Effective Public Debt Consolidation in a "Highly" Indebted Country: Armenia *

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Abstract – The effectiveness of monetary stabilization policies is critically affected by government fiscal policy and public debt dynamics. However the role of fiscal policy is often ignored or considered irrelevant by the Central bankers while conducting monetary policy. This paper employs a Semi-Structural approach to evaluate fiscal consolidation strategies considering the inter-linkages with the macroeconomic environment. Experimental analyses using Armenian data show that ignoring the importance of fiscal consolidation and public debt in models may distort the general suggestions and conclusions of monetary policy models. Evaluating different fiscal rules show that counter-cyclical rules bring a faster and more certain consolidation than pro-cyclical rule or no response rule.
Keywords: Monetary policy, Fiscal consolidation, Low income countries, Indebted countries, Armenia
JEL: E47, E52, E62, O23

1. INTRODUCTION

The effectiveness of monetary stabilization policies are crucially affected by the government fiscal policy and public debt dynamics. Fiscal consolidation strategies are often discussed without considering the inter-linkages with the macroeconomic environment [Leeper [2010]]. Things can be more obscured when the actions taken by the fiscal authorities contradict to the monetary policy goals. However, previously the role of fiscal policy was mainly ignored or considered irrelevant by the Central bankers while conducting the monetary policy. The recent growing emphasis on the importance of fiscal consolidation nudged monetary authorities to reconsider their approaches to implementing monetary policy and ability to impact the real economy. Many central banks have already modified their standard monetary policy models, and attempted to incorporate inclusive government sector in their Dynamic Stochastic General Equilibrium (DSGE) or Semi-Structural (SSM) models.

*The authors are grateful to an annonymous revewier. All views expressed are those of the authors and do not necessarily represent those of the Central Bank of Armenia
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This paper develops a SSM macro model with a comprehensive fiscal sector, stress-testing fiscal consolidation strategies and rules, and assessing medium-term fiscal sustainability. It also addresses debt-management, an aspect that is often under-appreciated. The evaluation of simulated fiscal scenarios is designed to examine three risks: output loss, political difficulty and the risk of consolidation failure. The primary advantage of our framework is in providing consistent trajectories of macroeconomic and fiscal variables at relatively limited costs in terms of model complexity and input requirements.

The use of a small SSM model, instead of a DSGE framework, is motivated by several arguments. First of all, incorporating the fiscal sector in the macroeconomic models is a new line of the literature and still there is no agreed approach for DSGE type models. Second, due to specific country features and the behavior of the representative agents, the choice of the model equations through SSM approach is more efficient than explicitly deriving them from the first order conditions of the optimization problems. Finally, in the SSM framework, the primary emphasis is on the data and the estimation of model parameters.

Albania, Armenia and Ghana, as classified by the IMF, are among the countries considered "highly" indebted low income countries which have adopted inflation targeting regime as a nominal anchor of the monetary policy. Additionally, Moldova and Georgia are similar countries implementing informal inflation targeting monetary policy. All the above mentioned countries have almost the same level of development and public debt. The experimental application is implemented using data for Armenia which can be considered as a representative country of the group; we leave for the future extensions to empirical estimations and comparison of all the countries in the group.

The findings may provide a good illustration of what kind of conclusions and observations could be made. The absence of long-term debt-anchoring fiscal policy in Armenia would restrict the possibility of policy makers to react to the business cycle fluctuations. Armenia would benefit from reducing its relatively high debt levels, because otherwise it faces a high risk that its interest costs rise above nominal income growth in the future.

But reducing the relative debt levels in Armenia will be difficult to achieve in the near future, because it requires large and persistent primary surpluses.

The rest of the paper is structured as follows. Section 2 presents the literature related to the topic. Section 3 outlines the key behavioral equations of the Semi-Structural model. Section 4 introduces the chosen economy, and brings stylized facts to give the reader a brief overview of the country. Section 5 suggests a discussion of the model estimation and solution, discusses the model properties. Section 6 reports the results of several policy experiments. Finally, the last section draws the conclusions and suggests policy recommendations.

2. Related Literature

A growing body of literature has examined the efficiency of inflation targeting framework and its impact on the macroeconomic performance of the country. Considering the small number of low income countries which have adopted inflation targeting regime, not surprisingly the empirical evidence in the literature for this group of countries is scant, with the main focus directed to the advanced or at least emerging economies. One of a few papers from the field is by Gemayel et al. [2011], where the authors questioned the impacts of inflation targeting on the macroeconomic performance of low income countries. The authors employed two different empirical approaches, difference-in-difference and panel analyses, to evaluate the impact of inflation targeting regime on the macroeconomic performance of low income countries. Their empirical findings show that inflation targeting improves inflation performance and contributes to the lower inflation and its volatility. Meanwhile, they found limited evidence of trade-off between inflation and output, which they claim can be due to the characteristics of these countries and not inflation targeting, which they see as an appropriate policy regime for the low income country groups on their way of building credibility.

In this paper we argue that these “low income inflation targeting” countries are "highly" indebted relative to their potential growths, which harms the optimistic fiscal expectations, and, according to Leeper [2010], poses overwhelming problems for central banks. Leeper [2010], who labels fiscal policy as the "Alchemy" to highlight its unsystematic speculations, speaks about the importance of anchoring fiscal expectations during the monetary policy analyses, and states that the central bank’s ability to control inflation and influence real activity rests fundamentally on fiscal behavior and people’s expectations of fiscal behavior. When those expectations center on the appropriate fiscal behavior, the central bank can affect economic activity and inflation in the usual ways. But when fiscal expectations are anchored elsewhere, it’s quite possible that monetary policy can no longer do its job controlling inflation and stabilizing real activity. Following Leeper [2010], we claim that in low income inflation targeting economies fiscal expectations are anchored elsewhere, and thus the efficiency of monetary policy decisions can be distorted.

Coenen et al. [2012] employ seven different structural models and to simulate fiscal stimulus shocks using seven different fiscal instruments. The authors address the questions about the long-run sustainability of deteriorating fiscal positions, and about the potential long-run crowding-out effects of the debt accumulation resulting from the fiscal stimulus. After the comparison of the output of these models, there seems to be a considerable degree of agreement across the theoretical models on both the absolute and relative sizes of different types of fiscal multipliers. The authors also highlighted the role of consistent monetary policy for obtaining largest possible effects of stimulative fiscal actions. Another conclusion was that some of the multipliers, particularly for spending and targeted transfers, have significantly large effects. Finally, Coenen et al. [2012] concluded that, unlike the temporary fiscal stimulus, permanent fiscal stimulus has significantly lower initial multipliers, and its long-run consequences could even be negative.

Problems with fiscal consolidation strategies and its inter-linkages with monetary policy were also analyzed by Kamenik et al. [2013], who employed a SSM model setup for stress-testing fiscal consolidation strategies and rules, with fiscal scenarios related to the

output loss, political difficulty and the risk of consolidation failure. The authors also focus on assessing medium-term fiscal sustainability, and debt-management. The utilized SSM model setup makes macroeconomic and fiscal variables consistent with one another, tracks the maturity structure of government debt in different currencies and the yield curve, includes a fiscal rule, which determines the deficit and the terms structure and currency with which it is financed, a monetary policy rule, an uncovered interest parity condition, and a New-Keynesian Phillips curve. Kamenik et al. [2013] applied the model to the data of Austria, the Czech Republic and Germany to implement stress-testing fiscal scenarios in deterministic and stochastic modes, analyze fiscal behavior, express it in well defined categories of debt/deficit targets and behavioral rules, evaluate the implications for the real economy and test the robustness with respect to shocks. The authors highlighted all the possible risks in these countries and their fiscal situation, and through the experimental analyses proposed possible optimal developments for these economies.

Our paper borrows heavily from the theoretical setup of the modeling strategy of Kamenik et al. [2013]. However, we pay a certain attention to the specific features of the country for which we estimated the model. The next section of the paper opens a discussion for the details of our theoretical strategy through the key behavioral equations.

3. The Key Behavioral Equations

This paper extends the small open economy New Keynesian rational expectation Phillips Curve modeling setup suggested by Galı and Gertler [1999], sometimes referred as "GAP models". The model is constructed based on key behavioral equations, augmented by including comprehensive fiscal block and country specific features. For the rest of the paper, we will use the following general notations; any variable given under bar will define the trend or long-term value, variables with gap subscript denote deviations from its long-run equilibrium, variables given under tilde will show the steady state values of the given variable, asterisk is the sign for foreign variables. The frequency of the model is

quarterly, and Δ sign in front of the variable shows the QoQ changes of the given variable, $\Delta 4$ sign shows the YoY changes. Most of the variables, if not specified otherwise, are under logs.

3.1. **Aggregate Demand.**

In the extended aggregate demand or IS curve equation (1), the behavior of output gap (Y_{gap}), which is defined as the deviation of the log of real output from its potential level (the level which can be produced, under current conditions, without generating pressures for inflation to rise or fall), is explained by its lag, monetary condition index (MCI in levels), the output gap of the main trading partners (Y^*_{gap}), remittances gap (Rem_{gap}), and fiscal impulse (FI in levels).

$$Y_{gap,t} = \beta_1 Y_{gap,t-1} - \beta_2 MCI_t + \beta_3 Y^*_{gap,t} + \beta_4 (Rem_{gap,t} + \beta_5 Z_{gap,t}) + \beta_6 FI_t + \varepsilon^Y_t \quad (1)$$

In the equation (1) monetary condition index summarizes the impact of monetary policy on the real economy through real exchange rate and real interest rate channels. The Central bank contributes to the positive output gap either by decreasing real interest rates, or by depreciating real exchange rate, and the reverse policy is implemented for restraining the excess economic advancements. A tighter monetary policy has the opposite effects. Monetary policy also has real effects through the "expectations" channel. Thus, MCI shows the weighted average effects of the deviations of the real interest rate from its neutral level (RR_{GAP} in levels), plus the country risk premium ($Prem$ in levels) and deviation of the real exchange rate from its trend level (Z_{gap}). Real exchange rate is defined as nominal exchange rate (domestic currency per unit of foreign currency), adjusted for differences in price levels in domestic and major trading economies. The country risk premium is defined as an auto-regressive process around the steady-state value, which also takes into account the developments in the public debt gap.

$$MCI_t = \kappa_1 (RR_{GAP,t} + Prem_t) + (1 - \kappa_1)(-Z_{gap,t}) \quad (2)$$

In the IS curve equation the inclusion of remittances gap is explained by the significant and structural role of the remittances for the given economies. The impact of the remittances are partially adjusted by the fluctuations in the real exchange rate. The remittances gap, as well as the output gap of the main trading partners are taken as exogenous.

