ՄԱԿՐՈՏՆՏԵՍԱԳԻՏՈՒԹՅՈՒՆ

VAHAN BABAYAN
Controller at Armenia's Securities Exchange,
PhD in Economics, Associate Professor

ARMEN ASATRYAN
Trading Support Specialist
at Armenia's Securities Exchange,
Master in Agribusiness – ANAU (ATC)

EMPIRICAL STUDY OF MACROECONOMIC FACTORS AFFECTING ARMENIAN DRAM VS U.S. DOLLAR EXCHANGE RATE FLUCTUATIONS

Exchange rate fluctuations have a significant impact on the economic growth of a country. The depreciation of national currency stimulates the economic growth of a particular country; however the overvaluation destroys it. In the end of 2014 Armenian dram devaluated by 16.6% against U.S. dollar. The devaluation of national currency resulted in a huge chaos in the financial system and became a tool for speculation among population. This study attempts to identify the macroeconomic factors affecting the exchange rate fluctuations of Armenian dram versus U.S. dollar. The estimation results showed that the net foreign assets, current account balance, international crude oil prices, gross domestic product, monthly average exchange rates of Armenian dram against Euro, remittances, real interest rate, consumer price index and gross external debt were statistically significant determinants of the monthly average exchange rate of Armenian dram against U.S. dollar.

Key words: *exchange rate, forecasting, linear regression model, depreciation, macroeconomic factors.*

JEL: E6, E60, E69

Introduction

Economic growth is considered to be one of the most important problems for developing countries[1]. Exchange rate fluctuations have a significant impact on the economic growth of a country. The depreciation of national currency stimulates the economic growth of a particular country; however the overvaluation destroys it[2]. Studies show that most developing countries have higher economic growth when national currencies are depreciated. Exchange rate fluctuations have universal effects, with consequences for prices, wages, interest rates, production levels, and employment opportunities[3]. It can also influence the value of the global investment portfolios, competitiveness associated with export as well as imports, international reserve value, debt payments currency value, and travelling costs for tourists in respect of own currencies values. Timely forecasting of the exchange rate is able to give important information to the decision makers as well as participants in the area of the internal finance, buy and sell, and policy making.

On November 24, 2014 Armenian dram devaluated by 16.6% against U.S. dollar. It was followed by another depreciation of Armenian dram against U.S. dollar by 36.86% on December 17, reaching 527.20 drams. This was the highest exchange rate in the last decade. The devaluation of Armenian dram at the end of 2014 resulted in a huge chaos in the financial system, increased the share of loans in foreign currencies (from 56% to 62.3%) while increasing the risk of dollarization of deposits[4], and was a source for a lot of speculation among population. Officials explain the dram's depreciation mainly by developments in the external financial market, as well as by the economic problems of Armenia's main partner, geopolitical situation, economic sanctions against Russia, oil prices and the devaluation of the Russian ruble. However, international financial organizations evaluate the situation as manageable, for those dealing with currency trade it was an opportunity for speculations, which in its turn resulted in panic among population. Armenian residents were buying and selling dollars from banks and in that way were earning additional amount of money. But because of devaluation some of them recorded losses. Such speculations were not protected by the government and the CBA.

To that end, a linear regression model was estimated using monthly time-series data for the period of 2004–2018 where average monthly exchange rate of Armenian dram was modeled as a function of Euro, net foreign assets, current account balance, international oil prices, gross domestic product, consumer price index and gross external debt. The estimation results showed that the net foreign assets, current account balance, international crude oil prices, monthly average exchange rates of Armenian dram against Euro,

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[1] See **Basirat Mehdi, Nasirpour Arezoo and Jorjorzadeh Alireza**, The effect of exchange rate fluctuations on economic growth considering the level of development of financial markets in selected developing countries, Asian Economic and Financial Review, 2014. - 4: Vol. 4: p. 517-518.

[2] See **Rodrik D.**, The Real Exchange Rate and Economic Growth, Harvard University, 2008: p. 365–367.

