Exchange Rate Dynamics in Armenia

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Abstract

Together with the impressive economic growth, Armenia's exchange rate has significantly appreciated with respect to major currencies in nominal and real terms, which has triggered alarms in various parts of the society. The Central Bank of Armenia and the government on one side and known economists, businessmen, and political leaders on the other side, provided their own, mostly contrary, interpretations and arguments over the causes of the appreciation. This study, which is part of a larger doctoral dissertation research, attempts to understand the underlying economic fundamentals that explain exchange rate dynamics in Armenia. The BEER has been identified as an appropriate approach for modeling long-run exchange rate dynamics in Armenia.

Preliminary results show that Armenian currency has been misaligned from its long-run equilibrium path determined by the economic fundamental variables. However, the degree of misalignment is sensitive to the set of economic fundamental variables used in the estimation. Even though, both models presented in this study have strong statistical parameters and yield similar misalignment trends, they differ in the magnitude of the misalignment. Further analysis are necessary to study the sensitivity of the results to the choice of the variables. Additionally, given the theoretical ambiguity of the signs of majority of variables, additional work is required to make the right inference about the results.

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Note: The results presented in this study are preliminary and should not be used for referencing purposes. The final study and results will be made available via request from the authors. Comments and suggestions are gladly welcome.

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Introduction

Economic problems associated with exchange rate dynamics have become one of the central issues dominating macroeconomic scientific research. Determination of the *right* exchange rate has been one of the key objectives for international investors, multinational corporations, and scientists (Rosenberg, 2003). Equally, the choice/adoption of the right exchange rate regime was on the agenda during 1980s and 1990s transition process from centrally planned to market oriented economies in the countries of the former Soviet Union (FSU) and Central and Eastern Europe (CEE). Several scientists have blamed economic crises in the developing world as being directly or indirectly caused by the inappropriate exchange rate policies in those countries[2]. Understanding of exchange rate behavior, underlying determinants, equilibrium path, exchange rate misalignment, and the impact on the overall economic performance and competitiveness have always been of great importance in the exchange rate literature (Edwards, 1989; Égert et al., 2005).

Productivity growth, increases in real wages, liberalization of capital accounts, increased foreign direct investments (FDI), and private remittances put an upward pressure on the real exchange rates. In recent years an exchange rate appreciation trend has been observed among many transition economies of the FSU and CEE, which raised the issue of whether this trend reflects adjustment towards equilibrium due to an initial undervaluation, or whether it corresponds to an equilibrium appreciation. As a result, supported with increased availability of data points and quality, exchange rate research focusing on developing and transition economies has witnessed unprecedented growth (Égert et al., 2005).

Appreciation of exchange rates has very important macroeconomic consequences. It may alter international competitiveness of the country, may affect inflation, output and FDI significantly, and may also signal a currency crisis (Dibooglu and Kutan, 2001). However, undervaluation of the currency may also have negative economic consequences. For example, it may lead to higher inflation and price instability due to dramatic growth in exports. Thus, adopting the *right* exchange rate policy and getting the exchange rate *right* becomes crucial for the overall success of the economy during the transition and in the long run (Égert et al., 2005).

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[2] Edwards (1989) refers to the 1980s debt crisis (Cline, 1983), failed experiments with free market policies in the Southern Cone (Corbo et al., 1986), and the disappointing performance of Africa's agricultural sector (World Bank, 1984).

This study is part of a doctoral dissertation that aims to discuss the macroeconomic implications of exchange rate dynamics on transition economies with a focus on Armenia.

Republic of Armenia is a land-locked country situated on the south-eastern edge of the Europe. For over 70 years it has been part of the Soviet Union. Before the devastating earthquake of 1988, which has paralyzed vast parts of its economy and killed more than 25,000 people, Armenia's scientific institutes were among the best in the entire Soviet block, supporting some of the highly recognized Soviet high technology and military developments. Its collective farms, kolkhozes and sovkhozes, vineyards, and factories produced some of the highest quality foods and consumer goods for a market of 286 million people. "Armenia was the California of Soviet high technology, the Italy of Soviet shoe manufacturing, the France of Soviet-made cognac" concludes the National Geographic (Viviano, 2004).

Fueled by liberal market and economic reforms that promoted investor confidence and boosted exports, Armenia was quick to recover from production decline experienced by all transition countries of the FSU and CEE (World Bank, 2007). Armenia's economic recovery started in 1994 along with the countries of CEE while the rest of the FSU countries (except Latvia) were still experiencing negative growth. Armenia's economy has registered double digit economic growth since 2001 averaging 12.26% annual growth during 2001-06 (World Bank, 2007; Roland, 2000; Iradian, 2007). Its exports grew by an average of 20.83% annually during 2000-05 surpassing all countries in the FSU and CEE. Armenia's inflation has also been surprisingly low averaging 2.6% annually during 2000-05, which is lower than other countries in FSU and CEE except Lithuania (0.9%), Czech Republic (2.5%), and Poland (2.5%) (World Bank, 2007; Iradian, 2007).

Such impressive economic performance in the last years has been accompanied with a rapid appreciation of the national currency, the Dram (ISO code: AMD), which has triggered alarms in various parts of the society. During 2003-2007, dram appreciated by 46, 27, and 29 percent with respect to US dollar, Euro, and Russian Ruble respectively (IMF, 2008) (see Figure 1).

