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## Macroeconomic Surprises and Stock Returns in South Africa

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Rangan Gupta\* and Monique Reid\*\*

### *Abstract*

*The objective of this paper is to explore the sensitivity of industry-specific stock returns to monetary policy and macroeconomic news. The paper looks at a range of industry-specific South African stock market indices and evaluates the sensitivity of these indices to a various unanticipated macroeconomic shocks. We begin with an event study, which examines the immediate impact of macroeconomic shocks on the stock market indices, and then use a Bayesian Vector Autoregressive (BVAR) analysis, which provides insight into the dynamic effects of the shocks on the stock market indices, by allowing us to treat the shocks as exogenous through appropriate setting of priors defining the mean and variance of the parameters in the VAR. The results from the event study indicate that with the exception of the gold mining index, where the CPI surprise plays a significant role, monetary surprise is the only variable that consistently negatively affects the stock returns significantly, both at the aggregate and sectoral levels. The BVAR model based on monthly data, however, indicates that, in addition to the monetary policy surprises, the CPI and PPI surprises also affect aggregate stock returns significantly. However, the effects of the CPI and PPI surprises are quite small in magnitude and are mainly experienced at shorter horizons immediately after the shock.*

Keywords: Bayesian Vector Autoregressive Model, Event Study, Macroeconomic Surprises, Stock Returns.

JEL Classification: C22, C32, E31, E44, G1.

### **1. Introduction**

Financial markets continuously incorporate information about monetary policy and the macroeconomic environment in order to make profitable investment decisions, and these are then reflected in stock prices. Although financial markets do not have perfect information or perfect foresight, they do behave in a forward looking manner, in that they constantly monitor the economy for new information that could impact on the profitability of their investment decisions.

In this paper we consider the sensitivity of a range of South African stock indices to unexpected movements of macroeconomic indicators such as monetary policy and the consumer price index. There are two main motivations for evaluating the reaction of the stock market to monetary policy and other macroeconomic news. Firstly, from a monetary policy perspective, stock markets form part of the transmission mechanism for monetary policy and therefore an understanding of this channel can assist policy makers to monitor and enhance monetary policy effectiveness. For example, the wealth channel of the monetary policy transmission mechanism captures the effect of monetary policy on interest rates and therefore asset prices, which by reducing a household's wealth will affect its consumption decisions.

Secondly, in finance, it is important to understand what leads to movements in the stock markets, both generally and in specific sectors, in order to manage funds profitably. It is obviously beneficial

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to an investor to know how specific stocks perform, but it is also valuable to have a clearer idea of what macroeconomic events influence sector-specific and general stock market indices. These indices are used as benchmarks to evaluate the performance of investments, as well as to provide a basis for index investing<sup>1</sup> and the creation of financial instruments such as options and derivatives.

The objective of this paper is to explore the sensitivity of industry-specific stock returns to monetary policy and macroeconomic news. The paper looks at a range of industry-specific South African stock market indices and evaluates the sensitivity of these indices to various unanticipated macroeconomic shocks (including a monetary policy shock and output shock). It is essential that these variables contain only new information, not that which the markets had already expected, since the market is unlikely to respond to policy actions that were already anticipated. To the best of our knowledge, this is the first study conducted on South Africa which analyses the impact of wide range of unanticipated macroeconomic shocks on stock returns. Earlier studies, such as Small and Jager (2001), Coetzee (2002), Prinsloo (2002), Durham (2003), Hewson and Bonga-Bonga (2005), Alam and Uddin (2009), Bonga-Bonga (2009), Chinzara (2010), Mallick and Sousa (2011) and Mangani (2011), mainly based on identified vector autoregressive (VAR) models (and at times panel data approaches with South Africa as a country in the panel), depict that a contractionary monetary policy leads to a decline in stock prices. This paper improves on these earlier efforts by using measures of monetary policy, as well as other macroeconomic news, which more cleanly isolates the unanticipated elements of the monetary policy variable and other macroeconomic indicators, in studying the impact of these surprises on stock returns in South Africa. Section 2 provides details about the data used in this paper, especially the construction of the macroeconomic and monetary surprise variables (the unanticipated components of the macroeconomic data releases). Section 3 presents the empirical results. We begin with an event study, which examines the immediate impact of macroeconomic shocks on a range of stock market indices. This is followed by a Bayesian Vector Autoregressive (BVAR) analysis, which provides insight into the dynamic effects of the shocks on the stock market indices, by allowing us to treat the shocks as exogenous through appropriate setting of priors defining the mean and variance of the parameters in the VAR. Finally, Section 4 concludes.

## 2. Data

Crucially, the regressors are macroeconomic ‘surprise’ variables. If the financial markets incorporate information in a forward looking manner, then we would not expect stock prices to respond to macroeconomic data releases that reveal that these variables moved as the markets had anticipated – the markets would already have incorporated any information that was expected into the stock prices. Instead, we would only expect stock prices to adjust in response to unanticipated macroeconomic news. Therefore it is inappropriate to use a series of the actual macroeconomic data releases to represent macroeconomic surprises (new information) being released into the market.

In addition, using the surprise component of macroeconomic variables reduces concerns about endogeneity in the study (Gürkaynak, Levin and Swanson, 2010). This is because feedback from the stock market to the macro economy (as reflected in the macroeconomic variables) is likely to be captured in the anticipated component of the macroeconomic data releases. Sections 2.1 and 2.2 will elaborate on how the surprise component of these variables is extracted.

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<sup>1</sup> Index investing (or passive investing) is when a fund is set up to track the movements in a specific index.

## 2.1 Macroeconomic surprises

The macroeconomic surprise variables<sup>2</sup> capture the surprise experienced by the market following the release of some macroeconomic data. These were calculated by finding the difference between the actual data release and the median forecast from survey of a panel of professional forecasters. In other words, the surprise variable is the component of the macroeconomic data release that was not anticipated by the panel of professional forecasters.

$$\text{Surprise} = \text{actual release} - \text{median forecast} \quad (1)$$

The survey of forecasts used was the Bloomberg consensus forecast, because the Bloomberg survey is conducted within the week preceding each of the data releases, so each forecast can easily be matched with the actual data release.

In addition, in order to replicate the actual conditions experienced in the market and by policy makers at the time that particular decisions are being made, it is important to use only real-time data. Orphanides (2001) highlighted the importance of using real-time (or first release) data and the practical relevance of this for South Africa was demonstrated by Van Walbeek (2006). Van Walbeek (2006) has shown that the size of the official revisions of some of the national accounts data in South Africa can be quite large, so failing to account for this could give misleading results. In order to collect this first release data for this study, the original source for each data series was consulted. For example, consecutive issues of the South African Reserve Bank (SARB) quarterly bulletins were consulted to collect the last figure of CPIX (defined as CPI excluding interest rate on mortgage bonds) which has not yet been revised<sup>3</sup>.

