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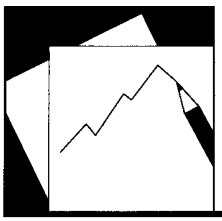

IMF Working Paper

Estimating Equilibrium Exchange Rates for Armenia and Georgia

Omar AlShehabi and Shuang Ding

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Middle East and Central Asia Department

Estimating Equilibrium Exchange Rates for Armenia and Georgia

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Abstract

The significant real exchange rate appreciation in Armenia and Georgia since 2003, coupled with persistent current account deficits, raises the question of whether real exchange rates have become overvalued. This paper seeks to identify possible exchange rate misalignment by applying the behavioral equilibrium exchange rate approach, complemented by an analysis of the traditional competitiveness indicators. The results indicate an undervaluation of the Armenian dram and no significant misalignment of the Georgian lari in 2006.

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I. INTRODUCTION

Armenia and Georgia are low-income countries undergoing significant transformations. Both countries experienced a sharp output decline in the early years of economic transition (1991–93) following the collapse of the Soviet Union. However, their economies have been growing briskly in recent years: Armenia has registered double-digit growth since 2002 in a relatively low-inflation environment, while Georgia has witnessed a pickup in both economic activity and inflationary pressures since 2005.

In recent years, both countries have experienced large foreign exchange inflows in the form of remittances, foreign aid, and foreign direct investments, which have contributed to a substantial appreciation of their real effective exchange rates (REER). This, together with persistent current account deficits,[2] has raised concerns in these countries over the negative effect of currency appreciation on external competitiveness, fueling political resistance to nominal exchange rate appreciation.

This paper seeks to investigate whether the recent real appreciation represents realignment toward equilibrium, or whether it has caused a misalignment in the real exchange rates. There are different ways to assess the real exchange rate level, but they generally fall into two major categories: (1) the macroeconomic balance approach, and (2) the behavioral equilibrium exchange rate (BEER) approach. The macroeconomic balance approach is based on the econometric estimate of the equilibrium relationship between the current account balance and a set of fundamentals. Under this approach, the extent of exchange rate misalignment is derived from the exchange rate adjustment needed to move the current account balance to its equilibrium.[3] The BEER approach, on the other hand, directly estimates the structural relationship between economic fundamentals and the equilibrium exchange rate, and identifies misalignment by comparing the actual (or projected) exchange rate level with its estimated equilibrium.

This paper focuses on the BEER approach. While it would be desirable to use multiple approaches to assess the exchange rate level in low-income transition economies such as Armenia and Georgia, the application of the macroeconomic balance approach is hindered by data limitations and uncertainties over trade elasticities.[4] The results indicate that the recent real exchange rate appreciation in both countries reflected a convergence to the equilibrium level. The results also show an undervaluation of the Armenian dram and no significant misalignment of the Georgian lari in 2006.

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[2] Compared with Georgia, Armenia's current account deficit declined significantly in the past decade, except for a rebound since 2004.

[3] The approach assumes that the real exchange rate movement is the only mechanism to achieve the adjustment in the current account, creating a bias in the estimate of exchange rate misalignment. The estimate is very sensitive to the elasticity of trade to the real exchange rate.

[4] Data for some of the potential variables (such as demographic ones) are available only on an annual basis, leaving too few observations to make reliable econometic estimations.

The rest of the paper is organized as follows: Section II reviews recent trends in competitiveness indicators and presents stylized facts pertinent for assessing the real exchange rate level. Section III describes the BEER methodology and discusses the estimation results. Section IV presents conclusions.

II. Stylized Facts on External Competitiveness

In low-income countries, the empirical analysis of the real exchange rate is often subject to important limitations, such as data weaknesses and numerous structural breaks. Therefore, in accessing exchange rates in such countries, a review of the traditional competitiveness indicators can provide a good starting point (Di Bella, Lewis, and Martin, 2007).

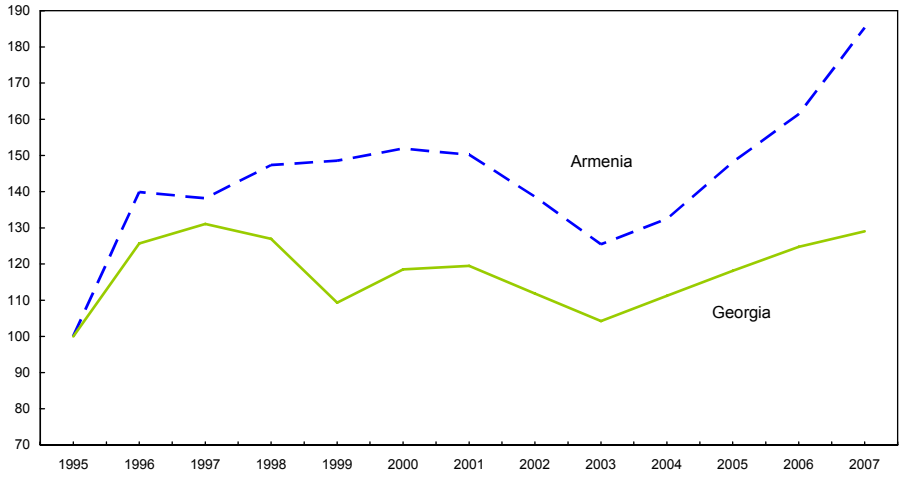
REER. Both Armenia and Georgia have experienced noticeable appreciation of the CPI-based REER since 2003 (Figure 1).[5] In Armenia, the real appreciation has been more pronounced (about 10 percent annually) and driven by significant nominal appreciation, while in Georgia a more modest real appreciation (about 5 percent annually) is attributable to both nominal appreciation and inflation differentials with its trading partners.[6] In both countries, the real appreciation has taken place amid large inflows of foreign exchange, notably remittances and foreign direct investments.

