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BANKING. BANKS

**RESERVE REQUIREMENTS IN THE SHADE OF NEW MACRO-
PRUDENTIAL REGULATION FRAMEWORK: DE-DOLLARIZATION
POLICY EFFICIENCY IN ARMENIA**

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During the last 10 year period Armenian financial sector has undergone severe shocks and accumulation of systemic risk that has resulted in a higher level of dollarization, thus limiting the Central Bank's ability to influent economic environment through conventional monetary policy tools. In this paper we document and empirically evaluate the use of unconventional regulatory tools in Armenia to reduce credit and deposit dollarization and maintain financial stability. Our analysis is based on the counter-factual test proposed by Pesaran and Smith (2012) and show that higher reserve requirements (since December 2014) as a tool for macroprudential regulation and the institute of deposit guarantee (since December 2015) had statistically significant effects on reducing both credit and deposit dollarization in Armenia. We also take into account the policy of foreign currency reserving in AMD. The results show that this policy had statistically significant effect on increasing both credit and deposit dollarization in Armenia.

Introduction

In this working paper, we empirically evaluate the effects of unconventional regulatory tools used by the Central Bank of Armenia to reduce credit and deposit dollarization and ensure stability in the financial markets. Decomposing the program into 3 stages we analyze three different policy changes in bank regulation:

1. reserving AMD for FX funding (2010),
2. increase in reserve requirement for FX funding compare to AMD funding (2014),

3. increase in the coverage limit of Deposit guarantee fund for AMD deposits (2015).

In most sub-Saharan African countries reserve requirements in FX deposits are maintained in local currencies, and Croatia had a similar regulation tool. The Croatian National Bank requires banks to hold a certain portion of the reserve on deposits denominated in foreign currency at the central bank in the form of a Croatian Kuna denominated deposit. Regarding the implementation of higher reserve requirement for FX funding, Peruvian case of implementing such a prudential regulation is a successful example. And finally, as a close to extreme example of differentiation between FX and local currency deposits, we can mention Uruguay which excluded dollar deposits from deposit insurance scheme. Similar analyses on estimation of de-dollarization policy effects were conducted for Peru by Castillo *et al.* in 2016 [2] and UK by Pesaran *et al.* in 2012 [6]. The methodology that we use in our analysis is based on Pesaran *et al.*, 2012, where the effectiveness of quantitative easing policy was evaluated. To test policy effectiveness requires a model to construct a counter-factual for the outcome variable in the absence of the policy intervention and a way to determine whether the differences between the realized outcome and the model-based counter-factual outcomes are larger than what could have occurred in the absence of policy intervention. For the Peruvian case, empirical analysis was conducted to test the effectiveness of different unconventional policy tools [1], particularly the differentiation in reserve requirements for foreign and domestic currency deposits [2]. It was found that two-thirds of the reduction of credit dollarization in Peru was explained by one of the key elements of the de-dollarization program – the reserve requirements tool.

In case of Armenia, policy tools turn out to have different effects. In particular, we found that both higher reserve requirement for FX deposits and higher deposit insurance coverage for domestic currency deposits have positive effect on de-dollarization. Meanwhile, regulation change on reserving AMD for FX deposits had inverse effect, increasing dollarization of both deposits and credits.

The paper is organized as follows: Section 1 represents a theoretical model, which describes how these policies affect the dollarization level. Section 2.1 provides an overview of the Armenian financial system dollarization and discusses the use of different policy tools aimed at financial de-dollarization. Section 2.2 the methodology for measuring the effectiveness of de-dollarization program is described. Besides, an empirical evaluation of three above mentioned policies is introduced. Finally, Section 3 concludes the results.

1. Theoretical model and its implications

In this section we describe the methodology which will help us evaluate the implications of the utilized policy instruments on the level of dollarization. We incorporate models developed by Luca and Petrova (2008) [5] and Catao and Terrones (2000) [3] into our analyses. This a one-period model has the following assumptions. At the beginning firms borrow from banks and immediately finance their cost of production. The initial exchange rate is assumed to be equal to one. Banks raise funds from deposits and foreign borrowings and lend to firms. After all allocations are made there is an exchange rate shock. The new exchange rate is denoted by S and the nominal rate of depreciation is described as $e = S - 1$. At the end of this one period firms make profit and repay bank loans. Banks repay their depositors and foreign debtors. The model consists of a demand side that replicates the model as it is in the Luca and Petrova (2008) [5] and supply side with modifications represented in the Section 2.2.