The macroeconomic surprises considered were the consumer price index (CPIX and then CPI from January 2009<sup>4</sup>), gross domestic product (GDP), the producer price index (PPI), and the current account (CA). Figures 1 to 4 illustrate the data for these four data series. Figure 1 illustrates the actual CPI<sup>5</sup> data release, the CPI predicted by the Bloomberg consensus forecast, and the surprise component of CPI. The actual and forecast values of CPI (read off the left axis) run closely together over the sample period. This is confirmed by the fact that the surprise component (read off the right axis) fluctuates around 0.

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<sup>2</sup> The dataset of macroeconomic and monetary policy surprise variables used in this study is an extension of that used in Reid (2009).

<sup>3</sup> Details about the collection of the first release data for each of the variable are explained comprehensively in Reid (2009).

<sup>4</sup> In January 2009 the SARB began to use the CPI rather than the CPIX as its official proxy for inflation. Between 2005 and 2008 steps had been taken to improve the CPI basket, and by 2009 it was deemed to be the most comprehensive measure of the cost of living in South Africa and a more appropriate official proxy of inflation (Statistics South Africa, 2009a; Statistics South Africa, 2009b). In this study, the focus is on inflation itself, and the series used as a proxy consists of the CPIX up to the end of 2008 and the CPI thereafter, which can be viewed as the 'targeted price index'. The CUSUM and CUSUM squared tests were also used to test for parameter instability which may give us reason to be concerned about the change in our series from CPIX to CPI. These tests were run for each of the eleven event study regressions in section 3. The CUSUM test rejected parameter instability at the 5% level of significance for all eleven regressions. The CUSUM squared test statistic does deviate beyond the 5% level of significance lines for financials, gold mining and industrials, but not far or for long, so this still does not provide a strong indication of parameter instability. The CUSUM squared test for the rest of the regressions also rejects parameter instability. These results are available upon request from the authors.

<sup>5</sup> Although this index consists of CPIX up to the end of 2008 and CPI thereafter, for convenience it will be referred to as the CPI series from this point in the paper.

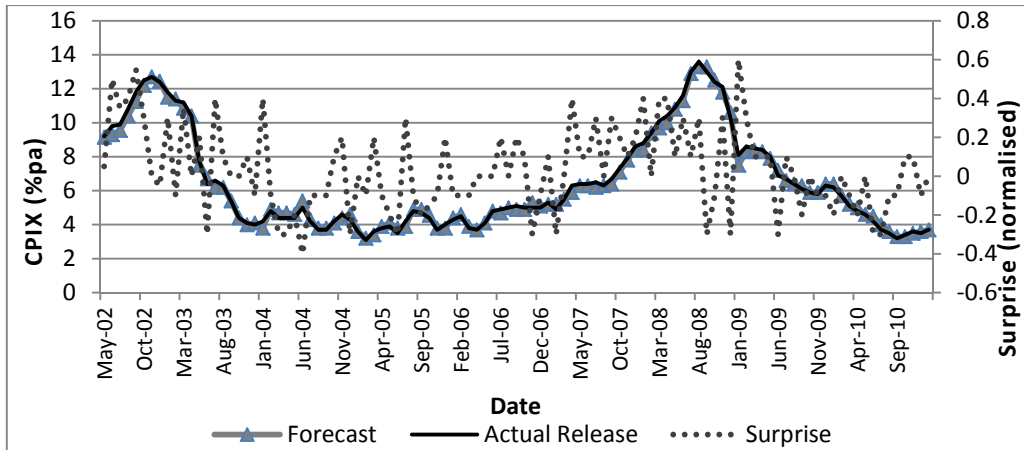


Figure 1: Consumer price index data

Similarly, figures 2-4 illustrate the actual GDP, PPI and current account data releases, the Bloomberg consensus forecasts, and the surprise components of these variables.

