REAL EXCHANGE RATE ON ECONOMIC GROWTH: EVIDENCE FROM POST – SOVIET STATES

By

UMARGALIYEV, Kairat

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Submitted to

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Abstract

Impact of real exchange rate on economic growth:

Evidence from Post-Soviet States

By

Kairat Umargaliyev

This study investigates the relationship between the real exchange rate and economic performance for 15 Post Soviet states from 1991 to 2015. Using fixed effects method together with a dynamic panel data technique, this paper provides empirical evidences for the positive growth effects of the real exchange rate appreciation. The impact is robust after using an alternative measurement of the real exchange rate and upon applying different identification strategy.

TABLE OF CONTENTS

List of Tables

List of Figure(s)

1. Introduction

The impact of real exchange rates on economic growth has been one of the most essential issues for economists and policy-makers in recent decades. Nevertheless, a unified opinion has not been found in among empirical literature. Some studies argue that the real exchange rate depreciation would promote growth through a production shift from the non-traded sector to the traded sector (Rodrik 2008, Gala 2008, Prasad et al. 2007, Di Nino et al. 2011), while other researchers have provided evidence in favor of the negative and statistically-significant impact of the real exchange rate overvaluation on economic performance (Razin and Collins 1997, Aguirre and Calderon 2005). In addition, there are empirical papers which report no significant effect of a devaluation of the real exchange rate on economic performance (Bahmani-Oskooee 1998, Upadhyaya and Upadhyay 1999, Nouira and Sekkat 2012).

In spite of a large number of researches investigating the nexus between real exchange rate and economic growth[1], it is not known conclusively if there is one that empirically investigates the effects of real exchange rate on economic growth for Post-Soviet countries. This paper

[1] See Eichengreen 2007 for a survey of literature

therefore attempts to fill that gap in current empirical literature and give new perspectives over the impact of foreign exchange policies on growth.

The main goals of this study are (i) to discover the causal relationship between the real exchange rate and economic growth; (ii) and to identify the signs, whether positive or negative, of the abovementioned relationship.

To examine the impact of the real exchange rate on economic growth, this paper would be applying the “fixed effects” method and the "difference" Generalized Method of Moments (GMM) estimation strategy developed by Arellano and Bover 1995 and Blundell and Bond, 1998 on panel data of 15 Post-Soviet states over the period from 1991 to 2015. The key independent variable of interest is the PPP adjusted bilateral price index of the real exchange rate (RER) from the Penn World Table (PWT) version 9.0 dataset. Upon estimating growth effects for baseline equation, this paper would then use a different measure of real exchange rate – real effective exchange rate computed by the IMF to test for the robustness of the main results. Moreover, in robustness analysis, two instruments for the real exchange rate would be used. The first one is the Chinn-Ito (2006) index of world capital flow and the second is the total amount of dollar sold in the domestic currency market. Due to the data constraints for both instruments, the period of

time of the sample has been restricted from 1991 – 2015 to 1996 – 2015 for the Chinn-Ito (2006) index. Separately, for the second instrument, the sample has been reduced to one country.

Once the endogenous problems have been addressed using the full set of fixed effects and "difference" GMM estimation methods, the main finding of this study would suggest that an appreciation of the real exchange rate positively affects economic growth. The growth effect of appreciation is statistically-significant and retains its (positive) sign upon various robustness checks of the baseline results.

The structure of this study is organized as follows: Chapter 2 provides a literature review of theoretical perspectives, early empirical studies and recent empirical studies of the relationship between real exchange rate and economic growth; Chapter 3 describes the variables used and explains identification strategy implied as well as presents empirical results; and Chapter 4 includes conclusions.

2. Literature Review

2.1 Theoretical Perspectives

The model developed by Mundell (1963) – Fleming (1962) suggests, assuming that the Marshall-Lerner conditions hold[2], that the depreciation or devaluation of the exchange rate stimulates growth. As the result of this traditional theoretical model, by promoting exports and making a replacement from imports to home products, the total demand would increase through the devaluation of the exchange rate. The origins of this "orthodox" view come from the Meade (1951) book where he extended the theory of the external balance and the internal balance. Dornbusch (1973, 1986) expanded the view later by examining it through the lens of the monetary approach. This perspective has become a base for some researchers to believe that by promoting the tradable sector, a real depreciation of the domestic currency would assist countries to evade a fiscal crisis and ensure a sustainable economic growth. Obstfeld and Rogoff (1995), in testing the Mundell-Fleming model, argued that due to devaluations, there could be the enlargement of aggregate demand. Thus, under the close monitoring of

[2] The demand for export and import of devaluing economy are elastic and If the total of export and import elasticities surpass one, in the absolute terms, then Marshall-Lerner conditions are satisfied.

IMF since early 1950s, the exchange rate has been used in projects of developing countries as the means to stabilize an economic situation of the time.

