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Macroeconomic Adjustment in Armenia: The Role of External Factors

Bas van AARLE[*], Robert SOSOIAN[**]

Abstract

This paper develops a small macroeconomic model of the Armenian economy. After setting up the model and its estimation, a number of macroeconomic scenarios is analyzed in the form of out-of-sample simulations. We analyze the transmissions in the model of a number of macroeconomic shocks and policy scenarios to obtain a better understanding of their possible effects on the internal and external balance of the Armenian economy. A special focus is put on the role of exchange rate and monetary management and the inflow of remittances in the Armenian economy.

Keywords: *Armenia, macroeconomic adjustment, macroeconomic models, macroeconomic policy.*

JEL Classification Codes*:* E42, E47, E51, E61, F41

[*] Hasselt University, Faculty of Applied Economics, Campus Diepenbeek, Agoralaan, 3590 Diepenbeek, Belgium. bas.vanaarle@uhasselt.be
[**] Credit Agricole Nederland, Amsterdam, the Netherlands. robert.sosoian@cag.nederland.nl

1. Introduction

Land-locked Armenia was one of the many USSR satellites that became independent in 1991 after the breaking-up of the Soviet Union. Experiencing a difficult transition during the 1990s, it managed to gradually achieve macroeconomic stability and experienced a vigilant rebound of economic growth the recent years. Since 2001, growth was around 10% and inflation has been low, so that it has been sometimes referred to as a 'Caucasian Tiger'.

According to the EBRD (2006) evaluation, Armenia has made relatively good progress in liberalisation and structural reforms compared with other countries in the CIS. Progress is especially made in the areas of privatisation and market liberalisation and also achievements in the area of financial sector liberalisation/regulation and infrastructure reforms, it outperforms the CIS average. Improvements in the business environment relate especially to tax reforms, simplifying the tax system, and efforts devoted to fight corruption. Also thanks to these developments, FDI to Armenia has increased the recent years from its low initial levels.

Aim of this paper is to present a small quarterly macroeconomic model of the Armenian economy, estimate the model for the period 1996-2007, and to work out a set of relevant macroeconomic adjustment scenarios for the period 2008-2011 that illustrate the most important macroeconomic mechanisms and policy strategies for the Armenian economy. In the analysis we focus in particular on the role of exchange rate and monetary management, fiscal policy and the importance of remittances to the Armenian economy. In order to do so, the links between monetary variables and balance of payments are modelled in detail.

Our focus on monetary and fiscal policy is related to the recent discussion if and how monetary and fiscal policies might need to be tightened in the light of growing internal and external imbalances following an economic boom. Our analysis is also linked to a number of studies on macroeconomic policy and determinants of inflation in transition economies. Studies such as Lissovolik (2003), for the case of Ukraine, and Vymyatnina (2006), for the case of Russia, present evidence that in the CIS countries there remain strong interrelations between inflation, money growth, exchange rate changes and wage growth and at the same time they are experiencing a process of de-dollarization, financial deepening and remonitization (implying e.g. high credit growth, a declining velocity and higher money multiplier). Taken together this implies that monetary authorities in the CIS countries are typically working within a delicate balance of different forces of power, where policy mistakes may easily unwind adverse inflationary pressures again. Armenia is therefore a good example of the challenges the CIS countries faced during recent years.

Our analysis is structured as follows. Section 2 summarizes the main macroeconomic trends in Armenia, Section 3 works out a small macroeconomic

model that we will use to analyze the Armenian economy. Section 4 estimates and simulates this model using Armenian data. In Section 5 a number of out-of-sample simulations for the period 2008-2010 are carried out to assess the effects of number of alternative scenarios.

2. Armenia: Macroeconomic Adjustments and Policies

This section provides an overview of the main macroeconomic developments, macroeconomic policies and their effects during the period 1995-2007. The macroeconomic trends in the Armenian economy clearly need to be placed in a broader context of economic transformation, institutional and political reforms and increasing openness to regional and global developments. After the initial deep and prolonged transformational recession in the 1990s, the Armenian economy has been gradually recovering, liberalizing and transforming since 2000.1 Table 1 summarizes the development of the main macroeconomic indicators during this period.

Table 1: Summary of Main Macro-Economic Adjustments, Armenia 1995-2007.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Real GDP Growth (%,yoy)	6.9%	5.9%	3.3%	7.2%	3.0%	4.6%	10.3%	13.7%	13.8%	9.9%	17.2%	13.3%	12.9%
CPI Inflation (%,yoy)	176.0%	18.7%	14.0%	8.7%	0.7%	-0.8%	3.2%	1.1%	4.7%	7.0%	0.6%	2.9%	4.4%
Employment Growth (%,yoy)	-1.0%	-2.7%	-3.8%	-3.1%	-2.5%	-1.5%	-3.5%	-8.2%	-2.9%	-0.6%	-0.2%	-0.2%	-0.6%
Current Account (mln US$)	-386.6	-475.3	-523.7	-595.4	-481.2	-466.4	-373.5	-321.2	-407.9	-449.5	-575.4	-811.1	-1500.0
Exchange Rate (Dram/US$)	405.9	414.0	490.9	504.9	535.1	539.5	555.1	573.4	578.8	533.5	457.7	416.0	342.1
Real Exchange Rate (%,yoy)		-62.0%	-15.5%	-11.6%	1.7%	5.4%	2.5%	-15.1%	-20.5%	10.7%	-16.0%	-6.2%	-15.2%
Fiscal Deficit (% GDP)	-6.0%	-4.4%	-2.6%	-3.8%	-4.1%	-4.9%	-4.3%	-2.5%	-0.9%	-1.1%	-1.0%	-0.3%	1.0%
M0 (%,yoy)	162.2%	35.2%	36.2%	11.7%	-2.5%	17.8%	19.8%	20.5%	22.2%	11.8%	43.1%	37.3%	44.0%
M2 (%,yoy)	94.6%	36.4%	36.9%	32.5%	20.5%	27.0%	20.9%	12.1%	18.6%	21.2%	28.2%	26.5%	40.6%
Remittances (%GDP)	16.2%	14.4%	19.3%	12.6%	12.4%	12.6%	11.3%	11.0%	11.1%	15.0%	13.4%	14.2%	13.4%
Foreign Reserves (mln US$)	38.3	49.8	103.5	148.4	125.8	155.8	157.6	240.3	276.5	309.7	556.6	774.0	1304.2

Source: IMF, own calculations

2.1.Economic growth

Since 2001, the Armenian economy has displayed high growth rates around 10%, marking a clear turnaround from the dismal economic performance in the 1990s. Increased inflows of remittances and FDI are among the factors contributing to the

[1] A detailed analysis of this reform and transition process is beyond the scope of this paper. See e.g. EBRD (2006) for a detailed analysis of the transition process in Armenia.

rapid growth. Like several other transition countries, the high growth rates have not been accompanied by high employment growth, in fact there has been essentially jobless growth for a decade in Armenia, reflecting shedding of job redundancies in the public sector due to privatizations and productivity growth in the private sector. A detailed account of the Armenian labour market, institutions and reforms is found in a recent Worldbank (2007) study.

2.2. Monetary and exchange rate policy

Alongside the economic boom of the recent years and relatively low inflation and strong remittances, money growth is very high. The observed decline in velocity, unsterilized interventions, the process of de-dollarization2 or 'dramization' and surging credit growth and capital inflows all contribute to the very high rates of money growth in the recent years. The Central Bank of Armenia (CBA) is planning a gradual introduction of a full-fledged inflation targeting framework, to reduce the volatility in inflation and inflation expectations. On January 1, 2006, the first steps in this process were formalised by announcing a 3% CPI inflation target.3

The exchange rate policy of the Dram can best be characterized as a 'dirty float', displaying considerable swings. Large and volatile inflows of remittances and foreign capital, imply volatility in balance-of-payments, the exchange rate and base money growth. In particular the large inflows of remittances tend to appreciate the Dram and to increase base money growth as the central bank finds it increasingly difficult to sterilize the foreign exchange interventions.

2.3. Fiscal policy, structural reforms

Subsidies to compensate the increases in the price of imported natural gas since 2006 put pressure on the expenditure side. On the revenue side, fiscal reforms are starting to yield some effect and the efficiency of tax administration and the tax collection to improve. Studies by Davoodi and Grigorian (2007), however, indicate that Armenia's tax system is still very far from efficient. In particular weak institutions and a large shadow economy are singled out as the factors behind the inefficiencies.

2.4. External balance

Armenia is a small open economy, as witness exports (and imports) to GDP fluctuating around 30%. Exports and imports are divided over CIS countries

[2] A detailed analysis on dollarization in Armenia is provided in Zoryan (2005) which finds that Armenia has featured among the former CIS countries with the highest rates of dollarization. The share of foreign currency deposits in total deposits rose from 38% in 1992 to over 70% in 2001, declining again from then. Remittances are noted as one of the factors behind dollarization in Armenia.

[3] See Dabla-Norris et al. (2006) and (2007) for all details on the introduction of inflation targeting in Armenia. Obstacles to a full-fledged IT strategy in Armenia are vulnerability to economic shocks, poor coordination between fiscal and monetary policy, underdeveloped financial systems, institutional weaknesses, and limited central bank technical capacity. Also the observation that not all traditional channels of monetary policy (interest rate channel.