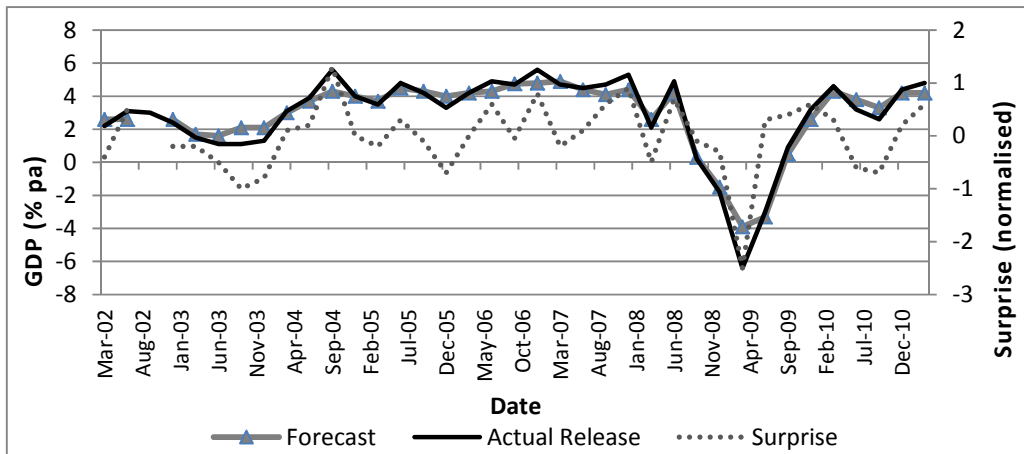


Figure 2: Gross domestic product data

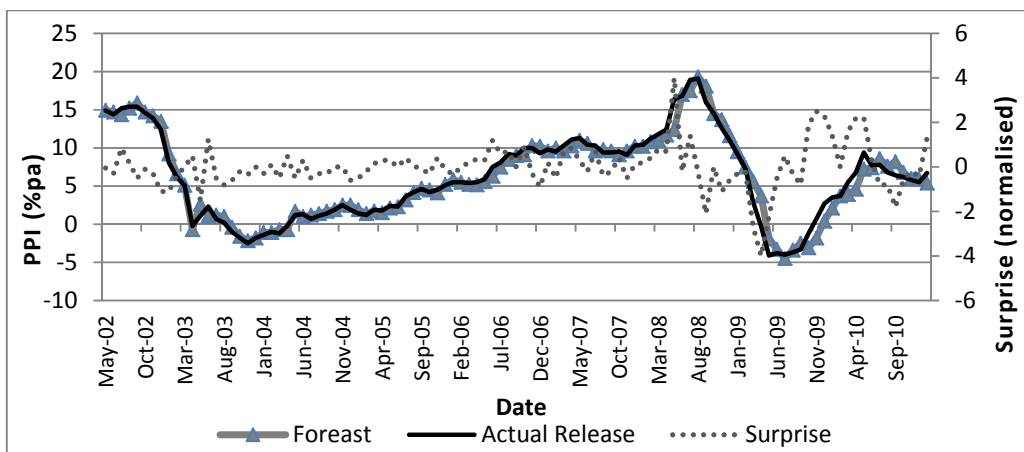


Figure 3: Producer price index data

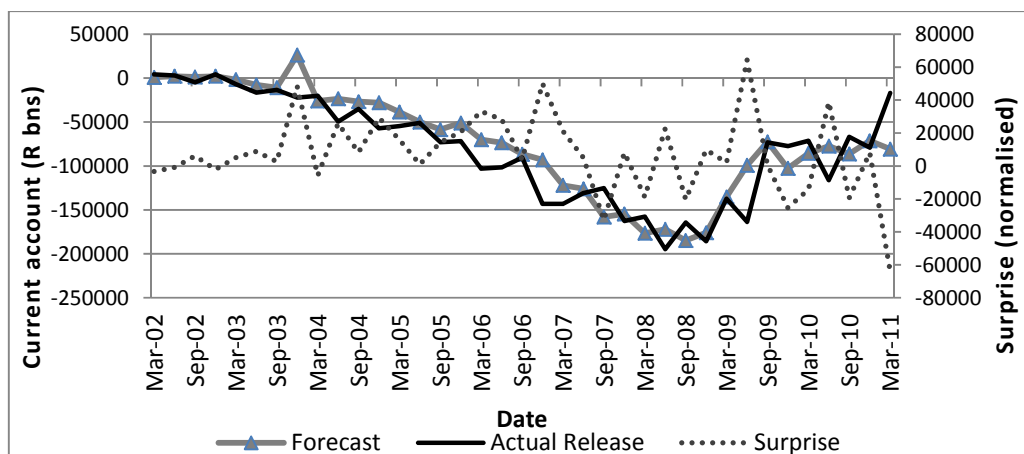


Figure 4: Current account data

## 2.2 Monetary policy surprise

The monetary policy surprise (illustrated in Figure 5 below) is constructed using the change in the 3 month Banker's Acceptance (BA) rate on the day after the Monetary Policy Committee (MPC) announces the official repurchase rate<sup>6</sup> (repo rate) decision. Unlike the other macroeconomic variables market data could be used to construct the monetary policy surprise. This market data was therefore selected rather than survey data to construct the monetary policy surprise, because it is available at a higher frequency and is of a higher quality.

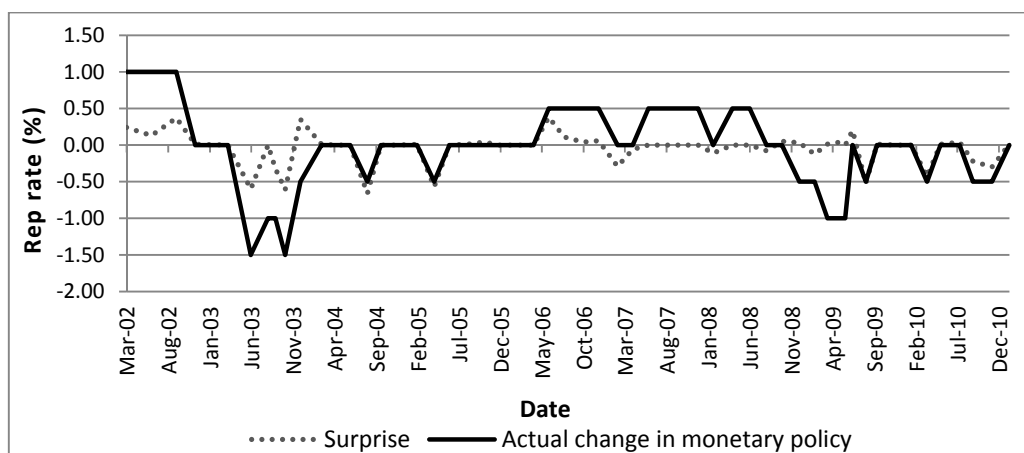


Figure 5: Monetary policy

Timing is important in an event study in order to ensure that the surprise is correctly measured and then matched to the movement in the dependant variable. In the case of the monetary policy surprise, the change in the BA rate on the day *following* the MPC announcement is used, because the announcement is made at 3pm, whereas the BA is set by the banks at midday. Therefore any response in the BA rate as a result of the monetary policy announcement will be captured on the day following the announcement.

<sup>6</sup> The repurchase rate is the monetary policy instrument used by the SARB.

### 2.3 Stock indices

Ten stock market indices are considered as the dependant variables throughout the paper. The South African All Share (ALSI) and top 40 (TOP40) are more general indices, and the other eight are industry-specific indices. They are mining (MIN), financials (FIN), financials and industries (FIN\_IND), general industrials (GEN\_IND), gold mining (GOLD), basic industrials (IND), resources (RES) and retailers index (RETAIL). Financials include banks, insurance, life assurance, speciality & other finance, investment companies, real estate and investment entities; general industrials include aerospace and defence, engineering and machinery, diversified industrials and, electronic and electrical equipment; while, basic industries incorporate chemicals, construction and building materials, forestry and paper and, steel and other metals. Finally, resources combine mining, and oil and gas. Financials and industries combine financials and basic and general industries. The stock price variables are constructed as the stock returns (first differences of the logs of the stock indices in levels) in percentages. Data on the stock indices is obtained from Bloomberg.

## 3. Results

As discussed earlier, the first step in our empirical analysis will be to use an event study to evaluate the immediate impact of the macroeconomic surprises on a range of stock returns. This will be followed by a BVAR analysis to provide insight into the dynamic impact of the shocks. The sample period considered in this paper is May 2002 to January 2011.

### 3.1. Event study

An event study makes use of a dataset that includes only dates on which an event (as defined in your study) occurs. In this study that means that the dataset includes only dates on which data was released about monetary policy or one of macroeconomic variables (dates on which there was no shock in any of the macroeconomic variables were excluded from the dataset). Therefore each surprise variable consists of a number of dates on which data is released about that particular variable and for which a degree of surprise is recorded, and the rest of the dates in the event study a zero would appear for this variable. This event study dataset consists of 352 observations.

Daily data was used in order to isolate the impact of the surprise experienced by the market on the day of a macroeconomic data release or monetary policy announcement. One of the challenges facing this kind of analysis is to limit the impact of endogeneity on the regression results. Using a smaller window reduces the chance that more than one macro shock is experienced in the window period and allows the researchers to isolate the impact of the specific shock and match it with the change in the stock index during that window period. Although intraday data is used by some studies, Erhmann and Fratzscher (2004) highlight the balance that must be struck between using a very narrow window to identify exogenous monetary policy surprises, and the broader window to allow estimation of *sustained* stock market effects (not just overshooting).