The role of the fiscal sector in the behavioral changes of aggregate demand in a short-run is highlighted through the fiscal impulse (FI in levels). Tighter fiscal policy (a lower FI) in a short-run reduces output gap either through a lower government consumption or a high taxation. A looser fiscal policy (a higher FI) has the opposite effects. Fiscal policy also has real effects through the "expectations" channel. In our model the fiscal sector is given a special emphasis, thus we will leave the further discussions of the fiscal policy in a separate section.

3.2. **Aggregate Supply.**

We follow the approach by Galı and Gertler [1999] and Christiano et al. [2005] in modeling aggregate supply, and employ a hybrid form of backward-looking and forward-looking small open economy Phillips curve equation. However we decompose for different components of inflation; core inflation, defined as headline CPI excluding food and energy components (XFE), food inflation (F) and energy inflation (E). The corresponding equations for the different components of inflation, along with the headline inflation equations are given in equations (3) through (7), where ΔCPI^{XFE}, ΔCPI^{F}, ΔCPI^{E}, and ΔCPI are CPI inflation for the respective groups, ΔRP^{XFE}, ΔRP^{F}, and ΔRP^{E} are relative prices, and finally RMC^{XFE}, RMC^{F}, and RMC^{E} are real marginal costs accordingly (in levels). Equation (3) represents the forward-looking open economy Phillips curve for core inflation defined as headline CPI excluding food and energy components, allowing for long term changes in relative price of core to headline inflation. It depends on past core inflation, headline inflation expectations, and real marginal costs. Extension for long-term changes in relative price of core to headline enables to have different steady-state

inflation for CPI components, while the headline inflation equals inflation target. Equation (4) captures food inflation. It closely resembles a forward-looking Phillips curve but focuses on the food prices part of the CPI basket only. The food inflation depends on lagged food inflation values, overall inflation expectations augmented for the eventual long-term changes in relative price of food to headline inflation, and on the current value of the real marginal costs of food good retailers. Equation (5) captures the evolution of domestic energy prices, assuming a pass-through of the world energy prices to domestic retail prices. Such pass through is elaborated in a simple way where the domestic energy inflation depends on its past value; on changes in the world energy prices, changes in the nominal exchange rate against the US dollar. Equations (6) and (7) capture the evolution of the headline inflation, as the weighted average of the three components. In the equations (3)-(7), the coefficients α_1, α_3 and α_5 capture persistence in the corresponding prices evolution, the coefficients α_2, α_4 and α_6 capture the contemporaneous pass through from the real marginal costs, the world food and energy prices to domestic prices. Together, the both group of coefficients determine the long-run pass through.

$$\Delta CPI_t^{XFE} = \alpha_1 \Delta CPI_{t-1}^{XFE} + (1-\alpha_1)(\Delta CPI_{t+1} + \overline{\Delta RP_{t+1}^{XFE}}) + \alpha_2 RMC_t^{XFE} + \varepsilon_t^{XFE} \tag{3}$$

$$\Delta CPI_t^{F} = \alpha_3 \Delta CPI_{t-1}^{F} + (1-\alpha_3)(\Delta CPI_{t+1} + \overline{\Delta RP_{t+1}^{F}}) + \alpha_4 RMC_t^{F} + \varepsilon_t^{F} \tag{4}$$

$$\Delta CPI_t^{E} = \alpha_5 \Delta CPI_{t-1}^{E} + (1-\alpha_5)(\Delta CPI_{t+1} + \overline{\Delta RP_{t+1}^{E}}) + \alpha_6 RMC_t^{E} + \varepsilon_t^{E} \tag{5}$$

$$CPI_t = \omega_{CPI^E} CPI_t^E + \omega_{CPI^F} CPI_t^F + (1-\omega_{CPI^E} - \omega_{CPI^F}) CPI_t^{XFE} + \nu_t^{CPI} \tag{6}$$

$$\nu_{CPI,t} = \nu_{CPI,t-1} + \varepsilon_t^{CPI}; \tag{7}$$

Equations 8-10 illustrate how the real marginal costs are determined for each type of inflation. According to the equation (8), RMC of core inflation is the weighted average of the domestic production, approximated by the output gap, and the imported goods, approximated by the real exchange rate gap. The coefficient α_7 captures the influence of

the gap in the real marginal costs on inflation (the slope of the Phillips curve) and measures the "sacrifice ratio", i.e., how much output will be lost in order to bring inflation down by one percentage point (a yardstick measure). For the case of *RMC* of food inflation we additionally controlled for the world food price index in US dollars (9). Thus the food real marginal cost is calculated as a combination of the output gap [1], the gap in the relative food prices and the World food prices adjusted with the real exchange rate. In other words, the domestic prices of food are driven by the de-trended relative world and domestic price of food goods adjusted for the overall movement in the real exchange rate. This relation between domestic food prices and world food prices as defined finds strong support in the data. The coefficient α_8 captures the impact of world food prices versus domestic business cycle (output gap) on food prices. Finally, the *RMC* of energy inflation is fully determined by the energy import prices, as the given economy is an energy importer country (10).

$$RMC_t^{XFE} = \alpha_7 Y_{gap,t} + (1-\alpha_7)(Z_{gap,t} - RP_{gap,t}^{XFE}) \tag{8}$$

$$RMC_t^{F} = \alpha_8 Y_{gap,t} + (1-\alpha_8)(Food_{gap,t}^{*} + Z_{gap,t} - RP_{gap,t}^{F}) \tag{9}$$

$$RMC_t^{E} = OIL_{gap,t}^{*} + Z_{gap,t} - RP_{gap,t}^{E} \tag{10}$$

3.3. **Uncovered Interest Rate Parity Condition (UIP).**

The interrelated behavior of domestic and foreign interest rates, and the nominal exchange rate in the model is captured by the uncovered interest rate parity condition with the mix of backward-looking and forward looking model-consistent expectations. The approach, that follows, generalizes a standard formulation [e.g., as in Berg et al. [2006]], by allowing for a non-zero growth rate of the exchange rate in the long-run. The coefficient

[1] In countries where data on agricultural GDP is available and domestic food prices are driven by domestic agriculture, then it in equation (9) could be proxied by the agricultural GDP GAP. In the rest of the system may be the non-agricultural GDP GAP as monetary policy could be expected to affect non agricultural GDP more strongly than agricultural GDP.

$(1-\eta_1)$ determines the degree of forward looking behavior in the financial markets. The second component of the equation is the backward-looking expectation of exchange rate, which projects the exchange rate in period t + 1 as an extrapolation of the past exchange rate adjusted for the growth rate of real exchange rate trend and the average inflation differential. While such expectations are not model consistent in the short-run, they are consistent in the long-run, in line with the finding that the PPP holds at longer horizons only. In other words, this part is the change in exchange rate, consistent with long-term economic fundamentals represented by the inflation targets and the real exchange rate trend. Additionally, trying to capture the significant and structural impact of the remittances on the exchange rate, we modified the UIP condition, and also controlled for the remittances gap.

(11)

$$S_t = (1-\eta_1)S_{t+1} + \eta_1[S_{t-1} + 2/4(\overline{\Delta 4CPI_t} - \overline{\Delta 4CPI_t^*} + \overline{\Delta Z_t})] + (-RS_t + RS_t^* + Prem_t)/4 - \eta_2 Rem_{GAP,t} + \varepsilon_t^S$$

In the equation (11) S is the nominal exchange rate (domestic currency per one unit of foreign currency), RS and RS^* are domestic and foreign nominal annualized interest rates correspondingly (in levels).

3.4. **Monetary Policy Reaction Function.**

The model is closed with the monetary policy reaction function (Taylor [1993]), which implies that the monetary authorities set quarterly policy rates in response to the deviations of one year ahead inflation forecast from its target, and the output gap. These gap variables determine the policy response to the deviations from the two targets of a dual mandate of a flexible inflation targeting central bank. The projected year-on-year inflation rate is based on the model forecast of inflation. This formulation has the property that the real policy interest rate rises in response to an increase in inflation, with a short lag because of the smoothing feature in the adjustment of the nominal rate. The nominal

interest rate is also a function of its own lagged value, which has the effect of smoothing the policy rate, to reflect the fact that, in practice, central banks do not typically change the policy rate in large increments [2]. Finally, in the Taylor rule equation, we also include the long run, neutral nominal interest rate (RS^n in levels) to capture the smoothing effects of the policy rate. Policy neutral rate, is the nominal interest that would prevail if inflation was equal to the target, and the output gap was equal to zero, and is measured by the sum of the equilibrium real interest rate and the projected year-on-year inflation.

$$RS_t = \gamma_1 RS_{t-1} + (1-\gamma_1)[RS_t^n + \gamma_2(\Delta 4CPI_{t+4} - \overline{\Delta 4CPI_t}) + \gamma_3 Y_{gap,t} + \varepsilon_t^{RS} \tag{12}$$

3.5. **Fiscal Block.**

As was mentioned in the aggregate demand block (1), behavioral changes of aggregate demand respond to fiscal impulses through the impacts of government consumption and taxation policy, as well as through the expectation channels. Behavior of the fiscal authority in the model was specified following the approach suggested by Kamenik et al. [2013], and consists of several decisions, in particular the level of structural deficit (SD in levels), the long-run structural deficit, or a sustainable deficit ($\overline{SD}$ in levels), the target level of debt ($\overline{B}$ as a percent in GDP), and fiscal rule written for the deficit (Def in levels).