(roughly one third) and non CIS countries (two thirds). During most recent years, a trade deficit in the order of 5 to 10 percent of GDP has been matched by inflows of remittances, FDI and financial capital. Remittances are a very important item for the Armenian balance-of-payments and the Armenian economy in general. Studies by USAID (2004) and IMF (2006) provides a detailed account of remittances to Armenia and their most important effects. Like capital inflows, remittances can fluctuate considerably over time and there are some statistical complications in measuring remittances as some remittances may remain outside the statistics and some transactions may incorrectly be classified as remittances. Notwithstanding this uncertainty, most estimates indicate that remittances to Armenia amount to around 1 bln USD annually, a considerable amount for a small economy like Armenia (in the order of 10 to 15 percent of GDP). Consumer surveys indicate that some 40 percent of households receive remittances from close and more distant relatives and that the share of such remittances in total household income range typically between 25 and 75 percent. Remittances to Armenia do not only result from workers working temporarily or seasonally abroad (in particular in Russia) but in particular from a large 'diaspora', large foreign communities of Armenian origin (in particular Russia, USA and France) that, sometimes over several generations, continue to be strongly linked to their homeland. Remittances are in particular linked to household consumption and to lesser extent private investment opportunities, especially real estate investment.

2.5. Financial sector

Reforms in the banking and financial sector have improved efficiency and increased financial intermediation. Measures by the CBA against non-cash payments and that stimulate the use of bank accounts, aim at reducing the shadow economy. Competition in the financial sector is increasing by the entrance of foreign banks and improved prudential supervision. Full liberalization of capital flows has been achieved as well.

2.6. Institutional aspects, reforms and the shadow economy

As noted in the introduction Armenia has managed to move the recent years to the frontier of the CIS countries in the area of various reforms, even if initial conditions were not the most favourable. Interestingly is also a gradual success in reducing the shadow economy: starting with a share of the shadow economy of over 90% of the official economy in 1996, it has been gradually reduced to less than 30% in 2005 according to the estimates of Tunyan (2005). It is beyond doubt that these positive developments concerning structural reforms and strengthening of institutions and governance, including a retreat of the informal economy, have also been providing a favourable contribution to macroeconomic stability by ameliorating the economic environment in a broader sense, even if it is hard to add concrete numbers to these factors.

3. A Model of the Armenian Economy.

Having obtained more insight into the most pronounced developments in the Armenian economy, this section develops a small scale model of the Armenian economy that can be used for (stylized) macroeconomic policy analysis based on quarterly data. In particular we want to analyze, the occurrence of macroeconomic shocks and alternative monetary and fiscal policies and their consequences according to the model. Also the effects of alternative scenarios of remittances is analysed, to gain more insight into the sensitivity of the Armenian economy to changes in remittances.

The base of the model that will be estimated in this section consists of a small dynamic open economy AD-AS-LM model with price and wage dynamics. There are currently no similar macroeconomic models of the Armenian economy to our knowledge. Table 2 provides the structure of the model which contains four building blocks: (a) aggregate demand and prices, (b) money, balance of payments, interest rates and exchange rates, (c) price, wages and (un)employment, (d) public finance.

Table 2: A Small Model of the Armenian Economy

(a) aggregate demand

$$\log(RCON) = \alpha_0 - \alpha_1(RSIN) + \alpha_2 \log(RYDP) \quad (1)$$

$$\log(RINV) = \beta_0 - \beta_1(RSIN) + \beta_2 \log(RGDP) \quad (2)$$

$$\log(REXP) = \gamma_0 + \gamma_1 \log(RRBL) + \gamma_2 \log(REXR) + \gamma_3 \log(WTR) + \gamma_4 \log(RGDP^{RUS}) \quad (3)$$

$$\log(RIMP) = \delta_0 + \delta_1 \log(RGDP) + \delta_2 \log(REM) - \delta_3 \log(RRBL) - \delta_4 \log(REXR) + \delta_5 \log(OIL) \quad (4)$$

$$YDP \equiv GDP + REM - REV + TRA \quad (5)$$

$$GDP \equiv CON + INV + EXP - IMP + GCO + CIN \quad (6)$$

$$RCON \equiv \frac{CON}{P},\ RINV \equiv \frac{INV}{P},\ REXP \equiv \frac{EXP}{P},\ RIMP \equiv \frac{IMP}{P},\ RYDP \equiv \frac{YDP}{P},\ RGDP \equiv \frac{GDP}{P} \quad (7)$$

(b) money, BOP, interest rates and exchange rates

$$\log\left(\frac{M2D}{P}\right) = \zeta_0 - \zeta_1 SIN + \zeta_2 \log(RGDP) + \zeta_3 \log(REM) \quad (8)$$

$$\log\left(\frac{FCD}{P}\right) = \varsigma_0 + \varsigma_1 d\log(EXR) + \varsigma_2 \log(REM) \quad (9)$$

$$M2 \equiv M2D + FCD,\ MMP \equiv \frac{M2}{M0},\ VEL \equiv \frac{GDP}{M2},\ DOL \equiv \frac{FCD}{M2},\ RPT \equiv \frac{\Delta M0}{\Delta(RES\$ * EXR)}, \quad (10)$$

$$RAR \equiv \frac{RES\$}{IMP\$},\ SGNY \equiv \frac{\Delta M0}{GDP}$$

$$M0 \equiv CBC + CLG - CGD + RES\$ * EXR \quad (11)$$

$$BOP\$ \equiv CUA\$ + FIA\$ + ERR\$ \equiv d(RES\$) \quad (12)$$

$$CUA\$ \equiv EXP\$ - IMP\$,\ FIA\$ \equiv FDI\$ - FDO\$ + REM\$ + OCF\$ \quad (13)$$

$$SIN \equiv SIN^{USA} + d\log(EXR) + RP,\ RSIN \equiv SIN - d\log(P) \quad (14)$$

$$RBL = EXR * EXR^{RUS},\ REXR \equiv \frac{EXR * PPI^{US}}{P},\ RRBL \equiv \frac{RBL * PPI^{RUS}}{P} \quad (15)$$

(c) prices, wages and (un)employment

$$\log(EMP) = \lambda_0 + \lambda_1 \log(RGDP) + \lambda_2 \log RWAG \quad (16)$$

$$LAB \equiv EMP + UNE,\ PRO \equiv \frac{RGDP}{EMP},\ RWAG \equiv \frac{WAG}{P} \quad (17)$$

$$d\log(WAG) = \nu_0 + \nu_1 d\log(P) + \nu_2 \log(UNE) + \nu_3 d\log(PRO) \quad (18)$$

$$d\log(P) = \eta_0 + \eta_1 d\log(WAG) + \eta_2 d\log(EXR) + \eta_3 d\log(OIL * EXR) + \eta_4 d\log(M2) \quad (19)$$

(d) public finance

$$\log(REV) = \chi_0 + \chi_1 \log(GDP) \quad (20)$$

$$DEFY \equiv \frac{REV - GEX}{GDP} + SGNY,\ TRA \equiv GEX - GCO \quad (21)$$

All variables are in domestic currency, unless otherwise indicated. The first building block defines aggregate demand. (1) gives real private consumption (RCON) as a function of real disposable income (RYDP) and the real interest rate (RSIN). Real consumption is obtained by deflating private consumption by the domestic price level, which is approximated by the CPI deflator (P), in the absence of a quarterly GDP deflator. Disposable income (YDP) is defined in a relatively crude way in (5) – for reasons of data-availability- using GDP, net transfers to the government (REV-TRA) and also remittances (REM) received from abroad. As explained above remittances constitute a significant part of household income in Armenia and by introducing them here in the consumption function of the macroeconomic model – via households' disposable incomes- we can analyze their effects via this channel. Remittances in the model will generate a set of effects through this important channel: by their effect on disposable income they affect consumption and thereby through a range of second-round effects all real and nominal variables. Remittances also transmit themselves via other channels: they affect directly the balance-of-payments, imports and money demand as explained below.

The real interest rate is defined in (14) as the nominal short-term interest rate (SIN), minus inflation. Interest rates and exchange rates are linked through the uncovered interest rate parity cum (exogenous) risk premium (RP) in (14). GDP is defined in (6) as the sum of consumption (CON), investment (INV), net exports (EXP–IMP), government consumption (GCO), and inventory accumulation (CIN). (7) defines real consumption, real investment, real exports, real imports, real disposable income and real GDP.

Real private investment (RINV), (2) is assumed to depend on the real interest rate (by a cost-of-capital argument) and real output (by an "accelerator" argument) (RGDP). Real exports (REXP), in (3) depend on competitiveness vis-à-vis the US (REXR) -defined in (15) as the nominal US$ exchange rate (EXR) times the relative output price level-, competitiveness vis-à-vis Russia (RRBL), world trade (WTR) and Russian real output (RGDPRUS). Similarly, real imports (RIMP) in (4) depend on competitiveness vis-à-vis the US and Russia, domestic real output, remittances and the oil price (OIL).