The Central Bank of Armenia, prominent economists, businessmen, and politicians offered their own interpretation of the cause of the appreciation, in many cases causing further controversies on the matter. The Central Bank of Armenia (CBA) has backed official governments view that the current appreciation is linked to the drastic growth in cash remittances regularly sent home by hundreds of

thousands of Armenians working abroad, mainly in Russia, and relatives living in other countries, as well as continuously weakening of the US dollar in international currency markets. The CBA estimates that about 40 percent of households in Armenia receive remittances from abroad. Meanwhile, politicians and economists critical of government policies, argue that the authorities have engineered the appreciation to pocket part of the hard currency and benefit import businesses either controlled or owned by the government officials. But the CBA strongly denied all wrongdoing and currency manipulation and insist drastic increases in the dollar remittances are the major cause of such changes. According to the CBA, dollar value of remittances jumped by 50 percent to $760 million in 2004. Compared to the monetary base of Armenia's small economy, about $268 million in circulation, the large amounts of remittances may indeed cause such major fluctuations in the currency exchange market. According to Mr. Smbat Nasibian, the chairman of Armenia's major commercial bank, the Converse Bank, "there are just too many dollars in circulation in Armenia." To the contrary, critics question the credibility of the official statistics on the remittances. In particular, Eduard Aghajanov, a leading economist and the former head of the National Statistical Service (NSS) has argued that "Armenians living in Russia or the United States could not have gotten 50 percent wealthier within a year" (Danielyan, 2005).

Whatever the reason is, such drastic appreciation has already generated negative reaction from the hundreds of thousands of Armenian families that rely heavily on remittances from abroad. The economic decline that followed the collapse of the Soviet Union has forced nearly one million Armenians, or about 30 percent of Armenia's current population, to migrate to other countries, primarily to Russia, in search for work. Banaian and Roberts (2007) estimate that remittances constitute 80 percent of the total income in the households that receive them. Despite large numbers, the CBA argues that dependence on remittances is exaggerated as they account for only about 25 percent of income in Armenia. CBA goes further arguing against intervention into the exchange market, as its primary objective is to ensure low inflation, which it has accomplished successfully[3]. Armenia's inflation has been one of the lowest among the FSU and CEE countries. During 1996-2007 is has averaged at 2.8 percent annually (IMF, 2007b; World Bank, 2007).

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[3] The CBA has announced a revision of its 2008 inflation target from 3 to 4 (±1.5) percent (IMFc, 2007).

The survey of the Armenian-European Policy and Legal Advice Center (AEPLAC) conducted in January 2005, found that more than 85 percent of respondents save money in US dollar, and that nearly 50 percent of those surveyed claim to have lost from the dram's appreciation and only 27.6 percent claimed to have been better off as a result of appreciation (Yeghiazaryan, 2004). Claims against government manipulation have become stronger due to the fact that virtually no imported product became cheaper due to the appreciation. Mr. Nasibian of the Converse Bank, believes that "the main reason for that is a very small number of importers. Each of them seems to have monopolized a particular field, making disproportionate profits" (Danielyan, 2005). Contrary, the government and the importers claim that the price increases in the world markets offset the potential for decline in the prices for imported goods. The latest International Monetary Fund review (IMF, 2007a) has concluded that further action is needed in Armenia "*to look for ways to reduce monopolistic practices in the import business, with a view to increasing the pass-through of exchange rate changes to domestic prices*".

Armenian export businesses have also raised alarms regarding continuing appreciation of the dram. Since late 2006, many exporters have articulated for more intervention from the CBA in the currency exchange market. More specifically, the head of the Diamond Company of Armenia, and the President of the International Association of Armenian Jewelers, Mr. Gagik Abrahamian has suggested a return to a fixed exchange rate regime around AMD 400/US$. The Director General of the Shoghakn diamond cutting company, Mr. Sergey Gasparyan, has also spoken with a similar support (Emerging Markets Monitor, 2006). Despite these calls for intervention, the CBA continues to hold to its primary objective of inflation targeting, and the Emerging Markets Monitor (2006) does not believe that there will be substantial changes in Armenia's monetary policy in the near future. It forecasts that AMD will move towards AMD 300 per US dollar by 2010 and believes that AMD appreciation has also created benefits, such as low inflation and low impact of international price increases on the Armenian market. For example, dram appreciation helped to prevent complete pass-through of increasing world oil prices to the domestic market. The CBA also believes that appreciation creates unique opportunity for local businesses to boost their competitiveness through acquiring new foreign technologies as AMD appreciation makes foreign technologies cheaper in local currency (Emerging Markets Monitor, 2006).

These contradicting arguments and statements continue to dominate public-private discussions in Armenia. Thus, scientifically robust explanations are timely and crucial to avoid further speculation and accusations around monetary developments in Armenia and their use for political manipulations.

Objectives

This study is part of a doctoral dissertation research, which does not intend to be a review or critique of exchange rate modeling methods, approaches, and techniques. A consensus on the validity and significance of those is yet to be reached among economists. It's overall objective is to survey, adapt, and extend empirical models from monetary and financial economics to the benefit of understanding and practical modeling of exchange rate dynamics and behavior, as well as exchange rate pass-through into prices of strategic and important consumer goods in Armenia. Specific objective of this part of the research is to examine the dynamics of the real exchange rate in Armenia and explain its relation to economic fundamentals.

The study aims to provide scientifically supported explanations of recent developments in the currency exchange market and the behavior of exchange rates in Armenia, thus offering an alternative to speculative theories that will facilitate further discussion and dialogue on the causes and effects of exchange rate dynamics in Armenia.

Theoretical background

The real exchange rate (RER) is one of the most important concepts in international economics and the most important relative price in international finance. It has attracted enormous attention from leading international organizations and researchers who try to understand the behavior of the real exchange rates and their determinants. The exchange rate research has been for the last few decades one of the most 'popular' theoretical and empirical research topics at the International Monetary Fund.

