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Evidence on the Relationship between Price Level and Macroeconomic Policies: Perspective of Bangladesh

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Abstract: This paper tries to examine the effectiveness of macroeconomic policies, namely fiscal, monetary and trade policies on price level in the context of Bangladesh from the period of 1981 to 2011. Technically, we assess the following questions: 'which of the macroeconomic policies affect the domestic price level most in case of Bangladesh?' or, 'which of the policies have the effect on price both in the short-run and long-run?' We employ the autoregressive distributive lag bound testing approach of cointegration and vector error correction-type Granger causality test using number of proxies for these policies to achieve this goal. Our result suggests that policies with their different proxies have a long-run relationship with the price level and this result is robust to Johansen-Juselius technique. Our short-run and long-run models show that fiscal policy and output are more responsible for combating rising in price level making fiscal theory of price level more valid in Bangladesh instead of standard monetary policies where both monetary and trade policies appeared themselves as insignificant. These long-run results are robust to both fully modified ordinary least squares and dynamic ordinary least squares method. Moreover, the structural vector autoregression analysis also supports the earlier results. This suggests that budget-type fiscal policies are more important for controlling inflation while monetary policy would act as passive.

Keywords: bound testing, cointegration, FTPL, price, SVAR

JEL Classifications: E31, E52, E63

1. Introduction

What will happen next year in Bangladesh if general price level increases by a large amount or at least as high as in 2008, a period which is blamed for the price hike? World Bank (2011) approximates that additional 44 million people may fall under the poverty level if the current food price is same as in 2008 in developing countries. Impacts of food prices on welfare are strongly influenced by the household's income and expenditure patterns and it adversely affect the households if they are net food purchasers rather than net food sellers (Vu & Glewwe, 2011). Ivanic & Martin (2008) also show that poverty increases are considerably more frequent and larger than poverty reductions in case of the rise in food prices. Increase in food price exacerbates both the rural and urban consumer as more than half of the consumption basket is composed of food and consumer price index (CPI) in Bangladesh is composed of about 58.84% from food and the rest is from non-food.[1]

Higher price not only aggravates poverty situation, but also reduces the rate of growth of income and makes it a burning question in developing countries like Bangladesh. Price and policies are always entwined and the central planner is always solicitous about the dynamics of price and the

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tools and instruments to stabilize the price level. Very often, policies fail to achieve the goals. Numbers of conditions are required to achieve those goals. Again, an instrument, which was effective in any period, may be futile in another period. Application of interest rate reduction or tax-cut in a recession or in a boom period, for instance, may behave pro-cyclically or counter-cyclically. For the monetary policy, independence of the central bank is most important because, any deviation from this not only alters its goals, but also increases the price level as price level stability is the prime goal of many central bank authorities (Cukierman *et al*., 1992). Credibility and flexibility of central bank authority are important for achieving its goal. At the same time, fiscal policies are prone to challenge to stabilize the economy in case of their inability to pursue its commitments. Though central bank knows that the discretionary policy will lead to bad outcomes of high inflation and low output, however, the fiscal authority may apply pressure on the central bank to try to boost output.[2] Again, during international shock due to oil-price shock or financial crisis, government policy very often comes into the stage to mitigate the problem. Another important aspect is trade policies which also affect the price level. So, it is important to search the interrelationship between the price level and the policies.

Inspecting the history of price and conforming macroeconomic and trade policies, we get different scenarios from 1980 to 2000. From the perspective of developing countries, it can be said that, after the liberation war, although Bangladesh followed import-substitution-industrialization policy, later in 1990s it followed export-led-growth strategies. The phase of import-substitution-industrialization policy was characterized by high inflation rates, high tariff rates, inefficient industries and large foreign debt. In 1970s, the effective rate of protection was more than 80 percent and the real interest rate was negative. Distortions in infrastructure pricing and the labor market were high. In 1980s, Bangladesh stepped itself into the era of trade liberalization through the prescriptions of International Monetary Fund (IMF) and World Bank. The phases were 1982-1986, 1987-1991 and 1992 onwards. Several industrialization policies were initiated. Despite these policies, Bangladesh experienced high inflation rate of an average 9.5% in 1980-1990. Taslim (1982) examined the monetarist theory to explain this inflation, but he found that neither monetarists nor structuralists could explain the inflation rate during his study period from 1959-60 to 1979-80. In those times, especially after the liberation war, Bangladesh was in the midst of the crisis of food grain due to bad harvest and rejection of food aid from the international side.[3] Again the period was characterized by political turbulences, regime change and lack of discretionary power of central bank authority. These decay the purchasing power of money. The government was the sole authority to hold down the price level. But its attempt failed to stable the price level. Historically it can be seen that government activities always fueled the inflation, mostly in the form of the budget deficit. From 1982-1989, the inflation rate was almost 10% per annum, whereas the growth rate of government expenditure vacillated during the period and peaked at 17% in 1986. Having some falling trends, this reveals that government policy always became inflationary in Bangladesh. During this period, the decade-average growth rate was 3.73% and in 1990s it was 4.81% despite the devastating flood in 1998. Per capita gross domestic product (GDP) in 1990s was twice than that of in 1980s. Excessive government expenditure impeded the growth in two ways in Bangladesh: the first was the crowding-out effect and the second was the high inflation rate. But things began to change in 1990s where several trade-liberalization reforms have been implemented. From 1990-2000, Bangladesh experienced both macroeconomic stability and robust economic growth having a transition of the political institution to democracy. It got pace in the second half of the 1990s with 5.15% growth rate per annum.[4] This period was also characterized by record-low rate of inflation (5.5%), large volume of external reserves and an improved resource position of the government. Although Bangladesh experienced shocks emanating from the large budget deficit and balance of payment problems, it overcame through some reforms. A low rate of inflation is one of the achievements in this decade even though government borrowing was high enough during this period coupled with high rate of growth of money and domestic credits. The prime reason for this low rate inflation was the robust growth of the agricultural sector and the export sector. Besides, liberalization reforms made the raw materials cheaper and the production cost began to decline.

One of the most challenging periods for macroeconomic stability was in 2008 when food price got itself in a position of such spike that the term ‘Food inflation’ was used to describe the inflationary pressure. Hike in international food price also exacerbated the welfare of domestic consumers. For the absence of social safety net, more people fall into poverty. The government had to import rice from the international market at a higher price. Neither monetary nor the fiscal, but supply side characteristics were the prominent reasons for this hike.

Analyzing the history, it appears that macroeconomic policies are not always successful for combating inflation. No one policy could alone combat inflation. Inflation is always a monetary phenomenon--this did not become true for Bangladesh. Evidence suggests that Bangladesh experiences rise in price for two reasons: excessive government expenditure and supply shock due to bad harvest or flood or external shock.

Considering the above facts, this paper tries to examine the relationship and interactions between the monetary, fiscal and trade policy with the general price level and would try to assess their shock on price through short-run and long-run relationship using a number of indicators of these policies.

2. Price and the Macroeconomic Policies

2.1 Theory and Econometric Specification

Prices and policies are intertwined as the central planner take various options and strategies to leave the price level at moderate level and at the same time higher price level induces the central planner to take those steps. Higher degree of volatility of price or simply inflation dwindle the growth of an economy. So, stability of price is very often appeared itself as not only a macroeconomic phenomenon but also a political phenomenon. History of literatures on the relationship between price and macroeconomic policies are long and most of the studies attempt to sort out the determinants of increase in price level or simply the inflation. Inflation is the most discussant feature in macroeconomics. Inflation dynamics are examined by several studies (Fuhrer & Moore, 1995; Gali & Gertler, 1999; Sbordone, 2002; Calvo, 1983). They all examined the inflation dynamics through new Keynesian Phillips curve (NKPC) using marginal costs, output and unit labor costs as determinants. The prominent feature of these studies is that all of them try to determine inflation using rational expectation hypotheses. Adam & Padula (2011) found that out of output-gap or unit labor costs as a measure of marginal costs, both of the proxies performed well. On the other hand, Norman & Richards (2012) found that the models matter, i.e. expectation-augmented, unemployment based Phillips curve could produce better forecast than others.

As the central banks of most of the developing countries cannot exercise their discretionary power due to the political interest group, very often monetarist theories come into veil in explaining the inflationary process. They also fail to control the inflation. The reason is that monetary policy cannot act independently to control the inflation rate, one of the major goals of the central bank. In recent history, fiscal view of inflation gains momentum to explain the inflationary process in developing countries. Fiscal policies reflect the stage of development and the corresponding role of government of the capitalist world. Infant stage of capitalism requires a vast volume of investment where government can finance it only a little. In such a case, govt. tends to borrow to offset the budget deficit. If the budget deficit is financed through money creation, then the result of an excessive budget deficit is inflation. Moreover, the excessive budget deficit could lower the capital intensity (Feldstein, 1983). If this is so, then the fiscal policy should act as active policy while the monetary policy would be passive. Feltenstein & Farhadian (1987) developed a model and showed empirically that changes in money supply is largely explained by government deficit, the wage bill of the government and state enterprises which induce the price level to rise. Ruge-Murcia (1995) developed a model where money supply is endogenously determined by the government's use of newly created money to finance its current expenditure. In addition, by the effect of the past period's of inflation on the real value of taxes and by empirically he found that steady-state inflation is associated with the government's spending. The fiscal theory of price level (hereafter FTPL) can predict the path of inflation whereas many traditional macroeconomic models very often cannot predict the path (Leeper, 1991; Sims, 1994; Woodford, 1994, 1995, 2001).

With this orientation, this study would follow the FTPL theory developed by Leeper (1991), Leeper and Yun (2006), Sims (1994), Woodford (1995) and Kim (2004). We will recapitulate the theory developed by Leeper & Yun (2006) and Kim (2004) and extend this theory by Sims (1994).

2.2 The model

Following Kim's (2004) model of inflation which incorporates both the fiscal and monetary policy and the solution of that model by Sims (1994), we get the following expression:

$$\hat{\pi}_t = -\left(\frac{m(\pi-\beta)}{m+bR}\right)\hat{V}_t - \left(\beta + \frac{m(\pi-\beta)}{m+bR}\right)\hat{Y}_t + \hat{Y}_{t-1} + \beta\hat{K}_t - \hat{K}_{t-1} \tag{1}$$

where, P_t = aggregate price level; $b_t = B_t/P_t$; $\pi_t = P_t/P_{t-1}$; $m_t = M_t/P_t$; $\hat{\pi}_t$ = rate of inflation; R = gross interest rate on bond; $\hat{V}_t$ = money demand shocks; $\hat{K}_t$ = aggregate demand shock (or discount rate shock); $\hat{Y}_t$ = endowment shock and β = discount factor.

2.3 Econometric specification

Following Eq.1 or Leeper & Yun (2006) or Sims (1994), we rationalize the variables that follow both the theory and empirical specification. The expansionary shock from government side may fuel the budget deficit in the economy through increase in government expenditure or tax-cut. This expansionary shock induces to borrow from domestic source such as central bank. The government issues bond and finances its deficit. This increases the bond holdings by the public and as a result the parameter (b) in Eq.1 increases. The monetary authority rules fix the interest rate (R) that increase the nominal amount of denominator due to increase in (bR) but the overall amount such as $\left(\frac{m(\pi-\beta)}{m+bR}\right)$ decreases in the economy by the mathematical rule. This concludes that the term is negatively related with the inflation rate ($\hat{\pi}_t$) in the presence of negative sign in the current period.

We know that change in bond is equal to the nominal government budget deficit. This identity postulates that government issues debt to borrow from the public and decrease the inflation rate. But the money holding by the public is offset by the increase in money holdings by the government (not the central bank) which may use to finance the deficit. This generates expansionary shock in the economy through the provision of government benefit. This exhibits that aggregate demand shock ($\hat{K}_t$) is positively related with the inflation $\hat{\pi}_t$ in the current period. This expansionary effect may dominate the contractionary effect of inflation of public side. This results in high debt and inflation.