The second block links money, balance of payments, interest rates and exchange rates. Broad money demand for domestic currency (M2D) is given in (8) as a function of real output, remittances and the nominal interest rate. The demand for foreign currency deposits (FCD) is assumed to depend on depreciation of the Dram and remittances according to (9). The total money supply (M2) equals the sum of broad money in domestic currency and foreign currency deposits and is determined by the workings of the money multiplier (MMP) on the stock of base money (M0) according to (10). (10) also defines velocity of money (VEL), dollarization (DOL), reserve pass-trough (RPT), reserve adequacy (RAR) and seignorage to GDP (SGNY), variables that are useful in monetary analysis to analyze various aspects relating to monetary policy. The reserve pass-through indicator is an indicator of the degree of sterilization of foreign exchange interventions since it measures the extent to which changes in net foreign reserves are reflected in the monetary base4. A value of 0 implies perfect sterilization, a value between 0 and 100% implies imperfect sterilization as reserves and base money move in the same direction. The reserve adequacy measures the coverage of 3 months of imports by reserves and can be used as a measure of exchange rate pressure/sustainability of balance-of-payments imbalances in the model. Base money itself consists according to (11) of a domestic component –credit of the Central Bank to the banking sector (CBC), and to the government, (CLG–CGD)- and a foreign component –the foreign exchange reserves (RES$).

The balance of payments (BOP$, defined in mln US$) is defined in (12) as the sum of the current account (CUA$), financial account (FIA$) and net errors and omissions (ERR$), matching the change in foreign exchange reserves. In (13), the current account equals exports of goods and services minus imports and the financial account equals net foreign direct investment (FDI$-FDO$), foreign remittances (REM$) and other capital flows (OCF$), which consists to a large extent of short-run portfolio capital flows. Both foreign direct investment and other capital flows remain exogenous in the model, for simplicity.

In the definitions of the foreign reserve accumulation, the balance-of-payments and base money, we see a second important way in which remittances enter the model: remittances are a sizeable balance of payments item in the case of Armenia and thereby affect reserve accumulation and –to the extent interventions are non-sterilized- base money growth.

Labor demand (EMP) in (16) is a function of (i) real output and (ii) the real producer wage (RWAG) which serves as a proxy of labor costs. In (17), the real wage is defined as the nominal wage (WAG) deflated by the price level and productivity is defined as real GDP per employee. The supply of labor (LAB) is defined as the sum of employed and unemployed persons (UNE). Note that the labor demand function

[4] Although less likely, a negative value of RPT is a possibility. It amounts to a form of 'super-sterilization' since in that case foreign reserves and base money change in opposite directions.

can be interpreted as an inverted production function in the model in case we assume here that the capital stock is approximately constant in the short-run.

Wage inflation according to (18) is driven by increases in output prices -reflecting wage indexation-, the level of unemployment -reflecting a Phillips-curve element-, and changes in productivity. The last effect could reflect the pressure on wages (and thereby on prices) from the Balassa-Samuelson effect that is often thought to have significant inflationary impacts in transition countries and an important factor behind the trend real appreciation noticed in many countries. Increases of domestic prices in (19) are the result of wage increases, depreciations of the Dram (reflecting pass-through), increases in oil prices and broad money growth.

Government revenues (REV) are related to output according to (20), government spending (GEX) equals government consumption and transfers that will be held exogenous. The fiscal deficit to GDP ratio, (DEFY), is defined in (21) as the difference between total government revenue (plus seignorage) and total government spending.

The model thus consists of 10 estimated macroeconomic relations ((1)-(4), (8),(9), (16), (18)-(20)) plus 35 definitions. As a result, it contains 21 exogenous variables (CGD, CIN, CLB, CLG, ERR$, EXR, EXRRUS, FDI$, FDO$, GCO, GDPRUS, LAB, OCF$, OIL, PPIRUS, PPIUS, REM$, RP, SINUS, TRA, WTR) and 43 endogenous variables (BOP$, CON, CUA$, CUAY, DEFY, DOL, EMP, EXP, FCD, FIA$, GDP, IMP, INV, M0, M2, M2D, MMP, P, PRO, RAR, RBL, RCIN, RCON, RES$, REV, REXP, REXR, RGCO, RGDP, RIMP, RINV, RPT, RRBL, RREV, RWAG, RYDP, SGNY, SIN, UNE, UNR, VEL, WAG, YDP).

4. Model Estimation and Simulation

When estimating the 10 structural relations we need to take into account a number of aspects: (i) the limited quality of the data (e.g. restricted number of observations), (ii) seasonal patterns in the data, (iii) non-stationarity of almost all variables. The Appendix provides details on the data set that is used. All data are at a quarterly frequency and are mainly from the IMF International Financial Statistics and Armenian national sources and cover the sample 1996:I-2007:IV. Seasonal adjustment of the variables is undertaken using the Census X-12 method.

To take into consideration that practically all variables are non-stationary, the structural equations of the model are estimated in the form of a vector error correction model (VECM). A VECM is a restricted vector auto-regressive model designed for use with non-stationary series that are co-integrated. The VECM has the co-integration relations built into the specifications so that it restricts the long-run behaviour of the endogenous variables to converge to their co-integrating relationship while considering at the same time the short-run adjustment dynamics towards the long-run equilibrium. The cointegrating relations in other words correspond with the long-run relation assumed by eqs. (1)-(4), (8)-(9), (16), (18)-

(20). The error-correction terms measure how deviations from long-run equilibrium are affecting the short-run adjustment dynamics.

The estimation results found for real consumption growth, real investment growth, real exports growth, real imports growth, broad money growth (in domestic and foreign currency), government revenue growth, employment growth, wage inflation and price inflation are provided in the Appendix. The long-run elasticities are grouped in the first part of the tables which displays the co-integrating equation, the short-run elasticities are found in the second part, together with the error-correction term.5 Generally we find more evidence for the expected signs of the coefficients in the long-run relations than in the short-run dynamics where we allow up to four lags in the specifications. Consumption seems mostly driven by real disposable income (which includes remittances as noted earlier) and less by real interest rate changes. The real interest rate effect is stronger in case of investment which is also strongly driven by output. Note that the initial negative short-run effect is compensated over time by the positive effect from the long-run cointegrating relation.

A real depreciation against the Russian Ruble and world trade are important determinants of Armenian export growth according to the estimates.6 Output, remittances, real US$ and Ruble exchange rates and the oil price (in Dram) account for imports mostly in plausible ways, even if the degree of explanation by this import function is relatively low. Two money demand functions are estimated: the demand for money M2 denominated in dram and foreign currency deposits; this will enable us to analyze dollarization in the model. Money demand in dram is determined by usual determinants as GDP and short term interest rates and in addition by remittances. The demand for foreign currency is found to be quite well explained by the rate of depreciation of the Dram and the remittances. Government revenues have been modeled in a simple manner, assuming GDP being their main determinant. Nevertheless, the empirical estimation of this government revenue functions appears adequate.

The estimated structural relations yield –together with the set of definitions in the model- a small but concise macroeconomic model that provides an account of the goods, labor and money market and foreign sector. In most cases the structural relations could be estimated with some degree of plausibility and accuracy; model simulation is now needed to assess the tracking ability of the estimated model.

[5] The VECM has the co-integration relations built into the specifications so that it restricts the long-run behaviour of the endogenous variables to converge to their co-integrating relationship while considering at the same time the short-run adjustment dynamics towards the long-run equilibrium. The co-integration term is known as the error-correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments.

[6] The real US$ exchange rate and Russian real GDP were left out in the final estimation (3) as their inclusion leads to a very poorly estimation of the export function, probably due to multi-collinearity.

Monetary and exchange rate policies play an important role in the model and may need some additional explanation. In case of *exchange rate targeting*, the exchange rate is set according to a pre-determined path, leaving interest rates, money balances and foreign reserves to adjust to any ex-ante disequilibrium in money and financial markets, according to (14), (8)-(12) respectively. A *monetary targeting* policy implies that base money growth is set according to a pre-determined path, leaving interest rates and exchange rates to adjust; in other words it implies a floating exchange rate regime. In addition, the model could be set up in such a way that *interest rate targeting*, a *currency board* or *inflation targeting* strategies could be approximated. It should be noted that the outcomes of in-sample simulations with the model are not critically dependent on the assumptions about the monetary regime, it merely concerns the assumptions which monetary variables are pre-determined and which are endogenous. With out-of-sample forecasting exercises the assumptions about the monetary policy regime are of course more crucial than in the in-sample dynamic simulations. In the simulations, we assume an exchange rate targeting strategy, implying that the exchange rate is set according to some pre-specified path, leaving foreign reserves and base money endogenous. This assumption appears applicable to the case of Armenia currently. As noted in Section 2, the CBA considers to adopt an inflation targeting strategy. Even this strategy may not be entirely contradictory to our approach here in case the exchange rate will be used as the main operational target as it is likely to be the case.

Figure 1 provides a dynamic in-sample simulation of the model. The solid lines indicate the actual data, the dotted lines the simulated adjustment according to the model. The model is simulated for the three-year period 2005:I-2007:IV. Dynamic simulations are an appropriate (and demanding) manner to assess the tracking ability of models. Dynamic simulation implies that the simulation model is provided the adjustment path of the exogenous variables plus the initial value of the endogenous variables in the model. It answers the question whether or not the model –given the adjustment of the exogenous variables- would predict comparable adjustment dynamics as those that have actually resulted.

Even if the model does not track all variables exactly –as to be expected given the simplicity of the model and the complexity of actual macroeconomic developments- the model in many cases follows quite well the direction of the observed adjustments.