The level of structural deficit depending on the previous values and business cycle gap (NY_{dev}), gradually converges to the long-run sustainable deficit. The business cycle gap equals to percent difference between actual nominal output and an average of previous and next years of nominal output. The sign of the multiplier of business cycle gap indicates whether fiscal authorities have pro or counter cyclical policy preferences.

$$SD_t = \chi_t(SD_{t-1} + \psi_1 NY_{dev,t}) + (1-\chi_t)\overline{SD_t} + \varepsilon_t^{SD} \tag{13}$$

[2] Woodford (2003) justifies interest rate smoothing by central banks as a way of keeping the policy signal clear. The markets would disregard as random noise the changes in highly variable rates.

$$NY_{dev,t} = NY_t - \frac{\sum_{k=0}^{4}(NY_{t-k} + NY_{t+k})}{2k+1} \tag{14}$$

The speed of convergence to the long-run sustainable deficit is controlled with coefficient of stiffness of structural deficit accommodation (χ). We have followed Kamenik et al. [2013] and assume non-linearity in the rule for the structural deficit. If the debt-to-GDP ratio increases above some levels, there is an increasing pressure from financial markets and international organizations to accommodate structural deficits faster to the sustainable levels consistent with growth expectations and the debt target. In order to model this non-linearity we make χ depend on the debt to GDP ratio. For debt less than B_{min}, χ is constant. If the debt to GDP ratio increases, then the coefficient approaches zero, and for the debt higher than B_{max}, it is zero. This means that the structural deficit will be equal to the structural deficit which is consistent with the economic fundamentals[3].

$$\chi_t = \frac{\widetilde{\chi}}{2} f(B_t, B^{max}, B^{min}) \tag{15}$$

The next behavioral equation is the long-run or sustainable deficit consistent with debt target and nominal income growth expectations (ΔNY^e). The nominal income growth expectations are defined as weighted average of the current and the next period nominal income growth.

$$\overline{SD_t} = \overline{B_t}(1 - \frac{1}{1 + \Delta NY_t{}^e}) \tag{16}$$

$$\Delta NY_t{}^e = \psi_2[(Y_t + CPI_t) - (Y_{t-1} + CPI_{t-1})] + (1 - \psi_2)\Delta NY_{t+1}{}^e \tag{17}$$

The dept target in the equation (16) is taken as a random-walk specification without drift. In general the level of debt is identified based on debt accumulation identity, where the debt level depends on actual deficit, previous level of dept and nominal income growth expectations (18). Given the targeted debt level, an upward revision in nominal income growth leads to a higher long-run sustainable structural deficit as fiscal policy

[3] $f(.)$ represents complementary error function for each element.

may afford running higher deficit, since the past debt is canceled by the higher growth. The equation is not an identity in a strict sense, as it has a residual term, which is necessary to explain the discrepancy between the observed debt and deficit data. Expected deviation from the debt target is defined as weighted average of the current and the next period debt gap.

$$B_t = Def_t + \frac{B_{t-1}}{1 + \Delta NY_t{}^e} + \varepsilon_t^B \tag{18}$$

$$B_{GAP,t} = \psi_3(B_t - \overline{B_t}) + (1 - \psi_3)B_{GAP,t+1} \tag{19}$$

Having defined the path of the structural deficit, the actual deficit will deviate from the structural deficit by the effect of automatic stabilizers and other temporary fiscal discretions. Thus, the short run fiscal rule can be presented as;

$$Def_t = SD_t - \psi_4 Y_{gap,t} - \psi_5 B_{gap,t} + \varepsilon_t^{Def} \tag{20}$$

From the other side, total budget deficit is itself a sum of three different components, primary budget deficit, debt service costs and budget deficit shock. Debt service costs include interest costs and exchange rate costs, connected with the public debt. Interest costs for the domestic debt were calculated based on the interest rates, which corresponds to the one year horizon of the yield curves. The transmission from the policy rate to this rate was modeled as the average of policy rates for one year horizon, plus the term premium, defined similarly to the country risk premium.

Finally, we define the fiscal impulse as the sum of all discretionary elements in the decisions about the debt target, structural and actual deficits. As was mentioned earlier we use the impulse in the model in describing the short-run effects of fiscal policy on the real economy.

$$FI_t = \varepsilon_{Def,t} + \Delta SD_t + \psi_6 \varepsilon_t^B \tag{21}$$

3.6. **Other Sections.**

The final block of the model includes auto-regressive equations for the exogenous variables and identities. In the model we assumed that the foreign variables and the long-run values, if not specified alternatively, follow first order auto-regressive processes and seek to achieve their potential steady state values. Finally, we used identities for defining the level of variables as the sum of the long run values and deviation from them, expectations, growth rates, and real values of the variables.

4. Stylized Facts About The Examined Economy

Following the objectives of the given research, the model was applied to the data of "highly" indebted low income countries, which have adopted inflation targeting regime as a nominal anchor of the monetary policy. As was mentioned earlier, Albania, Armenia, Ghana, Moldova and Georgia are among these countries. However under the scope of this research the experimental application was implemented only on the data of Armenia, which can be considered as a representative country from the group. Meanwhile, we realize the importance of applying the model for the rest of the countries in the group and leave the empirical estimations and comparison of the results for all the countries for the future extensions.

4.1. **Macroeconomic Environment in Armenia.**

Armenia began to implement independent monetary policy since early 1990s, and the Central bank of Armenia developed the first monetary policy program and adopted the strategy of monetary targeting as the method of monetary regulation since 1994. During the first period the primary goal of the Central bank was the domestic and external stability of the national currency. In 1996 it was adopted by law, that the primary goal of the Central bank is to keep prices at a low and stable level. The Central bank used indirect instruments to regulate the monetary aggregates for attaining the primary goal

of price stability. The further implementation of this strategy was problematic, as the underdeveloped financial markets and highly dollarized economy made the predictions and control of monetary aggregates challenging. Consequently, in 2006 the Central bank of Armenia passed to a new monetary policy regime and began to implement inflation targeting strategy. Since then the Central bank of Armenia adopted by law the official quantitative target of 4% within $\pm 1.5\%$ tolerance band for the inflation rate for a one year time horizon, and tried to achieve this target through an effective monetary policy. The new monetary policy strategy contributed to significant improvements in the independence and transparency of the Central bank. Meanwhile, there is no fiscal dominance, and direct financing of government is prohibited.

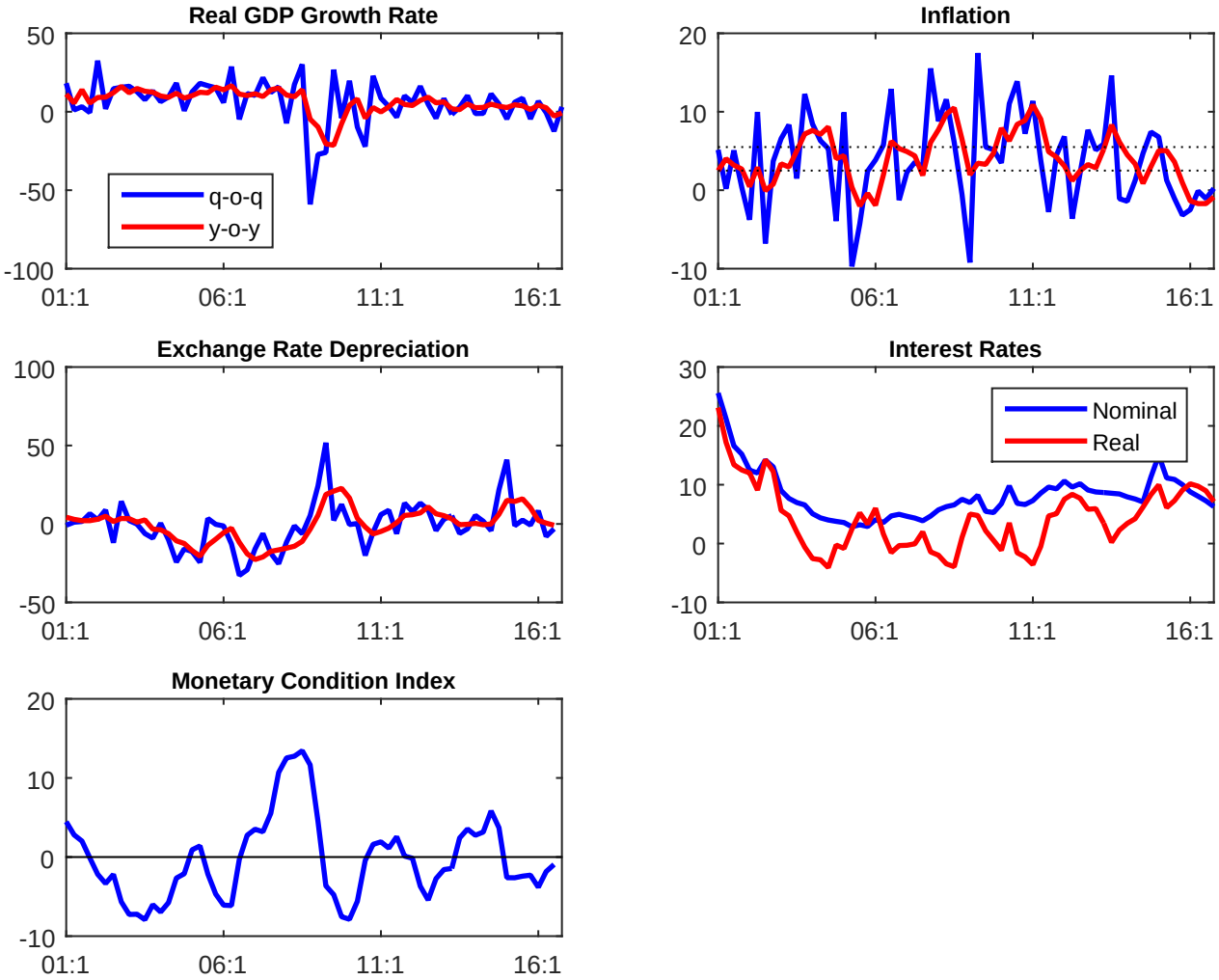
Overcoming the sharp macroeconomic contraction of the early 1990s, Armenian economy exhibited progressive economic growth, recording on average 11.7% y-o-y real GDP growth for the period 2001-2008 as shown in Figure 1[4]. However, the Armenian economy was significantly affected by the global financial crisis, observing one of the largest economic slowdown in the World, 14.1% decrease in real GDP. After the crisis, the economic recovery was very slow, and the average real GDP growth since then was only about 3.5%.

The developments of y-o-y CPI inflation rate indicate that, for the examined period 12 month CPI inflation was relatively low. Before adopting the inflation targeting strategy, the average 12 month inflation rate was about 3.1%. Since 2006, the average inflation rate was about 4.5%. However, if we will examine the number of cases when the inflation rate was within the targeted band, we can see that frequently it was outside the tolerance band, and since adopting the new policy regime only for about 28% of the cases the Central bank was able to keep the inflation rates within the band.

The developments of monetary condition index illustrate that before adopting the inflation targeting regime, the Central bank was mainly implementing expansionary monetary policy, contributing to the positive output gap. During the period 2006-2009 the MCI

[4]Some of the numbers in the figure are seasonally adjusted, thus may differ from the ones we speak here.

FIGURE 1. Macroeconomic Developments (in %)



index was a big positive number indicating about the contractionary policy restraining the excess economic advancements. After the crisis the implemented monetary policy was mainly contributing to the positive output gap.