On the other hand, up until the recessions that took place in Latin American countries after they applied economic adjustment programs in the late 1970s, there had been no serious debates over the positive relationship between currency devaluation and economic development. These events have raised the possibility that for developing countries, the depreciation of a currency could have contractionary effects on an economy. Diaz- Alejandro (1963), Edwards (1986) are among the first who provided theoretical support for potential channels through which real devaluation could have negative effects on economic growth. The main two channels could be summarized in the following categories: 1) Demand – side channels which include: reduction of real income effects (Bruno, 1979; Hanson, 1983), a decrease in investments effects and negative effects of the distribution of income on aggregate demand caused by the transfer of income from workers to profit earners of tradable goods (Krugman and Taylor, 1978); 2) Supply – side channels which include the cost of working capital effects where the interest rate might raise because of devaluation thus decreasing the demand for working capital by firms. Besides, there is also imported input cost effects when real depreciations increase the costs of production through

the use of largely imported manufacturing inputs that cannot be substituted easily by home production (Bruno, 1979; van Winjbergen, 1986).

2.2 Early Empirical Studies

Numerous studies have empirically evaluated the nexus between exchange rate and economic growth. Earlier advocates had provided support for expansionary effects of devaluations. For example, according to Gylfason and Schmid's (1983) research, devaluation affects real income and output through both the demand and supply side of economy. In fact, export, import and expenditure on the demand side dominate the cost of imported inputs on the supply side thus supporting the traditional view that by devaluating currency, there could be positive real effects on economy. In the context of trade liberalization, Donges, Krueger and Bhagwati (1978) prove that exchange rate depreciation do not necessarily lead to a recession. Kamin (1988) provides further results suggesting that devaluation may effectively promote economy growth. He argues that even though devaluation positively correlated with inflation and trade balance decreased (in the first year following currency depreciation), the positive effects of exchange rate devaluation

gained from improvement of balance of payment and export growth surpass net declining.

Subsequently, real devaluations have been found to be associated with the contractionary effects in a large number of studies. Agenor (1991) used 23 developing countries over the period 1978-87. In his empirical analysis, the author used the expected and unexpected effects of real depreciations as main regressors while the dependent variable was output growth. Upon applied fixed effects estimation method to his panel data sample, the results showed that an unanticipated depreciations of real exchange rate have positive impact on output growth, but an anticipated depreciation of RER exerted a contractionary effect. Kamin and Roger (2000) has examine the empirical robustness of negative association between real devaluations of the real exchange rate and real output by controlling for endogenous issues such as reverse causality, spurious correlation and short-term contractionary effects of depreciation. By applying the VAR model, the authors concluded that the high inflation and contraction of economic activity have been associated with the devaluation of the real exchange rate in Mexico. They found no evidence that a spurious correlation of output and devaluation with other types of shocks had affected the estimated results in any way. Morley (1992) studied least developed countries during their stabilization programs for the impact of real depreciations on

ability utilization. From that, he provided evidence suggesting that the sharp fall in investment caused by devaluations of exchange rate, has significant negative effects on output, but that the full effect may take at least two years to appear. In addition, by examining time-series data in Turkey and Jamaica, Berument and Pasaogullari (2003) and Atkins (2000) have respectfully suggested that there is a significant contractionary effect in replay to depreciation of the real exchange rate.

There is another part of empirical studies that has reported mixed results. For example, Edwards (1986) and Rhodd (1993) has found that although there are short-run negative effects from a depreciation of exchange rate, in the long-run, the output tends to respond positively to devaluation. Their findings are consistent with Cooper's earlier 1971 study, where he shows that despite the seemingly significant negative effects of devaluation but they have only temporary effects. Odusola and Akinlo (2001) in their study, used the VAR model and its structural variation of fluctuations in inflation and output that are driven by money base, exchange rates, interest rate, and income. Although in both medium and long terms, the effect of the exchange rate depreciation on the output seems to have expansionary effects, the opposite (negative effects) was found for the short period of time. Using the same identification strategy (VAR), El-Ramly and Abdel-Haleim (2008) showed

an initial contractionary response of devaluation for four years before the expansionary impact start to appear.

Additionally, there are some studies that report no significant impact of devaluation of exchange rate on economic activity. Bahmani-Oskooee (1998) used quarterly data of 23 LDCs on the measurement of domestic production and real as well as nominal effective exchange rate. He used the cointegration technique and error-correction method to study causality between exchange rate and output. The estimated results reveled no long-run effect of devaluations on output in most LDCs. Another research done by Upadhyaya and Upadhyay (1999) used six developing countries of Asia to investigate the effect of depreciation on output. By including monetary, fiscal, and external variables in their empirical model, the authors examined the impact of a depreciation of real exchange rate and the effects of nominal devaluation. Their study revealed that a depreciation of real exchange rate fails to make any impact on output over any period of time.

2.3 Recent Empirical Studies

A growth regression model where the main right-hand variable is considered as some versions of an index of the real exchange rate misalignment, namely, undervaluation or overvaluation has become the

popular identification strategy among recent studies. In order to construct such indexes, two approaches have been followed. The first one sets RER as the purchasing power parity level (PPP) corrected by the Balassa-Samuelson effect. The second approach defines RER in terms of macroeconomic fundamentals including total foreign assets, relative productivity, volume of trade and total government spending.