Again, it can be shown that high level of deficit is consistent with the growth in money supply and its increment may increase the money demand in the economy. The positive money demand shock $\hat{V}_t$ in the economy may increase the seigniorage. But monetary authority also works when the net tax level is consistent according to the fiscal authority rule that offset this positive shock with negative inflation tax. Hence, inflation decreases. Increase in money supply is same as the positive aggregate demand shock $\hat{K}_t$ in the economy. Eq.1 satisfies that positive aggregate demand shock and inflation increases in the economy at current period but decreases in the next period due to negative inflation tax today.

It can be shown that increase in growth rate of real gross domestic product is same as the decrease in growth in government debt. This implies that endowment shock ($\hat{Y}_t$) decreases the inflation while $\hat{Y}_{t-1}$ is positively related with the inflation.

Again, negative aggregate demand shock and positive money demand shock which constitutes the endowment shock can decrease the inflation rate in current period but this positive shock is negatively related to the inflation($\hat{\pi}_t$) due to $\hat{Y}_{t-1}$.

We also employ the 'trade policy' variable in this study for empirical investigation. The conventional studies show that trade openness can increases the trade balance of the economy. This improvement causes to increase the income level of the economy. As a result economy enjoys the positive money demand shock that decrease the inflation in the economy. This facilitates that the positive aggregate demand shock and positive money demand shock together decrease the inflationary pressure. Hence, $\hat{Y}_t$ is negatively related with the inflation ($\hat{\pi}_t$) in the current period.

Following Sims (1994), then the econometric specification of the model is:

$$p_t = a + bm_t + cgov_t + drgdp_t + eTO_t + \varepsilon_t \qquad (2)$$

where *p* = natural logarithm of consumer price index (CPI), *m* = natural logarithm of M2 money supply used as a proxy for monetary policy; *gov* = natural logarithm of government expenditure used as a proxy for fiscal policy; *rgdp* = natural logarithm of real GDP used as a measurement for endowment shock and *TO* = trade openness used as a proxy for trade policy and ε is the random error term. *t* is used for time dimension where t = 1, 2, ...

3. Data description and Methodology

3.1 Data Description

In order to find out the empirical relationship between price level and macroeconomic policies such as fiscal, monetary and trade policies, we consider real GDP per capita as a proxy for income, money supply and deposit interest rate as proxies for monetary policy, government expenditure as a proxy for fiscal policy and trade openness as a proxy for trade policy.[5] The data are taken from World Development Indicator (WDI) of World Bank and World Economic Outlook (WEO) of IMF from 1981-2011. Price is defined as the average Consumer Price Index (CPI) taken from WEO. Money supply is defined as quantity of money and quasi-money, i.e, M2 money taken from WDI in local currency unit and interest rate is measured as deposit interest rate (*INT*) in percentage form, which is also taken from WDI. Government expenditure (GOV) is taken from WEO in local currency unit. Real GDP per capita (RGDPPC) or simply Real GDP (RGDP) is taken from WDI in constant local currency unit. Trade Openness is used for the proxy of trade policies. In order to test the robustness of our result, we use several indices of trade openness. Our basic index for trade openness is Trade Intensity (*TI*) which is defined as the ratio of export plus import over GDP that is used in most of the literatures in inspecting the effect of trade openness on other macroeconomic variables. Beside this, we would use the following trade openness indices:

(1) Exports divided by GDP (X/GDP) suggested by Yanikkaya (2003)
(2) Imports divided by GDP (M/GDP) suggested by Yanikkaya (2003)
(3) RWTI (Relative World Trade Intensity), expressed by $\frac{(X+M)_i}{\sum_{j=1}^{n}(X+M)_j}$. Given a set of countries, j = 1, 2,.., n which includes country i, country i's relative trade intensity, which represents country i's total trade relative to total world trade. The intuition of creating this index derives from Squalli & Wilson (2009). This paper tries to measure trade openness by a similar index, which makes an attempt to measure a country i's relative world trade intensity.

(4) CTI (Composite Trade Intensity), expressed as $\frac{1}{\bar{x}}(RWTI_i \times TI_i)$ where $\bar{x} = \frac{\sum_{j=1}^{n}[\frac{(X+M)_i}{\sum_{j=1}^{n}(X+M)_j}]}{n}$. The advantage of using this index is that it incorporates the income generating benefits of being more trade openness. It resembles with the reality that more income

generating countries are gaining more trade openness. This measure is also used by Squalli & Wilson (2009). In addition, we also employ deposit interest rate (*INT*, measured in percentage form) as a proxy for monetary policy.

By employing five different indicators of trade openness and the indicators of other policies, we are able to make a thorough investigation of the relationship between price level and macroeconomic policies to avoid measurement problem. We did not incorporate any index of trade barriers because of data unavailability or insufficient data for bound testing approach. All of variables except the index of trade openness are in natural logarithmic form, hereafter, we denote them as lower case: *p* = lnCPI, *m*= lnM2, *gov* = ln GOV and *rgdp* = lnRGDP.

3.2 Model Specification

In this study, test of cointegration is carried out by autoregressive distributive lag model (*ARDL*) bound testing approach due to Pesaran *et al*., (2001) where we estimate six unrestricted error correction considering five different indicators of trade openness and one for *INT* considering *TI* as regressor where the definition is described earlier. We also test the cointegration by considering each of the variables as dependent where we use only one index of trade openness to test the causality.[6] It follows the *ARDL* bound testing approach to cointegration developed by Pesaran & Pesaran (1997); Pesaran *et al*., (2000) and later on by Pesaran *et al.*, (2001). Haug (2002) has argued that *ARDL* approach to cointegration provides better results for small data span such as in our case as compared to traditional approaches to cointegration developed by Engle & Granger (1987); Johansen & Juselius (1990) and Phillips & Perron (1988). Another advantage of *ARDL* bound testing is that unrestricted model of error correction model (*ECM*) seems to take satisfactory lags that captures the data generating process in a general-to-specific framework of specification (Laurenceson & Chai, 2003). This method stay away from the classification of variables as I (1) or I (0) by developing bands of critical values which identifies the variables as being stationary or non-stationary process. As other cointegration techniques (e.g. Johansen's procedures) require that the variables under question must be I (1), this *ARDL* method is free from this barrier as it takes both I (1) and I (0) variables. So, previous unit root test is unnecessary.[7] Again, the traditional cointegration technique is not free from endogeneity problem where *ARDL* technique clearly identifies the exogenous and endogenous variables under question. This concludes that the estimators under *ARDL* approach are biased and efficient as they correct the problem arising from serial correlation and endogeneity. Again the *ARDL* procedure approves the uneven lag order while others do not. However, Pesaran & Shin (1999) argued that the appropriate modifications of the order of lags are sufficient to simultaneously correct the problems arising from serial correlation and endogeneity.

The *ARDL* approach to cointegration involves estimating the conditional error correction version of the *ARDL* model for the above mentioned variables:

$$\Delta p_t = \alpha_0 + \sum_{i=1}^{\rho} \beta_i \Delta p_{t-i} + \sum_{i=1}^{\rho} \delta_i \Delta m_{t-i} + \sum_{i=1}^{\rho} \sigma_i \Delta gov_{t-i} + \sum_{i=1}^{\rho} \gamma_i \Delta rgdp_{t-i} + \sum_{i=1}^{\rho} \varphi_i \Delta to_{t-i} + \eta_1 p_{t-1} + \eta_2 m_{t-1} + \eta_3 gov_{t-1} + \eta_4 rgdp_{t-1} + \eta_5 to_{t-1} + e_t \quad (3)$$

We then 'bound test' for the presence of long-run relationship between price and other variables. F statistic is used for testing the existence of long-run relationships. The null hypothesis for testing the nonexistence of the first long-run relationship (i.e. $H_0 : \eta_1 = \eta_2 = \eta_3 = \eta_4 = \eta_5 = 0$) is denoted by

$F_p(p|m, gov, rgdp,to)$. If the computed F values fall outside the inclusive band, a conclusive decision of long-run relationship could be drawn without knowing the order of integration of the variables (see Pesaran *et al*., 2001).

After establishing the long-run relationship, we would proceed to the estimation of following augmented *ARDL* (m, n, o, p, q) model:

$$p_t = \theta_0 + \sum_{i=1}^{m} \xi_i p_{t-i} + \sum_{i=1}^{n} \psi_i m_{t-i} + \sum_{i=1}^{0} \zeta_i gov_{t-i} + \sum_{i=1}^{p} \varsigma_i rgdp_{t-i} + \sum_{i=1}^{q} \tau_i to_{t-i} + u_t \qquad (4)$$

Finally, we would estimate the following error correction model:

$$\Delta p_t = \alpha_1 + \sum_{i=1}^{m} \chi_i \Delta p_{t-i} + \sum_{i=1}^{n} \kappa_i \Delta m_{t-i} + \sum_{i=1}^{o} \nu_i \Delta gov_{t-i} + \sum_{i=1}^{p} \pi_i \Delta rgdp_{t-i} + \sum_{i=1}^{q} \varpi_i \Delta to_{t-i} + \lambda ECM_{t-1} + \vartheta_t \qquad (5)$$

where, *ECM* is the error correction model term.

The presence of a single long-run equilibrium relation entails the existence of causality in at least one direction, and for this purpose, we apply the Granger causality test (Granger, 1969) augmented by the error correction term, whose enclosure is completely essential; otherwise, the estimates from the vector autoregression (VAR) system in first differences would not be unambiguous (Engle & Granger, 1987). The advantages of using error correction specification are: (i) it allows short-run causality through by lagged differenced regressors, (ii) long-run causality through the lagged *ECM* term. To do this, we would run the following specification:

$$\Delta y_t = \phi + \sum_{i=1}^{n} \Theta_i y_{t-i} + \lambda ECM_{t-1} + e_t \qquad (6)$$

where, y_t is a 5 x 1 vector of the variables included in the model *(p, m, gov, rgdp, to)*. φ is the 5x1 vector of constant term and Θ is the 5x5 matrices which include the interaction coefficients of the variables involved in (4). λ is the 5x1 vector of coefficients of each of the error correction term and e_t is the vector of disturbances term.

4. Empirical Analysis and Discussion of Results

4.1 Stationarity Test

Before confronting to the econometric analysis, we would address the correlation pattern of the variables. The following table, Table 1 shows the correlation pattern of the variables. In this case, we use the growth rate form of the variables except the trade intensity. Figure 1 shows the correlation matrix among the variables in scattered form. Both the figure and table indicate that growth rate of *p*, is negatively correlated with the growth rate of *m*, growth rate of *rgdp* and growth rate of *TI* and, positively related to growth rate of *gov*. Figure 1 shows the correlation matrix where the same feature of Table 1 is envisaged. The first column of the figure shows the scatter diagram of growth rate of *p* against each of the regressors, namely growth rate of *m, rgdp, gov* and *TI*. This figure clearly indicates that growth rate of *p* and growth rate of *gov* is scattered positively depicting the feature that excessive government expenditure fuels inflation.

Although the *ARDL* specification does not require the stationarity test of the variables under investigation, nevertheless, we performed to check whether the variables are I (2) or not, because, in case of I (2) series, the bound testing approach is useless. In that case, the F-statistics resulting from bound testing approach which is suggested by Pesaran *et al*., (2001) and Narayan (2005) is no longer valid.

Table 2 and Table 3 show the unit root tests of the variables. The first table shows the Augmented Dickey-Fuller unit root test and the second one shows the Phillips-Perron unit root test.[8]

Table 2 shows the Augmented Dickey-Fuller unit roots test suggested by Dickey & Fuller (1979, 1981), in which we presume that the series would follow with none and with trend both in their level and first-differenced form. In both cases, we clearly accept the null hypothesis that the variables have e unit root at their level. So, we need to test at their first-differenced form and this ensures that all of the variables are I (1) except that for *p* and *INT*, as at first difference and trend, it becomes I (2). For the sake of generality, we assume the '*none'* case where all of the variables are I (1) at their level but I (0) at their first-differenced form. Table 3 also shows the Phillips-Perron test suggested by Phillips & Perron (1988) which ensures that the variables are also I (1) at their level but I (0) at their first-differenced form. These results ensure the feasibility of our bound testing approach and we could proceed to the cointegration test of *ARDL* bound testing method.