4.2. **Debt Accumulation History.**

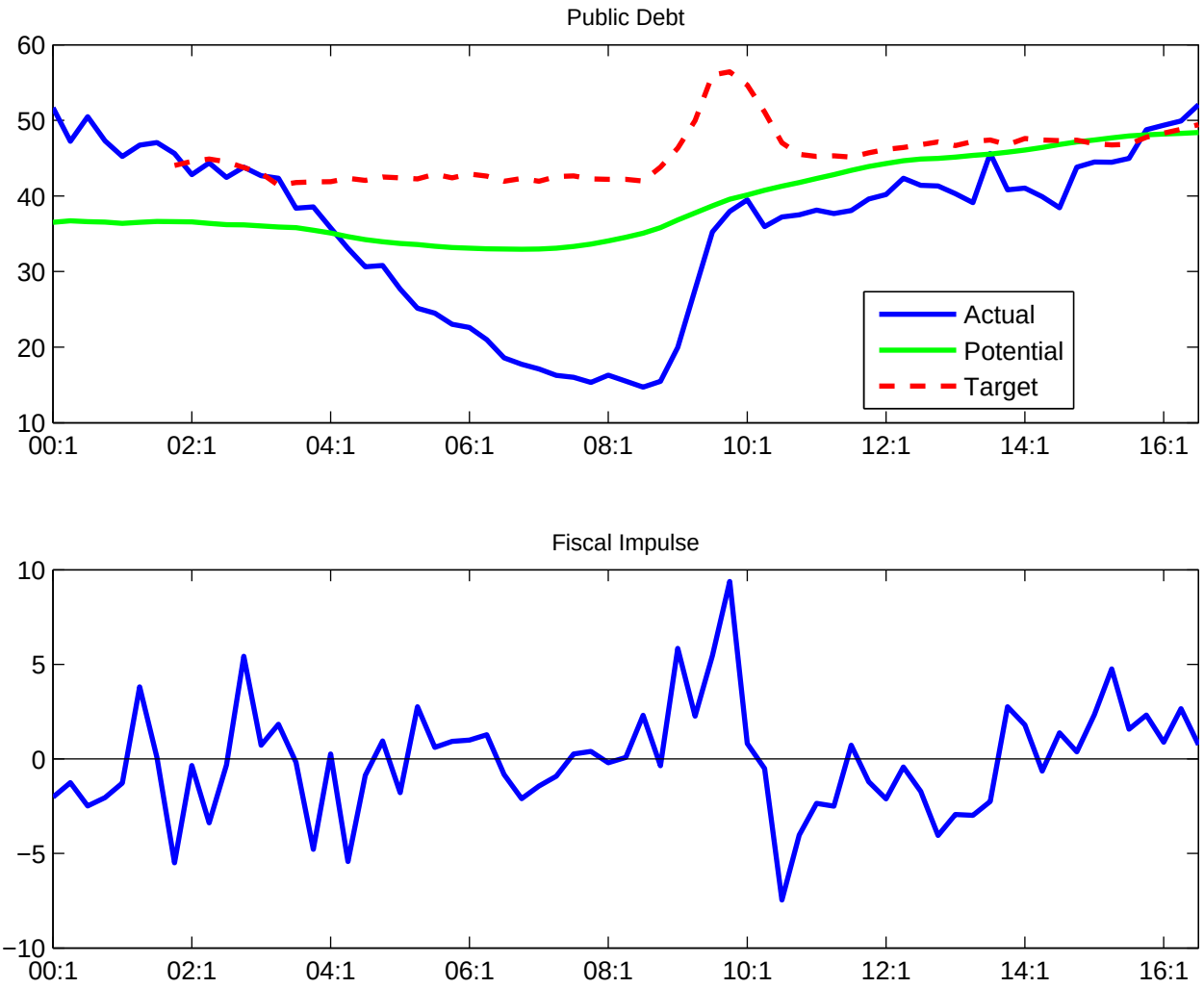
After the collapse of the Soviet Union, Armenia, along with many other post-Soviet countries, for a very short period of time accumulated considerable amount of public debt. Like the other similar countries, Armenia started to borrow externally to achieve financial and economic stabilization, close the budget deficit, correct the negative balance of payment, ensure the accomplishment of the adopted economic key policies and

finance the programs contributing to the economic development. As a result, till the end of 1999 Armenia's public debt in relation to GDP approached to about 52% level. During this period the loans were mainly received from multilateral creditors, including World Bank, IMF, and EBRD, national governments, mainly from Russian Federation, EU, and the USA, and commercial banks. During the period 2000-2008, when Armenia was observing double digit economic growth, the public debt decreased significantly, as a result of which debt to GDP ratio approached to 16.4%. During the crisis years debt to GDP ratio increased more than two times, and approached to 40.4% level. The sharp increase was mitigated, but the debt to GDP ratio continued to increase also during the post-crisis years, and at the end of the examined period it exceeded the 56.7% level.

The essential element of debt management strategy for Armenian government is the "Law on Public Debt Management" adopted at May 2008. The law aims to control the relations concerning public debt and to make those relations subject to law regulation. It is natural that even before the adoption of this law there were certain criteria and restrictions related to the regulations of the public debt, however with the introduction of this law all the criteria are going to be defined by law. In this regard articles 5.6 and 5.7 of the law are of great importance. Namely the articles state that as of the December 31 of the current fiscal year public debt should not exceed 60% of the GDP of the previous year. Once the public debt exceeds 50% ceiling, certain restrictions start to work, particularly the budget deficit of the coming year should not exceed 3% of the average GDP of the previous 3 years.

Can this ceiling be a safeguard against accumulation of extra debt that later might be a burden for the country in term of its service? If we look at the debt history of a developed state like the US, then most probably we will give a negative answer, as after the introduction of the debt ceiling in 1917, it has been raised more than 70 times. Meanwhile, if we look at the alternatives to increasing the level of the ceiling, like the decrease in public spending, increase in taxes or acceptance that the county is not able to repay its debt and is facing default situation, we should agree that ceiling is the one which although does

FIGURE 2. Public Debt (percent of GDP) and Fiscal Response (level)



not resolve the debt problem, but still does not cause any serious economic and political issues, and the government gets more time to find better solutions.

Figure 2, top graph, displays the developments of actual debt to GDP ratio, so called debt "target"[5] or ceiling, and the potential level of debt to GDP ratio, estimated by the model. The figure clearly illustrates that before the crisis the gap between the actual and potential, as well as actual and targeted debt to GDP ratio was rapidly decreasing, however after the crisis the both gaps narrowed, and at the end of the examined period the actual level exceeded both the potential and the targeted levels. The bottom graph of the figure 2 shows the developments of fiscal impulse for the examined period. From the

[5]We have employed this terminology, but in reality it is not the targeted level, but the threshold level.

graph, we can notice that although during the recent years the public debt is approaching and exceeding both the potential and targeted level, the fiscal impulse is still positive. Considering the recent government debt crisis in several European countries, this way of developments is distressing, and the question whether the debt of Armenia is manageable is becoming a burning topic of discussion. It is the time for the officials to stop walking on the same path with European countries and comparing the level of external debt or the ratio of GDP and external debt to those of European countries. This by no mean can be a justification. The European countries might have higher debts, but still be creditworthy, as a result of their strong economy. Still the same cannot be said about Armenian economy. Thus, there is a serious need to re-consider the debt management strategy and find a secure way of fiscal consolidation to overcome the risks and avoid default situations.

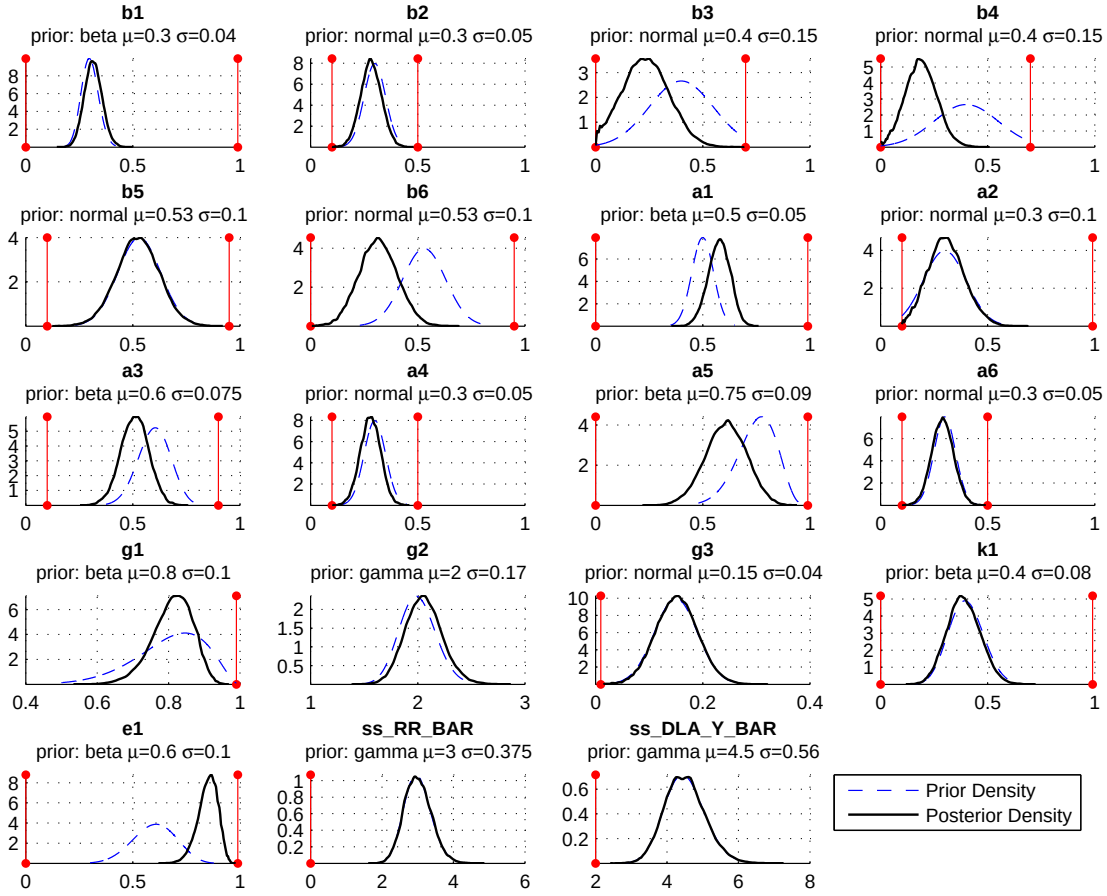
5. Bayesian Estimation And Model Properties

5.1. **Bayesian Estimation Of The Model.**

We estimate the model parameters with Bayesian estimation techniques, using information on 17 different observable variables listed in Table 1 for the years 2000 to 2006. We started the Bayesian estimation procedure with the construction of likelihood of the model by employing Kalman filtering. Then combining the prior knowledge on the parameters with the information contained in the data, we estimated the mode of the posterior distributions, by maximizing the log posterior function. Finally, Metropolis-Hastings algorithm was utilized to get the full information of the posterior distributions and evaluate the marginal likelihood of the model.