In order to estimate the sensitivity of stock returns to monetary policy and macroeconomic news, the approach used in Bernanke and Kuttner (2005) was adopted. Ten regressions were run, using one stock index at a time as the dependant variable. In each case, the dependent variable is the stock returns (in first differences of the log-levels of the stock indices in percentages). The log of the stock return was regressed on a range of variables that capture the macroeconomic and monetary policy news (surprise components of the macroeconomic data releases):

$$\text{Stock Returns} = \text{Constant} + \beta_1 \text{GDP}_t + \beta_2 \text{CPIX}_t + \beta_3 \text{PPI}_t + \beta_4 \text{CA}_t + \beta_5 \text{REPO}_t + \varepsilon_t \quad (2)$$

These macroeconomic surprise variables were normalised by dividing each series by its standard error (Gürkaynak, Sack and Swanson, 2005). This was done in order to ensure comparability of the surprises and ease interpretation. So the coefficient on each macro surprise should be interpreted as the percentage variation in the stock return caused by one standard deviation of the surprise. The monetary policy surprises (South African and Fed monetary policy) were the only surprise variables that were not normalised, and these coefficients are interpretable as the variation in the stock return due to a basis point variation in the monetary policy surprise variable.

Table 1: Event study results

<i>Log Returns</i>	<i>C</i>	<i>GDP</i>	<i>CPI</i>	<i>PPI</i>	<i>CA</i>	<i>REPO</i>	<i>R-squared</i>
<i>ALSI</i>	0.121	0.138	-0.118	0.055	-0.029	-2.774***	0.036
<i>TOP40</i>	0.711	0.136	-0.131	0.066	-0.031	-2.977***	0.035
<i>MIN</i>	0.119	-0.059	-0.222	0.090	0.074	-3.834***	0.032
<i>FIN</i>	0.159*	0.224	0.009	0.046	-0.107	-2.374***	0.023
<i>FIN_IND</i>	0.105	0.265	-0.049	0.028	-0.095	-2.471***	0.033
<i>GEN_IND</i>	0.198***	0.344	0.003	-0.031	-0.048	-3.122***	0.046
<i>GOLD</i>	-0.028	0.448	-0.462*	0.026	0.422	-3.261**	0.032
<i>IND</i>	0.072	0.263	-0.082	-0.002	-0.077	-2.444***	0.035
<i>RES</i>	0.133	0.007	-0.211	0.087	0.055	-3.558***	0.029
<i>RETAIL</i>	0.146**	0.261	-0.072	-0.041	0.007	-2.441***	0.034

Note: \*, \*\* and \*\*\* indicate that the coefficients are significant at 1, 5 and 10 % level of significance.

The results of the regression analyses (presented in Table 1) indicate that the impact of domestic monetary policy shocks on stock indices strongly dominate all other macroeconomic surprises<sup>7</sup>. The coefficients on REPO (the change in South African monetary policy) are consistently negative, and highly statistically and economically significant. A basis point variation in the monetary policy surprise variable causes a decrease in the return of the various stock indices of between 2.374% and 3.834%. The majority of the coefficients on the other variables were strongly insignificant. The only

<sup>7</sup> The impact of the 2007-2009 international financial crisis on these results could be a concern. To investigate this, the event study regressions were run for only the stable sample period, January 2003 - July 2007. This period excludes both the exchange rate shock of 2002 and the impact of the financial crisis. The results do differ slightly in that CPI becomes significant in six of the ten regressions (ALSI, FIN, FIN\_IND, GEN\_IND, IND and TOP40) and PPI in four of the ten (ALSI, MIN, RES and TOP40). However, the significant coefficients on CPI range from -0.347 to -0.388 and on PPI from 0.337 to 0.564, so the conclusion that monetary policy surprises are by far the most influential remains unchanged. In addition, the regressions were run for the period 2002- 2008, with and without including the Fed funds rate surprise in order to test the relevance of the monetary policy of the US on South African stock indices. The period 2002 – 2008 was used as this was the portion of our sample period for which the forward open market committee (FOMC) reports a point target for the Fed funds rate, which has been stopped since June 2008, and are available from Kenneth N. Kuttner's webpage (<http://econ.williams.edu/people/knk1/research>). The results were almost unchanged by the inclusion of the Fed funds rate surprise, so we concluded that it was not necessary to include US monetary policy in the main regressions of the paper. All these results are, however, available upon request from the authors.



exceptions were that the CPI coefficient in the Gold index regression was significant at the 10% level.<sup>8</sup>

Ceteris paribus, we would expect industries that are sensitive to cyclical movements, capital-intensive or relatively open to trade to be more sensitive to monetary policy surprises (Erhmann and Fratzscher, 2004). In our event study, mining, gold mining, resources, and general industrials appear to have coefficients larger than the ALSI, although only in the case of general industrials is the R-squared a little larger than those of the other regressions.

### 3.2 Bayesian VAR

The event-study approach indicates that the most dominant impact on stock returns comes from monetary policy surprises. However, the event-study cannot provide any insight into the dynamic effects of these surprises on the stock returns. The most popular way of analysing such dynamic relationships are via impulse response functions obtained from a VAR. Given this, we estimate a Bayesian version of the classical VAR model. Note that, the decision to use a BVAR model rather than a classical VAR model is to allow us to retain the exogeneity of the macroeconomic surprises in the framework, by setting appropriate priors on the mean and variance of the parameter space. This will be clear below once we discuss the basics of the BVAR and the choice of the priors.

It must be realized that nothing precludes us from using these shocks as exogenous variables in the classical VAR system. However, it is difficult to obtain impulse responses, following changes in these surprise variables. To do this one needs to follow a somewhat complicated methodology outlined in Bernanke and Kuttner (2005). Briefly, their method uses a log-linear approximation to decompose excess equity returns into components attributable to news about real interest rates, dividends, and future excess returns, then employs a VAR methodology to obtain proxies for the relevant expectations. These proxies for expectations are then related to the news about the path of monetary policy embodied in the surprises (derived from federal funds futures). This allows them to estimate the impact (impulse response functions) of federal funds surprises the variables of the system. Note that, one cannot use the standard Choleski-type identification procedure here (whereby the surprises would be ordered first), since, even though the ordering of the variables in the VAR would allow for no contemporaneous effect from the variables of the model on the surprises, lagged-effects on the surprises from the variables cannot be ruled out. In other words, the surprises calculated this way could possibly incorporate an endogenous policy response to information arriving within the month, implying that the impulse response functions may represent the effects of things other than the surprises. The BVAR approach helps us to stay within a simple VAR structure and also retain the exogeneity of the surprises.