However, the evolution of the REER itself conveys little information about how far it is from its equilibrium level and how much it has affected external competitiveness. Experience in other transition countries shows that the strong real appreciation during the transition period may indicate a significant undervaluation of their currencies in the early stage of transition. This implies that a large part of the strong appreciation could simply reflect a gradual convergence of the real exchange rate toward its equilibrium (Krajnyak and Zettelmeyer, 1998). In Armenia and Georgia, the recent real exchange rate appreciation could reflect a return to the equilibrium level following a substantial real depreciation in the early 2000s. It may also reflect productivity gains, or an overshooting in response to large foreign inflows.

[5] The REER data are taken from the IMF Information Notice System. The authorities calculate REER following essentially the same methodology but using different trade weights.

[6] The Armenian dram appreciated against the U.S. dollar by 46 percent from end-2003 to end-2007, and the Georgian lari appreciated by 23 percent during the same period.

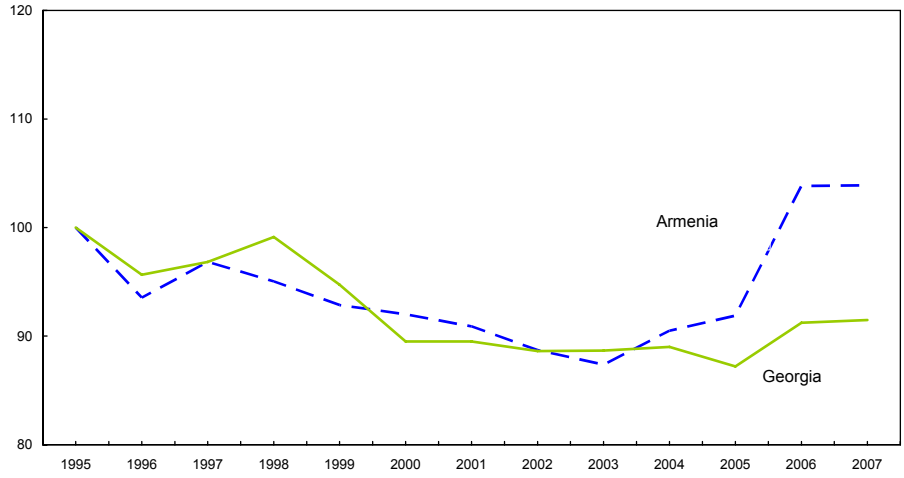
Figure 1. Armenia and Georgia: Real Effective Exchange Rates, 1995–2007 1/
(1995=100)



Source: IMF, Information Notice System.
1/ An increase indicates an appreciation.

Terms of trade. Both Armenia and Georgia are metal exporters and energy importers. In Georgia, the terms of trade improved slightly in recent years, as the effect of increases in international metal prices more than offset higher oil and natural gas prices (Figure 2). Armenia has seen a more significant improvement in its terms of trade due to sharp increases in the price of copper when the gas import price is still below the regional average. The terms of trade developments appear to provide some justification for different paces of real appreciation in these two countries, since an improvement in the terms of trade is generally associated with a higher equilibrium real exchange rate level.

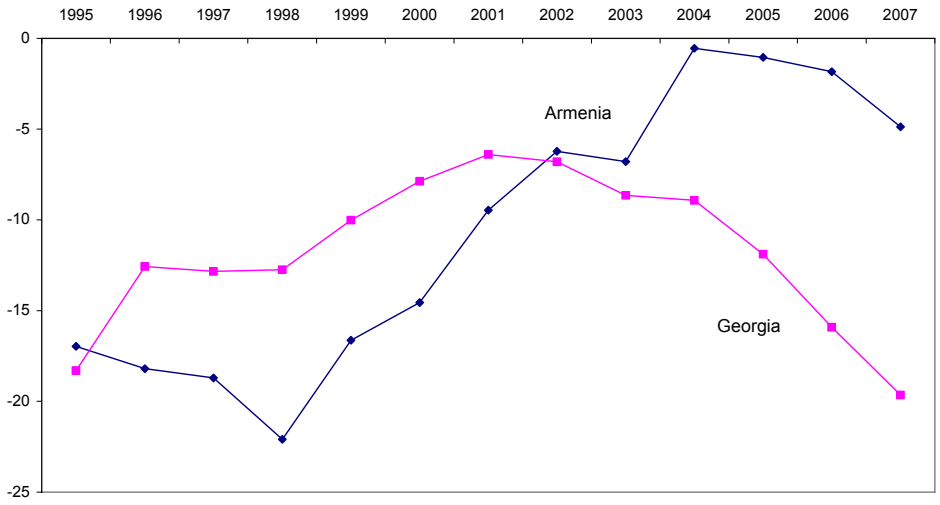
Figure 2. Armenia and Georgia: Terms of Trade, 1995–2007 1/
(1995=100)



Source: IMF, Global Economic Environment data.
1/ An increase indicates an improvement of the terms of trade.

Current account balance. Both countries have registered current account deficits since 1995 (Figure 3). This is not unusual in low-income transition economies that have to make large interest payments on their external debts, and import energy and other goods and services due to supply constraints and development needs. In Armenia, the increasing level of remittances has contributed to a remarkable improvement in its external current account. In Georgia, the current account appears to be deteriorating. Considering the likely loss of its major export items (scrap metal and aircraft repair services) in the longer term, prospects for an improved current account would depend critically on how quickly Georgia can build its new export base and capacity.[7] Reflecting the prolonged current account deficit, both countries have accumulated sizable net foreign liabilities,[8] which could imply an overvaluation of their currencies. In the meantime, the current account developments seem to indicate that Armenia's REER is less overvalued or more undervalued than Georgia's.