We employ the following general tips for choosing the appropriate distributions and initial priors. Those parameters, for which a lot of weight were given to the range near the mean value, were assumed to follow a normal distribution. The parameters, which are supposed to be restricted in some given interval, were assumed to follow a beta distribution. Particularly, we took all the auto regressive and persistence parameters with beta

FIGURE 3. Prior and Posterior Distribution of Structural Parameters



distributions. And finally, parameters, for which we need to rule out non-negative draws or restrict a lower bound, were supposed to have either gamma or inverse-gamma distributions. A visualization of the prior and posterior distributions are given in the Figure 3, and table 2 contains the main summary statistics of the prior and posterior distributions. From the results we can state that for part of the parameters, $\beta_1, \beta_2, \beta_5, \alpha_4, \alpha_6, \gamma_3, \kappa_1, \overline{RR}^{ss}$ and $\overline{Y}^{ss}$, the posterior mode was very close to the mean of the prior assumptions, meanwhile, for the rest of the parameters, the data appeared to be very informative, and the gap between posterior distribution and prior assumptions were significantly bigger. Particularly, it is worth mentioning the significant dissimilarities between the prior and posterior distribution of forward/backward-looking element in UIP (η_1), for which we got much higher posterior mode, about 0.86, than we were expected, indicating about highly persistence of the exchange rate.

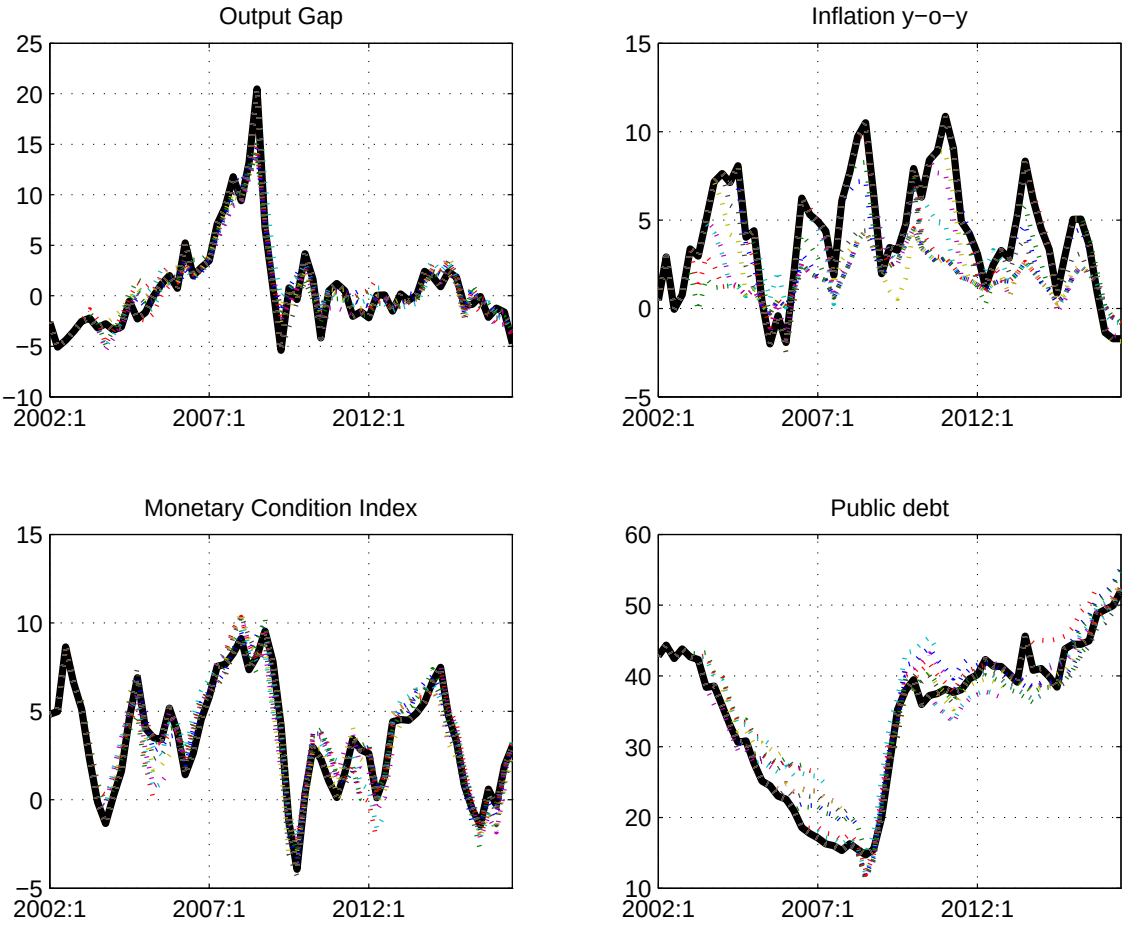
TABLE 1. Observable variables

Description	Observable variable
Real GDP (100*log)	$log(Y)$
CPI (level, 100*log)	$log(CPI)$
Core CPI excl. Food and Energy (level, 100*log)	$log(CPI^{XFE})$
Food CPI (level, 100*log)	$log(CPI^{F})$
Energy CPI (level, 100*log)	$log(CPI^{E})$
Nominal Exchange Rate (AMD/USD, 100*log)	$log(S)$
Nominal Policy Interest Rate (in %)	$log(RS)$
Foreign Nominal Interest Rate (in %)	$log(RS^{*})$
Foreign CPI (level, 100*log)	$log(CPI^{*})$
World Food Price Index (level, in USD 100*log)	$log(Food^{*})$
World Energy Price (level, in USD 100*log)	$log(Oil^{*})$
Remittances (USD, 100*log)	$log(Rem)$
Fiscal Impulse (in level)	FI
Public Debt (in % of GDP)	B
Share of External Debt (in % of GDP)	SB^{*}
Interest Cost (in % of GDP)	$INTCOST$
Exchange Rate Cost (in % of GDP)	$EXCOST$

TABLE 2. Prior and posterior distribution of structural parameters

		Prior distribution		Posterior distribution				
Variable	Distribution	Mean	STD	Mean	Mode	STD	Intervals, 95 %	
β_1	beta	0.3	0.04	0.32	0.31	0.04	0.15	0.49
β_2	normal	0.3	0.05	0.28	0.28	0.05	0.1	0.48
β_3	normal	0.4	0.15	0.24	0.24	0.11	0	0.69
β_4	normal	0.4	0.15	0.19	0.17	0.07	0	0.49
β_5	normal	0.53	0.1	0.52	0.55	0.1	0.13	0.92
β_6	normal	0.53	0.1	0.32	0.31	0.09	0.01	0.67
α_1	beta	0.5	0.05	0.58	0.59	0.05	0.37	0.75
α_2	normal	0.3	0.1	0.31	0.3	0.08	0.1	0.66
α_3	beta	0.6	0.08	0.51	0.52	0.06	0.27	0.75
α_4	normal	0.3	0.05	0.28	0.28	0.05	0.1	0.46
α_5	beta	0.75	0.09	0.61	0.62	0.1	0.24	0.93
α_6	normal	0.3	0.05	0.29	0.29	0.05	0.1	0.49
γ_1	beta	0.8	0.1	0.81	0.83	0.06	0.46	0.97
γ_2	gamma	2	0.17	2.06	2.05	0.17	1.42	2.82
γ_3	gamma	0.15	0.04	0.15	0.16	0.04	0.02	0.3
κ_1	beta	0.4	0.08	0.39	0.38	0.08	0.13	0.71
η_1	beta	0.6	0.1	0.85	0.86	0.05	0.61	0.98
$\widetilde{\overline{RR}}$	gamma	3	0.38	3	2.95	0.38	1.68	4.93
$\widetilde{\overline{\Delta Y}}$	gamma	4.5	0.56	4.5	4.21	0.56	2.44	7.23

FIGURE 4. In Sample Forecasting Performance of the Model

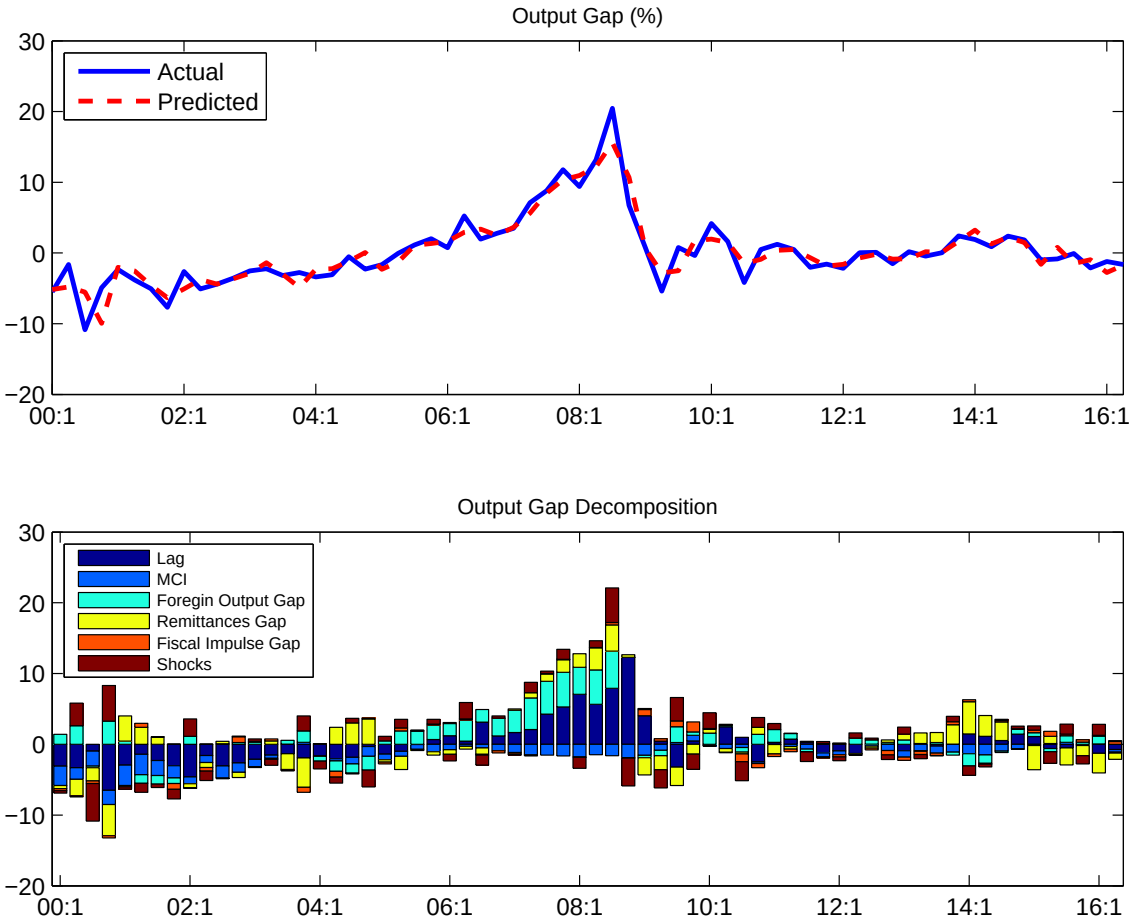


Finally, it is worth mentioning that the Bayesian estimates appear to be robust, as we have implemented different sensitivity analyses to check how the posterior distributions vary in response to different changes of priors.

