flow and cost of capital. Hutchison and Pasricha's (2015) study imply that greater monetary autonomy is due to greater exchange rate volatility and not the other way around.

Forch and Sunde (2012) investigated the effect of CBI on stock market returns in emerging economies and found evidence for a positive overall effect. Kurihara et al (2012) examined the effect of CBI on stock market prices and finds a positive effect of CBI on stock prices for developed countries but unlike Forch and Sunde (2012), their paper found the relationship to be insignificant for developing countries. Papadamou et al (2014) addressed the issue of impacts of central banks' conservativeness/independence on stock market volatility and found a positive link between stock prices volatility and central bank conservativeness.

Kuttner and Posen (2007) put forward a counter-argument to the above and considered the possibility that central bank governor appointments may not lead to any market reaction if macroeconomic performance is due to some exogenous factors and if the governors belong to a homogenous pool. Moser and Dreher (2007) suggested that the market may react positively or negatively based on the market's perception of the specific appointee and the institutional setting of the central bank.

2.4. Literature Review in the Context of India

In the case of India, empirical data to adopt an appropriate framework for measuring RBI's autonomy and to investigate its relationship with India's macroeconomic performance is almost absent. There are conceptual and theoretical studies by Goyal (2002, 2007 and 2010), Ramachandran (2000), Chandavarkar (2005) and Vasudevan (2007). Goyal (2002, 2007) suggested that a democratically accountable governor in a developing democracy would anyway keep inflation low. Goyal (2010) revealed that monetary policy has differed in the tenures of various RBI governors and thus there have been variations in performance parameters like inflation and economic growth. Goyal (2010) also suggests that a good deal depends on history and tradition and a fair amount even on the personalities involved. Chandavarkar's (2005) study stated that RBI autonomy is implausible in the absence of security of tenure for the governor which should be defined by statute specifying the terms and conditions of office and the qualifications for the job. Ramachandran (2000) pointed out that the RBI has historically confronted a major impediment in its monetary policy stance attaining independence and that is the growing fiscal-monetary policy nexus, which can be measured by the amount of net RBI credit to the government. Vasudevan (2007) pointed out that one of the measures suggested in the literature to increase independence is to delegate authority to a conservative central banker, who will then impose own preferences on the growth inflation trade-off.

2.5. Inclusion of Control Variables

Campillo and Miron (1997) find that more than monetary policy or CBI, other economic factors are significant determinants of macroeconomic performance variable such as inflation. Inflation is influenced by past money supply and exchange rates in the short run (Chhibber, 1991 and Lim and Papi, 1997), higher interest rates in the long run (Ravenna and Walsh, 2006 and Tillmann, 2008)*, inflation inertia (Hang and Thanh, 2010), broad money (Kandil and Morsi, 2009 and Dizaji, 2011) and GDP growth and money supply in high inflation countries (Lim and Sek, 2014). Exchange rate is related to interest rates (Hakkio, 1986) and terms of trade (Greenwood, 1984; Broda, 2002; Chen and Rogoff, 2003; Coudert et al, 2008 and Ricci, 2008). In case of long-run relationship, exchange rate is found to be associated with commodity terms of trade (Coudert et al, 2008), money supply, economic growth and long-term interest rate (Dropsy, 1996). Stock price is positively related to exchange rate (Aggarwal, 1981), industrial production (Geske and Roll, 1983; Fama, 1990; Koutoulas and Kryzanowski, 1996), interest rate movement (Oyama, 1997) and inversely related to exchange rate (Soenen and Hennigar, 1988). Chen et al. (2005) show that interest rate is not a significant determinant of stock prices. Papadamou et al (2014) find a positive relationship between interest rate volatility and stock market volatility and positive effect of economic growth and exchange rate on stock prices. In the context of India, there are studies (Sarma, 1982 and Rangarajan and Mohanty; 1998) that have examined the nexus between government deficits, money supply and inflation. Kapila (1992) has theoretically indicated that inflation is related to net RBI credit to the government.

To make the investigation stronger, based on the empirical literature, we have considered some of these policy variables (interest rates and money supply) and economic variables (real output and trade) as control variables in investigating the association between CBI and macroeconomic performance.

3. Data Variables and methodology

The hypotheses have been tested using a sample size of 273, considering five successive Governors of the RBI and monthly data on the selected variables for the period 1991-92 to 2012-13. The study is a single country study and employs time series regression technique to study the relationship between selected macroeconomic variables, monetary policy variables and RBI's autonomy. The selection of variables for the present study is based on the existing theoretical propositions and the empirical evidences. The study uses the time series monthly data obtained from the Database on Indian Economy, RBI.