[3] See **Uddin Kazi Mohammed Kamal, Quaosar G. M. Azmal Ali and Nandi Dulal Chandra**, Factors affecting the fluctuation in exchange rate of Bangladesh: a co-integration approach, The international journal of social sciences, 2013. - 1: Vol. 18: p. 1–2.

[4] See http://www.armbanks.am/en/2014/12/09/82332/.

remittances, real interest rate, consumer price index and gross external debt were statistically significant determinants of the monthly average exchange rate of Armenian dram against U.S. dollar.

Literature Review

Vahe Heboyan in his study entitled "Real Exchange Rate Determinants in Transition Economies: Do Macroeconomic Fundamentals and Political Risk Play a Role?" [5] applies several econometric estimation methods such as VAR, VECM, and ARDL, to analyze Armenia's real exchange rate dynamics in relation to economic fundamentals. The author also incorporates several political risk indicators in the analysis to see if they improve the overall performance of the real exchange rate models and inquires if changes in the political climate have affected the real exchange rate in Armenia. Finally, we evaluate the out-of-sample forecasting power of these models (1) to make an inference on the overall effectiveness of these models to forecast real exchange rate in a transition country; (2) to examine if accounting for the political climate and investment risk helps to improve the forecasting power; and (3) to see if any of these models perform better than the simple random walk as argued in Meese and Rogoff.

Katarzyna Twarowska in her paper entitled "Analysis of Factors Affecting Fluctuations in the Exchange Rate of Polish Zloty against Euro" [6] focuses on analyzing the determinants of the exchange rate of the zloty against euro and finding which of them plays an important role as factors affecting the zloty values. The author used regression analysis where annual average exchange rate was set as a function of a number of macroeconomic variables. As a result the financial account balance and inflation rate are the most important factors determining the level of EUR/PLN exchange rate. The market interest rate is the third most important factor determining the zloty exchange rate level. The fourth important variable which brings more variation in the zloty exchange rate is the government deficit, while the economic growth and the current account are less significant determinants of exchange rate.

Anita Mirchandani discusses various macroeconomic variables that have impact on the volatility of exchange rate of a currency in her "Analysis of Macroeconomic Determinants of Exchange Rate Volatility in India"[7] study. The main research method the author has used in this study is correlation analysis and hypothesis testing. The main findings of this study are that 1) the exchange rate has correlation with any of such variables like Inflation, Interest Rate, Foreign Investment, GDP Growth & Current Account Balance; 2) high inflation leads to depreciation of Exchange Rate of a currency; 3) high interest rate results in depreciation in the Exchange rate of currency; 4) exchange rate has positive correlation with GDP growth rate & current account balance.

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[5] See **Heboyan Vahé and Gunter Lewell F.,** Real Exchange Rate Determinants in Transition Economies: Do Macroeconomic Fundamentals and Political Risk Play a Role? The University of Georgia. - Pittsburgh, Pennsylvania: Agricultural and Applied Economics Association, 2011.

[6] See **Twarowska Katarzyna and Kąkol Magdalena**, Analysis of Factors Affecting Fluctuations in the Exchange Rate of Polish Zloty Against Euro, Management, Knowledge and Learning International Conference. - 2014, Poland.

[7] See **Mirchandani Anita,** Analysis of Macroeconomic Determinants of Exchange Rate Volatility in India, International Journal of Economics and Financial Issues, 2013. - 1: Vol. 3.

Data Description

Monthly time-series data for the period of 2004–2018 were used in the analysis. The dataset includes average monthly exchange rate of AMD vs USD and Euro, net foreign assets, current account balance, international crude oil prices, gross domestic product, foreign remittances to Armenia, real interest rate and consumer price index variables. Most of the original raw data were available on an annual and quarterly basis, that is why their monthly interpolations were ultimately used in the analysis. The data on average monthly exchange rate of Armenian dram vs USD and Euro for the period of 2004-2018 were available in CBA website's Statistics section. Net foreign assets, current account balance, gross external debt and gross domestic product for the period of 2004-2018 were taken from CBA's Statistics data bank [8]. As these variables were available on quarterly basis, they were interpolated to monthly data. International monthly oil prices were taken from the U.S. Energy Information Administration's website[9]. Remittances and Real interest rate were taken from the World Bank database[10] and monthly CPI was taken from Trading Economics database [11]. Table 1 shows the summary statistics of the variables.