5.2. **Forecast Performance.**

To analyze the degree of accuracy for the forecasting performance of the model, we tested the model in a rolling window in sample forecasting experiment with two year horizon. The first quarter of 2003 was taken as the starting point of the first simulation. The forecasting simulation was applied to four structural variables of interest, particularly, for output gap, y-o-y CPI inflation, monetary condition index and public debt, as a percent of GDP. The results of rolling window forecasts, along with the actual observed

FIGURE 5. Decomposition of Output GAP

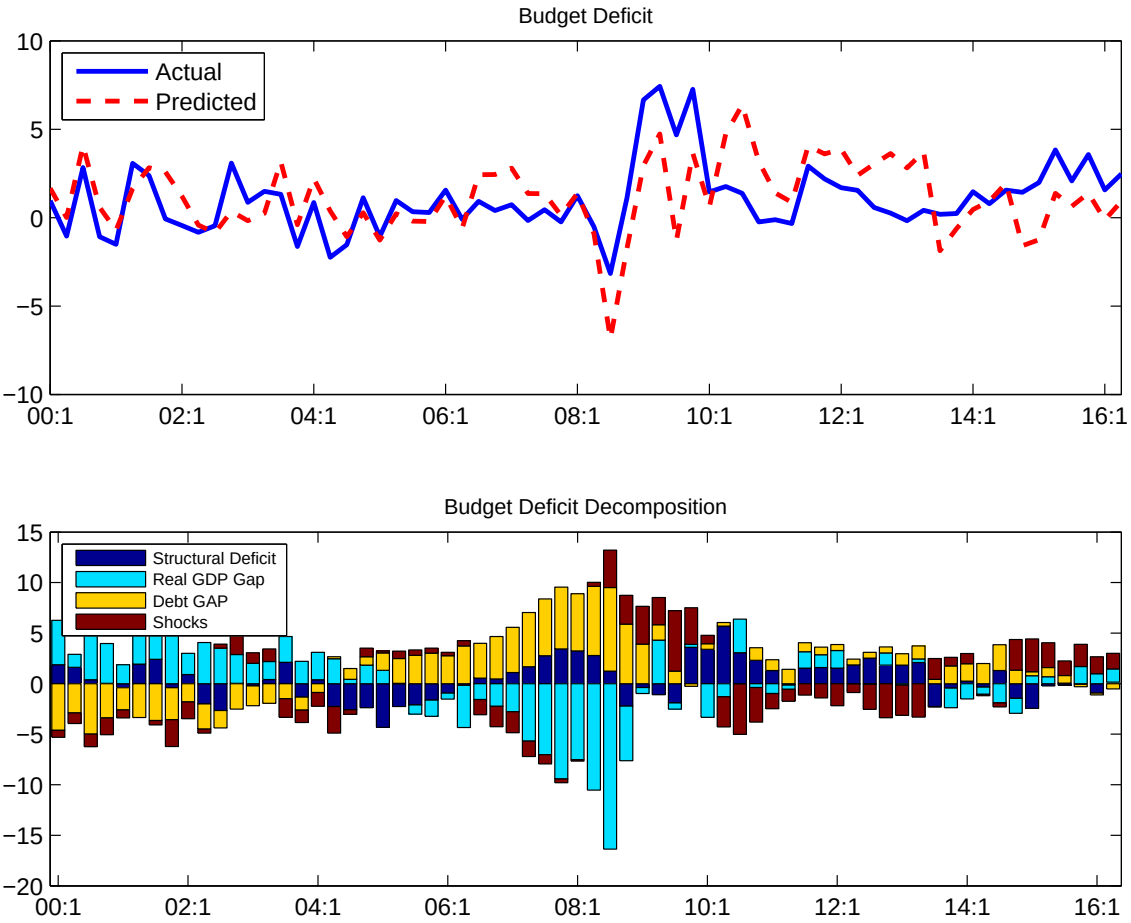


data, are illustrated in Figure 4. As can obviously be seen from the graphs, except the crisis period, in sample forecasts are mainly close to the actual observed data, which is a good indicator of a reasonable predicting power of the model.

5.3. **Model Properties.**

We apply forecast error variance decomposition analyses using the Bayesian estimation outputs to understand the driving forces of the outputs. The results are presented in Figures 5 through 6. Additionally, to examine the propagation of the shocks, we also estimate impulse response functions to each of the shocks, and report theses in Figures 7 through 9.

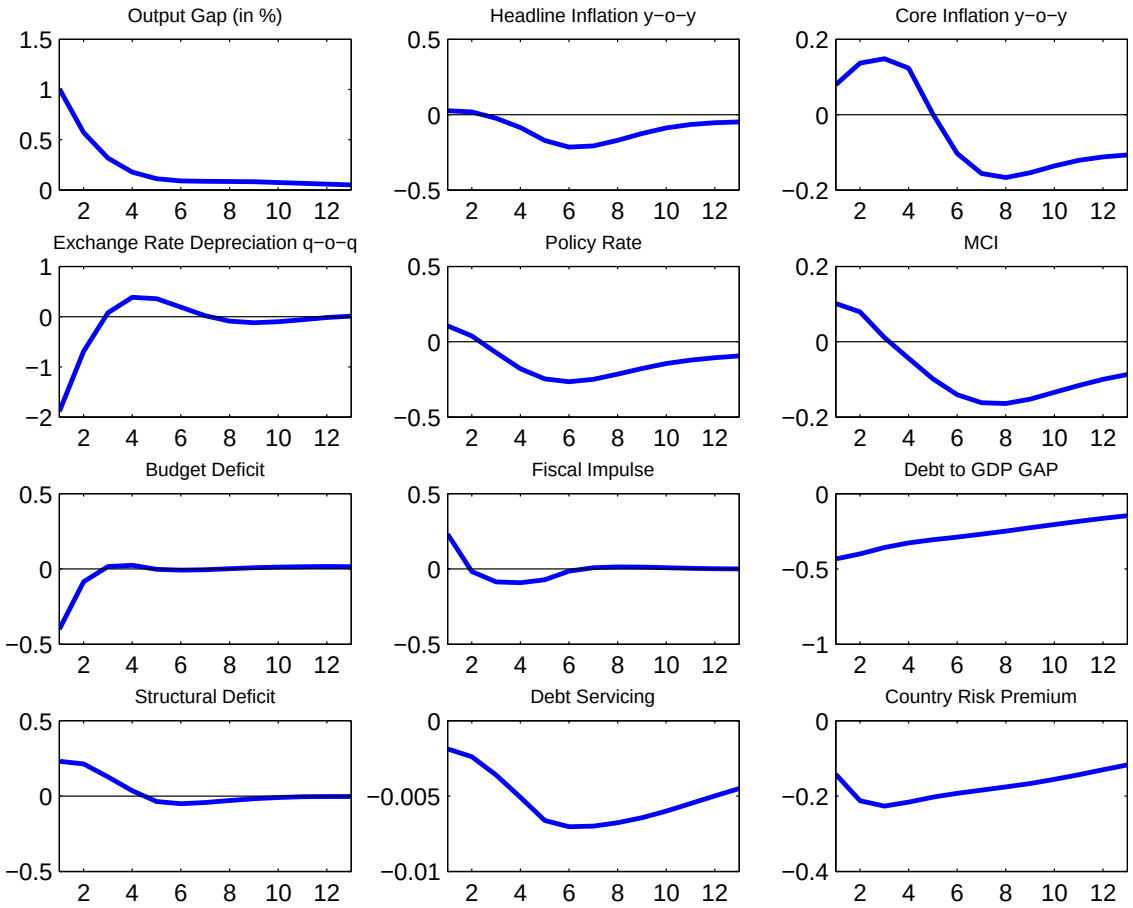
FIGURE 6. Decomposition of Budget Deficit



The results of output gap decomposition are mainly intuitive, and correspond to our expectations. The output gap which opened up sharply during the crisis period narrowed quickly and remain negative supported by an accommodating monetary policy stance. The large positive shocks to the aggregate demand during the period 2005-2008 was attributed by remittances from abroad and foreign demand. Post crisis period aggregate demand was attributed by fiscal stimulus which provided a boost to aggregate demand.

We also employed variance decomposition of budget deficit to interpret the fiscal behavior and its short-term and long-term implications during specific periods of time. The first thing to notice is the pre-crisis period, when for a while, budget deficit was mainly generated by the accumulation of public debt. Of particular interest is also the reaction