1.1. The demand side: Firms

There are M identical firms that borrow from domestic banks in domestic and foreign currency to finance the cost of one unit of input producing y units of the final goods. There are no alternative sources of financing. Firms profits are.

$$\Pi_f = py - r_L l_f - r_L^* (1 + t) l_f^* \quad (1)$$

where r_L is the interest rate for domestic loans and r_L^* is the interest rate for foreign loans, l_f and l_f^* is the volume of loans in domestic and foreign currencies respectively, p is the price of final goods and is imperfectly correlated with exchange rate. Firms choose their currency composition of borrowing l_f and l_f^* star to maximize their objective function:

$$E[\Pi_f] - \frac{1}{2} \gamma VAR(\Pi_f) \quad (2)$$

subject to budget constraint

$$w = l_f + l_f^* \quad (3)$$

where

$E[t] = t^e$, $E[t] = \sigma^2$, $COV(p, t) = \sigma E_p$ when using first-order conditions and aggregating over all M firms ($L_f^* = M l_f^*$, $L_f = M l_f$, $Y = M y$), the total demand for foreign and domestic currency loans is described as:

$$L_f^* = \frac{\gamma \sigma_{\epsilon p} \gamma r_L^* - M [r_L^* (1 + \epsilon^e) - r_L]}{\gamma \sigma_{\epsilon}^2 r_L^*} \quad (4)$$

$$L_f = M - L_f^* \quad (5)$$

Equation (4) shows that the demand for foreign loans is high if they have high foreign currency denominated revenues (y), the covariance between exchange rate and

inflation ($\sigma_{\epsilon p}$) is large, the expected relative cost of dollar loans is low (ϵ^e), the volatility of dollar loan payments (σ_ϵ^2) is low and the level of bank risk aversion (γ) is low.

1.2. The Supply Side: Banks

There are N identical, risk averse banks in the economy that fund their loans by deposits in domestic and foreign currency and foreign borrowings d , d^* and b^* respectively. Banks also make reserves for foreign currency deposits (i is reservation rate). Banks face balance sheet condition (6) and (7):

$$l_b + l_b^* + R_b = d + d^* + b^* \quad (6)$$

$$id^* \leq R_b \quad (7)$$

Banks' profit formula is presented in equation (8):

$$\Pi_b = r_l l_b + r_l^*(1+t)l_b^* - r_b d - r_b^*(1+t)d^* - r^*(1+t)b^* \quad (8)$$

Banks choose their portfolio allocations (l_b , l_b^* , d , d^* , b^*) to maximize their objective function (9):

$$E[\Pi_b] - \frac{1}{2} \delta VAR(\Pi_b) \quad (9)$$

In competitive equilibrium, arbitrage conditions imply that domestic and foreign interest rates for deposit, loan and foreign borrowing must be equal. Inserting second equation into first equation and aggregating for all banks we will get equation (10):

$$L_b^* = B^* + D^* + \frac{3N[r_L^*(1+\epsilon^e) - r_L] - ir_L N}{\delta \sigma_\epsilon^2 r_L^*} \quad (10)$$

We can see that the supply of foreign loans is high when foreign deposits and borrowing are high, the expected relative return is high, the exchange rate volatility is low and reserve requirement (i) is low. If we compute for interest rate differential we see that higher reserve requirement increases this differential thus making foreign currency loans more expensive. If we make some structural changes to reserve requirements that is, for foreign deposits banks have to make reserves in domestic currency and solve the same problem with different budget constraint for reserves we will get equations (11):

$$L_b^* = B^* + D^* + \frac{3N[r_L^*(1+\epsilon^e) - r_L] - i(1+t)r_L N}{\delta \sigma_\epsilon^2 r_L^*} \quad (11)$$

We see that the result is very similar to the equation (10). The main difference is that exchange rate shock appears with reserve rate. If we compute the difference between this equations we will get formula (12):

$$\Delta = ir_L N t^e \quad (12)$$

This difference means that if we make some structural changes to reserve requirements loan dollarization declines.

1.3. General Equilibrium

If we combine equations (4) and (10) we derive the equilibrium level of dollarization in the economy.

$$L^* = \frac{\sigma_{\epsilon p} Y}{\sigma_{\epsilon}^2 r^*} - \frac{M[r_L^*(1+\epsilon^e) - r] + 2irN}{\gamma r^{*2} \sigma_{\epsilon}^2} \quad (13)$$

In the second case we will get

$$L^* = \frac{\sigma_{\epsilon p} Y}{\sigma_{\epsilon}^2 r^*} - \frac{M[r^*(1+\epsilon^e) - r] + 2i(1+\epsilon^e)rN}{\gamma r^{*2} \sigma_{\epsilon}^2} \quad (14)$$

In this case also we get that the difference is the same as in partial equilibrium case but multiplied by 2.