By promoting their tradable manufacturing, some Asian countries have accomplished high rates of economic growth over the past several decades. Their export-led growth strategy has become a basis for policy-makers and researchers to promote the idea that the real exchange rate could enhance economic growth through maintaining its competitiveness. Rodrik (2008) supports the view, developed by Balassa 1964; Hahn and Matthews 1964[3], that the devaluation of the real exchange rate leads to shifts of manufacturing from non-tradable to tradable sector. Hence promoting to the output growth by enlarging the volume of tradable goods. In a panel data sample of 184 countries, Rodrik (2008) provides empirical evidence suggesting that the real exchange rate undervaluation has the positive growth effects on economic activity. In his study, Rodrik uses his undervaluation index,

[3] Technology progress and skill spillovers move faster in export sector than in non-export sector, thus the extension of tradable goods will increase productivity and growth.

which is the PPP-based real exchange rate measure, corrected for Balassa-Samuelson effect as the proxy for the real exchange rate. According to Balassa (1964) and Samuelson (1964), due to higher efficiency in tradable sector, relative prices of non-tradable sector are higher in richer states than in developing states. On the basis of this argument, Rodrik (2008) adjusted his index for the Balassa- Samuelson effect by regressing the real exchange rate with respect to per capita GDP and then determines his index of undervaluation as the difference between the observed rate and the Balassa-Samuelson-corrected rate. Trying to make causal inferences, Rodrik also uses Fixed Effects (FE) method and some versions of Generalized Method of Moments (GMM) estimators. His results reveal that the tradable sector is special in developing states because of unproportional suffering of it from institutional drawbacks and market failures. Thus, a devaluation of the real exchange rate enhances the relative financial gain of tradable sector, and could be used as second-best policy to decrease the economic cost of these distortions.

In following years, a great number of studies have used his undervaluation index for panel data analysis on the growth impact of real exchange rates. However, the PPP-based measure adjusted for Balassa-Samuelson effects approach for measuring real exchange rate

was first implemented in Dollar (1992) study[4] but obtain popularity with Rodrik (2008). Gala (2008) investigated the possible ways by which the real exchange rate could influence economic growth for a panel data sample of 58 developing countries for the period 1960–1999. His results have suggested a significant positive correlation between the real exchange rate undervaluation and growth. On the other hand, Gluzmann, Levy-Yeyati and Sturzenegger (2012) show that for developing countries, undervaluation of real exchange rate has had no significant response on the tradable sector. By exploring various elements of GDP per capita including consumption, investment, saving, exports, imports and employment as possible channels for the effects of undervalued currency, they have argued that undervaluation tends to lead to greater domestic savings and investment, as well as employment rather than to growth of export and import. The findings of studies by Di Nino, Eichengreen, and Sbracia (2011), Rapetti, Scott and Razmi (2012) have modified Rodrik's (2008) research. By expanding the time range back to 1861 and by using different measurements of real exchange rate that based on WPI and CPI, Di Nino, Eichengreen, and Sbracia (2011) have confirmed results found by Rodrik (2008). Furthermore, by

[4] Dollar (1992) empirically investigated the impact of outward orientation economy on growth rate by using the same index as a proxy for the real exchange rate misalignment.

changing the definition of developed and developing countries that Rodrik (2008) had sampled, Rapetti, Scott and Razmi (2012) showed that Rodrik's results had been sensitive to the cut-off point used to separate the countries between developed and developing. While in the Rodrik study, developing countries were defined as countries with a per capita GDP less than US$6000, Rapetti, Scott and Razmi (2012) have suggested that by selecting the threshold from anywhere in the $9,000-$15,000 range, the effects of undervaluation would be larger and more significant for developed countries as well.

Despite a large number of studies that have followed Rodrik's approach of measuring real exchange rate misalignment, Woodford (2009) has heavily criticizes Rodrik's undervaluation index. Woodford argues that due to the fact that Rodrik's panel growth regression had already includes country-fixed effects, there was no need to adjust for the Balassa- Samuelson effect. Thus, the average variations in the levels of the real exchange rate of developing states because of per capita deviations would have no effects for regression coefficient of undervaluation index. Woodford (2009) also raises objections regarding Rodrik's definition of developing countries. He provides evidence to show that if one changes the cut-off point of developing countries from $6000 to $8000, the growth effect of undervaluation would be decreased by one-third. Furthermore, when states with GDP less than $1000 are

dropped from the sample, the impact would be diminished by the half and become not significant.