FIGURE 7. IRF - 1 pp Positive Shock to Output GAP



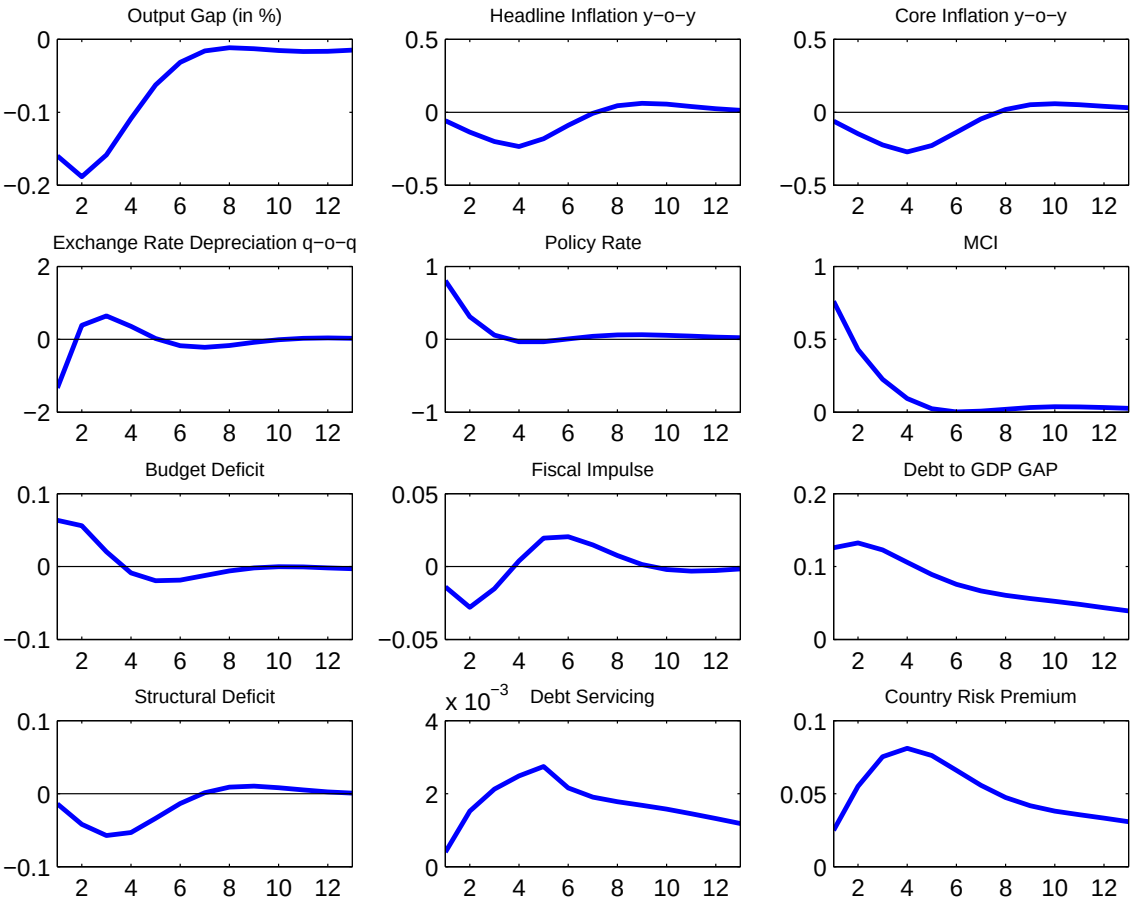
of fiscal policy to the financial crisis of 2008-2009. Fiscal authorities responded to the financial crisis by a mix of short-term fiscal expansion and medium-term austerity. The estimates of debt targets increased after the crisis, reflecting the anti crisis actions and structural reforms in the economy. The Government of Armenia applied short-term discretionary stimuli on the top of automatic stabilizers, which helped in smoothing the impact of the crisis on the real economy. Moreover, discrete fiscal policy contributed to the reduction of budget deficit thanks to tighten tax administration. Starting from 2014 both pension reforms and joining to Eurasian Economic Union accordingly increased the government costs and decreased the VAT contribute to the public deficit negatively, which aggravated the public deficit.

The responses of key variables of interest to three different shocks are explored; demand shock, policy rate shock, and structural deficit shock. In Figure 7, a positive demand shock raises output gap, the rate of inflation (core rises by more than headline, as core prices are more sensitive to the output gap) and reduces budget deficit by the effect of automatic stabilizers. Both the output gap and the deviation of inflation from target call for an increase in the real interest rate, i.e., a hike in the nominal rate greater than the rise in inflation. Reduction of budget deficit and higher nominal GDP growth compared to interest rate costs reduce public debt and open negative public debt gap which decreases country risk and term premiums. These changes causes an appreciation of the currency. Fiscal authorities, in case of pro cyclical fiscal policy aiming to bring debt to its targeted level have to raise the sustainable deficit. The sum of all discretionary elements in the decisions about the debt target, the change of structural deficit and actual deficit define fiscal impulse, which is positive. These changes dampen demand, and over the medium term output returns to the potential level. With the elimination of excess demand, inflation goes back to the targeted rate. All real variables return to their original values, implying that the nominal exchange rate depreciates in line with the permanently increased price level entailed by the period of higher inflation.

An interest rate shock, results in demand for domestic output to fall, a negative output gap opens up and induces an appreciation of nominal and real exchange rate (Figure 8). This reduces core and headline inflation. At the same time, an increased interest rate raises the outstanding debt service payments. Which causes a rise in budget deficit, public debt and country risk premium. Over time, to ensure a return to the inflation and public debt target, the central bank and the fiscal authorities have to unwind the increase in the interest rate and reduce the structural deficit. As a result, negative output gap gradually closes and neutralizes the dis-inflationary effects of the initial interest rate increase. In the long run, the real exchange rate returns to its equilibrium value.

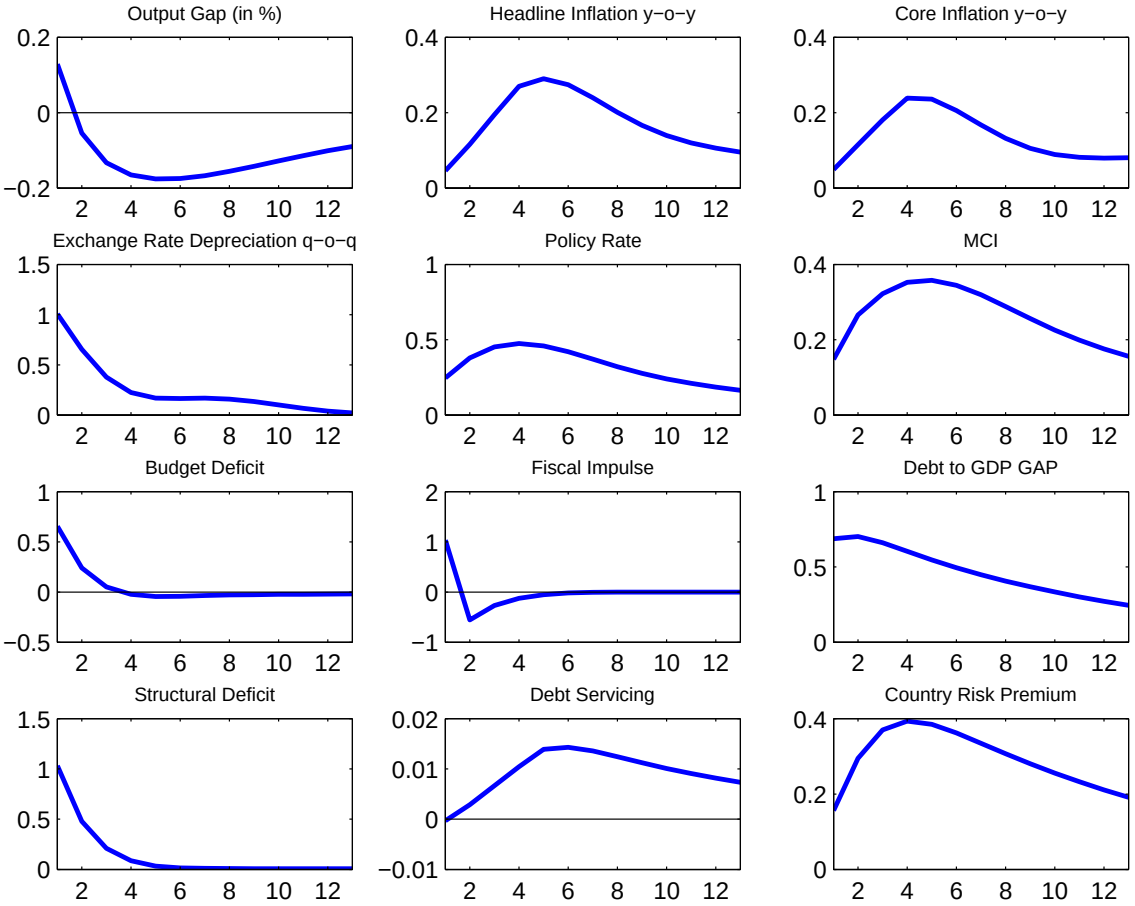
In Figure 9, a positive structural deficit shock raises budget deficit, fiscal impulse, public debt, output gap, the rate of inflation. Increased budget deficit and lower nominal

FIGURE 8. IRF - 1 pp Positive Shock to Policy Rate



GDP growth compared to nominal interest rate increases public debt and open positive public debt gap which pushes up country risk and term premiums. Both the positive output gap in the short run and the deviation of inflation from the target call for an increase in the real interest rate. This change causes a depreciation of the domestic currency and increases outstanding debt service payments. Over time, to ensure a return to the public debt target, the fiscal authorities have to unwind the increase in the structural or sustainable deficit. In the long run higher risk premium goes back to its long-run equilibrium value and causes domestic currency appreciation, contraction of real marginal cost and inflation. The output gap closes and output returns to the potential level.

FIGURE 9. IRF - 1 pp Positive Shock to Structural Deficit to GDP

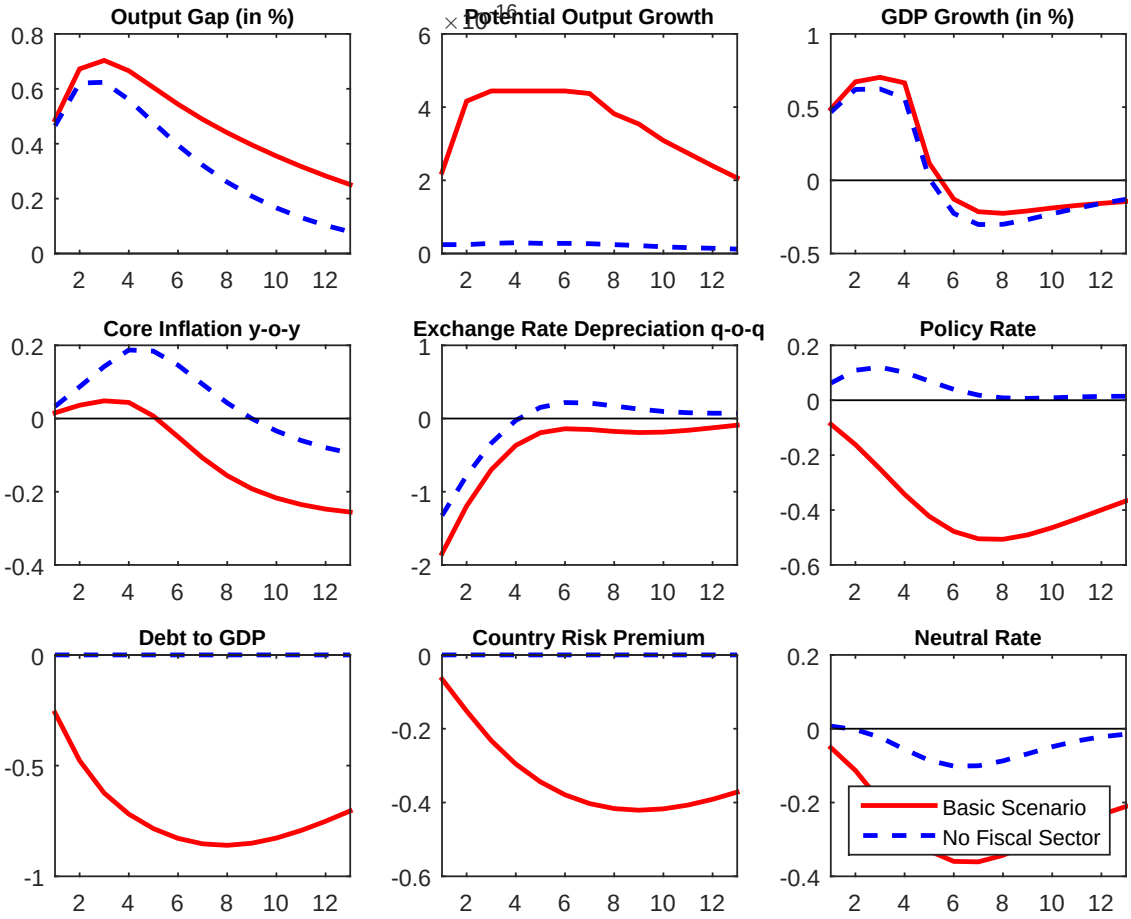


6. WHAT DOES THE MODEL SUGGEST?

To understand the importance of incorporating detailed fiscal sector with features related to the public debt, in the macro policy models for low income indebted countries, we implemented the following simulation; We closed the fiscal sector in our model and only left the exogenous fiscal impulse, and by utilizing impulse response analyses, we tried to understand the policy situation in comparison with our basic model.