Figure 3. Armenia and Georgia: External Current Account Balance, 1995–2007
(In percent of GDP)



Sources: Armenian and Georgian authorities; and Fund staff estimates.

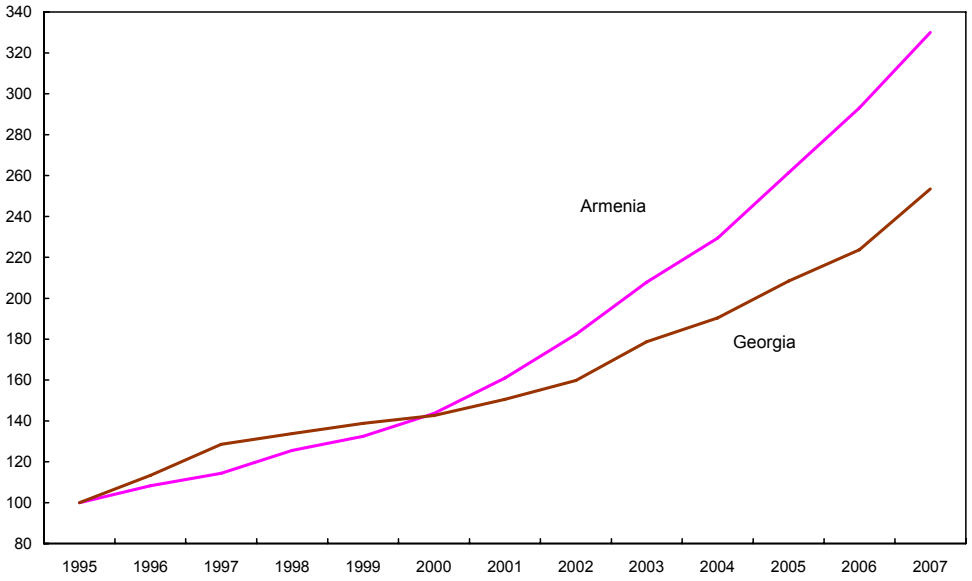
Productivity indicators. Countries with faster productivity gains will be able to sustain real exchange rate appreciation without losing external competitiveness, since the equilibrium real exchange rate level appreciates when the economies become more competitive. In low-income countries, one proxy for productivity gain is the increase in real GDP per capita. Both Armenia and Georgia have achieved a significant increase in real GDP per capita between 2003 and 2007 (Figure 4), but the gain in Armenia has been more pronounced (about 10 percent on an annual basis). Industrial unit labor costs show that

[7] Scrap metal is a depletable export by nature, and aircraft repair services are related to a deal with Turkmenistan in which Turkmenistan accepts Georgia's services as in-kind payment for Georgia's energy-related debt.

[8] The authorities' data on international investment positions show that net foreign liabilities were 24 percent and 65 percent of GDP in Armenia and Georgia, respectively, in 2006.

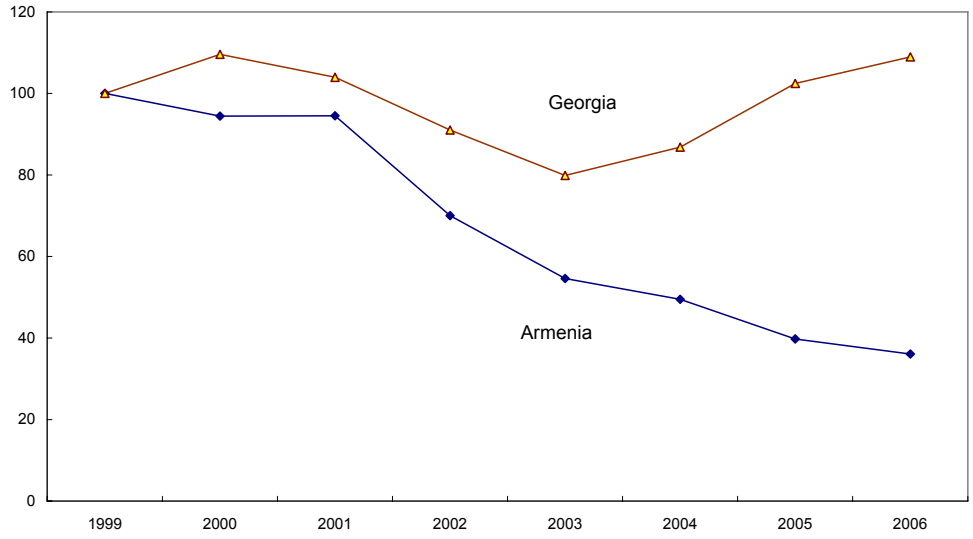
Armenia reduced unit labor costs by 33 percent in 3 years compared with an increase of almost 30 percent in Georgia (Figure 5). Both indicators suggest that Armenia's equilibrium real exchange rate appreciated more than Georgia's in recent years due to faster productivity growth.

Figure 4. Armenia and Georgia: Real Per-Capita GDP in Local Currencies, 1995–2007
(1995=100)



Sources: Armenian and Georgian authorities; and Fund staff estimates.

Figure 5. Armenia and Georgia: Industrial Unit Labor Costs, 1999–2006
(1999=100)



Sources: Armenian and Georgian authorities; World Bank World Development Inidcators database; and Fund staff estimates.

On balance, the traditional competitiveness indicators suggest that the faster appreciation of the Armenian dram in recent years—compared with the Georgian lari—has been underpinned by more significant improvements in the terms of trade, the current account balance, and overall productivity. However, it is still unclear whether the current real exchange rate level is appropriate, and how the exchange rate is likely to move in the future. To answer these questions, it is important to find out where the current real exchange rate lies relative to the equilibrium level.