2. Documentation and Evaluation of prudential tools

2.1. Dollarization and prudential tools

De-dollarization is a fundamental strategy of prudential policies aiming at preserving financial stability. Financial dollarization generates systematic risk at two dimensions: first it decreases the central banks capacity to act as a lender of last resort. Second, when banks lend in foreign currency, financial dollarization creates currency mismatches, which increases the credit risk.

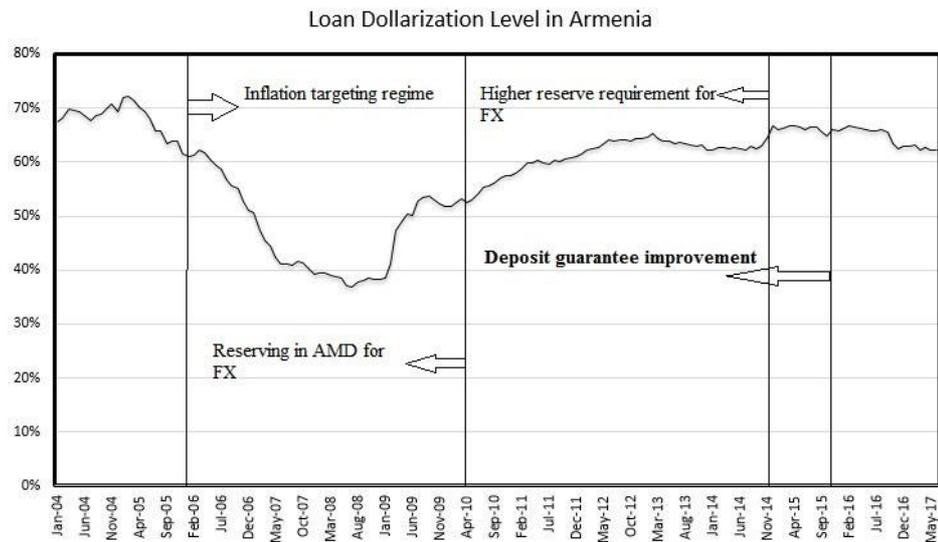


Figure 1: Loan dollarization

Source: Authors' calculations based on Central Bank of Armenia Monetary and Financial Statistics Loans and Deposits data.

The loan dollarization level dynamics are presented in Figure 1. It can be seen that from 2004 its level is very high, although for some dates its level reaches 50 percent, but then it increased up to 62 percent. From the figure it is seen that after switching to inflation targeting regime the dollarization started to decline and increased after 2008 financial crisis. After March 2010, when reserving in AMD for FX policy started, dollarization level started to increase. It can be the result of the policy mentioned above. In the figure there are presented the policy implementation dates. The same picture is in the case of deposit dollarization. All data starts from January 2004 and continues until June 2017. The implemented policies aimed at: 1) helping banks to internalize dollarization risks, 2) enhancing the financial system's capacity to absorb shocks. For achieving this aims the CBA increased the rate of reserve requirement for foreign currency. second, developed the guarantee of deposits giving 2.5 times higher guarantee level for AMD deposits than for FX deposits. The third started reserving for foreign currency deposits in AMD. The use of this policies is discussed below.

a) **Reserve Requirement** - Reserve requirements in dollars are used to increase the cost of lending and curb credit growth. After currency crisis on December 2014 the exchange rate was depreciated sharply, to reduce the risks related to this on 22th December 2014 the CBA increased the rate of reserve requirement for foreign currency up to 24 percent, after one week CBA set it equal to 20 percent, then on 20th September 2016 the rate was set equal to 18 percent. This raising of reserve requirements are described in Figure 1.