On the other hand, Razin and Collins (1997) have constructed an index of real exchange rate overvaluation based on macroeconomic fundamentals and used it for a pooled sample of 93 countries. Their findings suggest that their overvalued index not only negatively correlates with economic growth but also that the negative growth impact of overvaluation is prevailing the positive impact of undervaluation. Aguirre and Calderon (2005) developed three fundamental-based measures of the real exchange rate overvaluation for a panel sample of 60 countries over 1965-2003, in which they found a negative and significant relationship between RER and economic growth. Moreover, the negative effect of overvaluation holds when the fundamental-based indexes are substituted by PPP-based indexes. Following this, Macdonald and Veiera (2010) studied the currency misalignments and economic growth by applying the two-step System GMM panel growth models. Results provided by the authors suggest that the overvaluations have adversely affected growth rate while the undervaluation of the real exchange rate significantly enhances it. Their findings are in line with Béreau, Villavicencio, and Mignon (2012)'s study where the authors used panel smooth transition regression estimation models but reach the same conclusions.

There are some studies that have examined overvaluation of the real exchange rate as the possible channel through, for instance the "Dutch Disease" effect[5] of foreign aid could affect economic growth, thereby proving that aid inflows adversely influence economic competitiveness of a state(Rajan and Subramanian 2011). Another example could be Prassad, Rajan and Subramanian (2007) 's study. There, they investigated the relationship between absorptive capacity for foreign resources and economic growth through the lens of overvaluation.

[5] The "Dutch Disease" refers to adverse impact on Dutch production due to discoveries of the natural gas in nineteen sixties (Corden 1984).

3. Identification Strategy and Data

3.1 Data

The sample that is explored in this study consists of unbalanced panel of 15 Post Soviet countries over the period from 1992 to 2015. All variables except the real exchange rate are from World Bank, World Development Indicators (WDI) Database. WDI is a huge data source that collects information on the most used development indicators including national, regional and global estimates. The data for World Development Indicators is given by the various officially-recognized international sources. It is annually type of data that covers vast topics from 1960 to 2016. The main variable of interest is the PPP adjusted bilateral price index of the real exchange rate from Penn World Table (PTW) version 9.0 dataset. According to Feenstra, Inklaar and Timmer 2015, the price index defines as the PPP (ratio of nominal GDP in the local curency to “current-price” real GDP in other currency) divided by the nominal exchange rate. Based upon this difination, an increase in the real exchange rate reflects an appreciation and a decrease of the real exchange rate shows a depreciation. PWT is a database that covers 182 countries over the period from 1950 and 2014. It provides various data on comparative levels of income, output and input as well as productivity. Table 1 shows summary statistics of all variables.

Table 1: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
GDP per capita, PPP adjusted (log)	351	8.806952	.84789	6.947226	10.20098
Real effective exchange rate (log)	360	4.488525	.4795222	1.916923	6.180017
Real exchange rate, PPP adjusted (log)	345	-1.283046	.5049946	-2.525729	-.210721
Trade (% of GDP)	360	178.3611	102.4347	1	342
Government consumption (% of GDP)	360	156.8722	91.01462	1	303
Inflation (% of GDP)	312	150.6763	85.11736	1	274
Saving (% of GDP)	360	174.6028	99.03085	1	329
Investment (% of GDP)	360	167.9417	95.8628	1	319

3.2 Identification Strategy and Empirical Results

The empirical analysis begins by first using following basic estimation equation:

$$Y_{i,t} = \beta_0 + \beta_1 RER_{i,t} + \beta_2 X_{i,t} + \sigma_i + \delta_t + \varepsilon_{i,t}$$

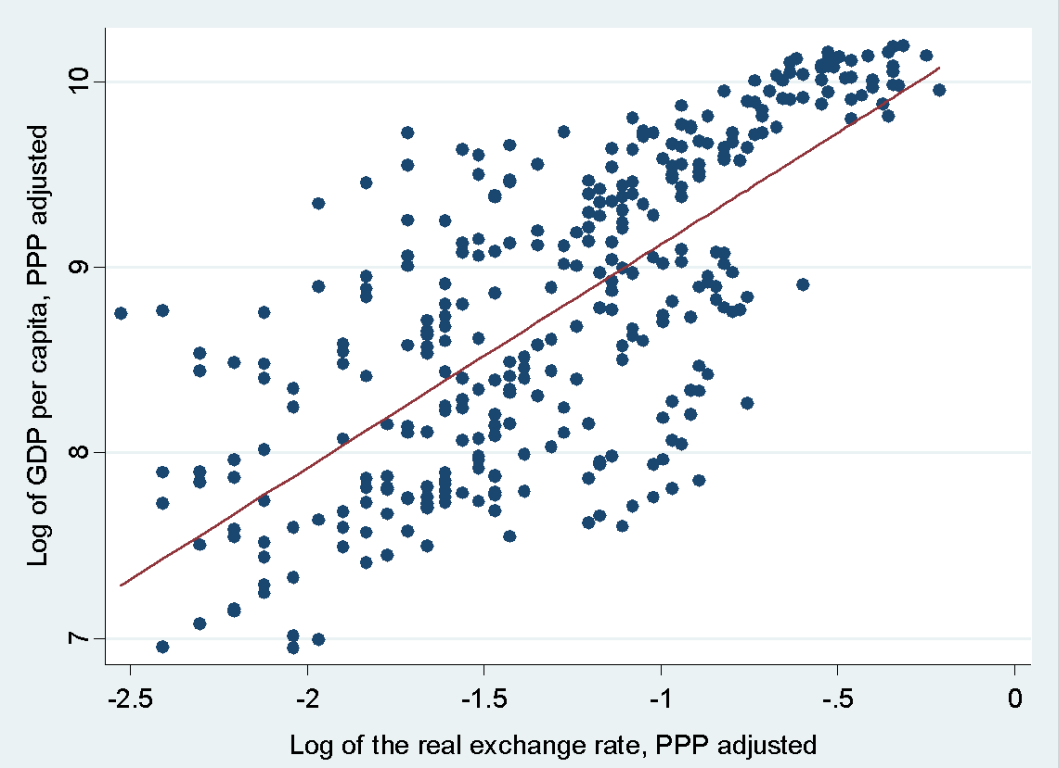
where $Y_{i,t}$ is log value of the GDP per capita, PPP adjusted at time t and country i. $RER_{i,t}$ is the logged real exchange rate, PPP adjusted. σ_i is a country-fixed effect, δ_t is a time-fixed effect (a year fixed effect) and $\varepsilon_{i,t}$ is an error term. $X_{i,t}$ is the set of control variables commonly used in empirical growth models[6]: trade, government consumption, inflation, savings, investments. All control variables are given in percentage of the GDP per capita.