Real exchange rate plays a crucial role in determining the competitiveness position of a country in the global market. Real exchange rates directly impact inflation and output in every economy and are more important for the young and fragile economies in transition. In these economies, one of the main macroeconomic discussions topics is the critical role of real exchange rate

in the economic adjustment process. Edwards (1994) believes that there is a general consensus among researchers that sustained real exchange rate misalignment will generate serious macroeconomic imbalances, and to correct the external imbalances, such as the current account deficit, strong demand management policies and real exchange rate devaluation may be required. Additionally, it has been established that much of the economic success in the 'successful' developing countries are due to successful exchange rate polices that maintained the real exchange rate at the 'appropriate' level. Thus, the behavior of the real exchange rate is a key component in macroeconomic policy evaluation and design.

A very important concept related to the real exchange rate economics, is the real exchange rate *misalignment*. Edwards (1989, p. 8) defines it as *sustained deviations of the actual real exchange rate from its long-run equilibrium level*. When the actual real exchange rate is below the equilibrium value, it is said that the real exchange rate is *overvalued*, and *undervalued* if it is above its long-run equilibrium mark. Thus, the understanding of the concept of the equilibrium, and *equilibrium real exchange rate (ERER)* in particular, becomes the critical building block in this entire story.

The concept of equilibrium itself has generated heated debates over diverse range of issues, such as its existence, uniqueness, optimality, determination, evolution over time, even if disequilibrium ever exists, and also the question if this concept can be separated from the models used to measure it. Von Neumann and Morgenstern (1944) believe that without imposing a structure by which different models should be judged upon, one cannot choose between them as the solution to all of them must satisfy the same analytical thinking. Therefore the concept of equilibrium is no less important within the context of the exchange rates than for other fields of economics (Driver and Westaway, 2004).

Driver and Westaway (2004) discuss the concept of the equilibrium exchange rate in the context of the time horizon, where they identify short-, medium-, and long-run equilibrium exchange rates:

(a) S*hort-run equilibrium* is defined as the exchange rate that results when its fundamental determinants are at their current settings after removing the effects of random shocks.

(b) *Medium-run equilibrium* is defined as the rate at which the economy achieves internal and external balance.

(c) *Long-run equilibrium* is achieved at the point when stock-point equilibrium is achieved for all agents of the economy.

Within the equilibrium setting, it is also important to know which measure of the exchange rate should be used, and why. The choice of the exchange rate measure (nominal versus real), the price deflator, or even if it is bilateral or effective measure directly depends on the relevant research agenda. Some choose to use the nominal bilateral exchange rate as determined directly in the financial markets. However, most exchange rate theories of equilibrium exchange rates refer to real exchange rate, even though different measures of relevant prices are used. Driver and Westaway (2004) have identified five price measures commonly used to define the real exchange rate: (a) consumer price index, (b) prices of tradable goods or output prices, (c) price of an economy's exports compared to the price of its exports, (d) relative unit labor costs, and (e) ratio of tradable to non-tradable prices.

There is a common consensus in the exchange rate literature that there is no single best modeling approach to the exchange rate behavior, as well as a common measure of relevant price. The choice of the approach depends on the question of interest and more importantly on the time horizon of the study. Driver and Westaway (2004) also believe that the approaches may differ in the treatment of dynamics and the time frame they concentrate on. The summarized overview of these different approaches compiled by Driver and Westaway (2004) is presented in Table 1.

The concept of exchange rate misalignment is perhaps the most challenging empirical problem in macroeconomics due to unobservable equilibrium value of the real exchange rate. However, the economic theory models ERER as a function of observable fundamental variables of the economy assuming that the actual RER converges to its equilibrium in the long run (Baffes et al., 1999).

Since early 1990s, a growing number of empirical studies have applied above relationship to studying equilibrium real exchange rates and misalignments associated with them. The behavioral equilibrium exchange rate approach (BEER) has become a standard workhorse in examining real exchange rates and their misalignment from long run equilibrium. The BEER approach has been popularized by Sebastian Edwards (1994; 1989) and MacDonald (1997) and used by many authors in the

empirical literature. This approach has also become a standard approach for exchange rate modeling at the International Monetary Fund.

The influential works of Edwards (1994; 1989) were the first substantial attempts to understand the behavior of the real exchange rate in a transition economy setting in terms of economic fundamentals. Edwards' framework has been adapted and extended by many. Khan and Ostry (1991) study the response of the ERER to the real shocks in the developing countries. Using panel data, they estimate ERER elasticities for trade shocks and commercial policies. Elbadawy (1994) applies the simplified version of the model to estimating ERER for Chile, Ghana, and India. Faruqee (1995) and Mongardini (1998) examine the ERER in Egypt, De Broeck and Sløk (2001) extend the model to the transition economies of the CEE and Baltic countries, Lane and Milesi-Farretti (2001) for Ireland, and MacDonald and Ricci (2003) for South Africa.

Chudik and Mongardini (2007) have applied the Autoregressive Distributed Lag (ARDL) modeling techniques pioneered by Pesaran and Shin (1999) to estimate equilibrium real exchange rates in 39 Sub-Saharan African (SSA) countries. BEER has not been successful when applied to a single country due to data limitations (only 26 yearly observations), but their panel data estimates were statistically and economically significant even when different estimation techniques were used. The authors have also developed a user friendly template that automates variable selection and estimation procedures (Chudik, 2006a; Chudik, 2006b).

Widespread success of the Edwards' (1994; 1989) seminal framework and its extended versions in the recent decade or two, and more specifically its use for studying the behavior and determinants of real exchange rates in CEE and FSU countries, provide an appropriate ground to adopt it for the purposes of examining the behavior of real exchange rate in Armenia and possible deviations from its long-run equilibrium path. More specifically, the approach and template used by Chudik and Mongardini (2007) are adopted for this study.