3.1. Methodology

This study employs the autoregressive distributed lag (ARDL) bounds test, proposed by Pesaran, Shin and Smith (2001). This test is chosen because it can be used irrespective of whether the regressors in the model are purely I(0), purely I(1) or mutually cointegrated. However, the model cannot be estimated in the presence of I(2) series. Therefore, before estimating the ARDL model,

*Following the New Keynesian model of business cycle, they show that interest rates influence firm's marginal costs of production that will cause inflation.

where subscript $t=1991m4, 1991m5, \dots, 2013m12$ which refer to the consecutive months from April, 1991 to December, 2013.

The variables are selected based on their theoretical importance and their empirical uses in the extant literature. WPI is the wholesale price index of a representative basket of wholesale goods and WPI changes is used as a central measure of inflation. EXR is the indices of real effective exchange rate (REER) of the Indian rupee. SPI is the monthly average of BSE Sensex. The BSE sensitive index or Sensex is a market capitalization-weighted index of 30 stocks that represents large and well established financially sound companies in India, and widely used in measuring the performance of Indian Stock market. The key variable in each of the three models is the CBI_RBI or the Central Bank independence index of the RBI which has been constructed for each year for the period under study. Since the yearly index remained the same for the months within the years, the monthly index could be obtained for the 271 observations. The details of the construction of the variable CBI_RBI is presented in section 1.1.6.2. The policy variables are the interest rate or the weighted monthly average of the call money rate (CMR) and broad money (BM). The unavailability of the monthly data on the 91 days treasury bills rate for the first six consecutive years of our study period has made us use the call money rate instead. Call money rate is the rate at which short term funds are borrowed and lent in the money market. RBI, banks, primary dealers etc. are the participants of the call money market. A tight liquidity condition leads to a rise in call money rate and vice versa. Broad money comprises of currency in circulation, demand deposits with banks and time deposits. IIP is the index of industrial production. Due to the data unavailability for the variable Gross Domestic Product (GDP) monthly, this study uses the IIP as an alternative to incorporate the real output. Trade has been measured by the term of trade (TOT). It is the ratio comparing export prices to import prices. All the variables, except CMR and TOT have been converted to their logarithm form.

Equations 4, 5 and 6 are modified and the three equations below are estimated for determining the estimates of the coefficients of the independent variables of the model in the long-run.

$$LOG_WPI_t = a_{4,0} + \sum_{i=1}^{4-1} \gamma_4 LOG_WPI_{t-i} + \sum_{i=0}^{4-1} (\vartheta_{4,1} CBI_{RBI_{t-i}} + \vartheta_{4,2} LOG_EXR_{t-i} + \vartheta_{4,3} LOG_BM_{t-i} + \vartheta_{4,4} CMR_{t-i} + \vartheta_{4,5} LOG_IIP_{t-i}) + \epsilon_{1,t} \quad (7)$$

$$LOG_EXR_t = a_{5,0} + \sum_{i=1}^{4-1} \gamma_5 LOG_EXR_{2,t-i} + \sum_{i=0}^{4-1} (\vartheta_{5,1} CBI_{RBI_{t-i}} + \vartheta_{5,2} LOG_WPI_{t-i} + \vartheta_{5,3} LOG_BM_{t-i} + \vartheta_{5,4} CMR_{t-i} + \vartheta_{5,5} LOG_IIP_{t-i} + \vartheta_{5,6} TOT_{t-i}) + \epsilon_{2,t} \quad (8)$$

$$LOG_SPI_t = a_{6,0} + \sum_{i=1}^{4-1} \gamma_6 LOG_SPI_{6,t-i} + \sum_{i=0}^{4-1} (\vartheta_{6,1} CBI_{RBI_{t-i}} + \vartheta_{6,2} LOG_EXR_{t-i} + \vartheta_{6,3} CMR_{t-i} + \vartheta_{6,4} LOG_IIP_{t-i}) + \epsilon_{3,t} \quad (8)$$

The orders of the lag of the explanatory variables are selected based on AIC. The estimated residual series of the model is known as the error correction term (ECT). Next, the error correction model is estimated with one lagged ECT to obtain the short-run dynamic parameters. It is as follows:

$$\Delta LOG_WPI_t = a_{7,0} + \sum_{i=1}^{4-1} \beta_{7,1i} \Delta LOG_WPI_{t-i} + \sum_{i=1}^{4-1} \phi_{7,1i} \Delta CBI_RBI_{t-i} + \sum_{i=1}^{4-1} \phi_{7,2i} \Delta LOG_EXR_{t-i} + \sum_{i=1}^{4-1} \phi_{7,3i} \Delta LOG_BM_{t-i} + \sum_{i=1}^{4-1} \phi_{7,4i} \Delta CMR_{t-i} + \sum_{j=1}^{5-1} \phi_{7,5i} \Delta LOG_IIP_{t-i} + \lambda_1 ECT_{1,t-1} + \epsilon_{4,t} \quad (9)$$