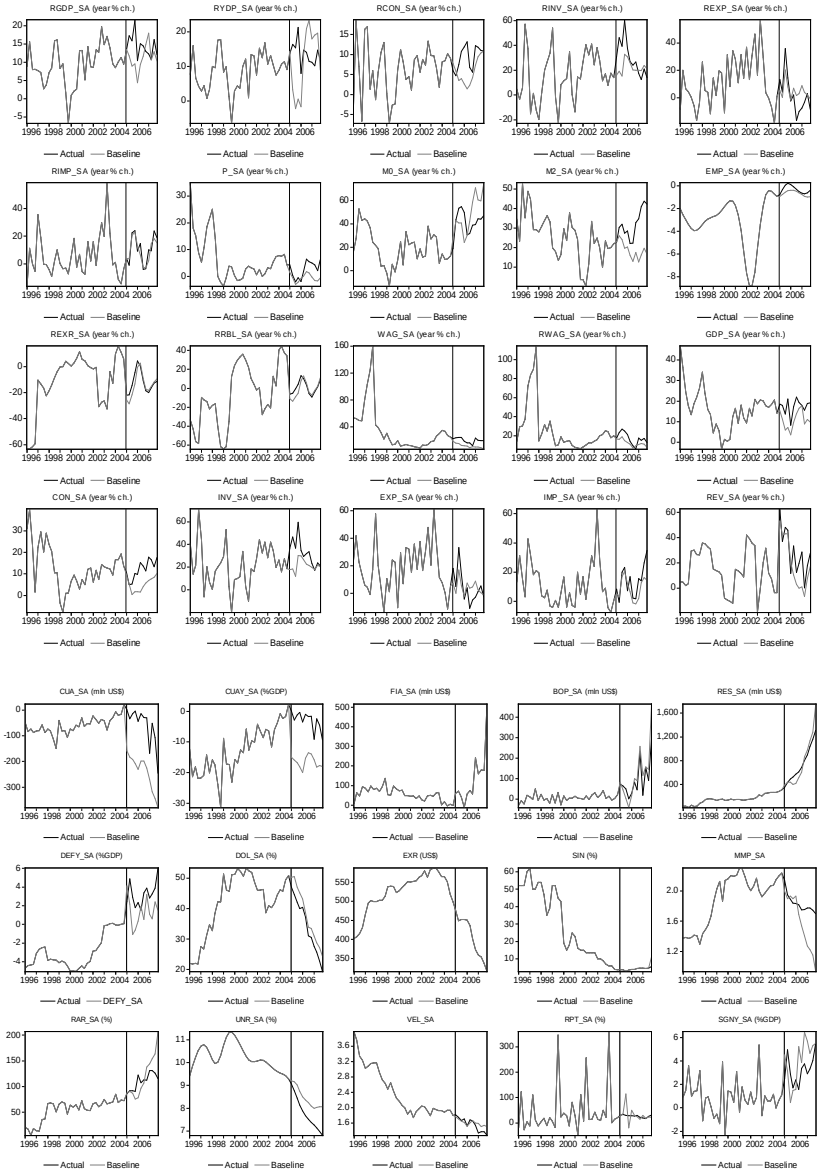


Figure 1: In-sample simulation 2006: I – 2007: IV

5. Alternative Macroeconomic Scenarios

In this section we simulate a few out-of-sample scenarios of the small-scale dynamic macroeconomic model of the Armenian economy. The simulations concern a three year period, 2008:I-2010:IV. In the baseline scenario the model is

simulated using the paths for the exogenous variables as specified in Table 3. While the results in the baseline scenario are sensitive -at least to some extent- to assumptions about each exogenous variable itself, it is assumed that the baseline is not too unrealistic to serve as a reference that can be used to compare the outcomes under the following changes in exogenous variables: Scenario 1 considers a decrease in remittances, Scenario 2 an appreciation of the exchange rate, Scenario 3 an increase in the oil price, Scenario 4 an increase in the risk premium, and Scenario 5 a decrease in the growth rate of government consumption.

Table 3: Baseline and alternative scenarios, 2008: I-2011: IV.

Baseline scenario 2008:I 2010:IV	
CGD : constant	*GEX* : 10% growth p.a.
CIN : constant	*LAB* : constant
CLB : constant	*OCF*$: 0
CLG : constant	*OIL* : 85$
ERR$: 0	*PPI_US* : 3% growth p.a.
EXR : 325	*PPI_RUS* : 8% growth p.a.
EXR_RUS : 25	*REM*$: 425 mln US$
FDI$: 200 mln US$	*SIN_US* : 3% p.a.
FDO$: 0	*WTR*: 6% growth p.a.
GCO : 10% growth p.a.	
GDP_RUS : 14% growth p.a.	
Alternative scenarios 2008:I 2010:IV	
*REM$*_1 = 325 mln US$	
*EXR*_2 = 300	
*OIL*_3 = 125 US$	
*RP*_4 = 6% p.a.	
GCO_5 = 6% growth p.a.	

The first alternative scenario demonstrates the important role of remittances in the Armenian economy. Changes in remittances are transmitted through various channels in the model as explained in description of the model. In the baseline remittances equal 425 mln US$ (per quarter) and in Scenario 1 remittances are reduced to 325 mln US$. Figure 2 shows the simulated effects of the drop in remittances.

Compared to the baseline, a drop in remittances, decreases consumption as disposable income decreases. Imports decline with a lag and this starts to contribute to GDP growth catching up again with the baseline after an initial drop in growth compared to baseline. Since remittances are a balance-of-payments item (included in the financial account), the drop in remittances has direct consequences in the form of a lower balance-of-payments surplus, lower foreign reserves and lower (base) money (growth). Another effect of remittances in the model results from the impact of foreign currency deposits and dollarization: lower remittances reduce dollarization. Finally, the lower rate of base money growth reduces seignorage revenues, thereby resulting also in some fiscal fall-out. This example,

therefore, illustrates quite directly, the importance of foreign remittances to the Armenian economy and the presences of a number of different channels that contribute to this.[7]

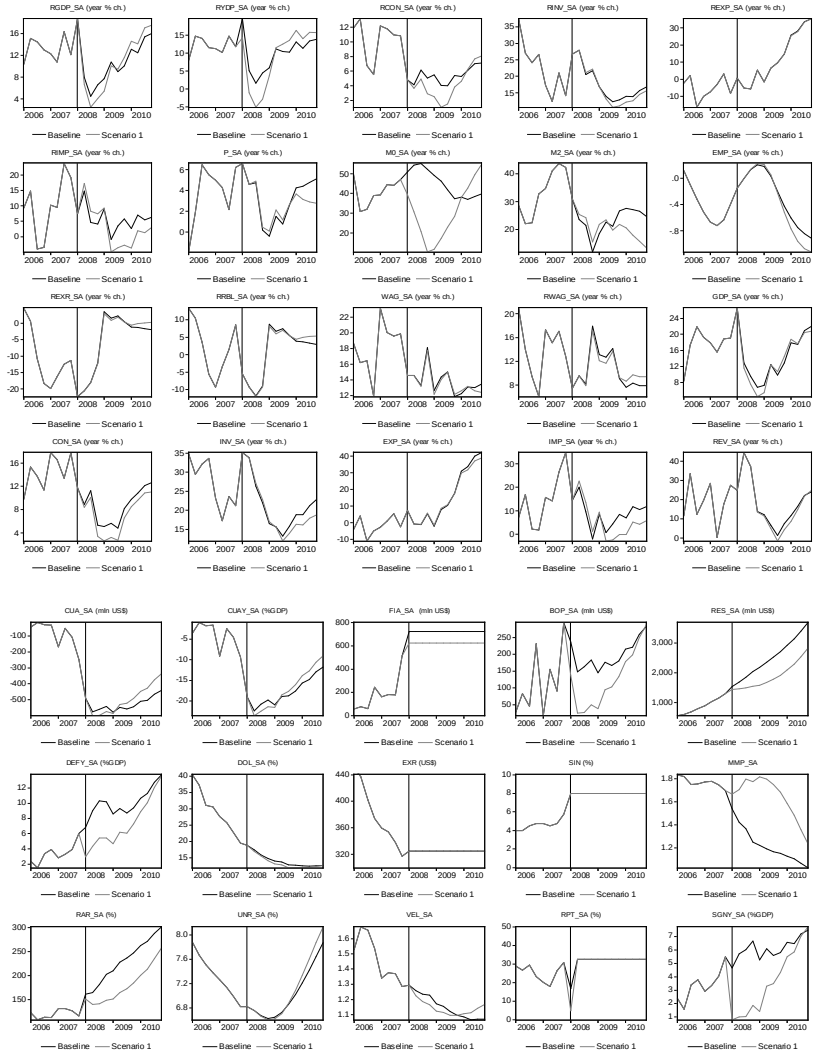


Figure 2: Simulation 2008: I – 2010: IV, baseline vs. Scenario 1, a decrease in remittances.

[7] In case of a floating exchange rate, results of a change in remittances would be quite different: in that case a decrease in remittances would be absorbed by a depreciation of the exchange rate which would crowd-in net exports thereby compensating for the drop in consumption resulting from the drop in remittances.