Edward's model is an intertemporal general equilibrium model of a small open economy in which both tradable and non-tradable goods are traded. The unique ERER is attained when the economy achieves its internal and external balance. Model's internal balance is achieved when all markets for non-tradable goods are cleared (static equilibrium). External balance is achieved when the

net present value of the future current accounts is non-negative at the given level of exogenous long-run capital inflows (dynamic equilibrium). A formal summary of the model is provided by Edwards (1994; 1989) and Mongardini (1998, Appendix II).

The basic structure of Edwards' real exchange rate model is:

$$\Delta \log e_t = \theta \left(\log e_t^* - \log e_{t-1} \right) - \lambda \left(Z_t - Z_t^* \right) +$$
$$+ \phi \left(\log S_t - \log S_{t-1} \right) - \psi \left(PMPR_t - PMPR_{t-1} \right)$$

(1)

where, e is the actual real exchange rate, e^* is the equilibrium real exchange rate (in turn a function of fundamentals), Z_t is an index of macroeconomic policies (i.e. the rate of growth of domestic credit), Z_t^* is the sustainable level of macroeconomic policies (i.e. the rate of increase of demand for domestic money), S_t is the nominal exchange rate, $PMPR$ is the spread in the parallel market for foreign exchange, and $\theta, \lambda, \psi, \text{and} \phi$ are positive parameters that capture the most important dynamic aspects of the adjustment process.

Equation (1) clearly illustrates that the real exchange rate is moving due to three forces. *First*, the actual real exchange rate will tend to independently correct existing misalignment through the partial adjustment term $\theta \left(\log e_t^* - \log e_{t-1} \right)$. The speed of the adjustment is determined by the parameter θ. The larger is the parameter, faster will be the speed at which the real exchange rate misalignment will be corrected. The *seconds* term that determines the real exchange rate movements is given by the term for macroeconomic policies, $-\lambda \left(Z_t - Z_t^* \right)$. According to Edwards (1994; 1989), if policies are "inconsistent" the real exchange rate will become overvalued, *ceteris paribus*. However, Chudik and Mongardini (2007) argue that it is not clear whether changes in these policies will have an impact on the ERER in the long-run. The *third* element of the equation is the change in the nominal exchange rate (i.e. nominal depreciation) represented by $\phi \left(\log S_t - \log S_{t-1} \right)$. Nominal depreciation will in the short-run cause the real exchange rate to depreciate. The magnitude will depend on the parameter ϕ. The *forth* element refers to the changes in the parallel market premium. An increase in the term will cause a real exchange rate appreciation.

The ERER in (1) can be written as:

$$\log e_t^* = \beta_0 + \beta_i \log\left(FUND_{it}\right) + \varepsilon_t \qquad (2)$$

where, $FUND_{it}$ represents a set of fundamental variables that are assumed to have a determining effect on the ERER. The choice of the fundamentals varies from one country to another. Likely determinants of ERER in a developing country, as discussed, for example, in Edwards (1994; 1989), Chudik and Mongardini (2007), and Roudet et al. (2007), are:

- **Terms of trade for goods** (TOT). Is defined as the price ratio of the country's exports over imports. An improvement in the terms of trade implies increase in the international price for exports, which will have a positive impact on the current account and lead to the ERER appreciation.

- **Government spending** (GOV). Usually defined as the government consumption of the non-tradable goods. An increase in the consumption vis-à-vis tradable goods will improve the current account and lead to appreciation of the ERER.

- **Market openness** (OPEN). This is a proxy for trade controls or restrictions. An increase in the openness will lead to an increased trade. The equilibrium response of the ERER will depend on whether this leads to improving or deteriorating current account.

- **Technological progress/productivity** (TECHPRO). Allows capturing the famous Balassa-Samuelson effect that the productivity improvements will generally be concentrated in the tradable goods sector. Technological progress increases the productivity in the economy and leads to the appreciation of the ERER without hurting its competitiveness.

- **Investment** (INV). Usually defined as the ration of investments to GDP relative to that of foreign partners. Investments in developing countries are usually concentrated in the imports sector, thus have negative impact on the trade balance. But the overall impact on ERER is still ambiguous as it still may capture technological progress.

- **Debt service** (DS). Is defined as a share of exports. An increase in the debt service payments leads to the deterioration of the external balance and will require price adjustments to restore the equilibrium. Thus, a ERER deprecation should be expected.

- **Net foreign assets** (NFA). Is a proxy for the country's net external position and is defined as a share of GDP. An improvement in the position (increase in capital inflows) leads to the appreciation of ERER.

- **Aid flows** (AID) as a share of exports. It represents a significant share of several developing and low income countries. An increase in the aid flows improves external balance and leads to ERER appreciation.

- **Controls over capital flows** (CAPCTRL). Similar to the market openness liberalization will have impact on the ERER. The direction will depend on real interest rate differential and country's risk profile.

After substituting (2) into (1), and for convenience and generalization using a single notation of macroeconomic policy variables, say $POLICY$, and omitting the PMPR term, we obtain a reduced form equation that could be estimated using conventional methods.

$$\log e_t = \gamma_i \log\left(FUND_{it}\right) + \left(1-\theta\right)\log e_{t-1} - \lambda_i\left(POLICY_{it}\right) + \phi NOMDEV_t + \varepsilon_t \qquad (3)$$

where, $NOMDEV$ stands for nominal develuation and γ's are combinations of β's and θ.

Nominal devaluation ($NOMDEV$) has positive sign and can be quite powerful for reestablishing real exchange rate equilibrium. However, Edwards (1989) believes that "*for the nominal devaluation to have a lasting effect, it is necessary that the sources of the original disequilibrium - positive EXCRE and DEH[4] - be eliminated. If this is not the case, soon after the devaluation the RER will again become overvalued*" (p. 141).

Data and Estimation Methodology

The study uses quarterly data covering 1996:Q1-2007:Q4. Table 2 provides a brief description of each variable and its source(s).