Figure 1 presents the scatter plot of the simple OLS regression between the real exchange rate and the GDP per capita. According to the Figure

[6] Sala-i Martin (1997) suggests that in growth regression models, 60 variables can be found significant. Moreover, following Temple (1999) and Loayza and Ranciere (2006), and Levine et al. (2000) empirical growth studies, a set of control variables were selected for this paper.

1, there is a strong and positive correlation between the adjusted to PPP, real exchange rate and GDP per capita, PPP adjusted. However, due to endogeneity of the right – hand variables the results from simple OLS and from basic equation are unable to estimate the causal relationship between exchange rate and GDP per capita. Moreover, even upon implementing the set of fixed effects, there is the possibility of a reverse causation and OVB. Thus, in order to correct the results, this paper would apply "difference" general method of moments (GMM) dynamic panel data strategy developed by Arellano and Bond (1991),

Figure 1: Scatter plot of GDP Per Capita and Real Exchange Rate



Arellano and Bover (1995) and Blundell and Bond (1998). Essentially, the “difference” GMM method transforms the variables into the level of differences, then uses their lagged levels as instruments[7]. Also, the robust two-step standard errors were computed by following Windmeijer (2005) methodology. It allows this paper to address the issues of joint endogeneity of all regressors in a dynamic formulation and to deal with some problems of potential biases.

$$Y_{i,t} = \beta_1 Y_{i,t-1} + \beta_2 RER_{i,t} + \beta_3 X_{i,t} + \varepsilon_{i,t}$$

where $Y_{i,t}$ is the PPP adjusted log value GDP per capita at time t and country i. $Y_{i,t-1}$ is the log of the GDP per capita, PPP adjusted, $RER_{i,t}$ is the logged real exchange rate, adjusted to PPP and $X_{i,t}$ is the same control variables used in first equation and $\varepsilon_{i,t}$ is the error term

The results of the basic equation as well as from the “difference” GMM estimates are given in Table 2. Column 1 represents simple OLS and the regression yields a highly significant (s.e 0.0593) coefficient. The estimate is positive and statistically significant which suggests that 10 percent increase in RER, PPP adjusted associates with 12 percent increase in GDP per capita. After controlling for additional covariance, the estimates remain positive and significant (Column 2). However, in Column 3 the results became drastically smaller 0.2296 but statistically

[7] See Roodman (2006) for a user guide.

significant at least on 1% level upon controlling for time fixed effects and country fixed effects. That is there are some variables that differ across entities but are constant over time as well as variables that change over time but the same across states that overestimate effects of real exchange rate on GDP per capita. Even after implementing the set of fixed effects, one should be caution in interpreting results as a causal relationship due to the disadvantage of fixed effects method which is inability in controlling for variables that not constant across states that vary over time. To deal with this issue, in the next specification the "difference" version of GMM method is implemented. Column 4 of Table 2 presents the estimate coefficients on log of real exchange rate, PPP adjusted which are remain positive and statistically significant. The results imply that 10 percent increase in the real exchange rate leads to the increase of the GDP per capita by around 2.3 percent.

3.3 Robustness Checks: Alternative Real Exchange Rate Measurement

As the first robustness check, this paper would use different index of real exchange rate – real effective exchange rate that is given by International Monetary Fund (IMF). This indicator measures the value of domestic currency against a weighed average of the currencies of

country's main trade partners and then divided by a price of deflator or index of cost. Thus, it is a measure of multilateral competitiveness.