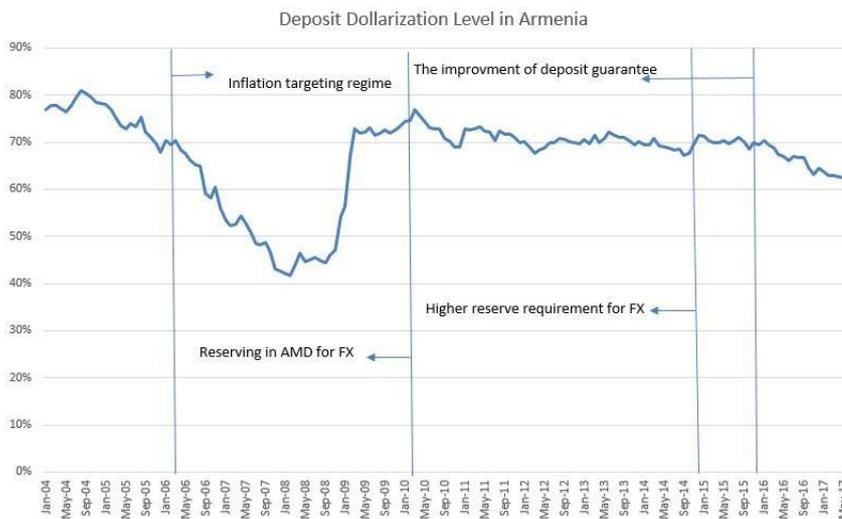


Figure 2: Deposit dollarization

Source: Authors' calculations based on Central Bank of Armenia Monetary and Financial Statistics Loans and Deposits data.

b) The guarantee of deposits From 2005 year the CBA established DEPOSIT GUARANTEE FUND OF ARMENIA. Till December 2015 the limits of guaranteeing were: 4 mln. dram for AMD deposits and 2 mln. dram for foreign currency deposits. As it is seen, the amount of guarantee for AMD deposits is two time higher than it is for foreign currency deposits. This difference may give incentives to depositors for saving in domestic currency. After November 2015 the limits were increased by 2.5 times: 10 mln. AMD for domestic currency deposits and 5 mln. for foreign currency deposits.

c) Reserving for foreign currency deposits in AMD In 2008 to de-dollarize the financial system, the reserve requirement for foreign currency in- creased from 8 to 12 percent. In 2010 the rate was subjected to structural change. Banks started to reserve for foreign currency in Armenian drams. This policy was done in stepwise. At beginning it was set 3 percent, then 6 percent, then 9 percent, then 12 percent.

2.2. *Evaluating the Effectiveness of Prudential Tools*

In this section, we evaluate the effectiveness of policies in reducing financial dollarization by following the methodology proposed by Pesaran and Smith (2016) [7]. We test the relevance of higher reserve requirements in foreign currency, the development of deposit guarantee institute and reserving in AMD for foreign currency for reducing the dollarization level. For performing a counter-factual exercise we first need identify periods before and after these policies were introduced. Starting from March 2010 the policy of reserving in AMD for foreign currency was introduced and it continues till now. Higher reserve requirements were introduced after 18th December 2014. The guarantee of deposits expand its limits after November 2015. Following Pesaran and Smith (2016) [7], the counter- factual values can be obtained as a conditional forecast generated by reduced form equation

$$y_t = a_1x_t + a_2w_t + e_{yt} \quad (15)$$

Where y is the outcome variable, which is affected by policy variable x and control variables w . Here w 's are affecting only y , and are invariant to policy changes. Under this assumptions the policy effect can be estimated by:

$$d_{t+h} = a_1(X_{t+h}^1 - X_{t+h}^0) \quad (16)$$

where the expression in the brackets is the average size of the policy effect. As a result, we compute the mean effect of policy by summing up the policy effects for the period it was introduced, and then test whether its statistical significance. The t-statistics is represented by the following formula:

$$\tau = d_h/\sigma_y \sim N(0,1) \quad (17)$$

In our policy evaluation, as an outcome variable we use the dollarization ratio, as policy variables we use the rate of reserve requirements for FX, a dummy variable, which equals to 1 starting from December 2015 and 0 before. To capture the policy of reserving in AMD for FX deposits we create a series which equals 0 before March 2010, 3 percent from March 2010 to July 2010, 6 percent from August 2010 to January 2011, 9 percent from February 2011 to October 2011, 12 percent after November 2011, and it changes according to RR for FX. As control variables that are time invariant to policy instruments we use the following variables: repo rate, federal interest rate, the US 10-year Treasury yield, exchange rate indices of main trading partners. Our estimated model has AR structure and is estimated by OLS regressions. An additional dummy variable is included in the regression to account for the effect of financial crisis in 2008. The results of the reduced form regressions are presented in the following tables.