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[4] EXCRE and DEH are excess supply for domestic credit calculated as the rate of growth of domestic credit minus lagged rate of growth of real GDP and ratio of fiscal deficit to lagged high power money respectively. They measure the role of macroeconomic policies in the RER behavior (Edwards, 1989, p. 137).

One of the major problems faced when working with time series data is the issue of stationarity in the series. In the short time series the determination of variables' order of integration becomes uncertain due to poor performance of unit root tests for small samples (Chudik and Mongardini, 2007). Gregory and Hansen (1996) argue that "*the standard tests for cointegration are not appropriate, since they presume that the cointegrating vector is time-invariant under the alternative hypothesis (p. 100)*" and that if there exists a cointegration, the standard ADF test may not reject the null, thus wrongly concluding that there is no long-run relationship. Gregory, Nason, and Watt (1996) have found that the power of standard ADF test decreases sharply when a structural break is present. Structural breaks occur with the technological progress, economic crises, changes in the people's preferences, policy or regime shifts, and institutional developments, which are very typical to developing and transition countries.

The traditional econometric cointegration approaches, such as Johansen's, require the series to be integrated to the same order, thus introducing a further degree of uncertainty into the analysis of level relationships especially in a transition country setting. Pesaran, Shin, and Smith (2001) developed a new approach for testing for the existence of level relationship between variables irrespective of whether the underlying variables are stationary, integrated to the order of one, or a mixture of the two. This approach has been successful and superior to the traditional Johansen cointegration test in a small sample (Chudik and Mongardini, 2007).

The estimation is done using an Autoregressive Distributed Lag (ARDL) Modeling approach proposed by Pesaran and Shin (1999). This approach makes estimation independent of the order of integration in the variables, thus provides statistically better results (Mongardini, 1998). The general ARDL model for a dependent variable y_t and independent variables x_t with only deterministic component being intercept is written as:

$$y_t = \sum_{i=1}^{p_y} \alpha_i y_{t-i} + \sum_{j=1}^{n} \sum_{i=1}^{p_x} \beta_{ji} x_{j,t-i} + c \qquad (4)$$

where, p_y, p_x are the orders of lags for dependent and independent variables, respectively, and n refers to the number of repressors. The corresponding error-correction will be represented with:

$$\Delta y_t = \pi_{yy} y_{t-1} + \sum_{j=1}^{n} \pi_{yx,j} x_{j,t-1} + \sum_{i=1}^{p_y-1} \theta_i \Delta y_{t-i} + \sum_{j=1}^{n} \sum_{i=0}^{p_x-1} \psi_{ji} \Delta x_{j,t-i} + c \qquad (5)$$

The bounds tests proposed by Pesaran, Shin, and Smith (2001) uses F-statistics to tests for the existence of the level relationship. The joint null hypothesis is:

$$H_0 : \pi_{yy} = 0 \cap \left\{ \pi_{yx,j} = 0, j = 1, 2, ..., n \right\}$$

This study uses a slightly modified version of the econometric template for conducting estimations using the ARDL approach developed by Chudik (2006b; Chudik, 2006a). It is user friendly and has MS Excel and EViews based interface that enables to carry estimations.

Due to small sample size, it is impossible to include all potential explanatory variables in the estimation process, thus there is a need for selecting the appropriate set of variables. The empirical literature commonly uses up to four explanatory variables in a small sample setting. The template enables to incorporate the variable selection into the estimation process.

Results

A total of 126 models are investigated for the best possible combination of four variables, which are then ranked according to the following principles:

(a) existence of a long-run cointegrating using the bounds testing;

(b) the number of statistically significant variables at 5 percent significance level; and

(c) the number of correct signs of the parameters as predicted by the economic theory.

Selected two best models with respective long-run parameter estimates and t-statistics and associated misalignments are illustrated below (Note: increase means appreciation).

Model A:

$$ERER = \underset{3.8}{0.48 \times GOV} - \underset{-4.5}{0.80 \times NFA} + \underset{2.3}{0.05 \times INV} - \underset{-5.0}{0.63 \times EXCRE}$$