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<sup>8</sup> As part of a robustness check, we isolated the positive and negative surprises in the data. We found that, in cases where both the positive and negative repo rate shocks are significant, the positive surprise outweighed the effect of the negative surprise on stock returns. For the stock returns on financials (FIN), financial and industries (FIN\_IND) and basic industries (IND), only the positive version of the surprises in repo rate was significant. The negative surprises to GDP were found to significantly affect FIN\_IND, general industrials (GEN\_IND), IND and resources (RES). Finally in the case of the stock returns for gold mining (GOLD), the negative version of the repo rate surprise and the positive version of the current account surprise were found to be significant. Thus, overall, there is some evidence of asymmetry in the effects of the surprises on the different stock returns. The full estimation details of these results are available upon request from the authors.

Our BVAR model includes the returns on the ALSI, the five surprises, and following Bernanke and Kuttner (2005), the real rate (calculated as the three-month bill yield minus the log difference in the non-seasonally-adjusted CPI), the relative bill rate (defined as the three-month bill rate minus its 12-month lagged moving average), the change in the bill rate, the (smoothed) dividend price ratio, and the spread between the 10-year and three-month Treasury yields. Data sources of the surprises and the ALSI have already been discussed above. All data on the remaining variables are obtained from the SARB's official website ([www.resbank.co.za](http://www.resbank.co.za)). Note that, since VARs require periodic time series data, the subsequent analysis will use the monthly measures of all the variables, including the surprises. Monthly values for the surprises were obtained by taking averages of the event-based daily data if there were multiple Monetary Policy Committee meetings in a month and when there was no such meetings held in a particular month, the value of the surprise for that specific month was set to zero. The BVAR model is estimated using one lag chosen by the Bayesian or Schwarz information criterion, over the period of May, 2002 till January, 2011, implying a total of 105 observations.

The Vector Autoregressive (VAR) model, though 'atheoretical', is widely used to study policy responses. An unrestricted VAR model, as suggested by Sims (1980), can be written as follows:

$$y_t = A_0 + A(L)y_t + \varepsilon_t \quad (3)$$

where  $y$  is a  $(n \times 1)$  vector of variables;  $A(L)$  is a  $(n \times n)$  polynomial matrix in the backshift operator  $L$  with lag length  $p$ , i.e.,  $A(L) = A_1L + A_2L^2 + \dots + A_pL^p$ ;  $A_0$  is a  $(n \times 1)$  vector of constant terms, and  $\varepsilon$  is a  $(n \times 1)$  vector of error terms. In our case, we assume that  $\varepsilon \sim N(0, \sigma^2 I_n)$ , where  $I_n$  is a  $n \times n$  identity matrix.

As described in Litterman (1981), Doan *et al.* (1984), Todd (1984), Litterman (1986), and Spencer (1993), the Bayesian method imposes restrictions on the coefficients of the VAR by assuming that parameters associated with longer lags are more likely to be near zero than the coefficients on shorter lags. However, if there are strong effects from less important variables, the data can override this assumption. The restrictions are imposed by specifying normal prior distributions with zero means and small standard deviations for all coefficients with the standard deviation decreasing as the lags increase. The exception to this is that the coefficient on the first own lag of a variable has a mean of unity. Litterman (1981) used a diffuse prior for the constant. This is popularly referred to as the 'Minnesota prior' due to its development at the University of Minnesota and the Federal Reserve Bank at Minneapolis.

Formally, as discussed above, the means and variances of the Minnesota prior take the following form:

$$\beta_i \sim N(1, \sigma_{\beta_i}^2) \text{ and } \beta_j \sim N(0, \sigma_{\beta_j}^2) \quad (4)$$

where  $\beta_i$  denotes the coefficients associated with the lagged dependent variables in each equation of the VAR, while  $\beta_j$  represents any other coefficient. In the belief that lagged dependent variables are important explanatory variables, the prior means corresponding to them are set to unity. However, for all the other coefficients,  $\beta_j$ 's, in a particular equation of the VAR, a prior mean of zero is assigned to suggest that these variables are less important to the model.

The prior variances  $\sigma_{\beta_i}^2$  and  $\sigma_{\beta_j}^2$ , specify uncertainty about the prior means  $\bar{\beta}_i = 1$ , and  $\bar{\beta}_j = 0$ , respectively. Note that, since we are working with variables that are mean-reverting, as shown in the

Appendix,  $\bar{\beta}_i$  was also set to be equal to zero (Banbura et al., 2010). Because of the overparameterization of the VAR, Doan *et al.* (1984) suggested a formula to generate standard deviations as a function of small numbers of hyperparameters:  $w$ ,  $d$ , and a weighting matrix  $f(i, j)$ . This approach allows the forecaster to specify individual prior variances for a large number of coefficients based on only a few hyperparameters. The specification of the standard deviation of the distribution of the prior imposed on variable  $j$  in equation  $i$  at lag  $m$ , for all  $i, j$  and  $m$ , defined as  $\sigma_{ijm}$ , can be specified as follows:

$$\sigma_{ijm} = [w \times g(m) \times f(i, j)] \frac{\hat{\sigma}_i}{\hat{\sigma}_j} \quad (5)$$

with  $f(i, j) = 1$ , if  $i = j$  and  $k_{ij}$  otherwise, with  $(0 \leq k_{ij} \leq 1)$ ,  $g(m) = m^{-d}$ ,  $d > 0$ . Note that  $\hat{\sigma}_i$  is the estimated standard error of the univariate autoregression for variable  $i$ . The ratio  $\hat{\sigma}_i / \hat{\sigma}_j$  scales the variables to account for differences in the units of measurement and, hence, causes specification of the prior without consideration of the magnitudes of the variables. The term  $w$  indicates the overall tightness and is also the standard deviation on the first own lag, with the prior getting tighter as we reduce the value. The parameter  $g(m)$  measures the tightness on lag  $m$  with respect to lag 1, and is assumed to have a harmonic shape with a decay factor of  $d$ , which tightens the prior on increasing lags. The parameter  $f(i, j)$  represents the tightness of variable  $j$  in equation  $i$  relative to variable  $i$ , and by increasing the interaction, i.e., the value of  $k_{ij}$ , we can loosen the prior.

We want to retain the exogeneity of the surprises, and hence, other non-surprise variables (the ALSI return, the real rate, the relative bill, the change in the bill rate, the dividend price ratio, and the spread between the 10-year and three-month Treasury yields) in the system would have minimal, if any, effect on the surprises. The surprises are sure to have an influence on the other South African variables. Therefore, setting  $k_{ij} = 0.5$ , as is traditionally done, would undermine the exogeneity of the surprises. Hence, borrowing from the BVAR models used for regional analysis (Kinal and Rattner, 1986, Shoesmith, 1992 and Gupta and Kabundi, 2010, 2011), involving both regional and national variables, the weight of a surprise variable in a surprise equation, as well as a non-surprise equation, is set at 0.6. The weight of a non-surprise variable in other non-surprise equation is fixed at 0.1 and that in a surprise equation at 0.01. Finally, the weight of the non-surprise variable in its own equation is 1.0. These weights are in line with Litterman's circle-star structure (Dua and Ray, 1995). Star (surprise) variables affect both star and circle (non-surprise) variables, while, circle variables primarily influence only other circle variables.<sup>9</sup> We set  $d = 2$  following Banbura et al. (2010). The overall tightness parameter ( $w$ ) is chosen based on a grid-search over 0.1 to 0.3 (values traditionally used in the literature) to ensure the best possible (minimum root-mean squared error for the) one-step-ahead forecast of stock returns over the out-of-sample horizon of January, 2007 till January, 2011 (covering the period of the financial crisis). The optimal value of  $w$  was obtained to be 0.1.