In Scenario 2 we study the effects of an instantaneous revaluation of the Dram of 7.5% from 325 in the baseline to 300 per US$ in Scenario 28. The effects that these alternative exchange rate scenarios produce are given in Figure 3.

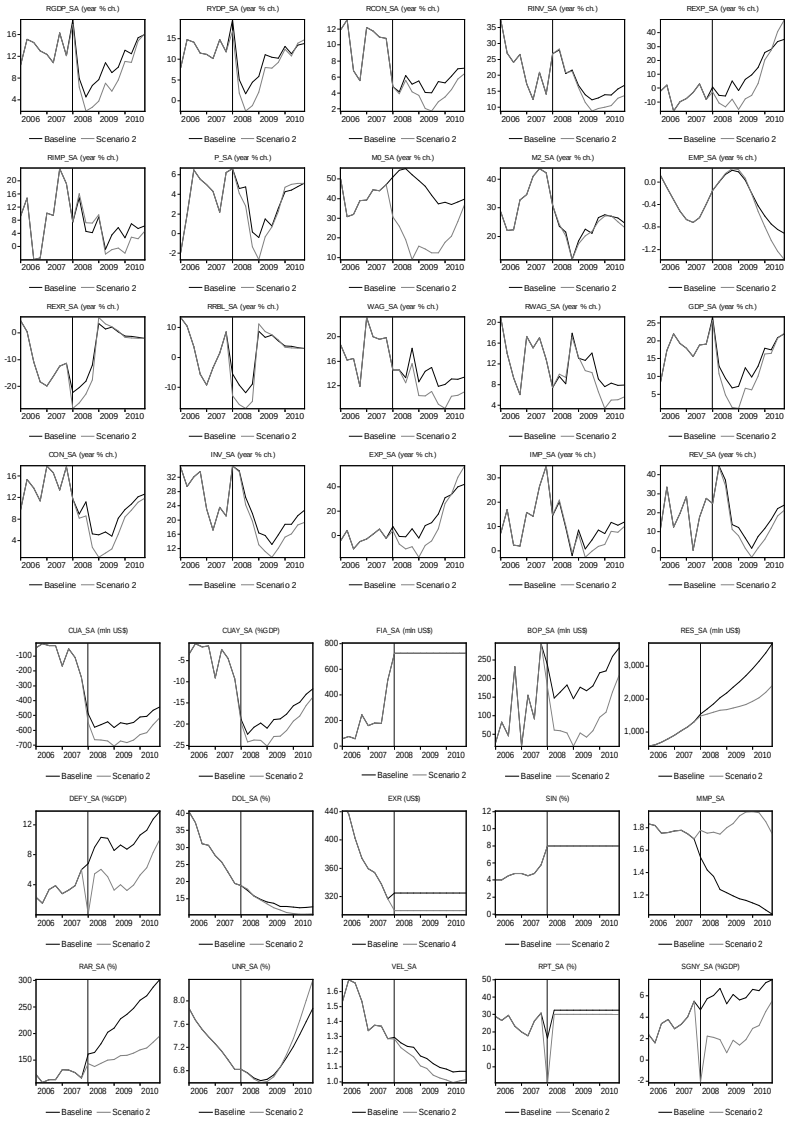
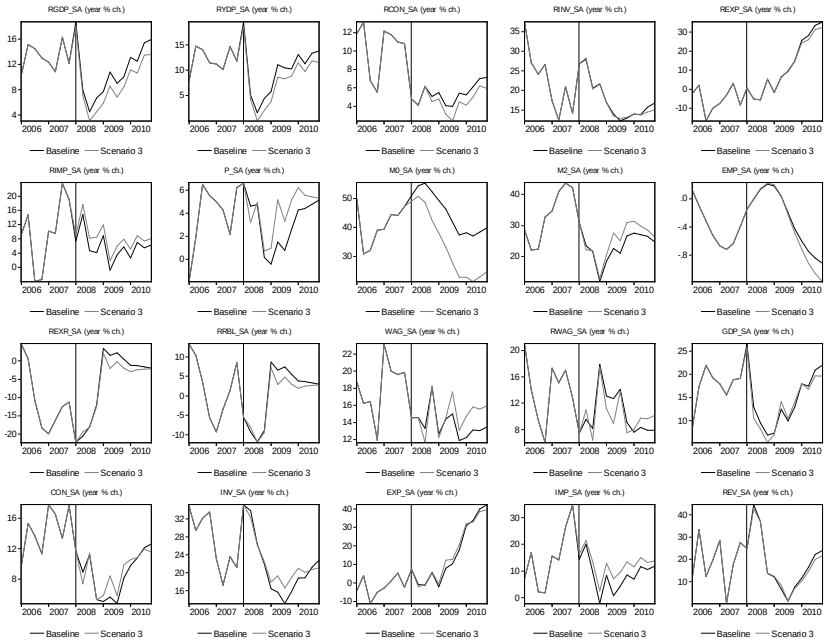


Figure 3: Simulation 2008: I – 2010: IV, baseline vs Scenario 2, an appreciation Dram.

[8] Note that in the model this is at the same time a 7.5% depreciation against the Ruble.

An appreciation of the exchange rate has a large number of effects in a small open economy like Armenia. Firstly there are trade effects: exports tend to grow less than in the baseline and imports to grow faster as the nominal appreciation is also a real appreciation as is seen in the adjustment of the real exchange rate against the Dollar and Ruble. Secondly, price effects reduce the price of imports and oil in domestic currency which moderates domestic inflation. Thirdly, dollar remittances (assuming that their volume remains constant) decline in value in terms of domestic currency, dragging disposable income and consumption growth quite markedly in the example. This perhaps less obvious effect may actually be quite important in the case of Armenia where remittances are sizeable. The simulated effect on real disposable income and consumption is indeed considerable even if of course also other transmission mechanisms may play a role. Fourthly, the decline in the current account has a negative impact (all compared to baseline) on the balance-of-payments, foreign reserves and base money growth. Finally, there is a direct effect on dollarization as an appreciation makes holding Drams more attractive compared to foreign currency.

In Scenario 3 the oil price increases to 125$ compared to the baseline of 85$. In contrast to other countries in the region, Armenia has no oil and gas production and is dependent on imports to cover its energy needs. Figure 4 displays the effects of this oil price shift in the model.



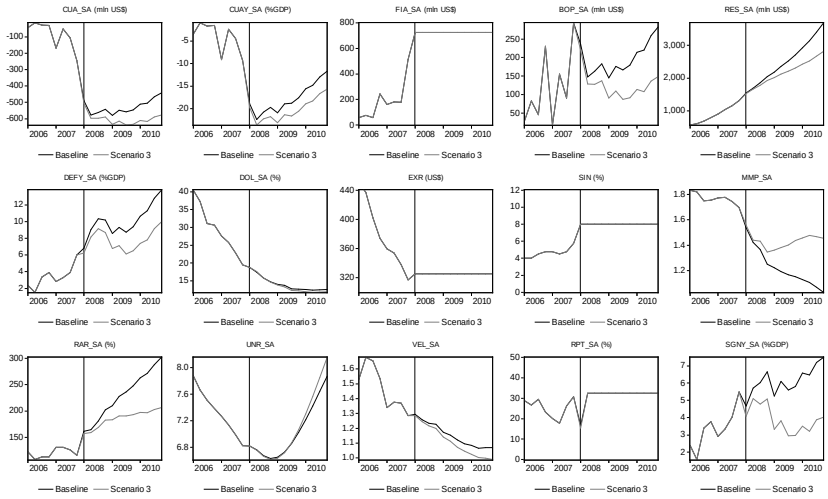


Figure 4: Simulation 2008: I – 2010: IV, baseline vs. Scenario 3, an increase in oil price.

The increase in the oil price is a shift factor in imports of importance. In the simulation of this shock in the model, imports increase, real output growth declines and price and wage inflation rise as a result of the higher oil price (compared to the baseline). The reduction of the current account balance implies a reduction in foreign reserves reducing base money growth. Given the increase in imports and the reduction in foreign reserves, the reserve adequacy ratio is reduced from two sides. We observe somewhat lower employment growth and a higher unemployment rate due to lower output growth.9

Armenia has undertaken a rapid liberalization process since 1999. This has led to a very liberalized capital account. Notwithstanding many economic benefits that relate to having much improved access to international financial markets, it may also increase vulnerabilities to disruptions in international financial markets and speculative flows. There are two places in our model where increased financial turmoil may exert their impact on the Armenian economy: a change in the amount of short-term speculative capital inflows variable, OCF, and a change in the risk premium on Armenian financial assets, RP. 10 Both are exogenous in the model for simplicity. We concentrate on the effects of changes in the Armenian risk premium

[9] Increasing energy subsidies would be another possible consequence of higher oil prices for the Armenian economy, inducing an increase in the deficit. We have not included such a mechanism in government spending and kept it exogenous in the model.

[10] See Pogosyan et al. (2008) for a model that endogenizes the risk premium on Armenian assets. Interestingly, their results point at the possibility that interventions by the CBA and remittances could be important determinants to the Armenian risk premium.

(reflecting e.g. changing perceptions of Armenian macroeconomic and/or political stability, or even broader changes in perceptions on emerging market economies making investors more or less risk averse towards investing in them). In Scenario 4 (displayed in Figure 5), an increase in the risk premium is simulated: it shows the effects of an increase from 3% in the baseline to 6%.