Table 2: Dynamic panel estimation of growth effects of real exchange rate

	Dependent variable: Log of the GDP per capita, PPP			
VARIABLES	(1)	(2)	(3)	(4)
Log of real exchange rate, PPP adjusted	1.2038***	1.2491***	0.2296***	0.2226***
	(0.0593)	(0.0646)	(0.0787)	(0.0707)
Trade (% of GDP)		-0.0005*	0.0003***	-0.0001*
		(0.0003)	(0.0001)	(0.0001)
Government consumption (% of GDP)		0.0000	-0.0004***	-0.0002**
		(0.0004)	(0.0001)	(0.0001)
Inflation (% of GDP)		-0.0005	0.0001	-0.0001
		(0.0004)	(0.0001)	(0.0000)
Saving (% of GDP)		0.0028***	0.0009***	0.0003***
		(0.0004)	(0.0001)	(0.0001)
Investment (% of GDP)		-0.0002	-0.0002*	0.0001
		(0.0004)	(0.0001)	(0.0001)
L.LogGDP				0.6902***
				(0.1091)
Constant	10.3275***	10.1235***	9.0220***	
	(0.0752)	(0.1614)	(0.1643)	
Country FE	NO	NO	YES	NO
Time FE	NO	NO	YES	NO
Observations	336	290	290	264
R-squared	0.5314	0.6382	0.9812	
Hansen test (p-value)				0.843
Serial correlation (p-values)				
First-order				0.184
Second-order				0.338
Instruments				25

Robust standard errors are shown in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3 reports the results of the real effective exchange rate on GDP per capita. Surprisingly, the estimate in column 1 has negative sign but statistically indistinguishable from zero. It could be explained assuming that there are some omitted variables that drag coefficient towards zero. However, upon using control variables in Column 2 the result of the variable of interest has changed its sign and became significant at 5% level. This confirms the earlier assumption about OBV and its underestimated effects on the coefficient of the real effective exchange rate. Column 3 presents the results of fixed effects model. The estimates show that the real effective exchange rate has no effect on per capita GDP. Column 4 shows the effect of the real effective exchange rate on GDP per capita in “difference” GMM model. The coefficient is positive and statistically significant at least on 5% level. The latter estimate indicates that an increase of real effective exchange rate by 10 percent leads to an increase in GDP per capita by around 2.7 percent which is quite in line with results reported in Table 2 Column 4.

The specification test of Hansen and the first and the second order serial correlation in Table 2 and 3 verify the validity of moment conditions and the absence of autocorrelation.

Table 3: Dynamic panel estimation of growth impact of real effective exchange rate

	Dependent variable: Log of the GDP per capita, PPP			
VARIABLES	(1)	(2)	(3)	(4)
Log of real effective exchange rate	-0.0356	0.1979**	0.0726	0.2692**
	(0.1066)	(0.0862)	(0.0585)	(0.1106)
Trade (% of GDP)		-0.0010**	0.0003***	-0.0001
		(0.0004)	(0.0001)	(0.0001)
Government consumption (% of GDP)		-0.0010*	-0.0005***	-0.0003
		(0.0006)	(0.0001)	(0.0002)
Inflation (% of GDP)		-0.0022***	0.0001	-0.0000
		(0.0005)	(0.0001)	(0.0001)
Saving (% of GDP)		0.0030***	0.0008***	0.0003
		(0.0005)	(0.0001)	(0.0002)
Investment (% of GDP)		0.0019***	-0.0001	0.0002
		(0.0006)	(0.0001)	(0.0002)
L.LogGDP				0.8081***
				(0.1503)
Constant	8.9675***	7.8566***	8.3840***	
	(0.4808)	(0.4283)	(0.2261)	
Country FE	NO	NO	YES	NO
Time FE	NO	NO	YES	NO
Observations	351	303	303	277
R-squared	0.0004	0.2515	0.9799	
Hansen test (p-value)				0.881
Serial correlation (p-values)				
First-order				0.249
Second-order				0.448
Instruments				26

Robust standard errors are in parentheses
*** p<0.01, ** p<0.05, * p<0.1

3.3.1 Robustness Checks: Different Identification Strategy

In second robustness check, two different instruments for the real exchange rate are used. First is Chinn-Ito index of openness to capital

account transactions. This is a continuous index based on four dummy variables that categorize restrictions on financial transboundary transactions reported in the IMF Annual Report on Exchange Rate Arrangements[8]. If this index takes the highest value, the country is more transparent to the cross – border financial transactions.

According to Calvo, Leiderman and Reinhart (1993) study, capital inflows contribute to the real exchange rate movements. Thus, it is quite relevant to use Chinn-Ito index as the instrument for real exchange rate since it is a measurement of country's level of capital account openness. Moreover, Habib, Mileva and Stracca (2016) provide evidences for the negative growth effects of the real exchange rate appreciation using Chinn-Ito index as the one of instruments for the real exchange rate.