$$\Delta \text{LOG_EXR}_t = a_{8,0} + \sum_{i=1}^{4-1} \beta_{8,2i} \Delta \text{LOG_EXR}_{t-i} + \sum_{i=1}^{4-1} \phi_{8,1i} \Delta \text{CBI_RBI}_{t-i} + \sum_{i=1}^{4-1} \phi_{8,2i} \Delta \text{LOG_WPI}_{t-i} + \sum_{i=1}^{4-1} \phi_{8,3i} \Delta \text{LOG_BM}_{t-i} + \sum_{i=1}^{4-1} \phi_{8,4i} \Delta \text{CMR}_{t-i} + \sum_{i=1}^{4-1} \phi_{8,5i} \Delta \text{LOG_IIP}_{t-i} + \sum_{i=1}^{4-1} \phi_{8,6i} \Delta \text{TOT}_{t-i} + \lambda_2 \text{ECT}_{2,t-1} + \epsilon_{5,t} \quad (10)$$

$$\Delta \text{LOG_SPI}_t = a_{9,0} + \sum_{i=1}^{4-1} \beta_{9,i} \Delta \text{LOG_SPI}_{t-i} + \sum_{i=1}^{4-1} \phi_{9,1i} \Delta \text{CBI_RBI}_{t-i} + \sum_{i=1}^{4-1} \phi_{9,2i} \Delta \text{LOG_EXR}_{t-i} + \sum_{i=1}^{4-1} \phi_{9,3i} \Delta \text{CMR}_{t-i} + \sum_{i=1}^{4-1} \phi_{9,4i} \Delta \text{LOG_IIP}_{t-i} + \lambda_3 \text{ECT}_{3,t-1} + \epsilon_{6,t} \quad (11)$$

Where the ECT_{t-1} represents the error correction period that defines the effectiveness of the correction mechanism in stabilizing disequilibrium in the model. Thus, a negative significant coefficient of the ECT is required to ensure the existence of a co-integration and it represents the adjustment speed of any disequilibrium in the model. The higher the magnitude of the ECT_{t-1} term, the better will be the speed of adjustment.

The ARDL model can capture both short-run and long-run causality. The significant coefficient for the ECT_{t-1} can provide the long-run causality which can be observed from the t-statistics. The short-run causal effects are captured by the coefficients of the first differenced variables by using the Wald test to check whether there is Granger causality between the dependent variables and the explanatory variables.

4. Results and Discussions

4.1. Construction of CBI_RBI

To make the testable hypothesis empirically operational, this paper attempts to measure the autonomy of RBI. This section details the construction of the Central Bank Independence Index of the RBI or the CBI_RBI variable. Following Cukierman et al (1992), this study uses the sixteen criteria as shown in Table 1A in Appendix 1 for constructing an index for RBI autonomy and are coded on a scale of 0 to 1 (lowest and highest levels of independence, respectively) with four attributes each for Personal or Political Independence (PI) and Monetary Policy Independence (MPI) and eight attributes for Fiscal Independence (FI). These reflect the independence of the chief executive officer (CEO) of the central bank, its independence in policy formulation, its objective or mandate, and the stringency of limits on its lending to the public sector. The scores attached to the sub-categories are defined. The RBI belongs to either one of the sub-categories of each criterion. The score assigned to each criterion is aggregated to obtain the value of CBI_RBI. Higher the CBI_RBI value, higher is the RBI autonomy. Table 1A in Appendix 1 presents the criteria list for Central Bank Independence Index constructed for Reserve Bank of India based on Cukierman et al. (1992). Table 2 measures the RBI's autonomy for the period 1990-91 to 2012-13 based on the attributes showing that RBI's autonomy has increased in the recent years.