III. Application of the BEER

A. Theoretical Background

The BEER approach has become one of the most popular methodologies for the estimation of equilibrium real exchange rates (ERER). Under this approach, the long-run relationship between the real exchange rate and its explanatory variables is derived and interpreted as the equilibrium relationship. Popularized by Edwards (1994) and Macdonald (1997), the BEER approach—in a panel regression context—has also been used by the IMF's Consultative Group on Exchange Rate Issues (CGER) in its real exchange rate assessments since 2003. The approach consists of three steps. First, cointegration econometric techniques are used to estimate a long-run relationship between the real exchange rate and a set of fundamentals. Second, ERER is computed as a function of the values of the fundamentals at a particular point in time. Finally, exchange rate misalignment is derived directly as the difference between the actual real exchange rate and the equilibrium value calculated in the second step.

The BEER approach has a few advantages compared to the macroeconomic balance approach.

- The approach is not based on any specific model of exchange rates, hence allowing for a very general framework of exchange rate modeling. This is in contrast to the macroeconomic balance approach, which imposes certain normative assumptions. The BEER approach simply searches for an econometrically significant relationship between the variables and the real exchange rate without specifying any conditions on the structure that the relationship takes.

- The BEER approach directly estimates ERER and the related exchange rate misalignment, while the macroeconomic balance approach estimates misalignment indirectly by calculating the exchange rate adjustment needed to achieve the equilibrium current account balance.

- The BEER approach also allows for a wide range of potential explanatory variables. These explanatory variables can be tailored to the country in question, allowing for an analysis of the specific variables that play an important role in real exchange rate determination in different countries.

The application of the BEER approach to Armenia and Georgia does, however, suffer from several drawbacks. First, the approach relies on the assumption that the equilibrium relationship can be derived from historical data, and that over the time interval in question

the exchange rate misalignment evens itself out, with the long-run misalignment being zero if a cointegrating relationship is present. But for countries like Armenia and Georgia that have undergone substantial structural changes, systematic misalignment may exist and time series techniques may yield misleading results. Second, the time series for each country are quite short: quarterly data are only available for 48 quarters for Armenia and 48 or 38 quarters for Georgia depending on which productivity variable is used. In single-country estimates, this could make the results highly uncertain. Third, there are data quality issues in these countries, especially when it comes to investment and net foreign assets.

B. Selection of Variables

The selection of the fundamental variables on which the real exchange rate is expected to depend is crucial to the BEER approach. There is extensive literature with a long list of potentially important factors in real exchange rate determination (e.g., Edwards, 1994, and Macdonald, 1997a). In the CGER estimation, six fundamental variables are used, namely net foreign assets, productivity differential, commodity terms of trade, government consumption, trade restriction index, and price controls (IMF, 2006). In this paper, seven different factors that could potentially affect the ERER level are chosen. Our selection is based on the potential importance of the factors for these countries and the availability of relevant data.

Productivity differential. Productivity differentials are used to capture the Balassa-Samuelson effect. The Balassa-Samuelson hypothesis postulates that increases in the productivity of the tradable sectors cause nontradable prices to increase relative to tradable prices, leading to real exchange rate appreciation. Ideally, direct measurements of productivity in the tradable and nontradable sectors should be used. However, such data do not exist for Armenia and Georgia, so two proxies are used to measure productivity differentials. One is the relative price of nontradables to tradables, calculated as the ratio of the consumer price index (CPI) to the producer price index (PPI) relative to trading partners, a measurement employed by Macdonald (1997a).[9] The other measurement is GDP per capita relative to trading partners (GDPC), which was used by Chudik and Mongardini (2007). The CPI/PPI ratio explicitly differentiates between the tradable and nontradable sectors, a feature that is lacking in the second measurement. The coefficient of the productivity variable is expected to carry a positive sign, since productivity gains are believed to lead to a higher real exchange rate index.

Terms of Trade (TOT). This variable is expected to have a positive effect on the ERER, as an improvement in terms of trade tends to appreciate the real exchange rate through real income or wealth effects (IMF, 2006).

Government consumption as a percentage of GDP relative to trading partners (GOV). If government consumption is biased toward the nontradable sector (which is generally the case), an increase in government consumption causes prices in the nontradable sector to

[9] The CPI is assumed to have a higher weight of nontradables in its basket than the PPI, with the ratio CPI/PPI indicating the relative movement in prices of nontradables to tradables.

increase, resulting in a real exchange rate appreciation. This effect has to be weighted against the condition that government expenditure will have to be financed by increases in taxes. Rising taxes would lead to falling disposable income, reducing consumption of nontradables and placing downward pressure on their prices. Most empirical studies, however, find that the first effect tends to dominate the second, and hence an increase in relative government consumption is likely to cause real exchange rate appreciation.[10]

Investment as a percentage of GDP relative to trading partners (INV). If investment has a high import content, as is often the case in low-income economies, it will have a negative impact on the trade balance and current account, resulting in depreciation pressures on the real exchange rate. Investment could, on the other hand, be associated with technological progress and increases in productivity (which cause the real exchange rate to appreciate). Therefore, its overall impact on the ERER is a priori ambiguous.

Net foreign assets as a share of GDP (NFA). The effect of the NFA on the ERER is theoretically ambiguous. Most studies on advanced economies predict a positive relationship between NFA and ERER. A higher NFA level boosts the current account by bringing in higher investment income. However, several studies have found a negative effect of the NFA on the ERER in the former Soviet economies (Burgess et al, 2003), where sustained foreign direct investment results in a deterioration of the NFA position while the related foreign currency inflows cause currency appreciation.