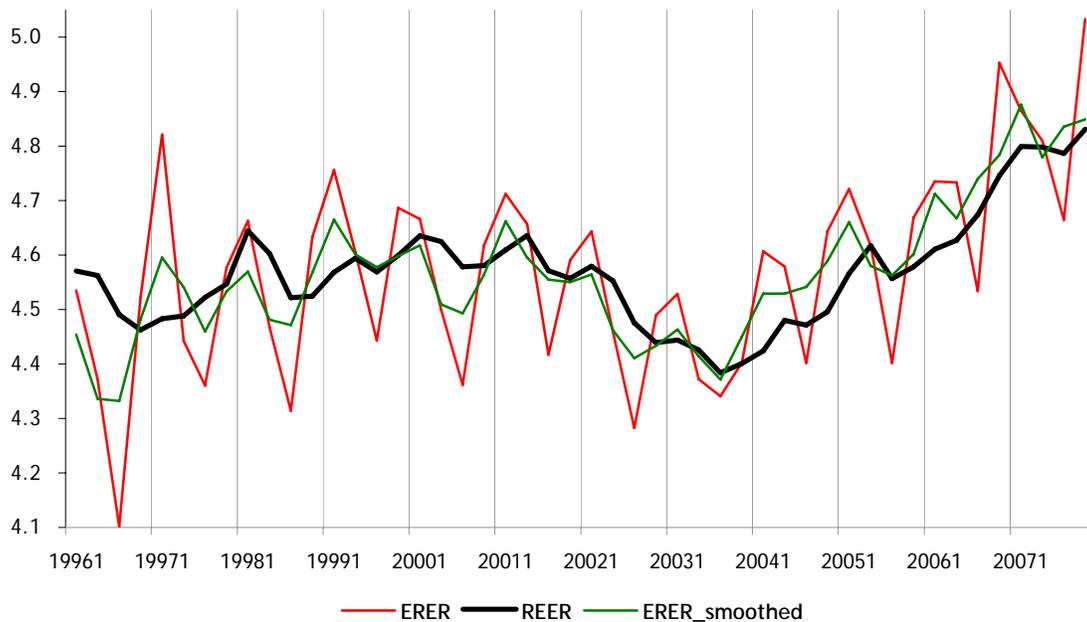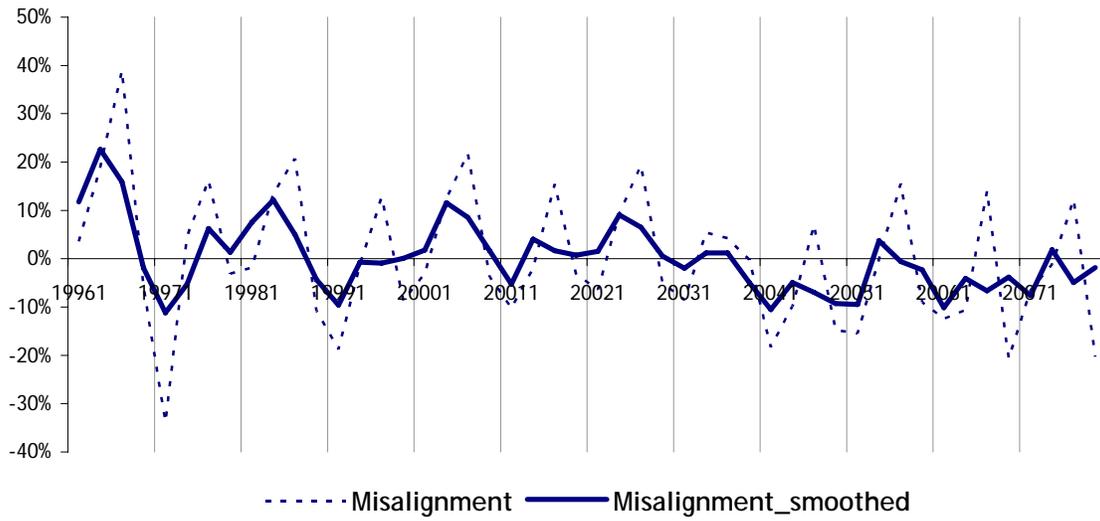**Figure 2. REER and ERER for Armenia, Model A**

Figure 3. Real Exchange Rate Misalignment in Armenia, Model A

Model B:

$$ERER = 0.28 \times GOV - 1.61 \times NFA + 0.88 \times EXCRE - 0.03 \times NOMDEV$$
$$\quad\quad\quad\quad\quad {}_{3.5} \quad\quad\quad\quad {}_{-7.3} \quad\quad\quad\quad {}_{-8.5} \quad\quad\quad\quad\quad {}_{4.6}$$

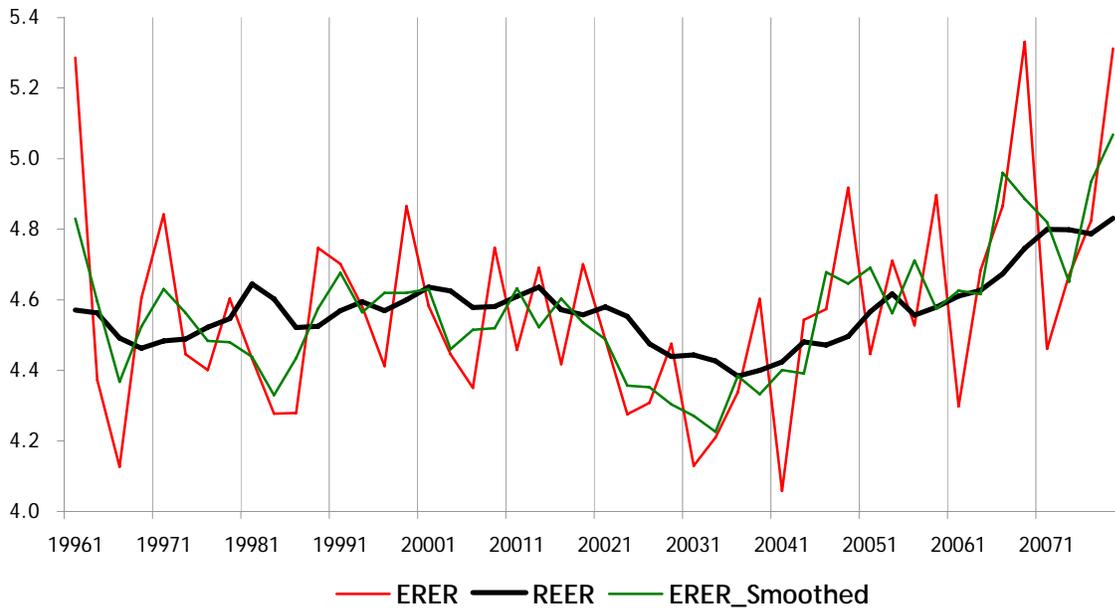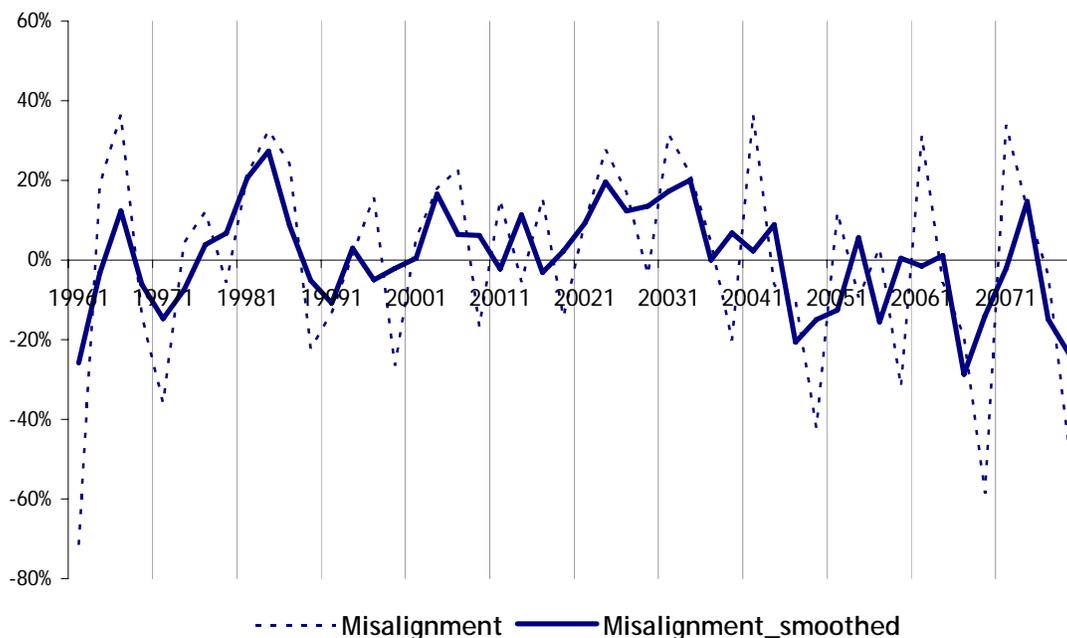**Figure 4. REER and ERER for Armenia, Model B**