Table 1

Summary statistics of the used variables

Variables	Units	Obs.	Mean	St. Dev.	Minimum	Maximum
Average monthly exchange rate of AMD vs USD	AMD	180	421.07	63.34	301.96	568.44
Net foreign assets	mln AMD	180	36,101.57	255,311.6	-493,815	449,143.7
Current account balance	mln $	180	-180.36	157.16	-541.29	149.93
International crude oil price	$/barrel	180	74.66	26.62	30.7	132.72
Gross domestic product	mln AMD	180	967,793	350,179.7	274,650.6	1,789,655
Average monthly exchange rate of AMD vs Euro	AMD	180	532.34	54.07	389.18	717.03
Remittances	mln $	180	368.62	128.96	98.05	742.69
Real Interest Rate	%	180	13.14	1.6	10.43	17.04
Consumer price index	-	180	103.94	18.13	75.89	129.67
Gross external debt	mln AMD	180	6,176.3	3,164.78	1,782.12	11,519.44

Empirical Specification

The estimated linear regression model is the following:

$$FX_t = \beta_0 + \beta_1 * NFA_t + \beta_2 * CAB_t + \beta_3 * COP_t + \beta_4 * GDP_t + \beta_5 * EUR_t + \beta_6 * REM_t + \beta_7 * RIR_t + \beta_8 * CPI_t + \beta_9 * GED_t + u_t$$

where

- FX_t is the average monthly exchange rate of AMD vs USD for time period t,
- NFA_t is the net foreign assets of the Republic of Armenia for time period t; mln AMD,

[8] See https://www.cba.am/en/sitepages/statdatabank1.aspx.
[9] See https://www.eia.gov/opendata/.
[10] See https://data.worldbank.org/country/armenia.
[11] See https://tradingeconomics.com/armenia/consumer-price-index-cpi.

- CAB_t is the current account balance of the Republic of Armenia for time period t; mln USD,
- COP_t is the international crude oil price for time period t; $/barrel,
- GDP_t is the gross domestic product of the Republic of Armenia for time period t; mln AMD,
- EUR_t is the average monthly exchange rate of AMD vs Euro for time period t,
- REM_t is the foreign remittances to the Republic of Armenia for time period t,
- RIR_t is the real interest rate of the Republic of Armenia for time period t,
- CPI_t is the consumer price index of the Republic of Armenia for time period t,
- GED_t is the gross external debt of the Republic of Armenia for time period t,
- u_t is the error term,

STATA10 statistical software package was used to estimate the model. Also, the model was checked and corrected for specification error, multicollinearity, and autocorrelation.

Multicollinearity

This problem states that several independent variables are closely correlated. In case of the presence of multicollinearity, the confidence intervals become larger which affect the individual statistical significance of parameter estimates of independent variables.

As the model includes many macroeconomic parameters, there is a high probability that many of them are correlated with each other. Collinearity diagnostics is used for checking the presence of multicollinearity which is shown in Table 2.

Table 2

Collinearity diagnostics

	VIF	SQRT VIF	Tolerance	R-squared
Net foreign assets	8.46	2.91	0.1182	0.8818
Current account balance	2.75	1.66	0.3636	0.6364
International crude oil price	4.46	2.11	0.2244	0.7756
Gross domestic product	8.42	2.90	0.1187	0.8813
Average monthly exchange rate of AMD vs Euro	1.84	1.36	0.5428	0.4572
Remittances	6.68	2.58	0.1497	0.8503
Real Interest Rate	3.08	1.76	0.3243	0.6757
Consumer price index	56.82	7.54	0.0176	0.9824
Gross external debt	52.42	7.24	0.0191	0.9809
Condition Number		168.3906		

According to Table 2, consumer price index and gross external debt variables are higher than 10 VIF factors; respectively, 56.82 and 52.42. At the

same time Tolerances for the same variables are less than 0.1 and closer to 0. Condition number is 168.3906 which is located between 100 and 1000 and it indicates that there is moderate multicollinearity.