Finally, once the priors have been specified, the BVAR model is estimated using Theil's (1971) mixed estimation technique. Specifically, suppose we denote a single equation of the VAR model as:

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<sup>9</sup> We also experimented by assigning higher and lower interaction values, in comparison to those specified above, to the star variables in both the star and circle equations, but, the pattern of the impulse response functions remained qualitatively unchanged. These results are available upon request from the authors.

$y_1 = X\beta + \varepsilon_1$ , with  $\text{Var}(\varepsilon_1) = \sigma^2 I$ , then the stochastic prior restrictions for this single equation can be written as:

$$\begin{bmatrix} M_{111} \\ M_{112} \\ \cdot \\ \cdot \\ \cdot \\ M_{mp} \end{bmatrix} = \begin{bmatrix} \sigma/\sigma_{111} & 0 & \cdot & \cdot & \cdot & 0 \\ 0 & \sigma/\sigma_{112} & 0 & \cdot & \cdot & 0 \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & 0 & \cdot & \cdot & \cdot & 0 \\ 0 & 0 & \cdot & \cdot & 0 & \sigma/\sigma_{mp} \end{bmatrix} \begin{bmatrix} a_{111} \\ a_{112} \\ \cdot \\ \cdot \\ \cdot \\ a_{mp} \end{bmatrix} + \begin{bmatrix} u_{111} \\ u_{112} \\ \cdot \\ \cdot \\ \cdot \\ u_{mp} \end{bmatrix} \quad (6)$$

Note,  $\text{Var}(u) = \sigma^2 I$  and the prior means  $M_{ijm}$  and variance  $\sigma_{ijm}$  take the forms shown in (4) and (5). With (6) written as:

$$r = R\beta + u \quad (7),$$

the estimates for a typical equation are derived as follows:

$$\hat{\beta} = (X'X + R'R)^{-1}(X'y_1 + R'r) \quad (8)$$

Essentially then, the method involves supplementing the data with prior information on the distribution of the coefficients. The number of observations and degrees of freedom are increased by one in an artificial way, for each restriction imposed on the parameter estimates.

The median along with the 16% and 84% quantiles for the sample of impulse response functions for the ALSI returns following one standard deviation increase in the five macro surprises are depicted in Figures 6 through 10 over one to 12-months horizon. In general, the magnitude of the effects on the stock returns emanating from the different surprises are quite small in magnitude, and ranges between 0.0241% (GDP) to 0.1087% (PPI). Following the CA surprise, the stock returns peak in the second month and the effect stays positive till six months. However, the effect is not significant. The CPI surprise significantly reduces the stock returns in the second month following the shock. The effect stays negative throughout the 12 month horizon. Interestingly the effect, though quite small, is again significant at longer horizons. The GDP shock causes stock returns to stay positive over the entire horizon, peaking in the third month. However, the effect is insignificant. The monetary policy shock (REPO) causes the stock returns to move negatively throughout the 12 months horizon, with the maximum effect being observed in the third month. The effect is significant for months 3, 4 and mildly for the fifth month following the shock. Finally, the PPI surprise increases the stock returns and makes it stay positive for 7 months, with a significant peak in the second month.

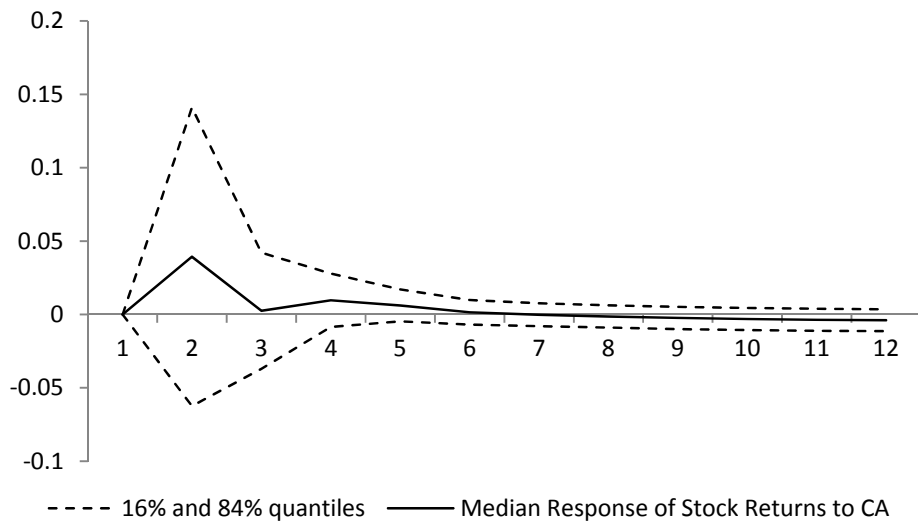


Figure 6. Impulse response of ALSI returns to one standard deviation shock to CA surprises

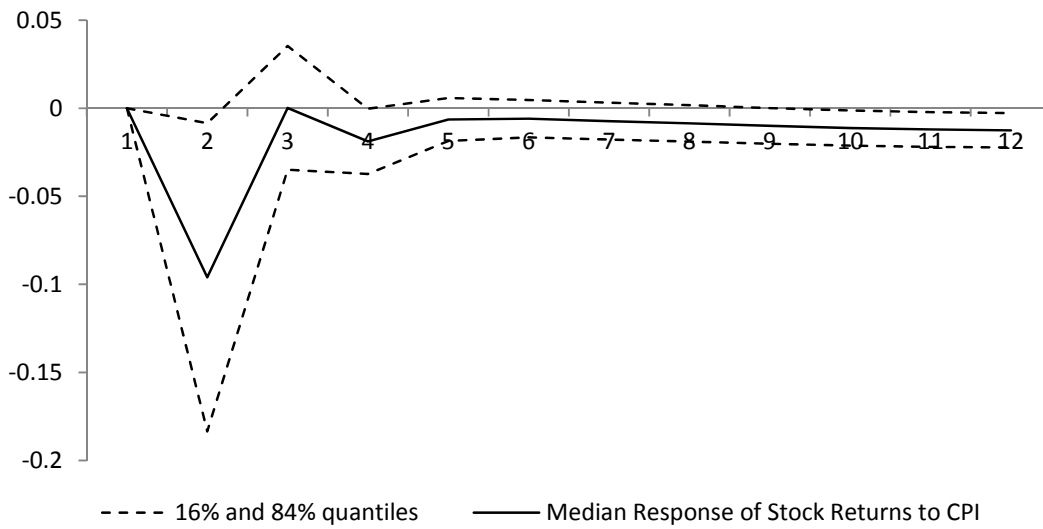


Figure 7. Impulse response of ALSI returns to one standard deviation shock to CPI surprises