Openness to trade (OPEN). Measured as a ratio of exports and imports to GDP, this serves as a proxy of trade restrictiveness. Trade protection leads to higher domestic prices and a more appreciated real exchange rate index.

C. Econometric Methodology

The main methodologies used for the BEER econometric estimations in this paper are: (1) the bound testing approach developed by Pesaran, Shin and Smith (2001) to establish the existence of a long-run relationship; and (2) the auto-regressive distributed lag approach (ARDL) used by Pesaran and Shin (1999) for the estimation of long-run coefficients. The bound testing approach is preferable to traditional methods such as the Johansen method, since it gives superior short-sample performance. The results are also independent of whether variables are I(0) or I(1), a significant advantage in short samples, where unit root tests are notoriously unreliable.[11] The methodology also has the feature of parsimonious lag structures, where the lag of each of the variables can be chosen instead of imposing a common lag structure on all variables (a feature that is lacking in the Johansen approach).

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[10] Egert and others (2004) give a survey of recent studies on the effects of increasing government expenditure on the real exchange rate, with an overwhelming majority finding appreciation effects.

[11] Traditional methods such as the Johansen approach require that the I(1) nature of variables be established using unit root tests before moving on to test for the existence of a cointegrating relationship. The bound testing approach does not have such a requirement.

Briefly, the bound testing approach works in the following manner. F and t statistics are computed for the long-run relationship between the independent and dependent variables. If the F and t values (in absolute terms) are larger than pre-established critical value bounds, the existence of a cointegrating long-run relationship can be concluded without testing whether the variables are I(0) or I(1). If the values are smaller (in absolute terms) than the bounds, no cointegrating relationship among the variables exists. If the values lie *within* the critical value bounds, then one needs to test for the order of integration of the variables, similar to the first steps involved in methods such as the Johansen cointegration test.

After the bound testing approach establishes the existence of a long-run relationship, ARDL is used to estimate the long-run coefficients. This methodology has superior short-sample performance and provides a correct inference independent of the variables' order of integration. In addition, Johansen's cointegration test and the vector error-correction model (VECM) are employed for robustness checks on the results.

An important issue is whether the data series should be smoothed in the regression or not. The paper focuses on regressions with no smoothing. As Saadi-Sedik and Petri (2006) point out, smoothing is not based on a well-grounded theoretical justification and the choice among different smoothing techniques is often ad hoc. Furthermore, most smoothing parameters chosen (e.g., Hoderick Prescott filter values) are based on cyclical properties for developed economies. There is no justification for assuming that these values are appropriate for developing economies such as Armenia and Georgia. Therefore, the paper chooses to run the regressions on the unfiltered data series.

Given the small sample size, a maximum of four explanatory variables out of the seven discussed above can be plausibly used in a regression. To this end, the paper explores every possible combination of four variables for each country to arrive at the relationship that meets the following criteria: (1) there is a significant long-run cointegrating relationship based on bound testing; (2) the coefficients on the variables based on ARDL are significant; and (3) the coefficients carry the expected sign as predicted by economic theory (see Section B). There are only two models, one for each country, that meet all the criteria. The regressions are run for several lag length specifications, with the results ranked according to several information criteria (Akaike information criterion, Schwartz Bayesian criterion, and R^2).

D. Estimation Results

For Armenia, the sample period encompasses 1995Q1 to 2006Q4, yielding 48 observations. The following econometric relationship meets the above criteria:

$$REER = 0.47GOV + 2.17TOT - 0.36OPEN - 0.05NFA \qquad (1)$$

(2.67***) (3.40***) (2.39**) (-2.68***)

The reported result is for the lag specification (2,2,2,2,2), where the t statistics are reported in the brackets, and *, **, and *** denote significance at the 10 percent, 5 percent, and 1

percent level, respectively. A more detailed presentation of the results is provided in the Appendix.

The F and t values for the bound testing (in absolute terms) are larger than the critical value bounds, establishing the existence of a long-run relationship. The t values for the coefficients are all significant at least the 5 percent level. These results hold true when using several alternative lag specifications, confirming that the results are robust. Furthermore, the error-correction term is negative and significant at the 1 percent level (-0.62 with a standard error of 0.11), indicating that the cointegrating relationship is stable. The results are also robust to changes in the sample period. For example, rerunning the regression starting from 1996Q1 or 1997Q1 yields very comparable results.

Estimating the relationship using the Johansen approach yields similar results:

$$REER = 0.46GOV + 3.15TOT - 0.13OPEN - 0.08NFA \qquad (2)$$

$$(0.10) \qquad (0.30) \qquad (0.09) \qquad (0.009)$$

The VECM reports a negative and significant adjustment parameter (-0.29 with a standard error of 0.07), indicating the existence of a stable cointegrating relationship.

As expected, the terms of trade play a vital role in determining the ERER in Armenia. The NFA has a negative sign, confirming that Armenia's experience is similar to that of other transition countries.

For Georgia, the sample period covers 1997Q3 to 2006Q4 using CPI/PPI and 1995Q1 to 2006Q4 using GDP per capita as productivity differential proxies, yielding 38 and 48 observations, respectively. The relationship that satisfies the bound testing and ARDL approach is as follows:

$$REER = 0.86CPI/PPI + 0.21GOV - 0.78OPEN - 0.72INV \qquad (3)$$

$$(2.4^{**}) \qquad (2.1^{**}) \qquad (-2.7^{***}) \qquad (-2.8^{***})$$

The reported result is for the lag specification (2,2,2,2,2), where the t statistics are reported in the brackets, and *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively. Once again, the results are robust to the use of several lag specifications and time intervals. The negative error-correction term (-0.21 with a standard error of 0.10) is significant at the 5 percent level, indicating the existence of a stable cointegrating relationship.