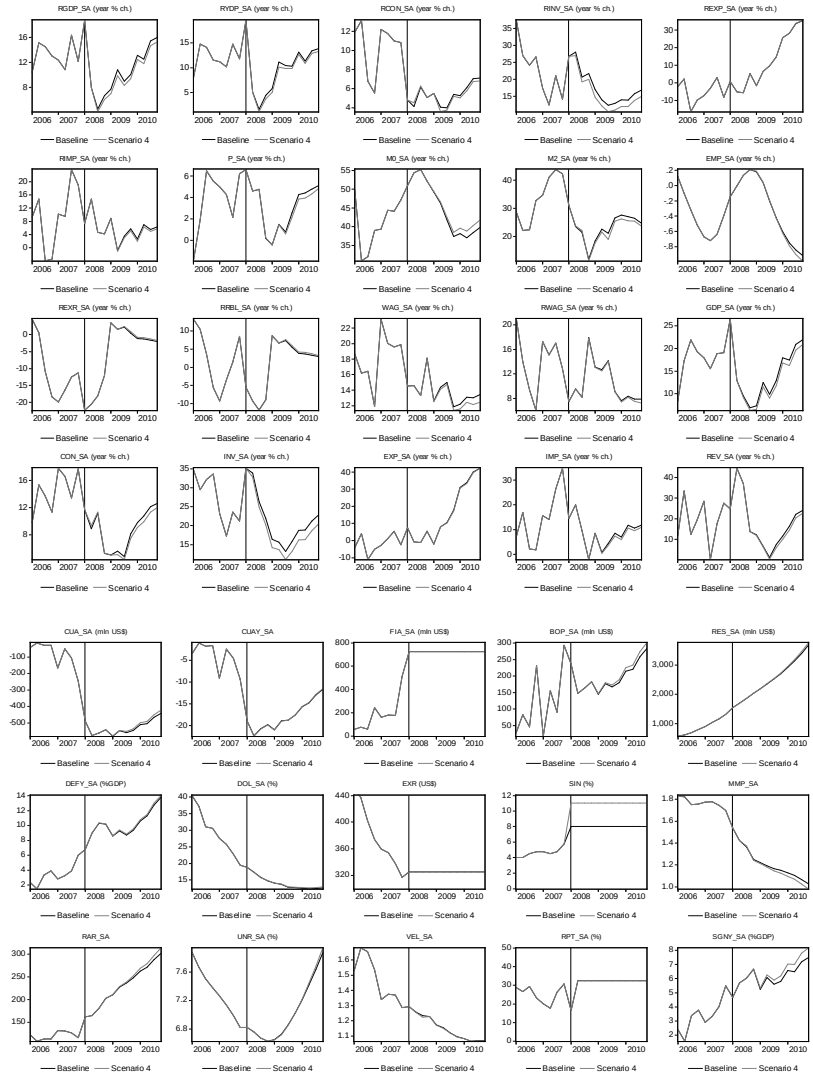
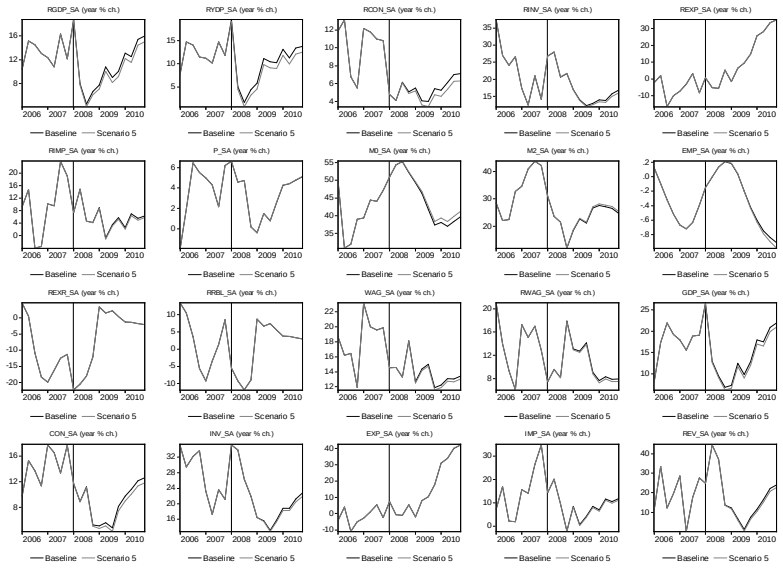


Figure 5: Simulation 2008: I – 2010: IV, baseline vs. Scenario 4, an increase in risk premium.

The transmission channels of this shock in the model are as follows: the increase in the Armenian risk premium increase interest rates. This directly affects investment and consumption as real borrowing costs increase. Lower output growth reduces employment and imports. As a result of the latter, the current account balance improves, and foreign reserves and base money increase compared to the baseline. Higher interest rates also reduce the demand for broad money which on its turn moderates inflation and thereby wage growth.

The Armenian government has maintained a balanced budget during the last years as part of a comprehensive fiscal reform and consolidation strategy, achieving more fiscal sustainability after several years of rampant fiscal deficits in the 1990s. Also 'off-budget' items e.g. implicit liabilities relating to arrears, pensions and energy-related subsidies appear to be more controlled and this 'quasi-fiscal deficit' reduced. The size of the government in GDP has also been gradually reduced, partly of course also due to a denominator effect with higher growth. In our last simulation example –found in Figure 6- we take a closer look at the possible effects of fiscal adjustments in the current Armenian context. Scenario 5 assumes an decrease in the growth rate of government consumption from 10% in the baseline to 6% in Scenario 5, reflecting e.g. an expenditure rationalization and improved fiscal management strategy that may have some plausibility in the case of the Armenian fiscal outlays.



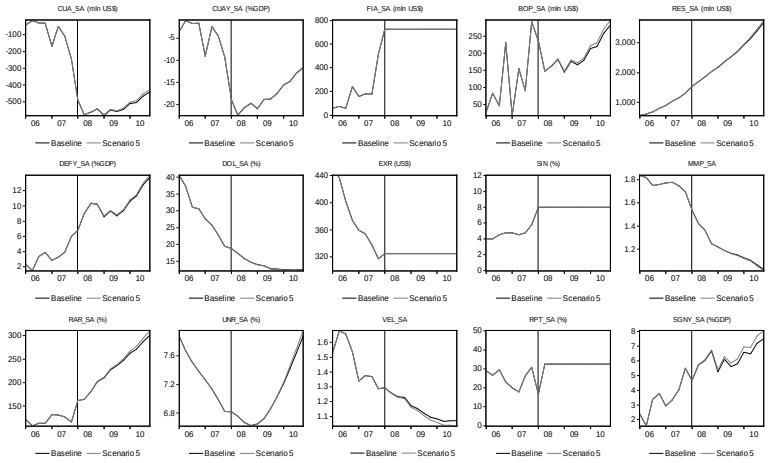


Figure 6: Simulation 2008: I – 2010: IV, baseline vs. Scenario 5, a decrease in government consumption growth.

The transmission channels of fiscal policy in the model are rather standard and focus on the spending effects: lower government consumption reduces spending and thereby output. This creates second order negative effects on variables such as consumption, imports, employment, current account and money. Effects on nominal variables such as prices, exchange rate are very small.

6. Conclusion

This paper developed, estimated and simulated a small, dynamic macro-economic model of the Armenian economy. Aim was to construct a model that was both not too large in the light of data limitations but would at the same time incorporate and highlight a number of interesting mechanisms that are important characteristics of the Armenian economy: the transition from low growth, high inflation to high growth, low inflation, financial and monetary deepening, the important role of remittances and the exchange rate, the presence of dollarization and strong and direct transmissions of monetary policy in this small open economy.

The model enables to analyze the effects on internal and external balance and goods-, labour- and money market dynamics in the Armenian economy produced by shocks to a set of exogenous variables. We focused on the possible effects of shocks to remittances, exchange rate, oil price, risk premium on Armenian assets and government consumption using out-of-sample simulations of the model of the Armenian economy during the period 2008:I-2010:IV.

These simulations gave in particularly more insight into the important role of remittances, the exchange rate and energy prices in the Armenian and how

changes therein may transmit themselves in various ways to the most important Armenian macroeconomic variables.

Extensions of the analysis can be envisaged in several directions: extending the number of shocks by considering e.g. shocks to FDI inflows or shocks to world trade reflecting the recent global economic slowdown. More generally, the effects of the recent global economic slowdown is likely to affect the Armenian economy in various ways. The current analysis identified the main channels by which the global factors may affect the Armenian economy. It would be interesting to analyse this more systematically in an follow-up study of the current one as preliminary data suggest that Armenian growth stalled during 2009. Another interesting directions could be to add additional mechanisms to the fiscal block in the form of endogenous fiscal spending and the accumulation of domestic and foreign government debt. This is also left here for future research.