Table 2: RBI's Independence Index and Different Attributes

Year	Governor	Personnel Independence					Monetary Policy Independence					Fiscal Independence								Overall Independence CBI of RBI		
		A 1	A 2	A 3	A 4	A 5	PI	B 1	B 2	B 3	C	M PI	D 1	D2	D 3	D 4	D 5	D 6	D 7		D 8	FI
1990-91	S. Venkatiramanan	0	0	1	1	0	1.33	1	0	0	0	1.6	0	0.3	1	0	1	0	1	0	4.15	7.08
1991-92	S. Venkatiramanan	0	0	1	1	0	1.33	1	0	0	0	1.6	0	0.3	1	0	1	0	1	0	4.15	7.08
1992-93	C. Rangarajan	1	0	1	1	0	1.83	1	0	0	0	1.6	0	0.3	1	0	1	0	1	0	4.15	7.58
1993-94	C. Rangarajan	1	0	1	1	0	1.83	1	0	0	0	1.6	0	0.3	1	0	1	0	1	0	4.15	7.58
1994-95	C. Rangarajan	1	0	1	1	0	1.83	1	0	0	0	1.6	0	0.3	1	0	1	0	1	0	4.15	7.58
1995-96	C. Rangarajan	1	0	1	1	0	1.83	1	0	0	0	1.6	0	0.3	1	0	1	0	1	0	4.15	7.58
1996-97	C. Rangarajan	1	0	1	1	0	1.83	1	0	0	0	1.6	0	0.3	1	0	1	0	1	0	4.15	7.58
1997-98	Bimal Jalan	1	0	1	1	0	2.08	1	0	0	0	1.6	1	0.7	1	0	1	1	1	0	6.43	10.11
1998-99	Bimal Jalan	1	0	1	1	0	2.08	1	0	0	0	1.6	1	0.7	1	0	1	1	1	0	6.43	10.11
1999-00	Bimal Jalan	1	0	1	1	0	2.08	1	0	0	0	1.6	1	0.7	1	0	1	1	1	0	6.43	10.11
2000-01	Bimal Jalan	1	0	1	1	0	2.08	1	0	0	0	1.6	1	0.7	1	0	1	1	1	0	6.43	10.11
2001-02	Bimal Jalan	1	0	1	1	0	2.08	1	0	0	0	1.6	1	0.7	1	0	1	1	1	0	6.43	10.11
2002-03	Bimal Jalan	1	0	1	1	0	2.08	1	0	0	0	1.6	1	0.7	1	0	1	1	1	0	6.43	10.11
2003-04	Y. V. Reddy	1	0	1	1	0	1.83	1	0	0	0	1.6	1	0.7	1	0	1	1	1	0	6.43	9.86
2004-05	Y. V. Reddy	1	0	1	1	0	1.83	1	0	0	0	1.6	1	0.7	1	0	1	1	1	0	6.43	9.86
2005-06	Y. V. Reddy	1	0	1	1	0	1.83	1	0	0	0	1.6	1	0.7	1	0	1	1	1	0	6.43	9.86
2006-07	Y. V. Reddy	1	0	1	1	0	1.83	1	0	0	0	1.6	1	0.7	1	0	1	1	1	1	7.43	10.86
2007-08	Y. V. Reddy	1	0	1	1	0	1.83	1	0	0	0	1.6	1	0.7	1	0	1	1	1	1	7.43	10.86
2008-09	D. Subbarao	1	0	1	1	0	1.83	1	0	0	0	1.6	1	0.7	1	0	1	1	1	1	7.43	10.86
2009-10	D. Subbarao	1	0	1	1	0	1.83	1	0	0	0	1.6	1	0.7	1	0	1	1	1	1	7.43	10.86
2010-11	D. Subbarao	1	0	1	1	0	1.83	1	0	0	0	1.6	1	0.7	1	0	1	1	1	1	7.43	10.86
2011-12	D. Subbarao	1	0	1	1	0	1.83	1	0	0	0	1.6	1	0.7	1	0	1	1	1	1	7.43	10.86

Note: Amitav Ghosh was the RBI Governor for 20 days from 15 January 1985 to 4 February 1985.

4.2. Descriptive Statistics

This section reports the descriptive statistics of all the variables under study. The descriptive statistics such as mean, standard deviation, skewness and kurtosis are presented in Table3. The value of the skewness and kurtosis shows that the distribution of the all the series is asymmetric. The standard deviation of the variables shows that the stock price index, money supply variables reserve money and broad money are relatively more volatile than the rest of the variables.

Table 3 Sample Descriptive Statistics

Variables	Obs	Mean	S.D.	Skewness	Kurtosis
WPI	273	4.48	0.40	-0.09	2.17
EXR	273	4.61	0.05	0.72	3.87
SPI	273	8.71	0.76	0.31	1.72
CBI_RBI	273	2.19	0.20	-1.29	3.53
IIP	273	4.49	0.44	0.05	1.73
CMR	273	1.98	0.48	0.11	5.96
RM	273	12.85	0.85	0.13	1.85
BM	273	14.29	1.03	0.02	1.81
TOT	273	0.77	0.13	0.16	2.34

Note: Obs= Observations; SD=Standard Deviation

Before estimating the co-integration relationship by ARDL bound test, we confirm the integration properties of the variables using the Augmented Dickey Fuller (ADF) unit root test to check for the stationarity of the data series. When the results are examined from Table 4, it is seen that exchange rate, interest rate and terms of trade are stationary at level and inflation, stock prices, RBI autonomy index, economic growth under the null hypothesis of no co-integration relationship, which means that the assumption can be examined irrespective of whether the explanatory variables are I(0) or I(1) rate and money supply are non-stationary at level and are integrated of order one.