The correlation matrix of independent variables is shown in Table 3

Table 3

Correlation matrix for independent variables

	NFA	*CAB*	*COP*	*GDP*	*EUR*	*REM*	*RIR*	*CPI*	*GED*
NFA	1.0000								
CAB	-0.3226	1.0000							
COP	-0.0137	-0.5299	1.0000						
GDP	-0.6279	0.1159	0.1487	1.0000					
EUR	-0.2029	0.4097	-0.2887	-0.0877	1.0000				
REM	-0.2903	-0.2258	0.6608	0.6899	-0.3166	1.0000			
RIR	-0.6399	0.2692	-0.3597	0.4072	0.1117	0.0045	1.0000		
CPI	***-0.8420***	-0.0160	0.1803	***0.7624***	-0.0190	0.4323	0.5042	1.0000	
GED	***-0.8173***	0.0075	0.1775	***0.7972***	0.0472	0.4597	0.4387	***0.9809***	1.0000

According to Table 3, gross external debt and consumer price index have the highest correlation coefficient (0.9809). Net foreign assets and Gross domestic product are also correlated with those two variables. However, the highly correlated two variables are left in the model, because they are important variables with right signs and statistically significant parameter estimates. Although these independent variables keep the multicollinearity issue, those variables are kept in the model.

Autocorrelation

In order to check whether the data has issue of serial correlation, Durbin-Watson and Breusch-Godfrey tests were used. Durbin-Watson d statistic was equal to 0.5613, which indicates the presence of positive serial correlation. Breausch-Godfrey test also mentioned about the presence of serial correlation.

Autocorrelation issue was improved using procedure developed by Newey and West, which allows to use Ordinary Least Squares (OLS) estimation and adjusts standard errors making them heteroscedasticity and autocorrelation consistent (HAC). For the Newey-West procedure lag length of 1 was chosen.

Estimation results

The financial regression output is the following.

$$\widehat{FX}_t = 335.4846 - 0.0000992 * NFA_t + 0.0512104 * CAB_t - 0.6552386 * COP_t + 0.0000323 * GDP_t + 0.60846 * EUR_t - 0.1219382 * REM_t - 4.899622 * RIR_t - 1.445284 * CPI_t + 0.0083635 * GED_t$$

Table 4 provides the estimated partial regression coefficients, corresponding p-values, t statistics, Newey-West standard errors, 95% confidence intervals, F statistic. 5% significance level has been chosen for analysis. According to the estimation results, the probability of obtaining an F value greater than or equal to 253.68 was equal to 0.000 which means that all the parameter estimates are jointly statistically significant at the 5% significance level. All the parameter estimates associated with the independent variables are statistically significant at 5% significance level. As shown the comparable R^2 is 0.9601, meaning that 96.01% of variation in the average monthly exchange rate of AMD vs USD is explained by the estimated model.

Table 4

Estimation Results

	Coefficient	*Newey-West St. Error*	*t*	*P>|t|*	*95% Conf. Interval*	
Net foreign assets	-0.00010	0.00001	-7.12	0.000	0.000	0.000
Current account balance	0.05121	0.01475	3.47	0.001	0.022	0.080
International crude oil price	-0.65524	0.09097	-7.20	0.000	-0.835	-0.476
Gross domestic product	0.00003	0.00001	3.24	0.001	0.000	0.000
Average monthly exchange rate of AMD vs Euro	0.60846	0.03089	19.70	0.000	0.547	0.669
Remittances	-0.12194	0.02419	-5.04	0.000	-0.170	-0.074
Real Interest Rate	-4.89962	1.41382	-3.47	0.001	-7.691	-2.109
Consumer price index	-1.44528	0.54358	-2.66	0.009	-2.518	-0.372
Gross external debt	0.00836	0.00311	2.69	0.008	0.002	0.015
Constant	335.48460	48.08424	6.98	0.000	240.566	430.404
R-squared	*0.9601*					
F-test	*253.68*					
Prob(F)	*0.0000*					