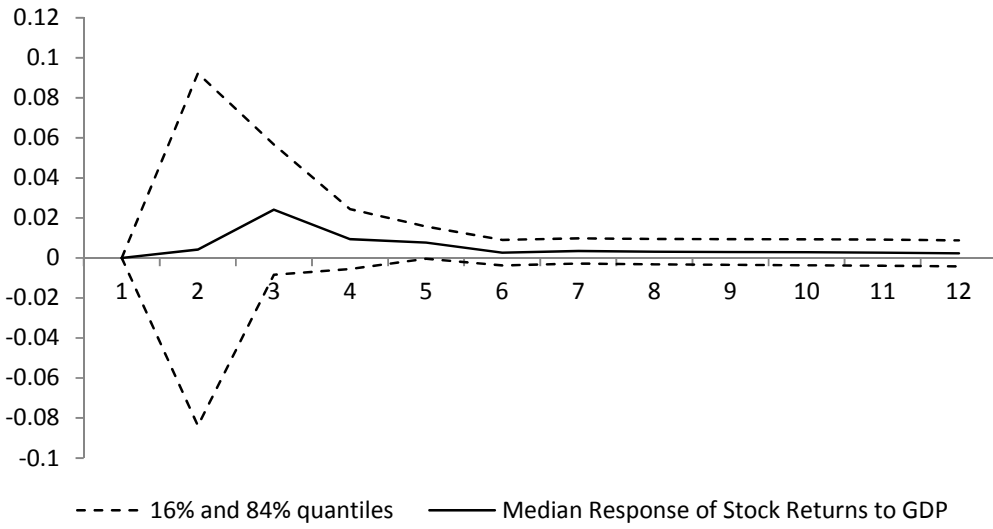


Figure 8. Impulse response of ALSI returns to one standard deviation shock to GDP surprises

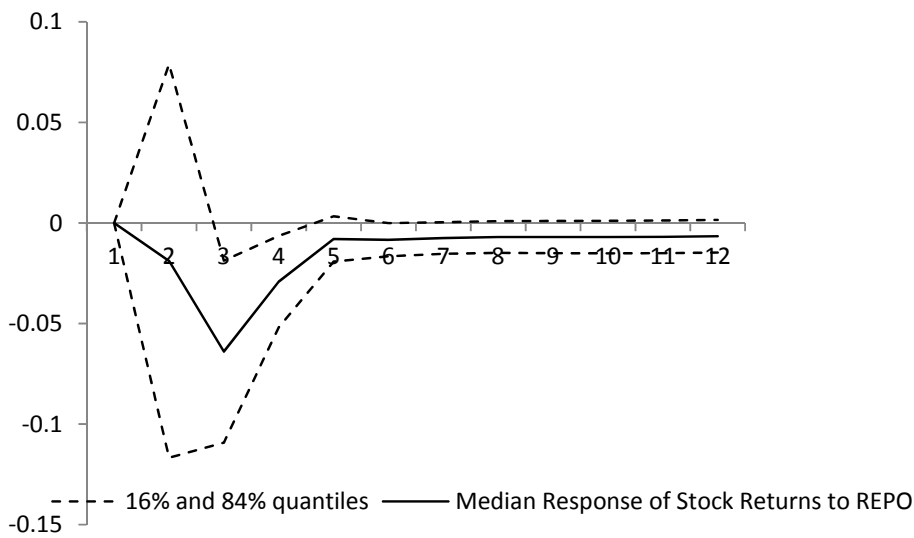


Figure 9. Impulse response of ALSI returns to one standard deviation shock to REPO surprises

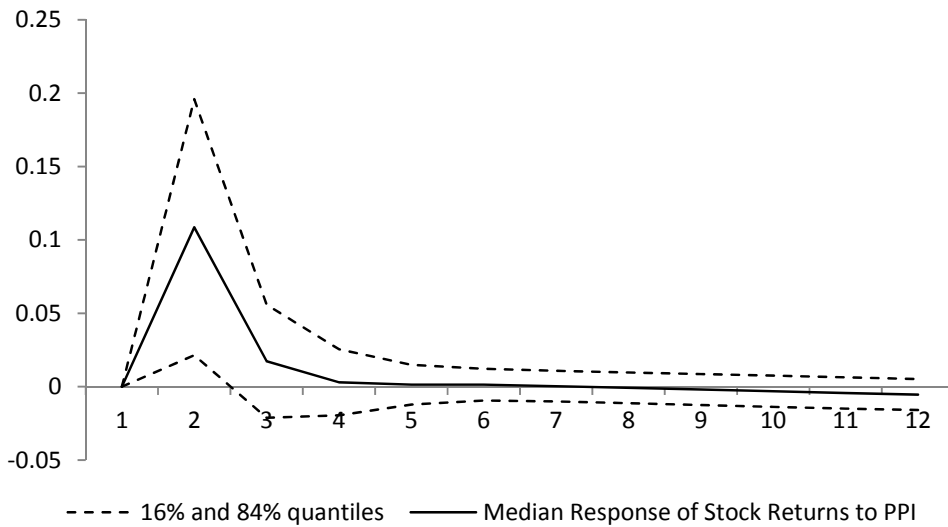


Figure 10. Impulse response of ALSI returns to one standard deviation shock to PPI surprises

When we compare our impulse response results with that of the event study, all the signs barring that of the CA surprise are the same. However, in addition to the monetary policy surprise, we also find significant effect emerging from the CPI and PPI shocks. Based on the dynamics, the PPI, CPI and REPO surprises have the largest effect on the stock returns, followed by the CA and GDP surprises.<sup>10</sup> Barring the PPI surprise, the behavior of the stock returns following other shocks is intuitively obvious. An increase in the stock returns following a positive PPI shock could however indicate the markets react positively at the onset due to increased profitability of the firms, but as soon as the higher PPI translates into higher consumer prices and its own effect starts to die down, the stock returns are eventually negatively affected.