Table 4 ADF Unit Root Test for Stationarity

Variables	I(0)	I(1)	Outcome
WPI	-3.21	-13.22***	I(1)
EXR	-4.38***	-8.12***	I(0)
SPI	-2.77	-12.18***	I(1)
CMR	-4.85***	-11.50***	I(0)
CBI_RBI	-2.10	-16.61***	I(1)
IIP	-1.95	-3.40*	I(1)
BM	-2.22	-3.40*	I(1)
NRCG	-2.86*	-25.63***	I(0)
TOT	-9.55***	-12.10***	I(0)

Notes: *** and * denotes 1% and 10% significance levels respectively and are based on MacKinnon approximate p-values

The results obtained from the bound test for co-integration relationship in each of Model 1, Model 2 and Model 3 are presented in Table 5. As the calculated value of the F-statistics for each of the three models 10.14, 5.861 and 3.15, respectively, are greater than the 1 per cent critical value of the upper bound for Model 1 and Model 2 and greater than the 10 per cent critical value of the upper bound for Model 3, there is evidence for the existence of co-integration or the presence of long-run relationship in each of the three models.

Table 5 Bound Test for the Existence of Co-integration Relationship

Test Statistic	Model 1	Model 2	Model 3
F-statistic	10.14*** K=5	5.861*** K=6	3.15* K=4
I0	3.06	2.88	2.2
I1	4.15	3.99	3.09

Note: I0 and I1 are the lower bound and upper bound respectively. K is the number of independent variables. *** and * denotes 1 per cent and 10 per cent significance level respectively

The estimated ARDL models analyzing the short-run and long-run relationships for the three models are reported in Table 6 and Table 7, respectively. In selecting an appropriate lag length (p), the Akaike's Information Criterion (AIC) was selected as the basis for determining the lag orders for the regressors and the model which minimizes AIC was chosen for each of the three dependent variables, respectively. Table 8 presents the short-run causal effects and the long-run effects. The F-statistic for the joint significance of the lagged variables indicate the short run effects and the t statistic of the lagged error correction term (ECT_{t-1}) for each of the three models imply long-run causality from the macroeconomic variables to inflation, exchange rate and stock price, respectively. In Model 1, the short run and long run relationship between RBI autonomy and inflation is weak, the relationships being insignificant in both Table 6 and Table 7. Moreover, the Granger causality test results show that RBI autonomy does not contribute to inflation in the short run as well as in the long run. This is supported by Hutchison and Pasricha (2015) who found that greater monetary autonomy has not delivered lower inflation rates in India. This may imply the presence of time inconsistency problem wherein the policymaker not insulated from the government is more concerned to exploit the short-run trade-off between employment and inflation. The result may also imply that the macroeconomic performance is more due to some exogenous factors or the economy cannot meaningfully draw inference about a new governor preference which may be due to the presence of a homogenous pool to which the governor belong as put forward by Kutner and Posen (2007).

In Model 2, the short run relationship between RBI autonomy and exchange rate is weak and RBI autonomy does not Granger cause exchange rate. Results in Table 7 indicate a significant long-run negative association between RBI autonomy index and exchange rate. RBI autonomy has a significant negative effect on exchange rate in the long-run. The result contrasts with the findings of Moser and Dreher (2007). The negative relationship may be due to RBI's having a below median central bank independence as measured by Cukierman et al. (1992) and as implied by Moser and Dreher (2007), if the central bank is politically dependent even to some extent, market perception about its independence is less likely to change.

In Model 3, the short-run and long run association between stock price and RBI autonomy is strong, with the relationship being positive with a lag of three months. Table 8 show RBI autonomy to Granger cause stock price in the short run with the desired positive sign. However, the long run effect of RBI autonomy on stock price is significantly negative. This finding contrasts with the positive effect found by Forch and Sunde (2012) and Papadamou et al (2014). The ECT_{t-1} for each of the three models imply that the speed of adjustment to equilibrium is relatively fast in the exchange rate model.

In Table 8, the lagged error correction terms carry the expected negative sign which is highly significant for each of the three models implying long-run causality from the macroeconomic variables to inflation, exchange rate and stock price, respectively. The long-run relationship of the macroeconomic variables with inflation is weak.

Results in Table 6 and Table 7 show that the three dependent variables are positively related to their past values and results in Table 8 show that the dependent variables are Granger caused by their past values. In case of the control variables, exchange rate and economic growth Granger cause inflation with a negative sign. In case of Model 2, exchange rate is positively related to inflation and negatively related to terms of trade in the short run terms of trade Granger causes exchange rate in the short run. Stock price is positively associated with economic growth and negatively associated with interest rate. Interest rate Granger causes stock price. The effect is negative and consistent with the empirical findings of Barrows and Naka (1994) and Chen et al. (2005). Stock price is positively influenced by economic growth which is in line with the findings of Papadamou et al (2014).