4.2 Cointegration Test

The cointegration relationship among the variables *p, m, gov, rgdp* and *to* is examined using the newly developed *ARDL* bound testing approach. Two steps are used in this procedure in a step-wise fashion. In the first step, the order of lags of the first differenced variables in Eq.3 is obtained from the unrestricted model by using Akaike Information Criterion (AIC) or Schwartz Bayesian Criterion (SBC). Again Pesaran & Pesaran (1997) argued that *SBC* should be used against the other criteria of model specifications because it often has more parsimonious specification.[9] Beside this, researchers usually depend on literatures and convention to determine the maximum lag length. As Pesaran *et al*., (2001) caution, there must be a balance between choosing the maximum lag length to mitigate the serial correlation problem and the minimum lag length to make the conditional *ECM* not to be over parameterized. In the literature on *ARDL* estimations, many studies work with annual data chose the lag length of two or three (Amusa *et al*., 2009; Pahlavani, 2005; Fosu and Magnus, 2006; Qayyum *et al*., 2008; Ahmed *et al*., 2013). Again our Dickey Fuller-Generalized Least Square (DF-GLS) test provides that the maximum number of lag that minimizes SBC ranges from 1 to 3.[10] In addition, Pesaran & Shin (1999) and Narayan (2005) suggest that, if observation is annual, the number of maximum order of lag for *ARDL* bound testing procedure would be 2. As our data span ranges from 1981-2011 depicting that we have 31 annual observations, we use both the maximum lag 1 and 2.[11]

In the second step we apply the bound F-test to Eq.3 in order to establish whether there exists a long-run relationship between the variables under study. The results of performed bound test are reported in Table 4.

Table 4 shows that each of the models has the evidence of cointegration when we consider p as dependent variable and *m, p, rgdp* and *to* are taken as independent variables. As we stated earlier that we would use five different indicator of trade openness, so in the model F_{pti}, we use *TI* as a proxy for trade policy where the subsequent models consider *RWTI, CTI, X_GDP* and *M_GDP* as a measure of trade openness as well as proxies for trade policy. We then test the hypothesis of no cointegration using both of criteria of the selection of model. We find enough evidence of rejecting the null of no cointegration in both AIC and SBC models depending on the critical values provided by Narayan (2005, page 1988−1989). Though our results show that in both cases the F-test statistics of bound testing are similar (SBC models produced the same results), our results support that there is a long-run relationship between the price level and other macroeconomic policies under consideration during the study period. Though our concern is to see the effect of macroeconomic policies on price level, we also present the bound testing results considering each of the variables as dependent variable. It is to be noted that in this case we use only *TI* as a proxy for trade policy. We also show the model consisting *INT* as dependent in the following table, Table 5.

Table 5 shows the cointegration test of the variables under consideration where we estimate the model in view of Eq.1 considering each of the variables as dependent. Again, we also consider *INT* as dependent instead of m. Among the six models, our baseline model shows only the long-run relationship among the variables. Other models show either there are inconclusive decisions or there is no cointegration. Though four out of six models show that error correction term is negative and among them, only two coefficients are highly significant, nevertheless, we would show the causality test of these four models in later section. These various specifications of models ensure that the price level has a long run relationship with the monetary policy, fiscal policy and trade policy which are undertaken during the study period.

The cointegration among the variables is also examined by the test proposed by Johansen & Juselius (1990). As we see earlier both of the unit root tests confirm that the series are I (0) at their first differenced form, the pre-condition for accomplishing Johansen's cointegration test, it can be shown that the variables under the study also show the cointegration and concludes that there is a long-run relationship among them. Table 6 confirms this result based on the assumption that the series are following no constant and no trend in their cointegrating relationship. The likelihood ratio test shows that between *p* and other variables, there are two cointegrating equation at 5% level of significance. We test this assumption by considering each of the proxies of trade and monetary policies and our results are same.[12] This confirms the sensitivity check of our *ARDL* bound testing cointegration result which confirms that our *ARDL* cointegration test is valid and robust.

Based on the results of Table 4, we need to step into the *ARDL* model having price on the left-hand-side variable. At this stage, we need to determine the optimal lags for the *ARDL* model before confronting to the estimation of long-run model to determine the coefficients of regressors and the coefficient of error correction term. A vast volume of studies are devoted in *ARDL* cointegration approach where both *AIC* and *BIC* criterion are used to select the models. As our bound testing approach confirms the same F-stat in both criterions, our long-run models also show the same results. In the following table, we present the long-run coefficients of *ARDL* model based on AIC, where AIC selects *ARDL* (1, 1, 0, 0, 0). For the robustness of our results, we also present the fully modified ordinary least squares (*FMOLS*) and dynamic ordinary least squares (*DOLS*) results considering the same variables.[13]

Table 7 shows the estimation of long-run models. Column 2 − 6 show the estimation of *ARDL* long run model where five proxies for trade policy are implemented and Column 7 shows the result of being using *INT* as a proxy for monetary policy. All results of *ARDL* long-run model show the expected sign of the variables which are used in this study. The coefficients of *m* are positive though they are insignificant. Again, when we used *INT* instead of m, the result became same. As we are examining the impact of monetary policies on price level, so results become insignificant because of either we did not use enough control variables or at least the monetary policy had no significant impact on price level in the period under study. To clarify this, we looked upon the relationship between indicators of monetary policy and the price level or simply the rate of inflation. Islam (2010) examined the transmission mechanism of central bank's monetary policy using the observation of fiscal year (hereafter *FY)* 2001 to *FY* 2010 and found that money supply had no discernible impact on inflation. This result is very much opposed to monetary theories, but, he stressed that. Again, it has no significant impact on interest rate. Theory says that money supply would lower the interest rate. An examination of data from *FY* 2001 to *FY* 2009 shows that during these nine years movements in interest rate (lending rate) were in the predicted direction in only three years. In the other six years, higher growth of broad money relative to the preceding year was accompanied by higher interest or a lower growth of money supply was accompanied by lower interest. Parikh & Starmer (1988) found that there is no significant relationship between prices and money supply in Bangladesh. They also found that money supply exhibits itself as endogenous and their results cast doubts on the monetarist's view of inflation. These facilitate that in the long-run money has little impact in inflation. Recent experiences also support these results. Bangladesh Bank's 2012-13 monetary policy statement (MPS) announces that two objectives such as controlling inflation and high output growth will be the main concern. But theory predicts that a central bank cannot pursue more than one goal at a time. High output growth is always inflationary and high inflation retards the growth. Again the central bank independence is always a matter for achieving the targets. Very often fiscal authority creates stress on central bank authority. To make the growth rates sustainable, it needs to maintain low inflation rate which may possible if the growth rate of money supply is reduced. But this may retard the growth rate. So, at present Bangladesh is maintaining monetary policy for high rate of growth of output. It's a paradoxical situation for Bangladesh that at the same time it achieves high rate of growth (at least it achieves positive rate of growth of GDP) and high rate of inflation. Hossain (1987) examined the two-way relationship between fiscal deficit and inflation and he found that government expenditure rather government revenues were more responsible for raising price level during the study period. Our result of positive and statistically significant coefficient of *gov* is in line with Hossain's (1987) results, where the fact behind this result is that government expenditures adjust themselves to inflation more rapidly than government revenues and increase the size of fiscal deficit in inflationary period. Again Taslim (1982) showed that neither the monetarist not the structuralist theory could adequately support the inflationary process in Bangladesh. These results support the fiscal view of inflation indicating that fiscal policy is more important than monetary policy for stabilizing price level.

The coefficient of *rgdp* is highly significant with predictive sign indicates that higher output will reduce the domestic price level if other things are held constant. This result is in line with Bruno & Easterly (1996), Kydland & Prescott (1990), Den Haan (2000) etc. They argue that among the two concepts of the relationship between inflation and growth, they advocate that the negative relationship arise from the supply shock where it renders the prices countercyclical while the demand shocks move pro-cyclical moves in prices towards output. Results from Shamim & Mortaza (2005) are also in line with our results. In fact inflation retards growth, if it crosses a certain threshold level. The coefficients of trade policy, where we use five different indices of trade policy appear positive though they are insignificant. Evans (2007) shows that openness is inflationary if the monetary authority enjoys the degree of monopoly power in international markets as foreign consumers have some degree of inelasticity in their demand for foreign goods. The decision of monetary authority is then to balance the effect of increased growth of money. Again, many developing countries import inflation from outer by importing raw materials and intermediate inputs and this is very much true for Bangladesh. Again if the country is more open, then monetary and fiscal authority tends to lose their ability to control inflation. Our *ARDL* results show that, though *m* and *TO*'s are insignificant, all of the variables appear with their predictive sign and our long-run results suggest that fiscal authority and output growth is more important to control inflation. These results are also supported by other long-run models in Column (8)-(9), where we represent *FMOLS* and *DOLS* results. Moreover, *DOLS* result becomes more significant indicating that macroeconomic policies are crucial for controlling inflation.

Table 8 provides the error correction representation of the selected *ARDL* models. Panel A shows *ECM* estimations having *p* as dependent variable. Panel B of the table shows the diagnostic tests of each model based on Table 5 and 7. Panel A in Table 8 shows the *ARDL* models based on AIC where proxies for both the monetary policy and trade policy are used. Except for the Model2, each of the *ARDL* models is *ARDL* (1, 1, 0, 0, 0) which is selected on *AIC*. Model 2 is also selected on *AIC* with *ARDL* (1, 0, 0, 0, 0). All of the models give us an idea about the short-run coefficients of each of the regressors. Model 1, 3, 4, 5 and 6 shows that the coefficient of *m* is significantly affect the price level and the coefficient is negative. It renders us that if all other things are equal, in the short-run monetary policies are effective to reduce inflation as more money supply would try to reduce the growth of prices. This result is surprising as monetarist view rejects this hypothesis. In inspecting the relationship between the growth rate M2 money supply and growth rate of CPI, which is shown in Figure 2 indicate that both the series move in opposite direction in many points. When the growth of money falls, the growth of CPI rises. This problem arises from several reasons. In inspecting the causal relationship between money supply growth and inflation, there exists a stable money demand function and in this study we are not estimating such a type of money demand function (Friedman, 1956; Judd & Scadding, 1982) and the monetarist authority must have the control on money supply. Again, after 2003, the causal relationship between these two variables is not apparently satisfied because in those periods money stocks behave as endogenous. Moreover, the effectiveness of monetary policy is happened after some periods. So, current period monetary policy has insignificant effect or negative effect on current price level. In spite of these problems, central bank is still exercising short and medium-term control over money supply through policy measure such as credit and capital controls and trade restrictions. Other variables, such as *gov* and *rgdp* show the significant short-run effect on price level while the trade policy shows positive but insignificant impact.

However, the most important term in Table 8 is the sign and coefficient of the *ECM* term. The negative sign of the *ECM* term confirms the expected convergence process in the long-run dynamics of price and macroeconomic policies. All of the models suggest the coefficient ranges from 17% to 26%. It demonstrates that depending on the model, about 17% to 26% of the last year's disequilibrium is corrected in the current year, suggesting a good speed of adjustment in the relationship process following a shock. Once a shock has occurred it takes price level in the period from 4 to 5 years to adjust with the policies that are taken to restore its long-run relation. Banerjee *et al*., (1998) state that a highly significant error correction term is the further proof of the existence of a stable long-run relationship and all models show that the ECM_{t-1} is highly significant.

To establish the goodness of fit of the *ARDL* models, four diagnostic tests have been carried out: (A) the Lagrange multiplier test of residual serial correlation, (B) the Ramsey regression specification error test (RESET) test using the square of the fitted values, (C) the normality test based on a test of skewness and kurtosis of residuals and (D) the heteroskedasticity test based on the regression of squared residuals on squared fitted values (see Pesaran & Pesaran, 1997 for details of these tests)

The diagnostic tests which are conducted in terms of above hypothesis suggest that the estimation of the long-run coefficients and the *ECM* term are free from serial correlation, heteroskedasticity, non-normality and model misspecification. All of the models are free from serial correlations which are being tested by both the Lagrange multiplier (LM) and F-test. Again, our models are free from heteroskedasticity, functional misspecification and non-normality of the residuals. These findings suggest that the estimation of *ARDL* models is correct and free from biasness. The values of the adjusted R^2 in the vicinity of 50-55% signify a good fit of the models.