Results using the alternative Johansen approach are slightly less conclusive. The maximum and trace eigenvalue tests establish the existence of a long-run cointegrating relationship at the 5 percent level. The approach also yields significant coefficients on all dependent variables with the exception of government consumption, which has a high standard error. Furthermore, although the coefficient of investment has the same sign as that reported in the ARDL approach, the difference in values is quite significant:

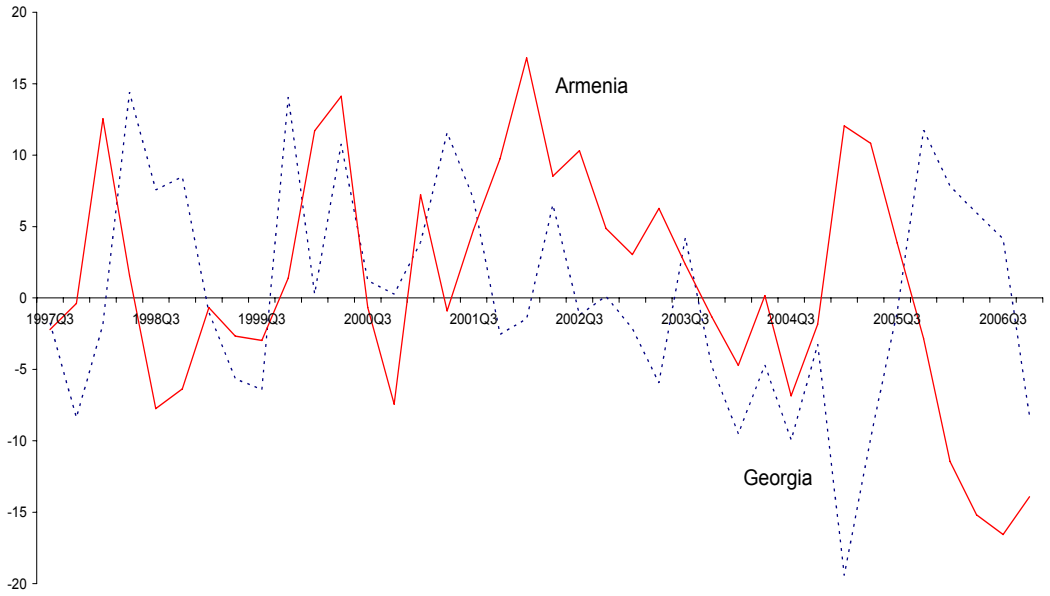
$$REER = 0.88CPI/PPI + 0.04GOV - 0.59OPEN - 2.13INV \quad (4)$$

(0.31) (0.09) (0.27) (0.24)

Both approaches however establish that CPI/PPI, openness, and investment play a very important role in determining Georgia's ERER.

Based on the estimated long-run relationships between the real exchange rate and the dependent variables, exchange rate misalignments in 2006 are evaluated by comparing the ERER—using the value of the fundamental variables in 2006—and the actual real exchange rate level. The results imply an undervaluation of the Armenian dram (14 percent) and an overvaluation of the Georgian lari (2 percent), both on a quarterly average basis (Figure 6).[12] The results also show that the equilibrium real exchange rate in Armenia appreciated rapidly compared with Georgia since 2003 (Figure 7).

Figure 6. Armenia and Georgia: Exchange Rate Misalignment, 1997–2006 1/
(In percent)



1/ Negative number denotes undervaluation.

[12] It should be noted that the assessment of the 2006 real exchange rate level is based on the assumption that exchange rate misalignment evens itself out during 1997–2006.

Figure 7. Armenia and Georgia: Equilibrium Real Exchange Rate Index, 1997–2006
(1997Q3=100)

IV. CONCLUSION

The BEER approach indicates that Georgia's REER in 2006 was broadly consistent with the economic fundamentals, and there is no serious exchange rate misalignment. On the other hand, Armenia's REER was undervalued, suggesting further real appreciation pressures in the years ahead. The sharp real appreciation of the dram that took place in 2007 provides indication of the strength of such pressure (Figure 1). The results appear to confirm that the recent rapid real appreciation in both countries reflected a movement toward equilibrium, and has not resulted in significant real exchange rate overvaluation.

The results also show that although Armenia's REER appreciated much faster than Georgia's in recent years, it was still substantially undervalued in 2006. The phenomenon can be attributed to the rapid appreciation of Armenia's ERER (Figure 7), an explanation supported by the terms of trade and productivity indicators discussed in Section II.

It should be noted that since the time series for econometric estimations are very short, and systematic exchange rate misalignment may very well exist in these two countries, the results of single-country BEER estimates should be interpreted with caution. One way to get over the weakness resulting from the short time series is to estimate equilibrium relationships within a cross-country panel framework. There are also attempts to estimate equilibrium exchange rates for transition economies based on out-of-sample estimations from more advanced economies (Kim and Korhonen, 2005).

Appendix. Methodology, Data Construction, and Results

A. Methodology and Data Construction

Calculations are done using constant partner trade weights in accordance with the most recent trade weights used by the IMF REER calculations (1999–2001 averages, commonly referred to as New2 weights in IMF REER calculations). The assumption of constant trading partner weights is a common assumption (see e.g., Macdonald, 2000, and IMF, 2006) necessitated by the limitations imposed by data considerations, since the REER calculations obtained from IMF sources are calculated using these weights. For consistency's sake, the same trade weights are used in the calculations of all trade-weighted variables (including REER). Based on data availability considerations, 16 trading partners are included for Armenia for all trade-weighted variables, while 17 trading partners are included for Georgia.

REER: ln of REER. Source: IMF EER estimates.