Figure 5. Real Exchange Rate Misalignment in Armenia, Model B

Conclusions and need for future research

Results of the study show that over the course of the study, the real exchange rate for Armenia was misaligned from its long-run equilibrium path. However, the degree of misalignment is sensitive to the set of economic fundamental variables used in the estimation. Due to the small sample size, it is impossible to include all variables that are suggested by the economic theory, thus a subset of those variables need to be chosen in the study. Even though, both models have strong statistical parameters and yield similar misalignment trends, they differ in the magnitude of the misalignment.

Further analysis are necessary to study the sensitivity of the results to the choice of the variable set. Additionally, given the theoretical ambiguity of the signs of majority of variables, additional work is required to make the right inference about the results. For this purpose, comments and/or suggestions are gladly welcome.

In the final research report, the feasibility of grouping of several variables will be studied to avoid the need for limiting number of variables in the model. Additionally, the short run volatility of bilateral nominal exchange rate will be studied based on changes in monetary aggregates and

expectations. An additional expectations defining variable(s) will be introduced to capture the potential effect of major political and economic events in the country.

And finally, the exchange rate pass-though into important price of important products will be examined. Understanding the impact of exchange rate fluctuations on the prices and output has a critical policy implication in order to determine the appropriate monetary policy response. It influences the future direction of the economic, social, as well as political developments in the country.

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Table 1. Summary of empirical approaches to estimating equilibrium exchange rates

	UIP	PPP	Balassa-Samuelson	Monetary Models	CHEERs	ITMEERs	BEERs	FEERs	DEERs	APEERs	PEERs	NATREX	SVARs	DSGE
Name	Uncovered Interest Parity	Purchasing Power Parity	Balassa-Samuelson	Monetary and Portfolio balance models	Capital Enhanced Equilibrium Exchange Rates	Intermediate Term Model Based Equilibrium Exchange Rates	Behavioural Equilibrium Exchange Rates	Fundamental Equilibrium Exchange Rates	Desired Equilibrium Exchange Rates	Atheoretical Permanent Equilibrium Exchange Rates	Permanent Equilibrium Exchange Rates	Natural Real Exchange Rates	Structural Vector Auto Regression	Dynamic Stochastic General Equilibrium models
Theoretical Assumption	The expected change in the exchange rate determined by interest differentials	Constant Equilibrium Exchange Rate	PPP for tradable goods. Productivity differentials between traded and non-traded goods	PPP in long run (or short run) plus demand for money	PPP plus nominal UIP	Nominal UIP including a risk premia plus expected future movements in real exchange rates determined by fundamentals	Real UIP with a risk premia and/or expected future movements in real exchange rates determined by fundamentals	Real exchange rate compatible with both internal and external balance. Flow not full stock equilibrium	As with FEERs, but the definition of external balance based on *optimal* policy	None	As BEERs	As with FEERs, but with the assumption of portfolio balance (so domestic real interest rate is equal to the world rate)	Real exchange rate affected by supply and demand (but not nominal) shocks in the long run	Models designed to explore movements in real and/or nominal exchange rates in response to shocks
Relevant Time Horizon	Short run	Long run	Long run	Short run	Short run (forecast)	Short run (forecast)	Short run (also forecast)	Medium run	Medium run	Medium run/ Long run	Medium run /Long run	Long run	Short (and short) run	Short and long run
Statistical Assumptions	Stationarity (of change)	Stationary	Non-stationary	Non-stationary	Stationary, with emphasis on speed of convergence	None	Non-stationary	Non-stationary	Non-stationary	Non-stationary (extract permanent component)	Non-stationary (extract permanent component)	Non-stationary	As with theoretical	As with theoretical
Dependent Variable	Expected change in the real or nominal	Real or nominal	Real	Nominal	Nominal	Future change in the nominal	Real	Real effective	Real effective	Real	Real	Real	Change in real	Change relative to long-run steady state
Estimation Method	Direct	Test for stationarity	Direct	Direct	Direct	Direct	Direct	Underlying balance	Underlying balance	Direct	Direct	Direct	Direct	Simulation

Source: (Driver and Westaway, 2004)