Another issue must be addressed for the stability of long-run coefficients that are used to form the error-correction term in conjunction with the short-run dynamics. Some of the problems of instability arose from inadequate modeling of the short-run dynamics depart itself from long-run relationship (Bahmani-Oskooee, 2001). So, it is useful to incorporate the short-run dynamics in testing for the constancy of long-run parameters. In view of this we applied cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) test provided by Brown *et al*., (1975) to residuals of each of the models.[14] The *CUSUM* shows if the cumulative sum goes outside the two critical lines, then the model is experiencing from instability. Similarly, *CUSUMSQ*, which is based on squared recursive residuals, goes outline the critical lines, the model is instable. The following figures, Figure 3 shows the *CUSUM* and *CUSUMSQ* of the model based on *AIC*.

Inspecting the figures, it is suggested that the model passes the parameter stability. Pesaran & Pesaran (1997) applied the same procedure to test the stability of the model. The result clearly indicates that the parameters are stable during the investigating period at 5% level of significance.

4.3 Granger Causality Test

The existence of long-run relationship among the variables indicates that there must be at least one direction of causality to hold the existence of long-run equilibrium relationship (Engle & Granger, 1987); however it does not indicate the temporal causality between the variables. So, in order to determine the short-run and long-run causality, we performed the augmented form of Granger causality test using error correction based Granger causality models which are weak (short-run) Granger causality and long-run Granger causality (see Doyle , 1998; Tang, 2008; Acaravci & Ozturk, 2010; Ghosh, 2010). Such a test is useful for several reasons: (1) a measure of statistical significance can be found by the statistical significance of the lagged differences of the variables, and (2) the presence of long-run relationship can be found by statistical significance of the lagged error correction term. It is essential to remember that only equation where the null hypothesis of no cointegration is rejected (Model 1) will be estimated with an error correction term. Another important aspect of this test is that it differs significantly from short-run error correction model since it uses the same lag-structure while the short-run vector error correction model may use different lag structure (Pesaran *et al*., 2001; Narayan & Smyth, 2006; Halicioglu, 2009).

Table 9 shows the short-run and long-run Granger causality test within *ECM* framework. From Table 5, we concluded that only the Model1, F_p shows the cointegration relationship among the variables. Other models do not show the cointegration, and, even if they show they are inconclusive. Despite these facts, we represent the causality test only for those models which shows at least co integral relationship. The reason for doing this is the sensitivity of the lag structure to the cointegration tests though our results are optimized through lag-length selection by *AIC* and *BIC*. Panel A of Table 9 represents the *ECM* equations derive from long-run results of Table 7. Panel B represents the causality test. We found a unidirectional causal relationship between *gov* and price and *gov* and m indicates that fiscal policy is important for determining the price level while the later postulates that fiscal policy has an effect on monetary policy implies that monetary policy is not independent. The reverse is not happened as we did not find any co-integral relationship between *gov* and other variables. Again, we did not find any co-integral relationship between *rgdp* and other variables. These limit us to find out the bidirectional causality (if any) among the variables. In case of *TI* as dependent, we find a unidirectional causality running from *rgdp* to *TI*. The above results confirm that in the short run *gov* is more responsible for the rise in price level.

Turning to the long-run causality results, we see that coefficient of the lagged-error correction term of *Fp* is negative and statistically significant exemplifies that there is a long-run relationship among the price and other variables which resembles our bound-testing results. The joint significance test of both the short-run and long-run confirms that the lag-structure is valid and we have both the short-run and long-run relationship where both of F-test statistics are significant at 5% level. The model F_m shows no short and long-run relationship where the coefficient of lagged-error correction term, F-test statistics of both short and long-run are insignificant. Again for F_{TI} model, we get there is both the short-run and long-run relationship between *TI* and other variables, which contradicts our bound-testing results. For F_{INT} model, we find no short-run causality but surprisingly we find long-run causality which is confirmed by long-run F-test statistics. So, we can say that whatever the proxies are used, there exists both the short-run and long-run relationship between price level and the macroeconomics policies.

The long-run causal relationship between price level and other macroeconomic variables which are in fact the proxies for macroeconomic policies and trade policies suggests that fiscal policy and output affect the price level both in the short-run and in the long-run. This supports the *FTPL* suggested by Leeper (1991), Sims (1994), and Woodford (1994, 1995, 1998, 2001). Like other developing countries, the central monetary authority is not very much independent (Dreher *et al*., 2008) which is a major condition for achieving price stability. Again, traditionally it follows the goals of achieving high rate of growth and employment. In that case, with the help of importing inflation and supply shock, the goal of price stability very often remains secondary issue. Eusepi & Preston (2011) claim in that case scale and composition of public debt implement a combination of "passive monetary policy" and "active fiscal policy". It is to be noted that government expenditure in Bangladesh is always inflationary because it comes first before tax revenues and historically Bangladesh is running budget deficit in almost all fiscal years. Very often government finances its expenditure through borrowing from local and foreign sources. McCullum & Nelson (2005) suggest that as long as the monetary authority cannot make itself as independent, FTPL provides the better understanding of rise in price level if it follows with money stock rule. Blinder & Solow (1972) show that indeed fiscal policy through expenditure and taxation is matter for inflation. Haque *et al*., (1991) concluded that that increase in government spending initially lowers the output. It will raise output and inflation in subsequent period. Vera (2009) developed a model and claimed that there is some misunderstanding about the affect of fiscal policy on macroeconomic variables and stressed that none of the conventional arguments against fiscal activism is wholly convincing. Rother (2004) confirms that activist fiscal policy has an important impact on CPI inflation volatility through examining the sample of Organization for Economic Co-operation and Development (OECD) countries. These render that although fiscal policy is assumed to be inflationary, nevertheless it should not be blamed at all.

Our result of negative relationship of GDP with inflation has long been traditionally examined in vast volume of literatures (Tobin, 1965; Stockman, 1981; Khan *et al*., 2001, 2006; Ghosh & Phillips, 1998; Fischer, 1993; Judson & Orphanides, 2002). Though trade policy has no significant effect on price level in this study, nevertheless we found positive association with the price level which are in line with Evans (2007); Zakaria (2010) etc. The positive relationship between inflation and openness is very much true for developing countries like Bangladesh. Kirkpatrick & Nixon (1977) argued that most of the developing countries are following import substitution industrialization policies through high tariff barriers. At the same time, they import raw materials, semi finished inputs and capital goods. As a result in spite of being export promotion policy which is now Bangladesh exercising, high dependency on these raw materials increase the likelihood of inflation.

4.4 Structural Vector Autoregression (SVAR) methodology

Very often the effectiveness of policy variables or shocks on output variable are identified by structural vector autoregression (Sims, 1980). More often the short-run shocks rather than long-run shocks are more interpretable and demanding (Keating, 1992).

The empirical model consider the variables *p, gov, m, to and rgdp*. The order in which the variables enter the orthgonalized innovations may influence the interpretations of the results.

A standard SVAR system can be written as

$$A_o Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + ... + A_p Y_{t-p} + \varepsilon_t \quad (7)$$

where Y_t is a $n \times 1$ vector of endogenous variables, Y_{t-i} for i =1 to p is the i-th lag of Y_t, A_0 to A_p are $n \times n$ matrixes of structural parameters, and ε_t is an $n \times 1$vector of structural shocks. The structural shocks are assumed to be uncorrelated among one another, i.e., $E(\varepsilon_t \varepsilon_t')$ is a positive definite diagonal matrix where E is an expectation operator and $E(\varepsilon_t \varepsilon_s') = 0$ for $s \neq t$. It is also common to normalize the variance-covariance matrix of the structural shocks such that $E(\varepsilon_t \varepsilon_t')$ = I (see

Christiano *et al*., 1999 p.11). Note that A_0 encodes the contemporaneous relationship of the variables in the form of zero restrictions.
Estimating A_0 to A_p and variances of the structural shocks is not straightforward, since this cannot be accomplished independently from a priori identifying restrictions. The reduced form of Eq. (7) is

$$Y_t = B_1 Y_{t-1} + B_2 Y_{t-2} + ... + B_p Y_{t-p} + u_t \quad (8)$$

where $B_i = A_0^{-1} A_i$ for i = 1 to p, $u_t = A_0^{-1} \varepsilon_t$ and $B(L)$ is a polynomial in the lag operator. B_1 to B_p can be estimated by ordinary least square regressions (equation by equation) and u_t are residuals of the regression. However, this might not be the estimates of structural parameters and structural shocks in order. In particular, when A_0 is not an identity matrix, $B_i \neq A_i$ for i = 1 to p and $E(\varepsilon_t \varepsilon_s') = \sum$ is not a diagonal matrix as each row of u_t is a linear combination of several structural shocks. In order to study the dynamic effects or variance decomposition of a single structural shock rather than some linear combination of them, we need to find a way to orthogonalize the matrix of the reduced form residuals. Let, W be a transformation matrix such that $E(Wu_t u_t' W')$ is a diagonal matrix. However, there are infinitely numbers of matrices that can orthogonalize the matrix of the reduced form residuals. If W is incorrectly specified, then the orthogonalized shocks do not have any economic interpretation.

For short-run identifying restrictions, researchers impose restrictions on the contemporaneous causal relationship matrix (A_0). We know that the relationship between the variance-covariance matrix of the reduced form residuals ($\sum$) and A_0 is according to the following expressions: $\sum = E(u_t u_t') = A_0^{-1} E(u_t u_t')(A_0^{-1})' = A_0^{-1}(A_0^{-1})'$. It can be seen that $A_0 = W$ (i.e. transformation matrix A_0) and $\sum$ can be estimated from sample data. It is to be noted that the restrictions on A_0 matrix must be imposed before it can be estimated. The necessary condition is to impose at least $n(n - 1)/2$ identifying restrictions where n is the number of variables in the system (Christiano *et al*., 1999)

A choice of the transformation matrix proposed by Sims (1980) is to let A_0 be a lower-triangular matrix. Each lower triangular matrix A_0 imposes exactly $n(n - 1)/2$ zero restrictions (thus the restrictions are just-identified) and associates with a (Wold) causal order on variables. A causal order ($(Y_1, Y_2, ..., Y_n)$ restricts the nature of how a shock to each variable in the system affects other variables contemporaneously. In particular, a shock to the variable Y_1 affect variables $Y_2,...,Y_n$ contemporaneously, while a shock to the variable Y_2 affect variables $Y_3,...,Y_n$ contemporaneously but not Y_1, and so on. Sims's (1980) approach is commonly known as recursive approach of *SVAR* where the restrictions are imposed by Choleski decomposition. Christiano *et al*., (1999) proposed the recursive identification scheme to identify the impulse response functions (IRFs) to a monetary policy shock. The recursive identification scheme is a type of short-run identification restrictions. It is to be noted that the complete knowledge of the causal order is not necessary. This is a major advantage of the recursive identification scheme.

Although recursive identification scheme has some advantages, it has some disadvantages too (Bernanke, 1986; Sims, 1986; Cooley and Le Roy (1985) criticized the theoretical recursive identification scheme used in most early *VARs*, noting that the estimated responses to shocks would vary based on the ordering of the variables, which was largely arbitrary. A particular drawback with these recursive *VAR* models was their inability to identify 'true' shocks, as they made no distinction between the endogenous and exogenous components of any macroeconomic policy.

Based on these two identifications, we will show the both identification approach: recursive approach and non-recursive or 'structural approach'.

(1) Recursive approach

The identification of A_0 matrix can be obtained by imposing the following identifying assumptions resulting in a recursive identified structural model of the form:

$$A_0 = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{bmatrix} \quad (9)$$

These identification restrictions are straightforward. Though the order of variables may influence the innovations, the recursive order is inherited from our previous results. Since macroeconomic policy shocks are identified through innovations, we keep the order of variables as like the *ARDL* specification to see the robustness of our earlier results.