The results of the comparative impulse response analyses of one pp shock to foreign demand are illustrated in the figure 10. The figure suggests that, unlike the no fiscal sector scenario, our basic scenario suggests expansionary policy response, as a result of which, much higher output growth, potential output growth and positive output gap. The path of the policy response is explained as follows; The country risk premium that

FIGURE 10. Comparison of Two Models

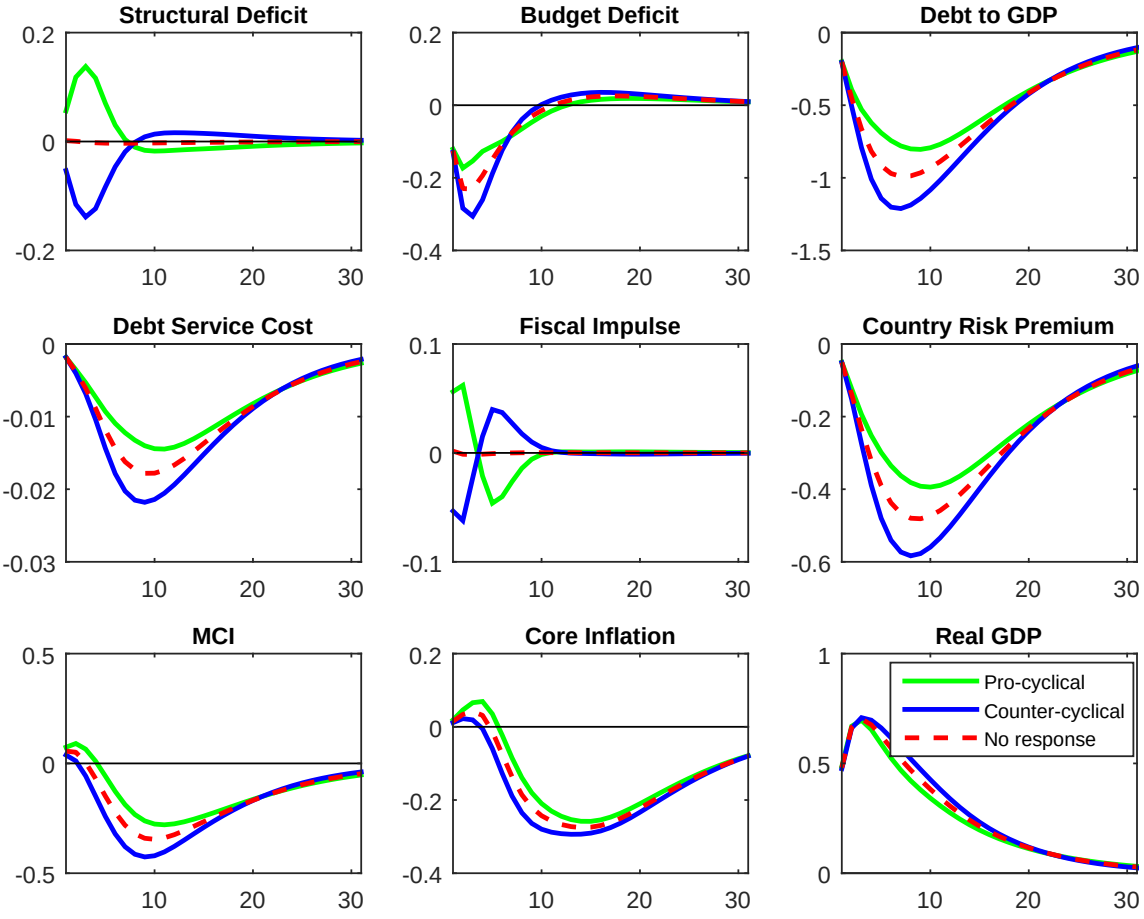


responds endogenously to the changing debt-ratios, cushions the negative impact of fiscal cuts while the exogenous shock to the risk premium amplifies the output losses. A faster debt reduction and therefore faster decrease in the risk premium leads to a further reduction in the sovereign risk premium, which in turn, provides an additional boost to investment. It then cushions the impact of fiscal retrenchments, and as a result fiscal consolidation leads to positive effects on GDP growth. As the sovereign risk premium decreases, the costs of government borrowing and the amount of interest payments decrease. Such a decrease in government interest payments positively influences to the reduction of debt to GDP ratio. In addition the power of pass-through between the sovereign risk premium and the nominal interest payments depends on a number of factors,

such as debt maturity and structure (fixed vs floating agreements). By the same pass-through mechanism as described above, this lower risk premium can lead to a decrease in the cost of credit, hence weight positively on growth. This, in turn, might result in an enhancement fiscal positions and further decreases in the sovereign risk premium, improving investment conditions and boost the potential output. Our findings, which are common across the recent literature [Nickel and Tudyka [2014], Corsetti et al. [2013] and Gerke et al. [2013]], amplify the importance of fiscal consolidation and debt management strategies in monetary policy macro models.

Our model framework can also be used in an evaluation of alternative fiscal policies and rules. In the model fiscal rule implies a trade-off between costs (primary surpluses) and benefits (lower debt, higher real output) of a consolidation strategy. To illustrate this, we examine our baseline scenario (1pp. positive shock to the foreign demand) with modified fiscal rules accounting for pro- and counter-cyclical nature of structural deficits, along with no response policy. A pro-cyclical rule adjusts structural deficits upwards during booms relative to the baseline. This reflects the assumption that extra growth is "spent". A counter-cyclical rule, by contrast, adjusts structural deficits downward during boom years relative to the baseline, which reflects the assumption that a fiscal authority uses such opportunity of good growth to decrease public debt. No response policy does not react at all. The parameters of the structural deficit rule in (13) are modified for this purpose. In the no response scenario, ψ_1 is set to zero. A positive value ($\psi_1 = 0.6$) implies pro-cyclical policy, as the structural deficit tends to grow in boom years, and a negative ($\psi_1 = -0.6$) value implies counter-cyclical policy, as structural deficits fall in the boom years. The scenarios are designed so that the structural deficits consistent with the baseline scenario are the same for the pro-cyclical and counter-cyclical cases. This is to allow for a direct comparison of the fiscal policies. Figure 11 illustrates 3 different fiscal scenarios: Pro-cyclical, counter-cyclical and no response cases. As expected, the counter-cyclical case has larger primary surpluses than the other two scenarios. The benefits of the counter-cyclical policies are in lower debt levels and a lower probability of a fiscal

FIGURE 11. Fiscal Consolidation with Different Scenarios



consolidation failure. It is because the consolidation is dominated by output costs and the benefits of a lower debt translating into a higher potential and lower interest costs. In case of pro-cyclical rule, the debt declines to the new target almost solely thanks to nominal GDP growth exceeding the interest rate paid on the debt. As such, the pro-cyclical rules are very vulnerable to shocks increasing the risk premiums or decreasing nominal GDP growth (such as a fall in potential GDP growth or an increase in the yield curve), which makes consolidation all the less likely to succeed overall.

7. CONCLUSIONS AND DISCUSSIONS

In this paper, we employed a Semi-Structural approach, instead of DSGE framework, utilizing Armenian data. we believe that the main conclusions, without loss of generality,

can be extended to the remaining countries of our interest that share similar features with Armenia.

The empirical results of the model enable us to address the question of whether ignoring the incorporation of fiscal consolidation and public debt in monetary policy macro models will create distortions in the general suggestions and conclusions of the model. And the second question, to find the best fiscal consolidation strategy for the examined economy by comparison of pro-cyclical, counter-cyclical and no response rules.

Applying the model to he Armenian data, we have made the following observations. Ignoring the importance of fiscal consolidation and public debt in monetary policy macro models will create distortions in the general suggestions and conclusions. Fiscal policy behavior in Armenia during the last decade has corresponded to a much higher debt target than the observed debt levels would suggest. Fiscal authorities responded to the financial crisis by a mix of short-term fiscal expansion and medium-term austerity. The estimates of debt targets increased after the crisis, reflecting a anti crisis action and structural reforms. The Government applied short-term discretionary stimuli on top of automatic stabilizers, which helped in smoothing the impact of the crisis on the real economy. Debt management strategies may become more vulnerable to the exchange rate risk due to the increasing foreign exchange component of the debt. There is serious risk of domestic debt interest rates exceeding nominal income growth in the future, which could adversely affect their fiscal consolidation efforts.

According to our analysis the Armenian economy can address these risks by adjusting its fiscal behavior in a number of ways.

- The monetary authorities should consider models with more detailed attention to the fiscal consolidation, and pay serious attention to the developments in the public debt.
- Continuing the trend of past policies would lead to higher debt levels in the future, and it is important to respond to the current situation by reducing future debt-to-GDP ratios.

- The economy faces the most acute need to change its fiscal policies. Trying to stabilize the future debt at around the target level will involve long periods of primary deficits and low growth, which might be difficult to achieve politically.
- Finally, our experiments also evaluate the contribution of different fiscal rules to the success of consolidation efforts, which means to reduce relative debt levels. For instance, we show that, as expected, counter-cyclical rules (adjusting structural deficits downwards during booms and vice verse) bring a faster and more certain consolidation than pro-cyclical or no response rules.

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