- The sign of the parameter estimate associated was expected to be positive, but the estimated coefficient is negative, which can be explained that Armenia is a net borrower country. If net foreign assets increase by 1mln AMD, on average, the average monthly exchange rate of AMD vs USD will decrease by 0.0000992 AMD, everything else held constant.
- The parameter estimate associated with current account balance, has the expected sign, if current account balance increases by $1 mln, on average, the average monthly exchange rate of AMD vs USD will increase by 0.0512104 AMD, everything else held constant.
- The international crude oil price has a negative correlation with dependent variable. If international crude oil price increases by 1$/barrel, on average, the average monthly exchange rate of AMD vs USD will decrease by 0.655 AMD, everything else held constant.
- An increase in gross domestic product affects the appreciation of the national currency. If GDP increases by 1 mln AMD, on average, the average monthly exchange rate of AMD vs USD will decrease by 0.0000323 AMD, everything else held constant.
- The average monthly exchange rate of AMD vs Euro has positive relationship to the dependent variable. This means that if average monthly exchange rate of AMD vs Euro increases by 1 AMD/Euro, on average, the average monthly exchange rate of AMD vs USD will increase by 0.60846 AMD/USD, everything else held constant.
- As foreign remittances increase the AMD improves its value against USD. This means that if the foreign remittances to Armenia increase by $1 mln, on average, the average monthly exchange rate of AMD vs USD will decrease by 0.12194 AMD, everything else held constant.

- One percent increase in real interest rate, may lead to on average 4.9 AMD increase in the average monthly exchange rate of AMD vs USD, everything else held constant.
- As consumer price index increases by 1, on average, the average monthly exchange rate of AMD vs USD will decrease by 1.445284 AMD, everything else held constant.
- An increase in gross external debt has a negative impact on exchange rate. $1mln increase in gross external debt increases the average monthly exchange rate, on average by 0.00836 AMD, everything else held constant.

Figure 1 presents the actual time series data in comparison with the predicted data. This graphical illustration shows how the model can further predict the exchange rate given the expected macroeconomic factors included in the model.