GOV: ln of government consumption ratio to GDP relative to trading partners. Seasonally adjusted. Sources: IFS, WEO, Haver Analytics and Central Bank of Iran.

INV: ln of investment ratio to GDP relative to trading partners. Seasonally adjusted. Sources: IFS, WEO, Haver Analytics and Central Bank of Iran.

TOT (terms of trade): ln of ratio of components-based goods export deflator to import deflator. Seasonally adjusted. Source: WEO.

CPI/PPI: ln of ratio of CPI to PPI relative to trading partners (proxy for price of non-tradables to tradables). Seasonally adjusted. Sources: IFS, IMF staff estimates, Haver Analytics, Central Bank of Iran.

GDPC: ln of real GDP per capita in U.S. dollars relative to trading partners (proxy for relative productivity). Seasonally adjusted. Sources: IFS, IMF staff estimates, Haver Analytics, Central Bank of Iran.

NFA (Net Foreign Assets): For Armenia, international investment positions (IIP) net values minus gold reserves. Missing data constructed by adding current account balance for the specified period to the preceding period. This construction is similar to that employed by the CGER (IMF, 2006) and is superior to more traditional constructions. For Georgia, accumulated current account balance over the sample period. This approach was also employed for Armenia as a robustness check. Results were indistinguishable from those obtained using IIP values. All values are seasonally adjusted. Source: IFS.

OPEN (Openness): ln of exports and imports as a ratio to GDP. Seasonally adjusted. Source: IFS.

B. Results

Table 1. Armenia: Estimated Coefficients for Several Lag Specifications

Ranking	Values		Lag spec	Long-run coefficients and standard errors								Error-Correction:	
	AIC	SBC	Rbar2	TOT		GOV		NFA		OPEN			
AIC													
1 (best)	-3.74	-3.26	0.84 (1,2,2,2,0)	**2.59**	0.71	**0.56**	0.21	**-0.05**	0.02	**-0.26**	0.14	**-0.52**	0.10
2	-3.72	-3.13	0.85 (2,2,2,2,2)	**2.17**	0.64	**0.47**	0.18	**-0.05**	0.02	**-0.36**	0.15	**-0.62**	0.11
3	-3.72	-3.20	0.84 (2,2,2,2,0)	**2.52**	0.67	**0.53**	0.20	**-0.05**	0.02	**-0.23**	0.13	**-0.56**	0.11
4	-3.70	-3.15	0.84 (1,2,2,2,2)	**2.32**	0.71	**0.52**	0.20	**-0.04**	0.02	**-0.38**	0.17	**-0.56**	0.10
SBC													
1 (best)	-3.74	-3.26	0.84 (1,2,2,2,0)	**2.59**	0.71	**0.56**	0.21	**-0.05**	0.02	**-0.26**	0.14	**-0.52**	0.10
2	-3.57	-3.25	0.81 (1,1,0,1,0)	**1.59**	0.86	**0.15**	0.24	**-0.02**	0.03	**-0.55**	0.22	**-0.28**	0.07
3	-3.48	-3.24	0.78 (1,0,0,0,0)	**0.73**	0.78	**0.00**	0.26	**0.00**	0.03	**-0.72**	0.25	**-0.23**	0.09
4	-3.52	-3.24	0.79 (1,1,0,0,0)	**1.02**	0.69	**0.11**	0.22	**-0.01**	0.02	**-0.67**	0.21	**-0.26**	0.09
Rbar2													
1 (best)	-3.72	-3.13	0.85 (2,2,2,2,2)	**2.17**	0.64	**0.47**	0.18	**-0.05**	0.02	**-0.36**	0.15	**-0.62**	0.11
2	-3.74	-3.26	0.84 (1,2,2,2,0)	**2.59**	0.71	**0.56**	0.21	**-0.05**	0.02	**-0.26**	0.14	**-0.52**	0.10
3	-3.72	-3.20	0.84 (2,2,2,2,0)	**2.52**	0.67	**0.53**	0.20	**-0.05**	0.02	**-0.23**	0.13	**-0.56**	0.11
4	-3.70	-3.15	0.84 (1,2,2,2,2)	**2.32**	0.71	**0.52**	0.20	**-0.04**	0.02	**-0.38**	0.17	**-0.56**	0.10

AIC = Akaike Information Criterion. SBC = Schwartz Bayesian Criterion. Rbar2: R^2. Lag spec = Lag specification for each of the variables (REER first). Error-Correction: Error-Correction Coefficient. All regressions include a deterministic intercept. The first column shows the best four ranking relationships based on the specified criterion. The result reported in the main text has the lag specification (2,2,2,2,2).