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Appendix: Data sources and Estimation results

The following data have been used in the analysis:

Table A.1: Variables and Data Sources

Variable	*Name*	*Units*	*Source*
CON	Private consumption	bln n.c.	IMF IFS line 96F..ZF and nat.stat.off.
RCON	Real consumption	bln n.c.	calculated as *RCON≡CON/P*
SIN	Money market interest rate	%	IMF IFS line 60B..ZF
YDP	Disposable income	bln n.c.	calculated as *YDP≡GDP+REM-REV+TRA*
RYDP	Real disposable income	bln n.c.	calculated as *RYDP≡YDP/P*
INV	Gross fixed capital formation	bln n.c.	IMF IFS line 93E..ZF and nat.stat.off.
GDP	Gross domestic product	bln n.c.	calculated as *GDP≡CON+INV+EXP-IMP+CIN+GCO*
P	CPI/Price level	1995=100	IMF IFS line 64..ZF
RGDP	Real gross domestic product	bln n.c.	calculated as *RGDP≡GDP/P*
EXP	Exports of goods and services	bln n.c.	IMF IFS line 90C..ZF and nat.stat.off.
REXP	Real exports	bln n.c.	calculated as *REXP≡EXP/P*
EXR	Exchange rate vs US$	per.avg	IMF IFS line ..RF.ZF
REXR	Real exchange rate vs US$	per.avg	calculated as $REXR \equiv EXR * PPI^{US}/P$
WTR	World trade	bln US$	calculated from IMF IFS
IMP	Imports of goods and services	bln n.c.	IMF IFS line 98C..ZF and nat.stat.off.
RIMP	Real imports	bln n.c.	calculated as *RIMP≡IMP/P*
OIL	Oil price	$ per barrel	IMF IFS line
M2	Money, M2	bln n.c	National Bank of Armenia
M2D	Money, M2 denominated in n.c.	bln n.c.	calculated from *M2 - FCD*
FCD	Foreign currency deposits	bln n.c.	National Bank of Armenia
EMP	Employment	1000 persons	IMF IFS line 67E..ZF and nat.stat.off.
WAG	Wages	n.c.	IMF IFS line 65...ZF and nat.stat.off.
UNE	Unemployment	1000 persons	IMF IFS line 67C..ZF and nat.stat.off.
REV	Government revenue	bln n.c.	IMF IFS line 81...ZF and nat.stat.off.
GEX	Government expenditure	bln n.c.	IMF IFS line 82...ZF and nat.stat.off.
GCO	Government consumption	bln n.c.	IMF IFS line 91F..ZF and nat.stat.off.
CIN	Change in inventories	bln n.c.	IMF IFS line 93L..ZF and nat.stat.off.
RES$	Foreign exchange reserves	mln US$	IMF IFS line .1L.DZF
CUA$	Trade balance	mln US$	calculated as *CUA≡(EXP-IMP)/EXR*
FIA$	Capital account	mln US$	IMF IFS line 78BJDZF
FDI$	Foreign direct investment	mln US$	IMF IFS line 78BEDZF
FDO$	Outward FDI	mln US$	IMF IFS line 78BEDZF
OCF$	Other capital flows	mln US$	calculated as *OCF$≡FIA$-FDI$+FDO$*
REM$	Remittances in US$	mln US$	
REM	Remittances in n.c.	mln dram, quarterly	calculated as *REM$*EXR*
M0	Base money, M0	bln n.c.	IMF IFS line 14..ZF and NBA
CBC	Central Bank credit to banks	bln n.c.	IMF IFS line 12E..ZF and NBA
CLG	Central Bank lending to govt.	bln n.c.	IMF IFS line 12A..ZF and NBA
CGD	Deposits govt. at CB	bln n.c.	IMF IFS line 16D..ZF and NBA
LAB	Labour force	1000 persons	calculated as *LAB≡EMP+UNE*

Table A.2: Vector Error Correction Estimates

Sample: 1996Q1 2007Q4 (48 observations)

t-statistics in brackets, _SA denotes seasonally adjusted

(1) Cointegrating Eq: CointEq1

LOG(RCON_SA(-1)) = 0.08*(SIN(-1)-@PCY(P_SA(-1)))/100+0.69*LOG(RYDP_SA(-1))-3.92
[2.14] [35.04] [0.76]

Error correction

D(LOG(RCON_SA)) = -0.36*CointEq1-0.003*D(LOG(RCON_SA(-1)))-0.11*D(LOG(RCON_SA(-2)))
[-1.26] [-0.01] [-0.53]

-0.06*D(LOG(RCON_SA(-3)))+0.11*D((SIN(-1)-@PCY(P_SA(-1)))/100)-0.08*D((SIN(-2)
[-0.37] [1.18] [-1.27]

-@PCY(P_SA(-2)))/100)-0.02*D((SIN(-3)-@PCY(P_SA(-3)))/100) -0.14*D(LOG(RYDP_SA(-1)))
[-1.14] [-0.84]

--0.08*D(LOG(RYDP_SA(-2)))-0.01*D(LOG(RYDP_SA(-3)))+0.03
[-0.48] [-0.08] [2.43]

R-squared: 0.34 Adj. R-squared: 0.16 Sum sq. resids: 0.05
S.E. equation: 0.04 F-statistic: 1.90 Log likelihood: 98.27
Mean dependent: 0.02 S.D. dependent: 0.04

(2) Cointegrating Eq: CointEq1

LOG(RINV_SA(-1)) = -1.53*(SIN(-1)-@PCY(P_SA(-1)))/100+1.60*LOG(RGDP_SA(-1))-8.86
[-2.54] [5.16] [-1.76]

Error Correction:

D(LOG(RINV_SA)) = -0.15*CointEq1+0.10*D(LOG(RINV_SA(-1)))-0.18*D(LOG(RINV_SA(-2)))
[-2.93] [0.83] [-1.50]

-0.02*D((SIN(-1)-@PCY(P_SA(-1)))/100)+0.09*D((SIN(-2)-@PCY(P_SA(-2)))/100)
[-0.17] [0.72]

-0.63*D(LOG(RGDP_SA(-1)))+0.06*D(LOG(RGDP_SA(-2)))+0.049
[-1.48] [0.13] [2.40]

R-squared: 0.66 Adj. R-squared: 0.55 Sum sq. resids: 0.21
S.E. equation: 0.08 F-statistic: 6.21 Log likelihood: 62.29
Mean dependent: 0.05 S.D. dependent: 0.12

(3) Cointegrating Eq: CointEq1

LOG(REXP_SA(-1)) = 0.41*LOG(RRBL_SA(-1))+0.75*LOG(WTR_SA(-1))-12.35
[4.26] [7.90] [-4.34]

Error Correction:

D(LOG(REXP_SA)) = -0.37*CointEq1+0.01*D(LOG(REXP_SA(-1)))+0.52*D(LOG(REXP_SA(-2)))
[-2.31] [0.03] [2.52]

+0.64*D(LOG(REXP_SA(-3)))+0.18*D(LOG(REXP_SA(-4)))-0.07*D(LOG(RRBL_SA(-1)))
[3.16] [1.23] [-0.75]

-0.18*D(LOG(RRBL_SA(-2)))-0.02*D(LOG(RRBL_SA(-3)))+0.22*D(LOG(RRBL_SA(-4)))
[-2.02] [-0.18] [2.73]

+1.28*D(LOG(WTR_SA(-1)))+1.04*D(LOG(WTR_SA(-2)))+0.42*D(LOG(WTR_SA(-3)))
[2.18] [1.81] [0.69]

+0.18*D(LOG(WTR_SA(-4)))+0.42*D(LOG(RGDP_RUS_SA*EXR))
[0.34] [2.30]

R-squared: 0.68 Adj. R-squared: 0.52 Sum sq. resids: 0.20
S.E. equation: 0.08 F-statistic: 4.06 Log likelihood: 61.19
Mean dependent: 0.02 S.D. dependent: 0.12

(4) Cointegrating Eq: CointEq1

LOG(RIMP_SA(-1) = -0.14*LOG(RGDP_SA(-1))+0.94*LOG(REM_SA(-1)*EXR(-1))
[-0.90] [6.53]

-0.56*LOG(RRBL_SA(-1))+0.74*LOG(REXR_SA(-1))
[-7.41] [8.36]

Error Correction:

D(LOG(RIMP_SA)) = -0.09*CointEq1-0.34*D(LOG(RIMP_SA(-1)))-0.09*D(LOG(RIMP_SA(-2)))
[-0.49] [-1.44] [-0.36]

+0.18*D(LOG(RIMP_SA(-3)))-0.16*D(LOG(RIMP_SA(-4)))+0.07*D(LOG(RGDP_SA(-1)))
[0.70] [-0.74] [0.17]

+0.23*D(LOG(RGDP_SA(-2)))+0.43*D(LOG(RGDP_SA(-3)))+0.52*D(LOG(RGDP_SA(-4)))
[0.61] [1.00] [1.24]
-0.16*D(LOG(REM_SA(-1)*EXR(-1)))-0.17*D(LOG(REM_SA(-2)*EXR(-2)))
[-1.35] [-1.78]
-0.12*D(LOG(REM_SA(-3)*EXR(-3)))-0.01*D(LOG(REM_SA(-4)*EXR(-4)))
[-1.31] [-0.06]
+0.10*D(LOG(RRBL_SA(-1)))+0.27*D(LOG(RRBL_SA(-2)))-0.01*D(LOG(RRBL_SA(-3)))
[0.46] [0.83] [-0.02]
-0.06*D(LOG(RRBL_SA(-4)))-0.14*D(LOG(REXR_SA(-1)))-0.43*D(LOG(REXR_SA(-2)))
[-0.32] [-0.62] [-1.21]
-0.16*D(LOG(REXR_SA(-3)))+0.02*D(LOG(REXR_SA(-4)))+0.03*D(LOG(OIL*EXR))
[-0.45] [0.09] [0.49]
R-squared: 0.52 Adj. R-squared: 0.11 Sum sq. resids: 0.14
S.E. equation: 0.073 F-statistic: 1.26 Log likelihood: 71.03
Mean dependent: 0.02 S.D. dependent: 0.08