#### 4. Conclusion

The objective of this paper is to explore the sensitivity of industry-specific stock returns to monetary policy and macroeconomic news. The paper looks at a range of industry-specific South African stock market indices and evaluates the sensitivity of these indices to a various unanticipated macroeconomic shocks. It is essential that these variables contain only new information, not that which the markets had already expected, since the market is unlikely to respond to policy actions that were already anticipated. To the best of our knowledge, this is the first study conducted on South Africa, which analyses the impact of wide range of unanticipated macroeconomic shocks on stock returns. Earlier studies mainly based on identified vector autoregressive (VAR) models (and at times panel data approaches with South Africa as a country in the panel), depict that a contractionary monetary policy leads to a decline in stock prices. This paper improves on these earlier efforts by using measures of monetary policy, as well as other macroeconomic news, which

<sup>10</sup> The variance decomposition analysis revealed a similar story with the CPI explaining on average (over the 12 month horizon) 0.9271% of the variability in ALSI returns, followed by PPI (0.8197%), REPO (0.4523%), CA (0.1166%) and GDP (0.0356%). Note that the explained variability essentially remained constant from the second month onwards. The details of these results are available upon request from the authors.

more cleanly isolate the unanticipated elements of the monetary policy variable and other macroeconomic indicators, in studying the impact of these surprises on stock returns in South Africa.

We begin with an event study, which examines the immediate impact of macroeconomic shocks on a range of stock market indices. This is followed by a Bayesian Vector Autoregressive (BVAR) analysis, which provides insight into the dynamic effects of the shocks on the stock market indices, by allowing us to treat the shocks as exogenous through appropriate setting of priors defining the mean and variance of the parameters in the VAR. The results from the event study indicates that with the exception of the gold mining index, where the CPI surprise plays a significant role, monetary surprise is the only variable that consistently negatively affects the stock returns significantly, both at the aggregate and sectoral levels. The BVAR model based on monthly data however, indicates that, though the effects of the surprises are quite small in magnitude, the CPI and PPI surprises, besides the monetary policy surprise, also affects aggregate stock returns significantly, but mainly at shorter horizons immediately after the shock.

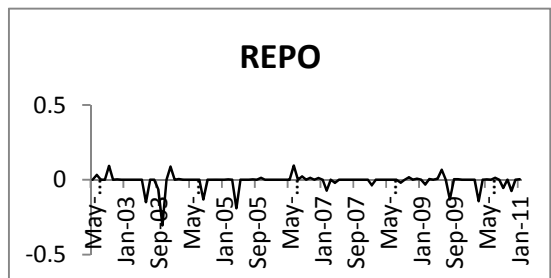
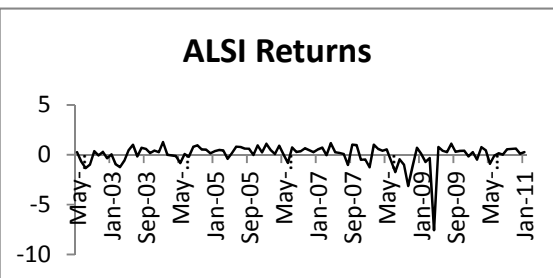
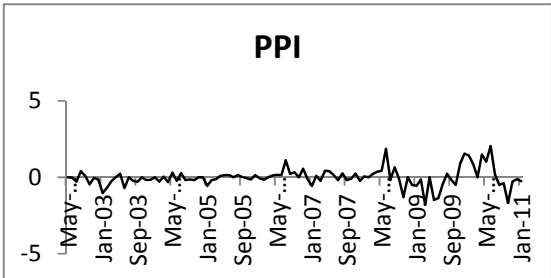
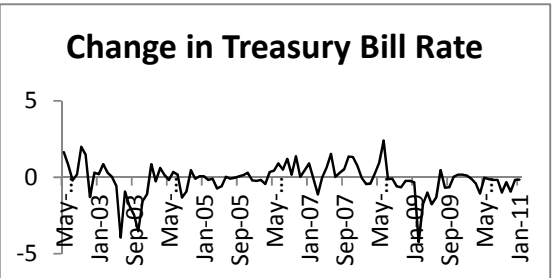
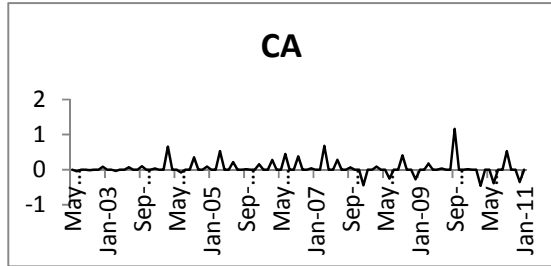
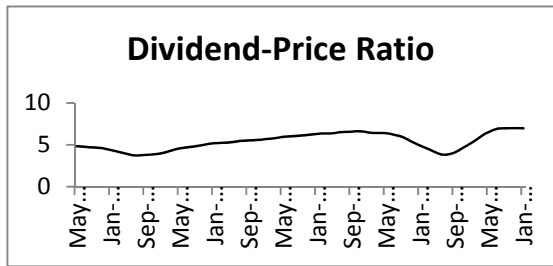
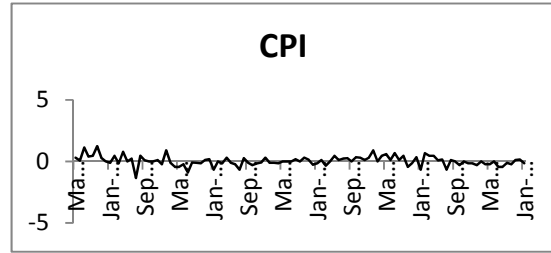
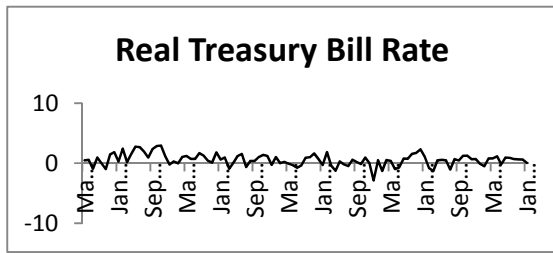
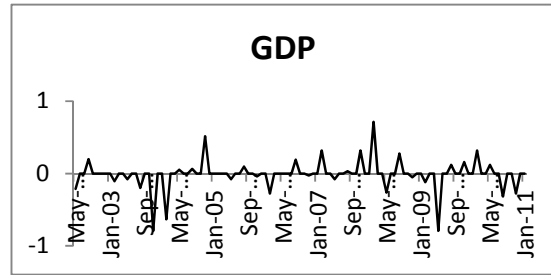
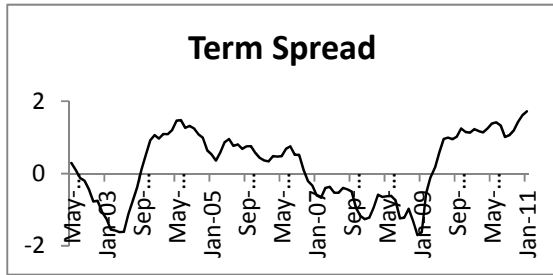
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APPENDIX:



### Relative Treasury Bill Rate