(2) Non-recursive approach

To check the robustness of our recursive results, we also apply the non-recursive method of *SVAR*, which we inherit from Kim & Roubini (2000); Sims & Zha (1995); Amisano & Gianini (1997). This decomposition imposes more structure on *VAR*. The identification matrix A_0 can be represented by the following equation:

$$A_0 = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & a_{35} \\ a_{41} & 0 & 0 & 1 & a_{45} \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{bmatrix} \quad (10)$$

The above matrix demands some explanation. As each of the rows represents a structural equation, the equation can be represented as follows:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & a_{35} \\ a_{41} & 0 & 0 & 1 & a_{45} \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{bmatrix} \begin{bmatrix} u_t^p \\ u_t^m \\ u_t^{gov} \\ u_t^{to} \\ u_t^{rgdp} \end{bmatrix} = \begin{bmatrix} \varepsilon_t^p \\ \varepsilon_t^m \\ \varepsilon_t^{gov} \\ \varepsilon_t^{to} \\ \varepsilon_t^{rgdp} \end{bmatrix} \quad (11)$$

In identifying the structural VAR, we make use of Amisano & Gianini (1997) strategy (AB method). In this method, enough restrictions are imposed on both matrices A_0 and B. For the system to be justly identified, it requires $2n^2 - n(n+1)/2$ or 35 restrictions on both A_0 and B matrix. Since the non-recursive structure imposes 20 restrictions on A_0 and 15 restrictions on B matrix, then the system is just-identified with 10 coefficients in A_0 and 5 coefficients in B matrix. The restrictions placed on the contemporaneous relationships among the variables are shown in Equation (11). In the left side of baseline, *SVAR* model coefficient b_{ij} points out that variable j affects variable i immediately. The identified system is $A_0 u_t = B\varepsilon_t$.

The first row depicts that innovation in price comes by itself. The second row shows that money is affected by both price-level and vice-versa. The third row explains that government expenditure or policy is effected by price-level, monetary policy and real output. This explores both the Wagnar hypothesis and the *FTPL* theory. The fourth row depicts that trade policy act as an exogenous factor to determine the price level to real output and the fifth row is nothing but the aggregate demand or GDP function. Though, very often the non-recursive *SVAR* does not refer to the structural equation, this equation is identified through priori information and previous empirical investigation.

4.5 Empirical results of the SVAR model

So far we have analyzed the short-run relationship and long-run relationship using *ARDL* and other methods which tell us the trend relationship linking the variables concerned. To analyze the short-run dynamics among the variables, we will investigate the impulse response function and variance decomposition based on *SVAR* specification to capture and identify the shocks from the policy variables. It will also help us to assess the relative responsiveness of the policies. The objective is to find, which policy generate more shocks to the price level given the other policies. The variance decomposition analysis will provide the information about the proportion of the movements in sequence due to its 'own' shocks vs. shocks to 'other' variables.

In order to set the lag length, we use two different criteria: AIC and SC. In the literature many studies work with annual data chose the lag length of two or three (Amusa *et al*., 2009; Pahlavani, 2005; Fosu & Magnus, 2006; Qayyum *et al*., 2008). Our lag length selection criteria and AIC and BIC both show that the number of lag for the basic VAR is 2. In addition, our VAR system passes the diagnostic tests: serial correlation, normality and linearity tests and stability tests. In both cases (recursive and non-recursive), the structural VAR is just identified, i.e., the imposition of restrictions on A_0 and B matrix are valid.

4.5.1. Recursive SVAR Estimates

A. Variance Decomposition

Table 10 represents variance decompositions while the impulse responses of each variable to typical (one-standard-deviation) structural shocks are presented in Figure 3 in case of recursive *SVAR* estimation. In Table 10, the reported numbers indicate the percentage change of the forecast error in each variable that can be attributed to innovations in other variables at 10 different time periods: 1 to 10. As our *SVAR* estimations are short-run analysis, we would define 1 to 3 as short-run, 4 to 6 as medium and 6 years ahead as medium to long-run. The generalized variance decomposition results tell us how each of the variables used in empirical analysis can be explained by the disturbance in other variables. In the first year, 100% of the variability in price level changes is explained by its own innovations, in the second year, 98.88% of the variability is explained by its own innovation and, in the third year, it is 91.48%. Though the variations from monetary policy, fiscal policy and trade policy to price level are relatively small, the effect of fiscal policy is large enough than other policy to make variations in price level. In the second year, variation from fiscal policy is more than that of monetary and trade policy to price level (0.65% > 0.14% and 0.65% > 0.22%). In the third year, fiscal policy dominantly makes the variation in price level than that of monetary and trade policy (6.79% > 0.94% > 0.69%). Throughout the period, fiscal policy dominantly affect the price level apart from the innovations coming from the price level itself. Table 10 also expresses some interesting results. In case of monetary policy, variations in monetary policy is explained by the innovations in the fiscal policy are about 15.82% in third year, 26.32% in fourth year and 26.21% in fifth year respectively. Again, the monetary policy is moderately explained by real output (5.94% in third year and 15.29% in fourth year respectively). While, both fiscal policy and real output are explained by monetary policy is too little. This concludes that the monetary policy in Bangladesh is not independent and various factors like fiscal policy, real outputs affect the monetary policy with some context. This variance decomposition analysis of recursive SVAR estimate suggests that, fiscal policy rather than monetary policy dominantly affect the price level if we keep apart the innovations coming from the price itself. It is to be noted that the previous price level is also an important factor for rising in price level.

B. Impulse Response Function

Figure 3 displays the response of price level and other variables to a one-standard deviation structural innovation. The two standard-error confidence intervals are shown by short-dashed lines. The first row shows the response of price level to the five variables: price level, monetary policy, fiscal policy, trade policy and real output. This row shows that, price level itself produces a positive and upward innovation up to third year but it is declining henceforth. Besides this, monetary, fiscal and trade and real output produce the usual results: monetary policy shock is in line with the standard theories of monetary transmission mechanism that is somewhat based on nominal stickiness. Trade policy produces negative innovations to the price level and real output also produces the negative innovations. But the magnitude of innovations of fiscal policy is far advance than other policies. In the third period, price level produces a positive innovation by itself an amount of 0.021 standard deviation, while monetary policy produces 0.004, fiscal policy produces

0.010, trade policy produces -0.003 and real output produces -0.001 amount of standard deviation of innovation to price respectively. This suggest that expansionary monetary policy (for investment purposes) provides some shocks on price level in the short-run, but in the long-run(after fifth year) monetary policy seems ineffective. It proves the neutrality of money in the long-run. In the long-run all policies become ineffective to produce any shocks to the price level. This again concludes that fiscal policy is the dominant policy that ignites the price level in the short-run while monetary policy acts as passive.

4.5.2. Non-recursive SVAR Estimates

Impulse Response Function

Figure 4 represents the variance decompositions of non-recursive *SVAR* estimates due to Kim & Roubini (2000), Sims & Zha (1995) etc. Besides the recursive approach, we employ the non-recursive approach of SVAR to see the robustness of our results. In this case, we estimate the *SVAR* based on Eq.11. Eq.11 describes the structural innovations which are based on priori theories and empirical observations. Panel (a) − Panel (d) show the impulse of fiscal policy, monetary policy, trade policy and real output on price level respectively.

Panel (a) envisages the impulse of fiscal policy on price. The fiscal shock has emerged in period 1, 2 and 3. After period 3, the shock is diminishing which depicts that the shock is adjusting in the long-run. Panel (b) provides the impulse of monetary policy on price. The shocks emanating from monetary policy is continuing up to 4th period and beyond this period, the shock is diminishing and establishing the neutrality of money. However, shock from trade policy in panel (c), which we denote as exogenous shock to price produce some positive shock but not widely in the 2nd period. Again, the shock from real output to price level is as usual, i.e.; higher output reduce the price level. Almost all of the results are consistent with our recursive and other long-run results. These results depict the role of fiscal policy on price level. It also expresses that monetary policy cannot alone fight against the rise in price level. It is the fiscal policy which creates an upward pressure on price level conjunction with monetary policy.

5. Conclusion

This study has tried to assess the impact of macroeconomic policies on price and to see the effect of any particular policy on this. Among the macroeconomic indicators, price is one of the most discussant features in developing countries like Bangladesh. Price dynamics and its relationship with the policies are not so beyond from development of an economy. Price always gives a signal to the authorities about the deviation from sustainable level of the economy. Very often the central planner takes various steps for the stability of price level. Therefore, the study has examined the empirical relationship between prices and the macroeconomic policies namely fiscal, monetary and trade policies.

To this line, we examined the price-policies relationship along with other determinants simultaneously to assess not only the short and long-run relationship, but also their effectiveness.

We investigated the short-run and long-run relationship between price and policies through *ARDL* bound testing approach where we adopt a number of proxies for these policies. We applied nominal money supply and deposit interest rate as indicators of monetary policy, government expenditure as an indicator of fiscal policy and five different indices of trade openness as indicators of trade policy along with real GDP as a proxy for income.

In this study, we found significant short-run and long-run relationship between price and policies; more specifically, we found fiscal policy has the important impact on the dynamics of price level both in the short and in the long-run. We also found the income as a significant determinant of price dynamics. Monetary policy appeared itself as significant in the short-run , but, they are ineffective in the long run in the period under study. We adopted different indices of trade policy with insignificant results though they came with predictive sign. We also estimate other long-run models like *FMOLS* and *DOLS* in which *FMOLS* result resembled with *ARDL* results. Surprisingly, *DOLS* gave the most noteworthy results in which all of the variables appeared as significant. All of the long-run models suggest that effects of fiscal policy and the growth of output are significant while the former affect the price level positively and the later lower the price levels, holding fixed the other factors. Along with these, we estimate *ARDL* short-run models considering different proxies for policies for the robustness of our results. To find a better proxy for any variables is always a challenging task and sometimes data aggravates the challenge. However, it is not possible to incorporate all of the indicators of policies which are operated in an economy. Very often the central planners use only a few indicators or instruments to conduct their policies. Considering these facts, we estimated both short-run and long-run models with different specification, and, in each case, the error correction term appeared as significant and negative indicating that there is cointegration among the variables. We also estimate the base equation while we consider each variable as dependent for causality test.

Investigating the cointegration by assuming each variable as dependent, we tested five models and found only one model was successful which showed the sign of cointegration. Although we found the inconclusive cointegration, we performed the augmented Granger causality test using error-correction-based Granger causality models which were weak (short-run) Granger causality and long-run Granger causality for our base equation. We found a unidirectional causal relationship between fiscal policy and price and fiscal policy and monetary policy. It indicates that fiscal policy is important for determining the price level while the later postulates that fiscal policy has an effect on monetary policy implying that monetary policy is not independent.. Again, we did not find any co-integral relationship between the income and other variables. These limit us to find out the bidirectional causality (if any) among the variables. In case of trade policy indicator as dependent, we find a unidirectional causality running from income to trade policy. The above results confirm that in the short run governments is more responsible for rise in price level. Again, we found two significant long-run causal relationships namely trade policy equation & *ARDL* long run relation where the former contradicts the latter's result. Thus, we could conclude ourselves with our base equation showing that price and the existing macroeconomic policies in Bangladesh had a long-run relationship and fiscal policy appeared as more important policy among them to stable the price level. Along with this, growth of income or output also plays an important role in determining price level.

We also estimated the impact through *SVAR* analysis. We conducted both the recursive and non-recursive SVAR method. The recursive method suggested that the variation in price due to fiscal policy is more than that of monetary policy where trade policy acted as negative. The non-recursive method produced the same result which was more robust to earlier results.

Macroeconomic policies are important for determining and controlling price level as they use number of instruments or intermediate targets to do that. Theories and evidences suggest that stability of the price level depends on the credibility and independence of the monetary authority. In pursuing its goal, central bank tries to commit an anti-inflationary monetary policy rule such as Taylor rule with a low-inflation target. But this stability is far from actual as fiscal policy with inconsistent price stability cannot achieve that long-run stability. This comes mainly from the volatile behavior from both the fiscal and the monetary authority. Woodford (2000) claims that if they are inconsistent in achieving their targets, they may come in consistent if the long-run equilibrium would involve inflationary and deflationary spiral. He also adds that even if they are consistent, the government budget behavior may create additional expectation which may distract the central bank's commitment to follow the Taylor rule type policy. So, gaining the stability in price, Ricardian type fiscal policy is more important. In recent *MPS* of the second half of FY 2012-13, Bangladesh Bank claims that it would foster the growth and control the price level. It's a challenging job because of upcoming election and shocks from international side. In fact, as we have seen earlier, the monetary policy should give importance on inclusive growth and investment and the current *MPS* are forwarding itself on that. It would create no extra aggregate demand. At the same time, a growth oriented and combating inflation type budget is more important for the stability of price level. This is the fiscal policy which is more important for control the price level.