(5) Cointegrating Eq: CointEq1
LOG(M2D_SA(-1)*100/P_SA(-1)) = -1.71*SIN(-1)/100+0.08*LOG(RGDP_SA(-1)))
[-3.54] [0.16]
+1.12*LOG(REM_SA(-1)*EXR(-1))
[1.83273]
Error Correction:
D(LOG(M2D_SA*100/P_SA)) = -0.04*CointEq1-0.01*D(LOG(M2D_SA(-1)*100/P_SA(-1)))
[-2.67] [-0.05]
+0.18*D(LOG(M2D_SA(-2)*100/P_SA(-2)))+0.26*D(LOG(M2D_SA(-3)*100/P_SA(-3)))
[1.15] [1.75]
+0.14*D(SIN(-1)/100)+0.22*D(SIN(-2)/100)-0.36*D(SIN(-3)/100)
[0.67] [1.24] [-1.99]
+0.001*D(LOG(RGDP_SA(-1)))-0.32*D(LOG(RGDP_SA(-2)))-0.31*D(LOG(RGDP_SA(-3)))
[0.00] [-0.90] [-0.96]
-0.13*D(LOG(REM_SA(-1)*EXR(-1)))-0.07*D(LOG(REM_SA(-2)*EXR(-2))) -0.07*D(LOG(REM_SA(-3)*EXR(-3)))
[-2.13] [-1.06] [-1.24]
R-squared: 0.37 Adj. R-squared: 0.16 Sum sq. resids: 0.15
S.E. equation: 0.07 F-statistic: 1.72 Log likelihood: 70.90
Mean dependent: 0.05 S.D. dependent: 0.07

(6) Cointegrating Eq: CointEq1
LOG(FCD_SA(-1)) = 0.23*@PCY(EXR(-1))+1.18*LOG(REM_SA(-1)*EXR(-1))
[3.91] [-17.41]
Error Correction:
D(LOG(FCD_SA)) = -0.02*CointEq1-0.09*D(LOG(FCD_SA(-1)))+0.14*D(LOG(FCD_SA(-2)))
[-3.67] [-0.76] [1.26]
+0.22*D(LOG(FCD_SA(-3)))+0.10*D(LOG(FCD_SA(-4)))-0.01*D(@PCY(EXR(-1)))
[2.17] [1.04] [-2.97]
+0.002*D(@PCY(EXR(-2)))-0.01*D(@PCY(EXR(-3)))-0.001*D(@PCY(EXR(-4)))
[0.75] [-2.51] [-0.88]
+0.02*D(LOG(REM_SA(-1)*EXR(-1)))-0.07*D(LOG(REM_SA(-2)*EXR(-2)))
[0.33] [-1.22]
+0.04*D(LOG(REM_SA(-3)*EXR(-3)))+0.07*D(LOG(REM_SA(-4)*EXR(-4)))
[0.56] [1.34]
R-squared: 0.78 Adj. R-squared: 0.65 Sum sq. resids: 0.09
S.E. equation: 0.06 F-statistic: 6.03 Log likelihood: 79.83
Mean dependent: 0.06 S.D. dependent: 0.10

(7) Cointegrating Eq: CointEq1
LOG(REV_SA(-1)*100/P_SA(-1)) = 1.24*LOG(GDP_SA(-1)*100/P_SA(-1))-4.70
[33.06] [-10.05]
Error Correction:
D(LOG(REV_SA*100/P_SA)) = -0.71*CointEq1+0.30*D(LOG(REV_SA(-1)*100/P_SA(-1)))
[-6.30] [2.67]
+0.21*D(LOG(REV_SA(-2)*100/P_SA(-2)))+0.27*D(LOG(REV_SA(-3)*100/P_SA(-3)))
[2.07] [2.81]
-0.94*D(LOG(GDP_SA(-1)*100/P_SA(-1)))-0.41*D(LOG(GDP_SA(-2)*100/P_SA(-2)))
[-3.13] [-1.52]

-0.43*D(LOG(GDP_SA(-3)*100/P_SA(-3)))
[-1.80]
R-squared: 0.74 Adj. R-squared: 0.68 Sum sq. resids: 0.14
S.E. equation: 0.06 F-statistic: 12.23 Log likelihood: 73.40
Mean dependent: 0.03 S.D. dependent: 0.11

(8) Cointegrating Eq: CointEq1
LOG(EMP_SA(-1)) = 0.14*LOG(RWAG_SA(-1))+0.50*LOG(RGDP_SA(-1))-0.02*@TREND+0.01
[-2.01] [-2.10] [2.70] [0.14]
Error Correction:
D(LOG(EMP_SA)) = -0.01*CointEq1+1.51*D(LOG(EMP_SA(-1)))-0.93*D(LOG(EMP_SA(-2)))
[-4.75] [11.86] [-4.73]
+0.21*D(LOG(EMP_SA(-3)))+0.001*D(LOG(RWAG_SA(-1)))-0.002*D(LOG(RWAG_SA(-2)))
[2.12] [0.05] [-1.56]
-0.002*D(LOG(RWAG_SA(-3)))-0.01*D(LOG(RGDP_SA(-1)))-0.003*D(LOG(RGDP_SA(-2)))
[-1.18] [-2.96] [-0.74]
+0.0003*D(LOG(RGDP_SA(-3)))-0.0004
[0.08] [-1.41]
R-squared: 0.99 Adj. R-squared: 0.98 Sum sq. resids: 0.01
S.E. equation: 0.001 F-statistic: 269.47 Log likelihood: 285.15
Mean dependent:-0.01 S.D. dependent: 0.01

(9) Cointegrating Eq: CointEq1
LOG(WAG_SA(-1)) = -0.59*LOG(UNE_SA(-1))+3.08*LOG(P_SA(-1))+0.21*LOG(PRO_SA(-1))
[-2.60] [8.94] [1.21]
Error Correction:
D(LOG(WAG_SA)) = -0.13*CointEq1+0.09*D(LOG(WAG_SA(-1)))-0.05*D(LOG(WAG_SA(-2)))
[-1.57] [0.89] [-0.36]
-0.44*D(LOG(UNE_SA(-1)))+0.46*D(LOG(UNE_SA(-2)))+0.52*D(LOG(P_SA(-1)))
[-0.38] [0.42] [0.99]
-0.56*D(LOG(P_SA(-2)))+0.07*D(LOG(PRO_SA(-1)))+0.25*D(LOG(PRO_SA(-2)))+0.05
[-1.02] [0.24] [0.91] [1.90]
R-squared: 0.67 Adj. R-squared: 0.58 Sum sq. resids: 0.13
S.E. equation: 0.06 F-statistic: 7.35 Log likelihood: 73.56
Mean dependent: 0.06 S.D. dependent: 0.09

(10) Cointegrating Eq: CointEq1
LOG(P_SA(-1)) = 0.16*LOG(WAG_SA(-1))+0.08*LOG(EXR(-1))+0.02*LOG(OIL(-1)*EXR(-1))
[-9.87] [-5.40] [-2.43]
+0.10*LOG(M2_SA(-1))-0.004*@TREND+1.70
[-2.54] [-1.76] [0.97]
Error Correction:
D(LOG(P_SA)) = -0.57*CointEq1+0.23*D(LOG(P_SA(-1)))+0.06*D(LOG(P_SA(-2)))
[-2.44] [1.08] [0.30]
+0.25*D(LOG(P_SA(-3)))+0.09*D(LOG(P_SA(-4)))+0.06*D(LOG(WAG_SA(-1)))
[1.63] [0.64] [1.86]
+0.11*D(LOG(WAG_SA(-2)))+0.03*D(LOG(WAG_SA(-3)))+0.05*D(LOG(WAG_SA(-4)))
[3.14] [0.54] [0.91]
-0.01*D(LOG(EXR(-1)))+0.18*D(LOG(EXR(-2)))-0.02*D(LOG(EXR(-3)))+0.13*D(LOG(EXR(-4)))
[-0.04] [1.31] [-0.17] [1.02]
+0.04*D(LOG(OIL(-1)*EXR(-1)))-0.001*D(LOG(OIL(-1)*EXR(-2)))
[1.55] [-0.27]
+0.001*D(LOG(OIL(-1)*EXR(-3)))-0.001*D(LOG(OIL(-1)*EXR(-1)))
[0.40] [-0.41]
+0.05*D(LOG(M2_SA(-1)))+0.03*D(LOG(M2_SA(-2)))+0.10*D(LOG(M2_SA(-3)))
[0.77] [0.43] [1.59]
+0.09*D(LOG(M2_SA(-4)))-0.06+0.001*@TREND
[1.91] [-3.41] [2.45]
R-squared: 0.82 Adj. R-squared: 0.65 Sum sq. resids: 0.01
S.E. equation: 0.01 F-statistic: 4.85 Log likelihood: 151.97
Mean dependent: 0.01 S.D. dependent: 0.02