Table 2. Georgia: Estimated Coefficients for Several Lag Specifications

Ranking	Values		Lag spec	Long-run coefficients and standard errors								Error-Correction:	
	AIC	SBC	Rbar2	OPEN		INV		GOV		CPI			
AIC													
1 (best)	-3.41	-3.11	0.73 (1,0,0,1,0)	**-0.78**	0.29	**-0.72**	0.26	**0.21**	0.10	**0.86**	0.36	**-0.21**	0.10
2	-3.40	-3.14	0.72 (1,0,0,0,0)	**-0.82**	0.34	**-0.73**	0.29	**0.15**	0.10	**0.96**	0.42	**-0.20**	0.11
3	-3.38	-3.03	0.73 (1,0,1,1,0)	**-0.70**	0.28	**-0.78**	0.26	**0.17**	0.10	**0.83**	0.33	**-0.29**	0.12
4	-3.37	-3.02	0.73 (1,1,0,1,0)	**-0.68**	0.34	**-0.67**	0.28	**0.20**	0.11	**0.77**	0.40	**-0.28**	0.09
SBC													
1 (best)	-3.40	-3.14	0.72 (1,0,0,0,0)	**-0.82**	0.34	**-0.73**	0.29	**0.15**	0.10	**0.96**	0.42	**-0.20**	0.11
2	-3.41	-3.11	0.73 (1,0,0,1,0)	**-0.78**	0.29	**-0.72**	0.26	**0.21**	0.10	**0.86**	0.36	**-0.21**	0.10
3	-3.36	-3.06	0.72 (1,0,0,0,1)	**-0.82**	0.36	**-0.76**	0.32	**0.18**	0.12	**0.94**	0.44	**-0.21**	0.10
4	-3.36	-3.06	0.72 (1,1,0,0,0)	**-0.73**	0.39	**-0.69**	0.32	**0.14**	0.11	**0.88**	0.46	**-0.28**	0.10
Rbar2													
1 (best)	-3.41	-3.11	0.73 (1,0,0,1,0)	**-0.78**	0.29	**-0.72**	0.26	**0.21**	0.10	**0.86**	0.36	**-0.21**	0.10
2	-3.38	-3.03	0.73 (1,0,1,1,0)	**-0.70**	0.28	**-0.78**	0.26	**0.17**	0.10	**0.83**	0.33	**-0.29**	0.12
3	-3.37	-3.02	0.73 (1,1,0,1,0)	**-0.68**	0.34	**-0.67**	0.28	**0.20**	0.11	**0.77**	0.40	**-0.28**	0.09
4	-3.36	-3.02	0.72 (1,0,0,1,1)	**-0.78**	0.31	**-0.74**	0.28	**0.23**	0.12	**0.85**	0.38	**-0.21**	0.10

AIC = Akaike Information Criterion. SBC = Schwartz Bayesian Criterion. Rbar2: R^2. Lag spec = Lag specification for each of the variables (REER first). Error-Correction: Error-Correction Coefficient. All regressions include a deterministic intercept. The first column shows the best four ranking relationships based on the specified criterion. The result reported in the main text has the lag specification (1,0,0,1,0).

Table 3. Armenia: Long-Run Relationship Results Using the Bound Testing Approach

	Information criteria		LM test				Critical value bounds:		
Lag length (in ECM representation):	**AIC**	**SBC**	**1**	p-value	**F-stat.**	**t-stat.**		**F-stat.**	**t-stat.**
p=0	-3.48	-3.09	0.01	92.7%	**3.57**	-2.83	1% level	3.41 4.68	-2.59 -4.44
p=1	-3.72	-3.13	0.00	96.3%	**6.16**	-4.68	5% level	2.62 3.79	-1.95 -3.83
p=2	-3.74	-2.93	0.04	83.5%	**3.62**	-3.42	10% level	2.26 3.35	-1.62 -3.49
p=3	-3.61	-2.60	5.70	2.8%	**2.24**	-2.67			
p=4	-4.26	-3.03	5.88	3.2%	**5.42**	-4.71			

AIC = Akaike Information Criterion. SBC = Schwartz Bayesian Criterion. LM Test = Lagrange Multiplier Tests for Residual Serial Correlation against order 1 with associated p-value. All regressions include a deterministic intercept.

Table 4. Georgia: Long-Run Relationship Results Using the Bound Testing Approach

	Information criteria		LM test				Critical value bounds:		
Lag length (in ECM representation):	**AIC**	**SBC**	**1**	p-value	**F-stat.**	**t-stat.**		**F-stat.**	**t-stat.**
p=0	-3.29	-2.85	0.02	90.2%	2.30	-2.70	1% level	3.41 4.68	-2.59 -4.44
p=1	-3.03	-2.37	0.05	82.9%	1.23	-1.83	5% level	2.62 3.79	-1.95 -3.83
p=2	-2.86	-1.97	3.25	9.3%	1.40	-1.76	10% level	2.26 3.35	-1.62 -3.49
p=3	-3.50	-2.38	4.32	7.1%	1.13	0.14			
p=4	-7.55	-6.19	0.05	84.5%	67.00	4.47			

AIC = Akaike Information Criterion. SBC = Schwartz Bayesian Criterion. LM Test = Lagrange Multiplier Tests for Residual Serial Correlation against order 1 with associated p-value. All regressions include a deterministic intercept.

Table 5. Armenia and Georgia: Johansen Cointegration Test and VECM Results

	Rank	λ_{trace}	λ_{max}	VECM Adj. Param.
Armenia	0	135.46***	82.41***	-0.29***
	1	53.05	24.57	(0.07)
	2	28.48	15.18	
	3	13.30	10.40	
Georgia	0	79.58**	36.58**	-0.03
	1	43.00	18.42	(0.07)
	2	24.58	11.18	
	3	13.40	8.23	

The statistics λ_{trace} and λ_{max} are Johansen's trace and maximal eigenvalue statistics. VECM adj. param. reports the adjustment coefficient obtained by VECM. Critical values are from MacKinnon et al (1999). All regressions include one lag and an intercept in CE. Standard errors are reported in parenthesis. The symbols *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively.

Table 6. Armenia and Georgia: Estimated Coefficients and Information Criteria Using Johansen's Approach

	CPI/PPI	GDPC	NFA	TOT	GOV	OPEN	INV	AIC	SC	Log Likelihood
Armenia			-0.08***	3.15***	0.46***	-0.13*		-14.7	-13.2	373
			(0.009)	(0.30)	(0.10)	(0.09)				
Georgia	0.88***				0.04	-0.59**	-2.13***	-12.32	-10.73	257
	(0.31)				(0.09)	(0.27)	(0.24)			

AIC = Akaike Information Criterion. SC = Schwartz Criterion. All regressions include one lag and an intercept in CE. The symbols *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively.

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