Table 6 Panel A: Short-run Relationship

Variable	Model 1 (LOG_WPI) ARDL(2,2,0,0,3)	Model 2 (LOG_EXR) ARDL(1,0,0,0,1,0)	Model 3 (LOG_SPI) ARDL(2,4,3,0,0)
$\Delta \text{LOG_WPI}$		0.241 (1.696)*	
$\Delta \text{LOG_WPI}_{t-1}$	0.243*** (4.207)		
$\Delta \text{LOG_EXR}$	0.030 (1.424)		-0.031 (-0.145)
$\Delta \text{LOG_EXR}_{t-1}$	-0.072 (-3.395)***		
$\Delta \text{LOG_SPI}_{t-1}$			0.326 (5.773)***
$\Delta \text{CBI_RBI}$	-0.001 (-0.259)	-0.007 (-1.145)	-0.003 (-0.142)
$\Delta \text{CBI_RBI}_{t-1}$			0.033 (1.604)
$\Delta \text{CBI_RBI}_{t-2}$			-0.043 (-2.076)**
$\Delta \text{CBI_RBI}_{t-3}$			0.040 (1.930)**
ΔCMR	-0.0001 (-1.154)	0.00004 (0.134)	-0.005 (-3.816)***
ΔCMR_{t-1}			-0.0005 (-0.381)
ΔCMR_{t-2}			-0.003 (-2.326)**
$\Delta \text{LOG_BM}$	0.029 (0.718)	0.042 (0.496)	
$\Delta \text{LOG_IIP}$	-0.044 (-5.105)***	0.005 (0.237)	0.156 (2.259)**
$\Delta \text{LOG_IIP}_{t-1}$	0.004 (0.392)		
$\Delta \text{LOG_IIP}_{t-2}$	-0.027 (-3.099)***		
ΔTOT		-0.036 (-2.607)***	

Note: *, ** and *** denote 1 per cent, 5 per cent and 10 per cent significance level, respectively.

Table 7 Long-run Relationship

Independent Variables	Model 1 (LOG_WPI) ARDL(2,2,0,0,0,3,)	Model 2 (LOG_EXR) ARDL(1,0,0,0,0,1,0)	Model 3 (LOG_SPI) ARDL(2,4,3,0,0)
CBI_RBI	-0.002 (-0.083)	-0.018 (-1.829)*	-0.217 (-2.440)**
LOG_EXR	-0.693 (-1.274)		0.995 (0.662)
CMR	-0.007 (-1.191)	-0.002 (-1.144)	-0.036 (-1.685)*
LOG_BM	0.185 (1.031)	0.019 (0.221)	
LOG_IIP	0.337 (0.881)	0.086 (0.775)	2.03 (6.218)***
LOG_WPI		0.023 (0.137)	
TOT		0.082 (0.948)	
C	-3.365 (-1.389)	4.279 (11.743)***	-2.681 (-0.417)

Note: *, ** and *** denote 1 per cent, 5 per cent and 10 per cent significance level, respectively.

Table 8 Short run and Long run Causality

Independent Variable	Dependent Variable		
	$\Delta \text{LOG_WPI}_t$	$\Delta \text{LOG_EXR}_t$	$\Delta \text{LOG_SPI}_t$
$\sum_{j=1}^p \Delta \text{LOG_WPI}_{t-j}$	15.32***	0.606	
$\sum_{j=1}^p \Delta \text{LOG_EXR}_{t-j}$	7.04***		0.143
$\sum_{j=1}^p \Delta \text{LOG_SPI}_{t-j}$			27.322***
$\sum_{j=1}^p \Delta \text{CBI_RBI}_{t-j}$	0.109	0.717	2.305*
$\sum_{j=1}^p \Delta \text{CMR}_{t-j}$	2.009	0.264	6.767***
$\sum_{j=1}^p \Delta \text{LOG_BM}_{t-j}$	0.617	0.062	
$\sum_{j=1}^p \Delta \text{LOG_IIP}_{t-j}$	15.946***	0.073	2.093
$\sum_{j=1}^p \Delta \text{TOT}_{t-j}$		3.529*	
ECT _{t-1}	-0.024 (-5.892)***	-0.161 (-6.534)***	-0.070 (-4.645)***

Note: Figures are all the F-statistic values of the Wald test. The ECT_{t-1} is obtained from the estimation of the ARDL Model 1, Model 2 and Model 3, respectively. The selected lag length for the ARDL model 1 is (2,2,0,0,0,3,0), model 2 is (1,0,0,0,0,1,0) and model 3 is (2,0,0,0,0,0,0). Figures in parentheses is the t-statistic for the coefficient of the ECT_{t-1}. *, ** and *** denote 1 per cent, 5 per cent and 10 per cent significance level, respectively.