Table1.1 Higher reserve requirement policy effect on loan dollarization

Explanatory	Loan dollarization	t-statistics	p-value
constant	-28.577	-1.37	0.174
RR	-.4789	-4.41	0.000
Repo	1.307	10.43	0.000
Fed rate	-.925	-7.54	0.000
GS10	-1.096	-4.71	0.000
ExRate	8.968	2.38	0.019
Dummy	-2.609	-4.43	0.000
Lag12	.678	21.3	0.000

Table 1.2 Higher reserve requirement policy effect on deposit dollarization

Explanatory	deposit dollarization	t-statistics	p-value
constant	83.443	3.34	0.001
RR	-.558	-5.44	0.000
Repo	1.413	11.56	0.000
Fed rate	-0.907	-7.46	0.000
GS10	-0.902	-3.91	0.000
ExRate	-9.025	-2.07	0.041
Dummy	-2.226	-3.60	0.000
Lag12	.493	10.55	0.000

Table2.1 Deposit guarantee institute effect on loan dollarization

Explanatory	Loan dollarization	t-statistics	p-value
constant	-36.056	-1.74	0.083
DGI	-4.878	-4.73	0.000
Repo	0.495	3.41	0.001
Fed rate	-.825	-8.93	0.000
GS10	-1.523	-7.01	0.000
ExRate	10.605	2.86	0.005
Dummy	-3.017	-7.05	0.000
Lag12	0.678	24.81	0.000

Table2.2 Deposit guarantee institute effect on deposit dollarization

Explanatory	Deposit dollarization	t-statistics	p-value
constant	80.59	3.25	0.001
DGI	-5.456	-5.34	0.000
Repo	0.485	3.17	0.002
Fed rate	-.788	-8.84	0.000
GS10	-1.410	-6.39	0.000
ExRate	-8.093	-1.87	0.063
Dummy	-2.747	-6.76	0.000
Lag12	0.483	3.25	0.000

Table3.1 Reserving in AMD for FX effect on loan dollarization

Explanatory	loan dollarization	t-statistics	p-value
constant	173.948	8.52	0.000
RFX	0.6856	6.60	0.000
Repo	-.193	-1.12	0.063
Fed rate	-.989	-9.13	0.000
GS10	0.127	0.4	0.088
ExRate	-26.014	-7.48	0.000
Lag12	0.371	9.75	0.000

Table3.2 Reserving in AMD for FX effect on deposit dollarization

Explanatory	deposit dollarization	t-statistics	p-value
constant	299.584	9.85	0.000
RFX	0.448	3.79	0.000
Repo	0.330	1.89	0.060
Fed rate	-.993	-8.72	0.000
Dummy	-1.1331	-2.00	0.048
ExRate	-45.488	-9.26	0.000
Lag12	0.147	9.75	0.000

The estimators for both the impact of reserve requirement and deposit guarantee institute have the expected negative sign and are statistically significant, in the regressions for both loan dollarization and deposit dollarization. The interesting result has the policy of reserving in AMD for FX. Its sign is positive and statistically significant. Next, we use the reduced forms to perform a counterfactual exercise and evaluate their significance. We measure what would be the levels of loan and deposit dollarization if the CBA had not increased the reserve requirement rate, had not improved deposit guarantee institute and set the policy of reserving in AMD for FX. In order to test this we compute the policy effectiveness ratio by the equation 16. We perform the counterfactual exercise considering two periods: before and after the policy. For reserve requirement we restrict the sample till December 2014. For deposit guarantee institute we take period till December 2015, and for reserving in AMD for FX we take the period till March 2010. The results are presented in table 4.

Table 4.1 Policy effectiveness statistics: Loan dollarization

Policy	Mean effect	Effectiveness statistics	p-value	Expected sign
RR	-3.481	-2.443	0.046	yes
DGI	-4.878	-3.647	0.008	yes
RinAMDforFX	9.0598	6.779	0.000	no

Table 4.2 Policy effectiveness statistics: Deposit dollarization

Policy	Mean effect	Effectiveness statistics	p-value	Expected sign
RR	-4.060	-2.8033	0.026	yes
DGI	-5.456	-4.055	0.005	yes
RinAMDforFX	5.925	3.826	0.007	no

As tables 4.1 and 4.2 show, the higher reserve requirement since December 2014 had negative and statistically significant effect on both loan and deposit dollarization, also has the expected sign. The counterfactual exercise considers 31 periods starting from December 2014. The same negative impact has also deposit guarantee institute. In the case of reserving in AMD for FX we have a positive and statistically significant effect, but not the expected sign.