The estimation equation for first-stage of 2SLS:

$$\mathrm{RER}_{i,t} = \beta_0 + \beta_1 \Phi_{i,t} + \beta_2 X_{i,t} + \varepsilon_{i,t}$$

where RER_i is the real exchange rate adjusted to PPP, $\Phi_{i,t}$ is the Chinn-Ito index, $X_{i,t}$ is vector of control variables and $\varepsilon_{i,t}$ is the error term.

The second-stage of 2SLS

$$Y_{i,t} = \beta_0 + \beta_1 \widehat{\mathrm{RER}}_{i,t} + \beta_2 X_{i,t} + \varepsilon_{i,t}$$

where $Y_{i,t}$ is the GDP per capita, PPP adjusted, $\widehat{\mathrm{RER}}_{i,t}$ is predicted value of the real exchange rate, PPP adjusted from first-stage of 2SLS, $X_{i,t}$ is

[8] See Chinn-Ito 2006 for the details of the construction of the index

the set of control variables and $\varepsilon_{i,t}$ is the error term. Due to data constrains, the years of the sample have been scaled down from 1991 – 2015 to 1996 – 2015.

Table 4 reports the IV results for the reduced sample. Column 1 presents the simple OLS results according to which real exchange rate positively correlates GDP per capita. In fact, 10 percent increase in the PPP adjusted real exchange rate associates with 13 percent increase in GDP per capita. There is a little change in the main estimate after controlling for additional covariates in Column 2. Column 3 reports positive but statistically not different from zero results upon controlling for covariates and applying country and time fixed effects. The key estimate retains statistically insignificant in the "difference" GMM model specification in Column 4. However, when the real exchange rate adjusted to PPP is instrumented with the Chinn-Ito index, the regression yields positive and highly significant results. The estimates in Column 5 suggest that an increase of real exchange rate by 10 percent leads to an increase in GDP per capita by around 14 percent.

F – statistic as well as its *p* – value (not reported) from the first – stage regression of 2SLS suggest that the relevance condition[9] holds

[9] The instrument must correlate with endogenous independent variable of interest

and the weak instrument issue does not threaten the estimated results of instrumental variable approach.

Table 4: 2SLS estimation of growth effect of real exchange rate for reduced sample

	Dependent variable: Log of GDP per capita, PPP adjusted				
VARIABLES	(1)	(2)	(3)	(4)	(5)
Log of real exchange rate, PPP adjusted	1.3355***	1.3861***	0.0723	0.0822	1.3930***
	(0.061)	(0.074)	(0.076)	(0.087)	(0.238)
Trade (% of GDP)		-0.0006	0.0001	-0.0000	-0.0006
		(0.000)	(0.000)	(0.000)	(0.000)
Government consumption (% of GDP)		0.0001	-0.0003***	-0.0002	0.0001
		(0.000)	(0.000)	(0.000)	(0.000)
Inflation (% of GDP)		-0.0005	0.0001	0.0001	-0.0005
		(0.000)	(0.000)	(0.000)	(0.000)
Savings (% of GDP)		0.0027***	0.0007***	0.0001	0.0027***
		(0.000)	(0.000)	(0.000)	(0.000)
Investment (% of GDP)		-0.0006	-0.0003**	0.0002	-0.0007
		(0.000)	(0.000)	(0.000)	(0.001)
L.LogGDP				0.8429***	
				(0.117)	
Constant	10.4468***	10.3109***	8.4535***		10.3194***
	(0.073)	(0.177)	(0.119)		(0.321)
Country FE	NO	NO	YES	NO	NO
Time FE	NO	NO	YES	NO	NO
Observations	283	245	245	219	245
R-squared	0.5653	0.6443	0.9868		0.6443
Hansen test (p-value)				0.659	
First order				0.102	
Second order				0.0098	
Instruments				21	
First stage F					29.64

Robust standard errors are in parentheses
*** p<0.01, ** p<0.05, * p<0.1

However, the exclusion restriction condition[10] of a valid instrument cannot be verified due to the "just – identified" model specification.

As the second instrument, this paper is using the total amount of the dollar sold in domestic currency market as the instrument for real exchange rate, PPP adjusted and previously used set of the same control variables. Due to lack of data on the instrument for major variable of interest, the sample is restricted to only one country, Kazakhstan.

It is important to have a valid instrument in 2SLS approach. The valid instruments should be correlated with endogenous regressor but independent to any other omitted characteristics (i.e., uncorrelated with the dependent variable through any channels other than their effect via the endogenous key variable). This is the so – called exclusion restriction cannot be statistically tested in this setting because only one instrument is used. However, in empirical literature, such studies as Hau, Killeen, and Moore (2002), Killeen, Lyons, and Moore (2006), Lyons (2001), and Rime (2001) show that outcomes from the foreign currency markets, specifically from those with electronic trading systems, are highly correlated with exchange rate fluctuation. This is the key motivation for instrumenting the real exchange rate with the instrument.

[10] Corr ($\Phi_{i,t}$, $\varepsilon_{i,t}$) = 0, the instrument is not correlated with the error term.