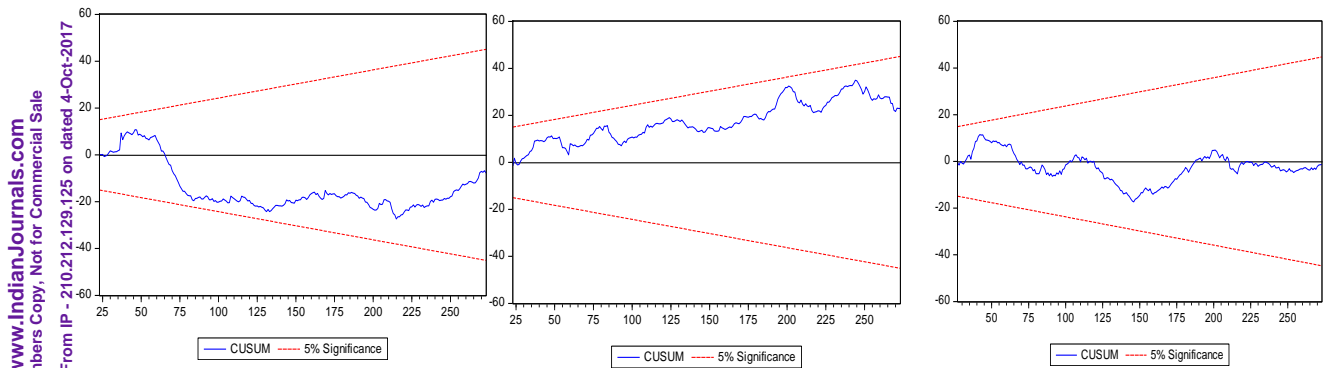
The F-statistic results in Table 9 show that Model 1, Model 2 and Model 3 pass the diagnostic tests for serial autocorrelation. Finally, we have examined the stability of the long-run parameters together with the short-run movements for the equations. For test, we relied on cumulative sum (CUSUM) test. The CUSUM plots in Figure 1 from a recursive estimation of the three models indicates stability in the coefficients over the sample period.

Table 9 Results of Serial Correlation LM Test

Test Statistic	Model 1 (LOG_WPI)	Model 2 (LOG_EXR)	Model 3 (LOG_SPI)
F-Statistic	0.588 (0.556)	0.287 (0.750)	0.012 (0.987)

Note: Test is based on Breusch-Godfrey serial correlation test. Figures in parentheses are the probability values.

Figure 1 Plot of Cumulative Sum of Recursive Residuals



The straight lines represent critical bounds at 5 per cent level of significance

Model 1 (LOG_WPI)

Model 2 (LOG_EXR)

Model 3 (LOG_SPI)

5. Conclusion

Using time-series monthly data of macroeconomic variables for the tenure of five successive RBI Governors for the period 1991-2012, this study attempts to find out whether the RBI Governors exercise a certain degree of autonomy. RBI autonomy index has been constructed based on the criteria of Cukierman et al (2001). The results indicate that some Governors exercised more autonomy as compared to the others. This paper also investigates whether RBI autonomy affects the performance of the macro-economy. The autoregressive distributed lag (ARDL) bound test has been estimated to examine the presence of long-run relationship of macroeconomic performance variables inflation, exchange rate and stock price with RBI autonomy as well as a few control variables. The short-run and long-run causal effects of RBI autonomy on these three variables have also been captured. The results find insignificant negative association between RBI autonomy and inflation. The results indicate RBI autonomy to have a negative influence on exchange rate and

stock price in the long-run. However, there is a positive effect of RBI autonomy on stock prices in the short-run.

RBI governors in the past had managed to have some degree of autonomy even while keeping the government on their side. The government's say on inflation and interest rate is very much expected in an economy like India, where it may have to emphasize more on output and employment which have crucial impact on the lives of the people. To keep inflation low, RBI must increase its autonomy substantially, by insulating itself from the government more now than in the past. In case of favourable exchange rates also, greater autonomy of the RBI becomes a pre-requisite.

The study is not without limitations and as such there is scope for further research. The most obvious limitation of this study is that it considers only a limited set of data by excluding data on fiscal and budgetary situation due to its insufficient availability. Moreover, this study has left out the variable net RBI credit to the Government from the analysis as it results in an unstable model. However, the variable is one of the important dependent variable in a few studies investigating the relationship between RBI autonomy and economic performance, especially in India. Thus, including data on fiscal deficit and net RBI credit to Government will make the empirical results more meaningful. Another limitation is not considering the possibility of the presence of a two-way causality between inflation and the degree of RBI independence. The Government emphasizing more on output and employment in a transition economy like India and thus resulting in high inflation rate make it easier for the Government to influence monetary policy. The presence of a two-way causality between inflation and the degree of RBI independence can be investigated to find whether the degree of RBI autonomy is influenced by high inflation in a transition economy like India or RBI autonomy affects inflation rate. Moreover, an investigation on the relationship between RBI autonomy and India's inflation-targeting framework may give stronger answers to our investigation.