Although the focus of the monetary policy in Bangladesh is in line of international best practices, the Bangladesh Bank is yet to design and implement a monetary policy framework that would achieve price and exchange rate stability on a sustained basis. In fact, until recently the choice of monetary policy strategy did not get priority in Bangladesh. It seems that, monetary policy was conducted passively in conjunction with fiscal policy and their common objective was to achieve and maintain an adequate level of foreign exchange reserves rather than price stability by itself. Our results stress mostly on the application of the *FTPL* which makes the policies to have a unique equilibrium depicting the passiveness of monetary policy. It means that Bangladesh Bank is experiencing lack of credibility and flexibility which confront itself to maintain output and exchange rate stability rather price level stability. Recent study by Dreher *et al*., (2008) and the earlier study by Cukierman *et al*., (1992) examine that higher turnover ratio[15], a proxy for central bank dependence, is responsible for creating inflation and their data suggest that Bangladesh is experiencing the dependence of central bank. The question is, why did central bank did not try to make itself as independent? One possible answer is that Bangladesh experiences a short episode of high inflationary phases in 1970's and historically Bangladesh was not an inflation-prone country. Those periods were characterized by import-substitution-policy, state-owned-enterprise policy and the prescription of IMF and donor agencies. In such an environment central bank independence was not possible. The second possible answer may be come from budget deficit. Historically Bangladesh is experiencing a series of budget deficit, and, in many years it also experienced supply shock due to natural disasters and international shock. In such case, govt. needs to finance for import and for domestic needs. This spurs the price level and makes the central bank's independence of no use. In this situation, central bank concentrates on the stability of the growth rate and makes itself as guardian to check balance of payments position and international reserve.

In this study, we just only investigate the relationship between the price level and the macroeconomic policies using a number of proxies for them. We did not incorporate any kind of shock to this relationship. Again, price is affected by many other factors which could only be assessed by general equilibrium analysis. In many cases, effectiveness of policies is measured by loss function, which is kept for further research.

Endnotes

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1. See Monthly Economic Trends, Bangladesh Bank.

2. Sauer & Strum (2007) argued that rigid prices, relatively impatient households, a high preference of policy makers for output stabilization and a deviation from the steady state all worsen the performance of the timeless perspective rule and can make it inferior to discretion.

3. See Islam, Nurul (2005).

4. All of the data are compiled from Hossain , 2000, 2006; Mahmud , 2006; Bhattachariya, 2004; Various issues of Monthly Economic Trends, Bangladesh Bank and Bangladesh Bureau of Statistics (BBS).

5. One can use several proxies for these policies, such as tax rate for fiscal policy, exchange rate for monetary policy and effective rate of protection for trade policy. Again, in later we find that real GDP per capita cannot be used for our proposed *ARDL* bound testing approach as it portrays I(2) series.

6. This facilitates to do the short-run and long-run Granger causality test which is to be reported in later section.

7. Nevertheless we perform unit root test to check whether the variables are I(2). In case of I(2) variables, the *ARDL* bound testing approach becomes useless.

8. See Dickey & Fuller, 1979, 1981; Phillips & Perron, 1988

9. We would report both the criterion of selecting *ARDL* models.

10. See Elliott (1996)

11. It is to be noted that to keep the degrees of freedom maximum, we restrict ourselves to use only one control variables. Our statistical program suggested by Pesaran and Pesaran's (1997) Microfit allows us to use only 1 lag for our error correction model for this data span. We used other programs for cointegration test and found no significant F stat for rejecting the null of no cointegration. In addition, we use both the criteria of selecting model.

12. Results will be shown upon request.

13. *FMOLS* is fully modified OLS where we consider Bartlett weights and number of trancation lag is 1in non-tranded case. See more in Pedroni, P. (2001) and Phillips, P. C., & Hansen, B. E. (1990). For *DOLS* (Dynamic Ordinary Least Square) see Stock and Watson (1993)

14. We have calculated CUSUM and CUSUMQ of each of the *ARDL* models of Table 7. Due to space problem, we report the results only for *ARDL*1. The other results are significant which are to be presented upon request.

15. See Cukierman *et al*., 1992; Drehar et al., 2010. Al-Marhubi (2000) found a positive relationship between turnover of central bank governors with inflation indicating that higher turnover is characterized by dependence of central bank which means lack of credibility and flexibility. This feature retard central bank to maintain its credibility to keep the inflation low.

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Table 1: Correlation matrix

Variable	**Growth of p**	**Growth of m**	**Growth of rgdp**	**Growth of gov**	**TI**
Growth of p	1.0000				
Growth of m	-0.0304	1.0000			
Growth of rgdp	-0.2742	0.0548	1.0000		
Growth of gov	0.1935	0.1568	0.1570	1.0000	
TI	-0.2195	-0.0084	0.7755	0.2306	1.0000

Table 2: Unit Root Test (Augmented Dickey-Fuller Test)

Variable	Level				1st Difference			
	None	Decision	With Trend	Decision	None	Decision	With Trend	Decision
p	-3.267**	I(0)	-3.592**	I(0)	-3.012**	I(0)	-2.677	I(1)

m	-0.567	I(1)	-2.021	I(1)	-4.237***	I(0)	-4.186**	I(0)
gov	0.715	I(1)	-1.993	I(1)	-6.669***	I(0)	-6.665***	I(0)
rgdp	6.636	I(1)	-0.084	I(1)	-2.753*	I(0)	-6.087***	I(0)
TI	0.030	I(1)	-2.461	I(1)	-4.608***	I(0)	-4.675***	I(0)
RWTI	-0.083	I(1)	-1.994	I(1)	-7.532***	I(0)	-7.991***	I(0)
CTI	0.445	I(1)	-1.847	I(1)	-5.654***	I(0)	-5.999***	I(0)
X_GDP	0.802	I(1)	-1.994	I(1)	-4.401***	I(0)	-4.678***	I(0)
M_GDP	-0.989	I(1)	-2.870	I(1)	-5.117***	I(0)	-5.085***	I(0)
INT	-1.484	I(1)	-1.400	I(1)	-2.879*	I(0)	-2.859	I(1)

N.B: *, ** and *** denote 10%, 5% and 1% level of significance respectively. The values are given in the cells are calculated values of the regressions. The null hypothesis is the series has a unit root which is tested against Mackinnon Critical values.

Table 3: Unit Root Test (Phillips-Perron Test)

Variable	Level				1st Difference			
	None	Decision	With Trend	Decision	None	Decision	With Trend	Decision
p	-2.473	I(1)	-3.141	I(1)	-2.898*	I(0)	-2.447	I(1)
m	-0.542	I(1)	-2.167	I(1)	-4.191***	I(0)	-4.139**	I(0)
gov	1.086	I(1)	-2.049	I(1)	-6.794***	I(0)	-6.840***	I(0)
rgdp	8.294	I(1)	0.108	I(1)	-2.655*	I(0)	-6.222***	I(0)
TI	0.301	I(1)	-2.326	I(1)	-4.428***	I(0)	-4.495***	I(0)
RWTI	0.566	I(1)	-1.732	I(1)	-7.436***	I(0)	-8.319***	I(0)
CTI	1.249	I(1)	-1.482	I(1)	-5.607***	I(0)	-6.006***	I(0)
X_GDP	1.220	I(0)	-1.755	I(1)	-4.193***	I(0)	-4.429***	I(0)
M_GDP	-0.822	I(0)	-2.773	I(1)	-5.060***	I(0)	-5.034***	I(0)
INT	-1.642	I(1)	-1.785	I(1)	-2.791*	I(0)	-2.749	I(1)

N.B: *, ** and *** denote 10%, 5% and 1% level of significance respectively. The values are given in the cells are calculated values of the regressions. The null hypothesis is the series has a unit root which is tested against Mackinnon Critical values.

Table 4: Bound F-test for cointegration

Model	LHS variable	Forcing Variable		AIC Model (1,1,0,0,0)		AIC Model (1,0,0,0,0)	
F_{pti}	*p*	*m, gov, rgdp, TI*		15.0835***			
F_{prwti}	*p*	*m, gov, rgdp, RWTI*		15.6882***			
F_{pcti}	*p*	*m, gov, rgdp, CTI*		15.8957***			
F_{pxgdp}	*p*	*m, gov, rgdp,X_GDP*		15.1972***			
F_{pmgdp}	*p*	*m, gov, rgdp, M_GDP*		14.9628***			
Fpint	*p*	*INT, gov, rgdp, TI*				61.9856***	
Asymptotic Critical Values		1%		5%		10%	
		I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
Narayan (2005, page 1988, 1989)		4.768 (5.205)	6.670 (6.640)	3.354 (3.715)	4.774 (4.878)	2.752 (3.097)	3.994 (4.118)

Appendix Case III
(and IV)

N.B: The null hypothesis is η1 = η2= η3= η4= η5=0 in Eq. 3. They represent the coefficients of the lagged levels as per equation (1). Critical bounds for the F statistics are applicable for 31 observations with unrestricted intercept and no trend. See case III in Narayan (2005), p. 1988 for details. Inconclusive means if the value of F-statistics lie between the upper and lower critical value.. All of the models are assuming there is no trend and intercept. We also present in parenthesis of each of the critical values the values of Case IV of Narayan (2005, page 1989) which assumes that the model has unrestricted intercept and restricted trend. *** represents the 1% level of significance.

Table 5: Cointegration Test (Based on AIC)

Model	LHS Variable	Forcing Variable	F-stat	Error Correction Term	Cointegration
Fp	*p*	*m,gov,rgdp,TI*	15.0835***	-0.2506(0.000)***	Present
Fm	*m*	*p,gov,rgdp, TI*	2.0596	-0.0874(0.419)	Inconclusive
Fgov	*gov*	*p,m,rgdp,TI*	---	---	No Cointegration
Frgdp	*rgdp*	*p, m, gov, TI*	---	---	No Cointegration
F_{TI}	*TI*	*p, m, gov, rgdp*	1.3979	-0.3829(0.008)***	Inconclusive
F_{INT}	*INT*	*p,gov, rgdp, TI*	2.7825	-0.1635(0.138)	Inconclusive

N.B: *, ** and *** denote 10%, 5% and 1% level of significance respectively. Inconclusive are based on the critical values provided by Narayan (2005, p. 1988) in case III. No integration means either the error correction term is positive or the *ARDL* procedure cannot estimate the proposed equation. Pesaran and Pesaran (1997) also confirm this result.

Table 6: Johansen Test for Cointegration

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.692445	76.83957	59.46	66.52	None **
0.507885	42.64560	39.89	45.58	At most 1 *
0.393253	22.08334	24.31	29.75	At most 2
0.195402	7.593694	12.53	16.31	At most 3
0.043466	1.288723	3.84	6.51	At most 4

N.B: *(**) denotes rejection of the hypothesis at 5%(1%) significance level. L.R. test indicates 2 cointegrating equation(s) at 5% significance level

Table 7: Estimated Long-run Coefficients (Based on AIC) [dependent variable, p]

1	2	3	4	5	6	7	8	9
Variable	*ARDL*1 (1,1,0,0,0)	*ARDL*2 (1,1,0,0,0)	*ARDL*3 (1,1,0,0,0)	*ARDL*4 (1,1,0,0,0)	*ARDL*5 (1,1,0,0,0)	*ARDL*6 (1,0,0,0,0)	*FMOLS*	*DOLS*
m	0.152 (0.221)	0.184 (0.177)	0.177 (0.191)	0.125 (0.335)	0.168 (0.174)		0.113 (0.387)	0.920 (0.038)**
INT						0.030 (0.145)		
gov	0.534 (0.027)**	0.493 (0.073)*	0.441 (0.107)	0.543 (0.0250**	0.540 (0.023)**	0.867 (0.000)***	1.000 (0.000)***	0.762 (0.006)***
rgdp	-0.472 (0.000)***	-0.465 (0.001)***	-0.409 (0.007)***	-0.454 (0.001)***	-0.494 (0.000)***	-0.644 (0.000)***	-1.213 (0.003)***	-4.022 (0.022)**
TI	0.444 (0.340)					0.411 (0.546)	-0.004 (0.992)	3.083 (0.076)*
RWTI		154.08 (0.411)						
CTI			1.588 (0.216)					
X_GDP				1.057 (0.341)				
M_GDP					0.648 (0.376)			
No. of Obs	30	30	30	30	30	30	30	27
F-stat								19397.92 (0.000)***

N.B: *, ** and *** represents 10%, 5% and 1% level of significance respectively. Figures in parenthesis are p-values. Each of the *ARDL* models use Newey-West adjusted S.E.s Bartlett weights, truncation lag = 1 and are based on AIC. *FMOLS* also use Bartlett weight and truncation lag=1. *DOLS* uses Newey-West adjusted Standard Errors and maximum lag of 4.