Conclusion

Particular characteristics specific to high dollarize economies, such as currency mismatches and excessive leverage with foreign lenders cause concerns for financial stability, as they may have an impact on the transmission mechanism of monetary policy through several channels. In economies affected by financial dollarization, a large depreciation of the exchange rate can lead to higher default rates among firms with currency mismatches, and affect borrowers' balance sheets by altering their income flows and loan repayment capacity. Thus, a large increase in the exchange rate may increase default risks of borrowers by inducing higher leverage and lower income flows. Therefore, macroprudential policies can limit the negative effect of the risk-taking channel [4], both ex ante and ex post, and become central to an effective conduct of stabilizing policy. In the case of our policies, we showed that only two of three policies had statistically significant negative effect on both loan and deposit dollarization. In the case of reserving in AMD for foreign currency, we showed that it have a counter effect on dollarization. This can be the result of excess domestic money. Furthermore, we provide preliminary empirical evidence that bolder measures, aimed at reducing vulnerabilities such as credit and deposit dollarization directly through the use of additional reserve requirements can significantly enhance financial stability, thereby creating space for macroprudential policy to fulfil the gap in power of traditional monetary and fiscal policy measures.

*Պարտադիր պահուստավորումը նոր մակրոպրուդենցիալ կարգավորման
համատեքստում. ապադոլարիզացիայի
քաղաքականության արդյունավետությունը Հայաստանում
Գասպարյան Ռ. Լ., Թարվերդյան Հ. Մ.*

Վերջին տասնամյա ժամանակաշրջանում Հայաստանի ֆինանսական ոլորտը ենթարկվել է ուժեղ ցնցումների և համակարգային ռիսկի կուտակման՝

հանգեցնելով դոլարիզացիայի ավելի բարձր մակարդակի, այդպիսով, սահմանափակելով Կենտրոնական բանկի դրամավարկային քաղաքականության ավանդական գործիքներով տնտեսական միջավայրի վրա ազդելու կարողությունը: Այս հետազոտական աշխատանքում մենք փաստագրում և էմպիրիկ գնահատական ենք տալիս վարկերի և ավանդների դոլարիզացիան նվազեցնելուն և Հայաստանում ֆինանսական կայունության ապահովման նպատակով կարգավորման ոչ ավանդական գործիքների կիրառմանը: Մեր հետազոտությունը հիմնված է Փեսարանի և Սմիթի (2012) առաջարկած հակափաստային թեսթի վրա և ցույց է տալիս, որ ավելի բարձր պարտադիր պահուստավորման պահանջները (սկսած 2014թ.-ի դեկտեմբերից)՝ որպես մակրոպրուդենցիալ կարգավորման գործիք և ավանդների երաշխավորման ինստիտուտ (սկսած 2015թ.-ի դեկտեմբերից), ունեցել են վիճակագրորեն էական ազդեցություն Հայաստանում ինչպես վարկային, այնպես էլ ավանդային դոլարիզացիայի կրճատման վրա: Մենք նաև հաշվի ենք առնում, որ արտարժույթով ավանդները պահուստավորվում են ՀՀ դրամով: Արդյունքները ցույց են տալիս, որ այս քաղաքականությունը վիճակագրորեն էական ազդեցություն է ունեցել Հայաստանում և՛ վարկային և՛ ավանդային դոլարիզացիայի աճելու վրա:

***Резервные требования в контексте нового макропруденциального регулирования: эффективность политики дедолларизации в Армении
Гаспарян Р. Л., Тарвердян Г.М.***

В течение последнего десятилетнего периода финансовый сектор Армении подвергся сильным потрясениям и накоплению системного риска, что привело к более высокому уровню долларизации, тем самым ограничив способность Центрального банка влиять на экономическую среду с помощью традиционных инструментов денежно-кредитной политики. В этой статье мы документируем и эмпирически оцениваем использование нетрадиционных регулятивных инструментов политики в Армении для снижения долларизации кредитов и депозитов и поддержания финансовой стабильности. Наш анализ основан на контрафактическом тесте, предложенном Песараном и Смитом (2012), и показывает, что более высокие резервные требования (с декабря 2014 года) как инструмент макропруденциального регулирования и институт гарантии депозитов (с декабря 2015 года) оказали статистически значимое влияние на снижение как кредитной, так и

депозитной долларизации в Армении. Мы также учитываем политику резервирования иностранной валюты в Армянских драмах. Результаты показывают, что данная политика оказала статистически значимое влияние на увеличение как кредитной, так и депозитной долларизации в Армении.

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