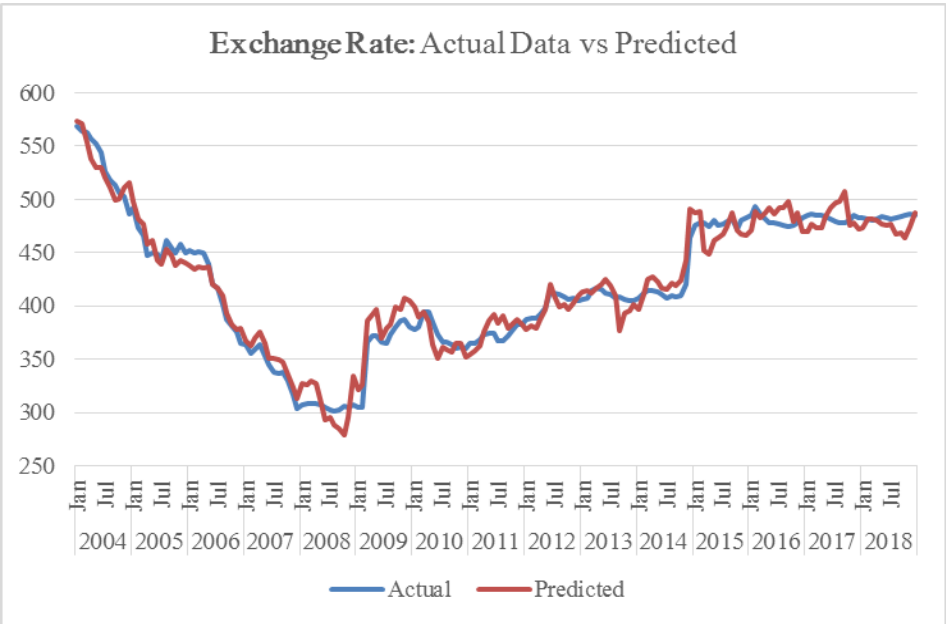

Figure 1. *Exchange Rate AMD/USD: Actual Data vs Predicted*

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ՎԱՀԱՆ ԲԱԲԱՅԱՆ
ՀՊՏՀ կառավարչական հաշվառման և աուդիտի ամբիոնի դոցենտ, տնտեսագիտության թեկնածու

ԱՐՄԵՆ ԱՍԱՏՐՅԱՆ
ՀԱԱՀ ագրոբիզնեսի դեպարտամենտի մագիստրոս

Մակրոտնտեսական գործոնների ազդեցությունը ՀՀ դրամի և ԱՄՆ դոլարի փոխարժեքի տատանումների վրա.– Փոխարժեքի տատանումները զգալի ազդեցություն ունեն երկրի տնտեսական աճի վրա: Ազգային արժույթի թերագնահատումը խթանում է երկրի տնտեսական աճը, սակայն վերագնահատումը խոչընդոտում է այն: 2014 թ. ավարտին հայկական դրամը ԱՄՆ դոլարի նկատմամբ արժեզրկվեց 16.6%-ով: Ազգային արժույթի արժեզրկումը հանգեցրեց քաոսի ֆինանսական համակարգում և դարձավ բնակչության շրջանում շահարկումների գործիք: Այս ուսումնասիրության նպատակն է բացահայտել այն մակրոտնտեսական գործոնները, որոնք ազդում են դրամի և դոլարի փոխարժեքի տատանումների վրա: Գնահատման արդյունքները ցույց են տվել, որ զուտ արտաքին ակտիվները, ընթացիկ հաշվի մնացորդը, համախառն ներքին արդյունքը, նավթի միջազգային գները, եվրոյի նկատմամբ հայկական դրամի միջին ամսեկան փոխարժեքները, դրամական փոխանցումները, իրական տոկոսադրույքը, սպառողական գների ինդեքսը և համախառն արտաքին պարտքը դրամի և դոլարի միջին ամսական փոխարժեքի վիճակագրորեն նշանակալի որոշիչներն են:

Հիմնաբառեր. *փոխարժեք, կանխատեսում, գծային ռեգրեսիոն մոդել, արժեզրկում, մակրոտնտեսական ցուցանիշներ:*
JEL: E6, E60, E69

ВАГАН БАБАЯН
Доцент кафедры управленческого учета и аудита АГЭУ, кандидат экономических наук

АРМЕН АСАТРЯН
Магистр департамента агробизнеса НАУА

Эмпирический анализ макроэкономических факторов, влияющих на среднемесячный курс армянского драма по отношению к доллару США.– Колебания обменного курса оказывают значительное влияние на экономический рост страны. Снижение курса национальной валюты стимулирует экономический рост конкретной страны, однако его переоценка имеет обратный эффект. В конце 2014 года армянский драм обесценился на 16.6% по отношению к доллару США. Девальвация национальной валюты поставила в затруднительную ситуацию финансовую систему страны и стала инструментом для спекуляций среди населения. Целью данного исследования является выявление тех макроэкономических факторов, которые

влияют на колебания обменного курса армянского драма по отношению к доллару США. Следуя результатам исследования, чистые иностранные активы, текущий баланс операций, международные цены на нефть, среднемесячный обменный курс армянского драма по отношению к евро, валовой внутренний продукт, денежные переводы, реальная процентная ставка, индекс потребительских цен и валовой внешний долг являются статистически значимыми факторами среднемесячного значения курса армянского драма по отношению к доллару США.

Ключевые слова: *валютный курс, прогнозирование, линейно-регрессионная модель, обесценивание, макроэкономические показатели.*
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