Table 8: Error Correction Representation of the Selected Model

Panel A Variable	**Model1** *ARDL* (1,1,0,0,0)	**Model2** *ARDL* (1,0,0,0,0)	**Model3** *ARDL* (1,1,0,0,0)	**Model4** *ARDL* (1,1,0,0,0)	**Model5** *ARDL* (1,1,0,0,0)	**Model6** *ARDL* (1,1,0,0,0)
Δm	-0.109(0.076)*		-0.106(0.083)*	-0.111(0.063)*	-0.118(0.062)*	-0.101(0.096)*
ΔINT		0.005(0.065)*				
Δgov	0.133(0.050)*	0.149(0.011)**	0.118(0.130)	0.999(0.169)	0.133(0.051)*	0.138(0.042)**
Δrgdp	-0.118(0.010)**	-0.111(0.015)	-0.111(0.030)**	-0.092(0.062)*	-0.111(0.023)**	-0.126(0.004)***
ΔTI	0.111(0.306)	0.071(0.517)				
ΔRWTI			36.955(0.357)			
ΔCTI				0.358(0.135)		
ΔX_GDP					0.259(0.269)	
ΔM_GDP						0.166(0.353)
ECM_{t-1}	-0.250(0.000)***	-0.172(0.002)***	-0.239(0.000)***	-0.225(0.000)***	-0.245(0.000)***	-0.256(0.000)***
Panel B						
R^2	0.608	0.574	0.605	0.627	0.609	0.605
Adj R^2	0.526	0.506	0.522	0.550	0.527	0.523
AIC	73.21	72.95	73.08	73.97	73.24	73.09
SBC	69.01	69.45	68.88	69.77	69.04	68.89
F Version Diagnostic Test						
(A)Serial Correlation	F(1,23) =1.821(0.190)	F(1,24) =0.726(0.402)	F(1,23) =1.612(0.217)	F(1,23) =1.085(0.308)	F(1,23) =1.809(0.192)	F(1,23) =1.883(0.183)
(B)Functional Form	F(1,23) =1.015(0.324)	F(1,24) =0.076(0.785)	F(1,23) =1.029(0.321)	F(1,23) =0.271(0.607)	F(1,23) =0.855(0.365)	F(1,23) =1.276(0.270)
(C)Normality	NA	NA	NA	NA	NA	NA
(D)Heteroscedasticity	F(1,28) =0.274(0.605)	F(1,28) =0.568(0.457)	F(1,28) =0.252(0.619)	F(1,28) =0.043(0.836)	F(1,28) =0.166(0.687)	F(1,28) =0.402(0.531)
LM Version Diagnostic Test						
(A)Serial Correlation	$\chi^2(1)$ =2.201(0.138)	$\chi^2(1)$ =0.881(0.348)	$\chi^2(1)$ =1.965(0.161)	$\chi^2(1)$ =1.352(0.245)	$\chi^2(1)$ =2.187(0.139)	$\chi^2(1)$ =2.70(0.132)
(B)Functional Form	$\chi^2(1)$ =1.268(0.260)	$\chi^2(1)$ =0.095(0.758)	$\chi^2(1)$ =1.285(0.257)	$\chi^2(1)$ =0.349(0.554)	$\chi^2(1)$ =1.075(0.300)	$\chi^2(1)$ =1.577(0.209)
(C)Normality	$\chi^2(2)$ =0.729(0.694)	$\chi^2(2)$ =0.507(0.776)	$\chi^2(2)$ =0.849(0.654)	$\chi^2(2)$ =0.783(0.676)	$\chi^2(2)$ =0.910(0.634)	$\chi^2(2)$ =0.608(0.738)
(D)Heteroscedasticity	$\chi^2(1)$ =0.290(0.590)	$\chi^2(1)$ =0.597(0.440)	$\chi^2(1)$ =0.267(0.605)	$\chi^2(1)$ =0.046(0.828)	$\chi^2(1)$ =0.176(0.674)	$\chi^2(1)$ =0.425(0.514)

N.B: Δ denotes the first order difference operator. *, ** and *** represent 10%, 5% and 1% level of significance respectively. AIC Akaike Information Criterion, SBIC Schwarz Information Bayesian Criterion . Here higher values of the criteria are preferred to lower ones by design. The nulls are (A) No serial correlation, (B) No functional-from misspecification, (C) No non-normal errors and (D) No Heteroscedasticity for the respective tests. For details of diagnostics tests see Pesaran and Pesaran (1997), Ch. 18.

NA = Not applicable

Ahmed, Dey and Das, Journal of International and Global Economic Studies, December 2015, 8(2), 49-90

Table 9: Granger Causality Test Results:

Panel A	**ECM Equations**
Model	
Model1	*ECM = p - 0.15234*m -0.53421*gov + 0.47290*rgdp - 0.44434*TI*
Model2	*ECM = p -0.030123*INT -0.86729*gov + 0.64440*rgdp -.41195*TI*
Model3	*ECM = p - 0.18452*m -0.49309*gov + 0.46564*rgdp -154.0849*RWTI*
Model4	*ECM = p - 0.17785*m -0.44186*gov + 0.40969*rgdp - 1.5888*CTI*
Model4	*ECM = p- 0.12516*m -0.54306*gov +0.45456*rgdp -1.0570*X_GDP*
Model6	*ECM = p -0.16869*m - 0.54081*gov +0.49443*rgdp -0.64845*M_GDP*

Panel B

Dependent Variable	Short-run(or weak Granger Causality Test)						Long-run Granger Causality test	Short-run Joint Significance (F-test)	Long-run Joint Significance (F-test)
	Δp	Δm	ΔINT	Δgov	$\Delta rgdp$	ΔTI	ECM_{t-1}		
Δp	-	- 0.049(0.470)	-	0.146(0.052)*	0.024(0.963)	0.098(0.471)	-0.371(0.004)***	3.34(0.023)**	3.31(0.023)**
Δm	-0.558(0.392)	-	-	0.358(0,089)*	0.555(0.704)	-0.255(0.545)	-0.063(0.346)	0.69(0.7387)	0.65(0.778)
Δgov	-	-	-	-	-	-	-	-	-
$\Delta rgdp$	-	-	-	-	-	-	-	-	-
ΔTI	0.131(0.671)	0.028(0.827)	-	0.141(0.189)	1.167(0.084)*	-	-.870(0.011)**	5.22(0.003)***	4.91(0.004)***
ΔINT	7.740(0.309)		-	3.083(0.340)	-2.325(0.889)	5.162(0.485)	-.138(0.087)*	1.98(0.125)	4.36(0.004)***

N.B: Figures in parenthesis indicate p-values. *, ** and *** represent 10%, 5% and 1% level of significance respectively

Table 10: Variance decomposition analysis (recursive *SVAR*)

	Period	*p*	*m*	*gov*	*to*	*rgdp*
p	1	100.0000	0.000000	0.000000	0.000000	0.000000
	2	98.88781	0.144891	0.658003	0.228253	0.081046
	3	91.48664	0.944924	6.799791	0.690161	0.078485
	4	84.91274	2.045144	11.58914	1.258967	0.194005
	5	82.16396	3.253841	12.52525	1.876464	0.180485
	6	80.78091	4.309944	12.26028	2.174003	0.474861
	7	79.52702	4.974193	12.04062	2.134604	1.323572
	8	77.89970	5.208426	11.94347	2.248961	2.699447
	9	75.77625	5.149908	11.88704	2.614730	4.572075
	10	73.38363	4.972581	11.78788	3.016929	6.838981
m	1	1.827248	98.17275	0.000000	0.000000	0.000000
	2	6.711123	92.78635	0.200398	0.186307	0.115827
	3	10.54524	67.11047	15.82189	0.573453	5.948945
	4	8.561235	49.30948	26.32353	0.511749	15.29400
	5	7.449188	41.76286	26.21283	3.387228	21.18789
	6	7.782683	36.32565	23.66447	7.851274	24.37592
	7	8.352602	32.60434	21.67851	9.733734	27.63082
	8	8.581722	30.03120	20.20038	9.829691	31.35701
	9	8.578761	28.02614	18.90230	9.772532	34.72027
	10	8.474686	26.23187	17.72174	10.18246	37.38925
gov	1	19.75774	0.107810	80.13445	0.000000	0.000000
	2	20.52873	0.158698	78.29473	0.934195	0.083656
	3	19.96057	0.266703	74.21458	1.833405	3.724739
	4	20.11583	0.587163	71.21613	1.770138	6.310749
	5	20.28429	0.726066	67.91984	3.156180	7.913623
	6	20.02313	0.708310	64.52381	4.526930	10.21782
	7	19.38525	0.668835	61.44166	4.829446	13.67481
	8	18.70310	0.647349	58.43793	4.921615	17.29001
	9	18.09162	0.642158	55.47512	5.391984	20.39911
	10	17.46643	0.653618	52.46805	6.292084	23.11982
to	1	11.08728	2.708140	2.090062	84.11452	0.000000
	2	14.01447	3.856623	1.704004	80.15235	0.272552
	3	14.60781	5.097017	2.058293	75.52042	2.716460
	4	13.48007	5.168281	2.152000	75.27187	3.927772
	5	13.21815	5.087141	3.569381	74.16294	3.962395
	6	13.00613	5.006410	3.945294	74.14280	3.899370
	7	12.80615	4.929193	3.988006	74.29983	3.976827
	8	12.65068	4.892788	4.437433	73.48589	4.533208
	9	12.53624	4.880634	4.579185	72.82928	5.174661
	10	12.47964	4.880336	4.563312	72.50748	5.569227
rgdp	1	2.270184	0.127288	1.627539	11.23904	84.73595
	2	1.220069	0.392774	5.370845	14.60791	78.40840
	3	1.033025	0.699032	7.003910	16.75140	74.51263
	4	1.226625	1.096321	7.592140	17.67800	72.40692
	5	1.616322	1.463417	7.469581	17.93910	71.51158
	6	2.032787	1.750847	7.061728	18.03881	71.11582
	7	2.396379	1.951747	6.626412	18.13228	70.89318
	8	2.677524	2.084118	6.271271	18.20172	70.76537
	9	2.882732	2.169594	6.008879	18.22183	70.71697
	10	3.033279	2.225404	5.815851	18.21255	70.71291