Table 2. Data Description and Sources

Variable	Description	Log transformation	Data source
REER	Real equilibrium exchange rate. Is a multilateral CPI based real effective exchange rate. It is defined in terms of Armenian Dram per unit of foreign currency, so that an increase (decrease) in REER represents depreciation (appreciation).	Yes	2
ToT	Terms of trade for Armenia is defined as the ratio of export price index over import price index.	Yes	1, 3, 4
GOV	Government consumption as a share of GDP relative to that of foreign trading partners.	Yes	1, 2, 4
OPEN	Openness to trade: exports plus imports as a share of GDP.	Yes	1, 2
NFA	Net foreign assets as a share of GDP.	No	1, 2
INV	Direct investments in rep. economy as a share of GDP relative to that of the trading partners.	Yes	1, 2, 5
EXCRE	Excess supply of domestic credit. Measured as the rate of growth of domestic credit minus the lagged rate of growth of real GDP.	No	1, 2
PROD	Measure of productivity. Proxied by per capita real GDP relative to that of the trading partners.	Yes	1, 2, 6, 7
DS	Debt service as a share of exports.	No	1, 8, 9
MONDEV	Nominal devaluation. Nominal effective exchange rate is used.	No	2

Sources:
   (1) own calculations
   (2) (IMF, 2008)
   (3) (NSS, 2003a; NSS, 2006; NSS, 2007a)
   (4) (Datastream International, May 1, 2008)
   (5) (Armenian Economic Association, April 29, 2008)
   (6) (IMF, May 9, 2008)
   (7) (NSS, 2001; NSS, 2003b; NSS, 2007b)
   (8) (IMF, 1998; IMF, 1999; IMF, 2001; IMF, 2002)
   (9) (CBA,   2006)

Figure 1. Exchange Rates Indexes for Armenia, 1996-2007 (2000=100)
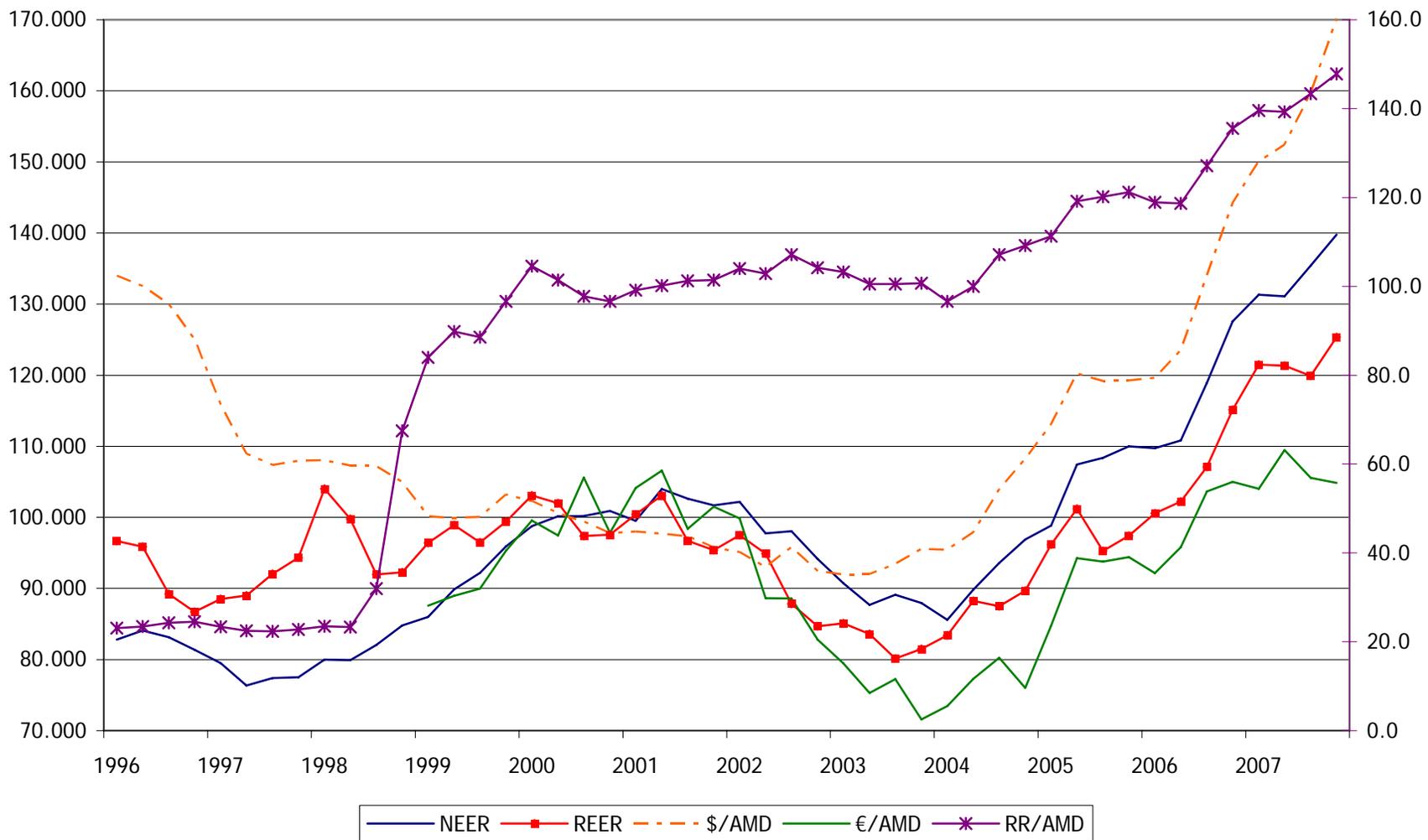
Source: own calculations, (IMF, 2008)
Note: increase means an appreciation. Russia is represented on the right axis.