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Appendix 1

Table 1A Criteria List for Central Bank Independence Index constructed for Reserve Bank of India based on Cukierman, Webb and Neyapti (1992)

	Variables	Codes
A	Chief Executive Officer (CEO)	
A1	Term of Office Over eight years Six to eight years Five years Four years Under four years or at the discretion of appointer	1 0.75 0.5 0.25 0
A2	Who appoints CEO? Board of central bank A council of the central bank board, executive branch, and legislative branch Legislature Executive collectively (e.g., council of ministers) One or two members of the executive branch (prime minister, president, or any other member)	1 0.75 0.5 0.25 0
A3	Dismissal No provision for dismissal Only for reasons not related to policy (incapacity or violation of law) At the discretion of central bank board At legislature's discretion Unconditional dismissal possible by legislature At executive's discretion Unconditional dismissal possible by executive or not mentioned	1 0.83 0.67 0.5 0.33 0.17 0
A4	May CEO hold other offices in government? No Only with permission of the executive branch No rule against CEO holding another office	1 0.5 0
B	Policy Formulation	
B1	Who formulates monetary policy? Bank alone Bank participates, but has little influence Bank only advises government Bank has no say	1 0.67 0.33 0
B2	Who has final word in resolution of conflict? The bank, on issues clearly defined in the law as its objectives Government, on policy issues not clearly defined as the bank's goals or in case of conflict within bank A council of the central bank, executive branch, and legislative branch gives final decision The legislature has final authority on policy issues The executive branch on policy issues, subject to due process and possible protest by CB The executive branch has unconditional priority	1 0.8 0.6 0.4 0.2 0
B3	Role in the government's budgetary process Central bank active Central bank has no influence	1 0
C	Objectives Price stability mentioned as the major or only objective in the charter, and in case of conflict with government CB has final authority to pursue policies aimed at achieving this goal Price stability is the only objective Price stability is only one goal, with other compatible objectives, such as a sExhibit banking system Price stability is only one goal, with potentially conflicting objectives, such as a full employment No objectives stated in the bank charter Stated objectives do not include price stability	1 0.8 0.6 0.4 0.2 0
D	Limitations on lending to the government	
D1	Advances (limitation on non-securitized lending) No advances permitted Advances permitted, but with strict limits (e.g., absolute cash amounts or up to 15 percent of government revenue) Advances permitted, and the limits are loose (e.g., over 15 percent of government revenue)	1 0.67 0.33

	No legal limits on lending	0
D2	Securitized lending Not permitted Permitted, but with strict limits (e.g., up to 15 percent of government revenue) Permitted, and the limits are loose (e.g., over 15 percent of government revenue) No legal limits on lending	1 0.67 0.33 0
D3	Terms of lending (maturity, interest, amount) Controlled by the bank Specified by the bank charter Agreed between the central bank and the executive Decided by the executive branch alone	1 0.67 0.33 0
D4	Potential borrowers from the bank Only the central government All levels of government (state as well as central Those mentioned above and public enterprises Public and private sector	1 0.67 0.33 0
D5	Limits on central bank lending defined in Currency amounts Shares of central bank demand liabilities or capital Shares of government revenue Shares of government expenditures	1 0.67 0.33 0
D6	Maturity of loan Within six months Within one year More than one year No mention of maturity in the law	1 0.67 0.33 0
D7	Interest rates on loans must be Above minimum rates At market rates Below maximum rates Interest rate is not mentioned No interest on government borrowing from the central bank	1 0.75 0.5 0.25 0
D8	Central bank prohibited from buying or selling government securities in the primary market Yes No	1 0

Notes: The twenty-four criteria are aggregated into nine criteria first as follows: 1. Five variables concerned with the independence of the CEO are aggregated with equal weights, i.e., $(1a+1b+1c+1d+1e)/5$; 2. The four policy formulation variables are aggregated with equal weights, i.e., $(2a+2b+2c+2d)/4$; 3. Objectives criterion, 3; 4. Advances criterion under limits on lending; 5. Securitized lending criterion under limits on lending; 6. Terms of lending criterion under limits on lending; 7. Potential borrowers from the bank criterion under limits on lending; 8. Four criteria—4e, 4f, 4g, and 4h—on limits on lending are aggregated to one by using equal weights, namely $(4e+4f+4g+4h)/4$; 9. Six variables concerned with board members are aggregated with equal weights, i.e., $(5a+5b+5c+5d+5e+5f)/6$. From these nine aggregated variables, CBIU is constructed which is the unweighted average of the nine aggregated variables.