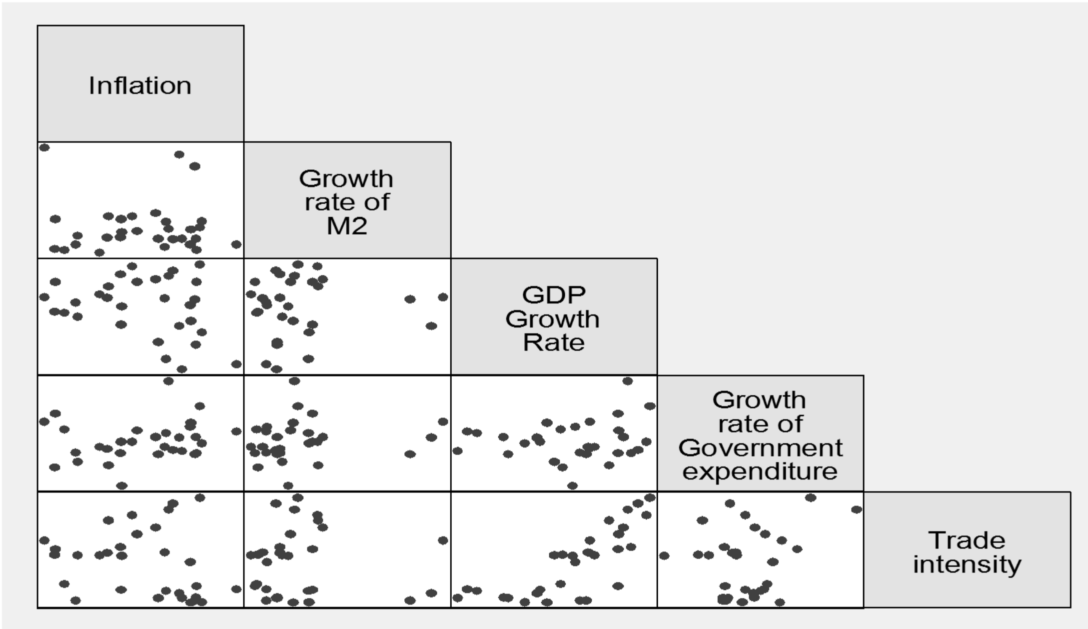


Figure 1: Correlation matrix (Scatter Diagram)

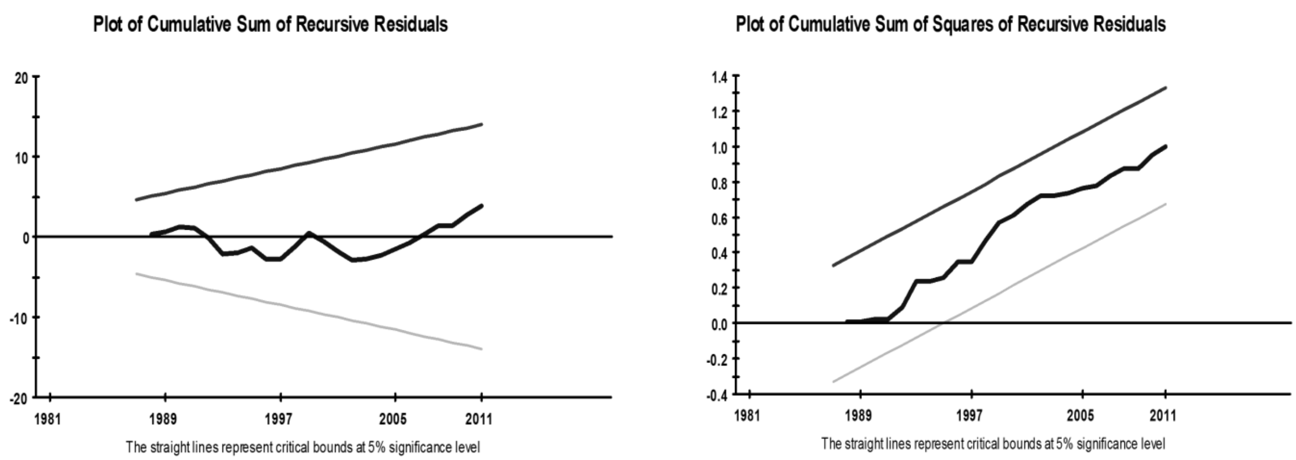


Figure 2: (a) CUSUM and (b) CUSUMSQ based on AIC and the model is *ARDL*1 (1, 1, 0,0,0)

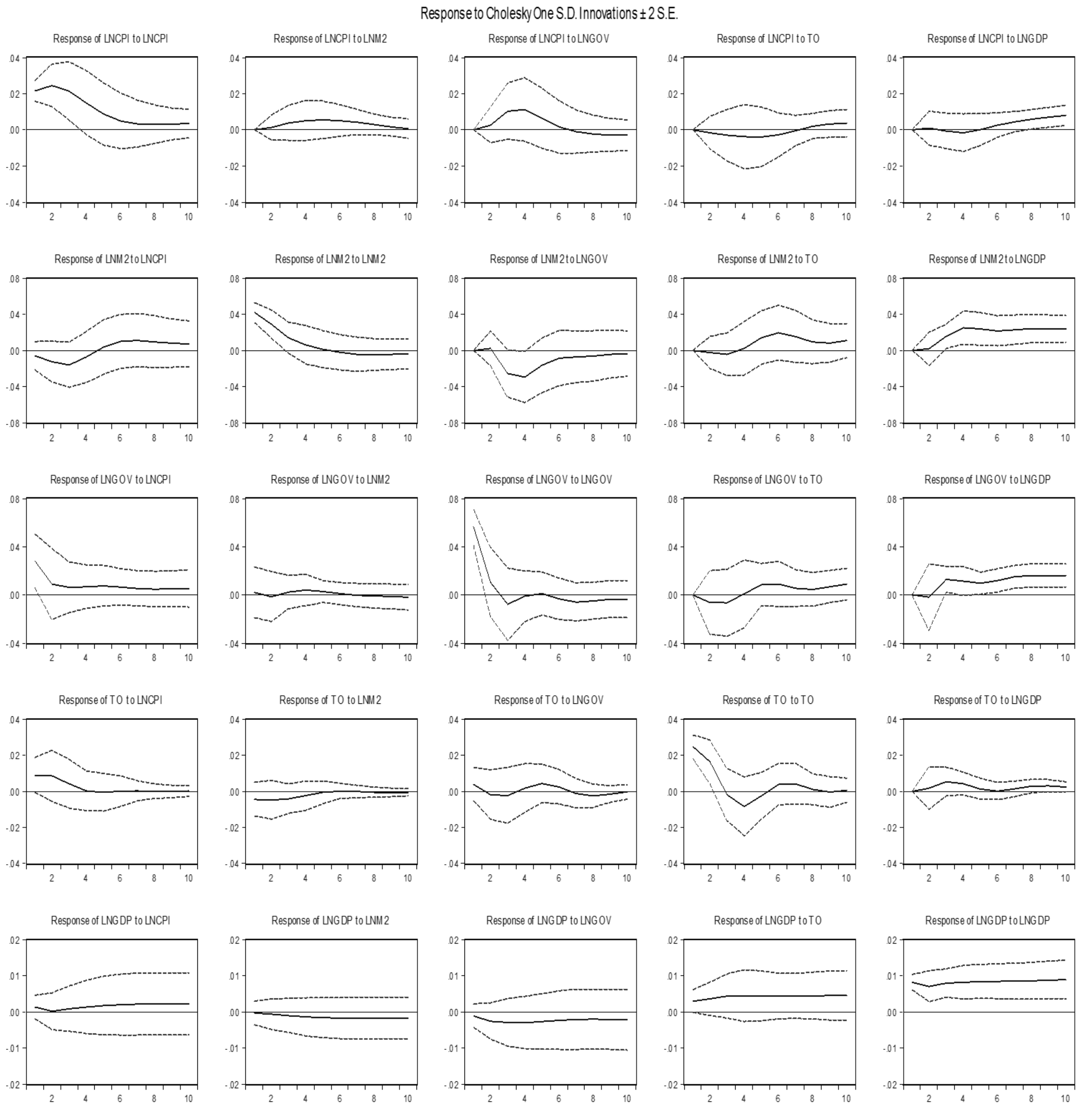
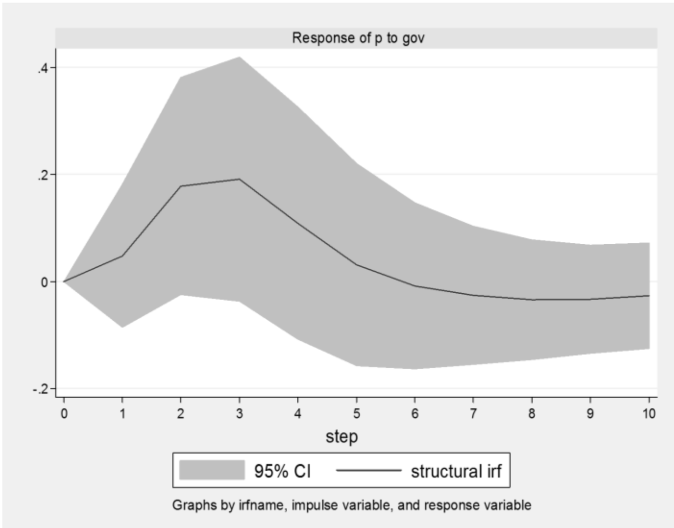
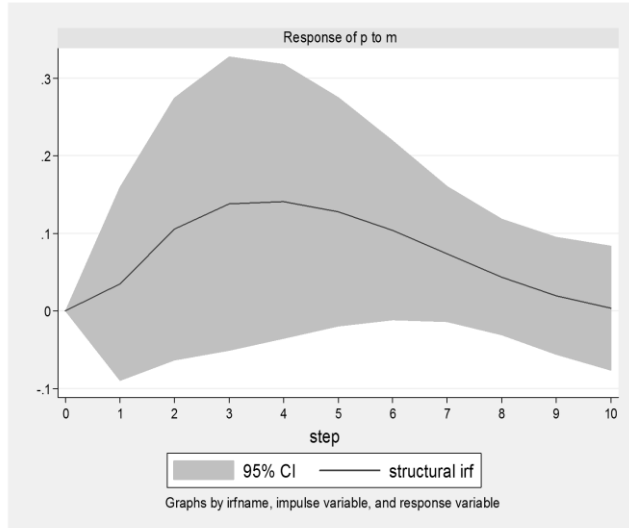


Figure 3: Impulse Response Function (Recursive *SVAR* estimates)



(a)



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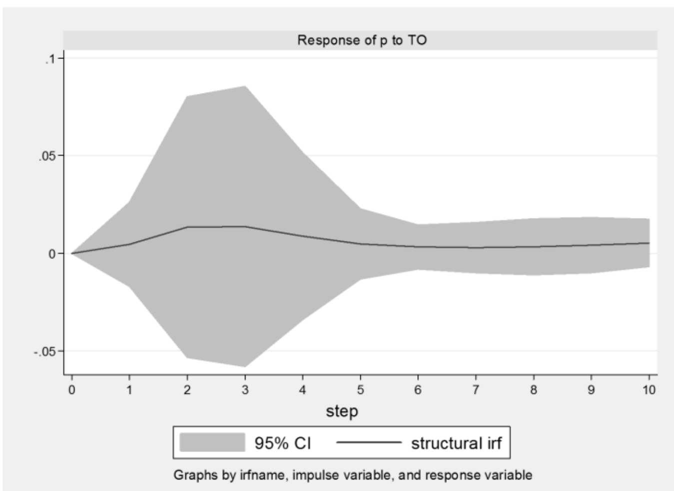

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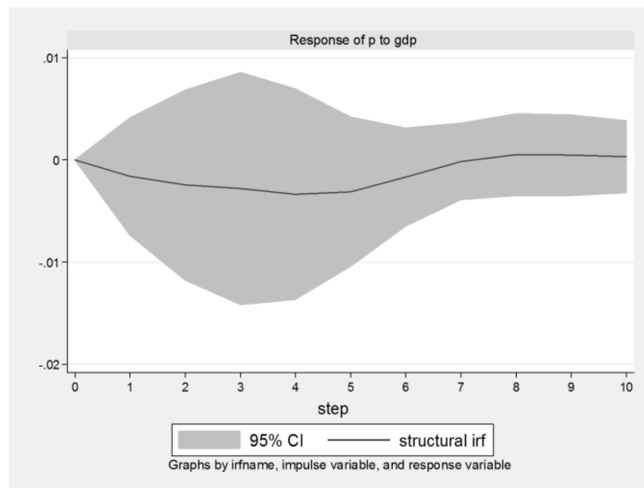

(d)

Figure 4: Impulse Response Function (Non-recursive *SVAR* estimates):
(a) response of *p* to *gov* (b) response of *p* to *m* (c) response of *p* to *TO* (d) response of *p* to *rgdp*