Moreover, the valid instrument should meet instrument relevance condition (the endogenous key variable should be correlated with the instrument). F-statistic and its *p* – value (not reported), from first-stage show estimates that are comfortably above conventional threshold of 10 reassuring that there is no problem with the weak instrument issue and relevance condition.

The estimation equation for first-stage of 2SLS:

$$\mathrm{RER_i} = \beta_0 + \beta_1 \mathrm{Z_i} + \beta_2 \mathrm{X_i} + \varepsilon_i$$

where $\mathrm{RER_i}$ is the PPP adjusted real exchange rate, $\mathrm{Z_i}$ is the total amount of the dollar sold on the domestic currency market, $\mathrm{X_i}$ is vector of control variables and ε_i is the error term.

The second-stage of 2SLS

$$\mathrm{Y_i} = \beta_0 + \beta_1 \widehat{\mathrm{RER_i}} + \beta_2 \mathrm{X_i} + \varepsilon_i$$

where $\mathrm{Y_i}$ is the GDP per capita, PPP adjusted, $\widehat{\mathrm{RER_i}}$ is predicted value of the real exchange rate, PPP adjusted from first-stage of 2SLS, $\mathrm{X_i}$ is the set of control variables and ε_i is the error term.

Table 5 reports the results of IV approach where odd columns report specifications without the vector of control variables. Column 1 and 2 represent the OLS estimates. The results show strong and positive correlation between per capita GDP and the index of the real exchange rate. However due to endogeneity problems in OLS models

one should not interpret results as causal. The Column 3 and 4 show the second-stage results of IV. The coefficients are statistically significant at least at 1% level and have positive sign which imply that 10 percent increase in the real exchange rate leads to increase of GDP per capita, PPP adjusted in around 8.9 percent.

Table 5: 2SLS estimation of growth effect of real exchange rate for Kazakhstan

	Dependent variable: Log of the GDP per capita, PPP			
			Second-stage results (IV)	
VARIABLES	(1)	(2)	(3)	(4)
Log real exchange rate, PPP adjusted	0.7760***	0.5769***	0.9961***	0.7970***
	(0.0984)	(0.0948)	(0.0760)	(0.1749)
Control Variables	NO	YES	NO	YES
Constant	10.4555***	9.7699***	10.6688***	10.1362***
	(0.0906)	(0.2009)	(0.0680)	(0.3437)
Observations	23	23	21	21
R-squared	0.8034	0.9298	0.8772	0.9250
Frist stage F			201.91	19.98

Robust standard errors are in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Over all, the estimated coefficients are positive and robust after implementing different identification strategy and another version of the measurement of the real exchange rate. The rise of the real exchange rate shows an appreciation, hence the results indicate that the appreciation leads to the growth of GDP per capita. The results are

consistent with findings of the studies such as Frankel (2005) and Calvo and Reinhart (2002).

4. Conclusions

In the recent decades, empirical studies that examine the relationship between the real exchange rate and economic growth applying panel data estimation strategies have developed considerably. However, there has not been a unified consensus regarding the effects of the real exchange rate on growth. Some studies have suggested a positive growth effect of a depreciated currency (Rodrik 2008, Gala 2008) while another branch of empirical literature argues in favor of conventional (contractionary) effects of the real exchange rate devaluations on growth rates (Edwards 1986, Kamin and Rogers 2000). Also, there are some authors such as Bahmani-Oskooee (1998) and Upadhyaya and Upadhyay (1999) who fail to provide statistical evidences for any effects of devaluation on output. The prevalent feature of all studies though is that regardless of a sign of estimated coefficients, the effect tends to be stronger and more robust for developing countries[11].

The major empirical contribution of this work has been to extend the boundaries of ongoing debate on the causal relationship between real exchange rate and economic growth. Moreover, this study would

[11] See Rapetti (2013) for a recent survey of empirical literature

allow for a deeper look at the impact of real exchange rate on economic performance from the prospective of a group of countries that had a common system of government (Soviet Union) for a long period of time.

The main findings provided by applying the fixed effects and "difference" GMM identification strategies suggest the negative impact of devaluation of the real exchange rate on economy for Post-Soviet countries. The estimates remain positive and robust upon using an alternative measurement of exchange rate, real effective exchange rate and after applying the instrumental variable approach. The result of this study is in line with the findings of Bebzcuk et al. (2006), Bleaney and Vargas (2009), Blecker and Razmi (2008) that also use GMM estimation models and provide empirical evidence for the contractionary effect of devaluations for developing countries.

There is a need for further studies and empirical evidence in the analysis of the "real exchange rate – economic growth" relationship to throw more light on precise channels such as savings and investments through which the real exchange rate can have an impact on economic activity. The link between trade and the real exchange rate should deserve special attention from researchers since it is not empirically clear via which channel (whether it is export, import or transportation cost) RER affects trade. Such future studies would be helpful in making policy recommendations for a sustainable economic development. As

such, it is hoped that the reasons suggested in this paper would encourage governments to give more consideration to the currency policy rather than providing guidelines for targeting the real exchange rates.

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