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An Empirical Assessment of the Economic Model of the Exchange Rate

Dr. Nurseiit, N. A [α], Bissembayev, A. S. [σ], Maulenov, A. O. [ρ] & Dildebaeva, Zh. T. [ω]

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I. Introduction

Now the exchange rate of tenge is subject to sharp unpredictable fluctuations. In conditions of strong dependence of Kazakhstan's economy on foreign trade and foreign investments, as well as high share of imports in production costs and high external debts of economic entities, such sharp fluctuations in exchange rate have a very negative effect on business. They lead to price uncertainty, which makes it difficult to plan and conduct business, investing and calculating the return on investment, causes additional business costs for changing price tags and changing priorities, etc. All this reduces the growth rates of real production and with sharp fluctuations in the rate may lead to a decline in production and living standards of the population.

The course in the country is now freely floating or equilibrium. Moreover, the last devaluation in August of 2015 by 35.6% was conducted in order to move the national currency to free float (Reuters, 2015). However, Kazakhstan officially went over to the regime of a free floating exchange rate in April of 1999, when the exchange rate fell by 40% (Kase, 2018). The question arises, why it was necessary to go into the same regime for the second time or was the first fake? The plasible explanationhere is that the rate of tenge is politically determined than economically conditioned[1]. In both cases, the delay in devaluation was caused by the upcoming presidential elections, since a stable currency is a symbol of the effectiveness of the acting authorities in the eyes of the electorate, while a non-stable currency would say the opposite.

In the first case, the presidential elections were held on January 10, 1999, and in the second case - on April 26, 2015, despite the fact that deterioration of external economic conditions due to a strong devaluation of the ruble was observed much earlier in August 1998 and in August 2014, respectively. At the same time, the authorities of the country held 2-3 months after the presidential election, so that the philistine did not directly associate the devaluation of the national currency with the presidential elections. Thus, the tenge was artificially held in the first case for 7 months, and in the second case - for 11 months, despite the fact that there was a significant revaluation of the national currency, which led to non-competitiveness of domestic products, deterioration in financial performance and bankruptcy of Kazakh enterprises, and rising unemployment among the population.

Of course, the policy of demonstration of the strength of the economy of Kazakhstan and its national currency - tenge, which continues to be “stable” despite unfavorable external circumstances, was very expensive for the country. In 1998, the National Bank of Kazakhstan spent on the support of tenge from $400 to $600 million, which amounted to 30-35% of the country's gold and foreign exchange reserves (Arystanbekov, 2015). In 2014-2015, the loss of gold and foreign exchange reserves to support the unrealistic exchange rate of tenge was $39.7 billion, including $22 billion in 2014 (83% of the country's gold and foreign exchange reserves)[2] and $17.7 billion (63%) in 2015 (Liter, 2016). However, these reserves could be used in a much better way. Instead of throwing them into the wind for the sake of false ponts, they could be used to create new factories and plants that would allow increasing output,

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[1] In August 1998 and August 2014 there was a significant devaluation of the Russian ruble, in the first case caused by the crisis in the South-East Asia and the technical default on Russian government bonds, and in the second case due to a sharp drop in oil prices and the introduction of sanctions on Russia by Western countries because of the joining of the Crimea.

[2] This value is given without taking into account the funds of the National (Oil) Fund of Kazakhstan.

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and solving the problem of unemployment and insufficient income for the majority of the population.

Therefore, the main purpose of this article was to identify the main factors influencing the equilibrium exchange rate of the tenge, the construction of the corresponding model and its econometric verification on the data of Kazakhstan.

There are many different methodologies for explaining the equilibrium exchange rate. Some of them use purchasing power parity for this purpose (Rogoff, 1996). Others associate the formation of the course with performance as in the model of Balassa-Samuelson, which implies that countries with rapidly expanding economies should tend to have more rapidly appreciating exchange rates (Balassa, 1964; Samuelson, 1964; Tica and Druzic, 2006). Others consider the dependence of the rate on terms of trade, openness of the economy and capital flows (Neary, 1988; Montiel and Peter, 1999). In the study, we use the equilibrium-rate model developed by Nurlan Nurseiit in 2004 (Nurseiit, 2004).

II. Research Methodology

As a model of the equilibrium exchange rate, we used the equilibrium exchange rate model (Nurseiit, 2004, pp. 104-105) for a short period of time, which has the following form:

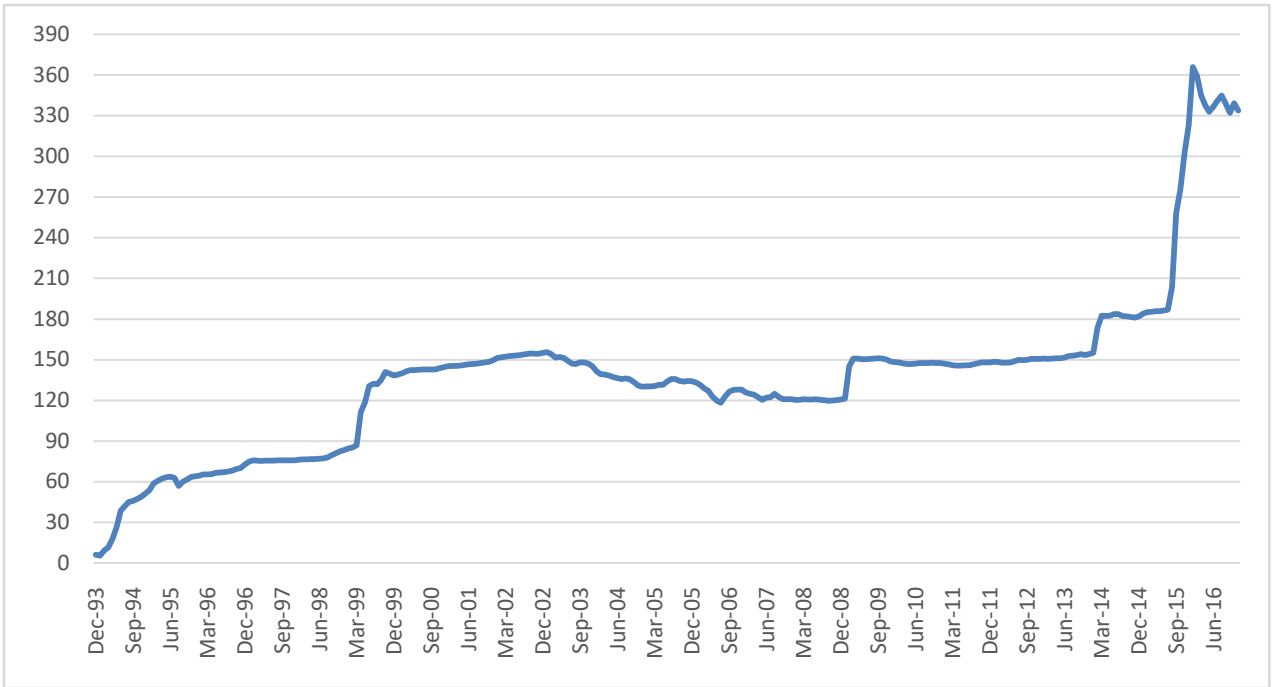
$$E = \frac{\frac{M}{k} * (\dot{m} - \dot{y}) - \Delta B + I * (r_I + 1/t_I)}{CAB + DI + \Delta D - D * (r_D + 1/t_D)} \qquad (1)$$

Where E is the nominal exchange rate of the national currency expressed in units of foreign currency; M - money supply in the economy of the country; k - money multiplier; $\dot{m}$ – the growth rate of the money supply; $\dot{y}$ - growth rates of nominal GDP;ΔB–net sale of government securities; I - the amount of internal debt; CAB - current account balance of the balance of payments; DI - net inflow of direct investment; D - amount of external debt; r_I - the rate on the country's domestic debt; r_D - the rate of the external debt of the country; t_I - the average maturity of a country's domestic debt; t_D - the average maturity of a country's external debt.

The following relationships are observed (Nurseiit, 2004, pp. 104). The exchange rate is appreciated with a decrease in the money supply (M), or an increase in the money multiplier (k), and when, the nominal GDP growth rates exceed the growth rates of the money supply ($\dot{y} > \dot{m}$).

The exchange rate is appreciated by the sale of securities (ΔB), a decrease in the size of domestic date (I) and the interest rate on domestic debt (r_I) and the increase in the maturity of this debt ((t_I).

The current appreciation of the national currency may be also due to an increase in the surplus of the current account of the balance of payments (CAB), a net inflow of direct investment (DI) and loans (ΔD), a decrease in external debt (D), interest rate (r_D) and an increase in the maturity of external debt (t_D).



Source: National Bank of Kazakhstan, 2018

Figure 1: Dynamics of the nominal exchange rate of tenge

As a source of data on the money supply, the balance of the current account of the balance of payments, foreign direct investment, the size of external debt and its rates, we used the data of the National

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Bank of Kazakhstan. As a source of data on domestic debt, the data of the Ministry of Finance of Kazakhstan, and as data on GDP growth, the data of the Committee on Statistics of Ministry of National Economy of Kazakhstan were used. The data were analyzed for the period from the 1st quarter of 2005 to the 4th quarter of 2016. (Table 1)

Table 1: Methods of Calculating Data

Symbol	Name	Calculation method
M	Money supply	The M2 monetary aggregate calculated at the nominal tenge rate by constant prices (2016q4 = 100%), $ bn. The CPI of USA for All Urban Consumersis used as inflation rate.
MM	The growth rate of money supply	Calculated as the rate of change in M2 money supply in constant US dollars, %.
yy	Growth rates of the nominal GDP	The growth rate of nominal GDP, by the previous quarter,%. Before the nominal GDP was recalculated into US dollars.
K	The money multiplier	It is calculated as the ratio of money supply to the monetary base (reserve money).
DB	Net sale of government securities	Difference between sales and purchase of government securities in terms of dollars, $ mln.
CAB	Current account of the balance of payments	Difference between export and import receipts on the current account, $ mln.
DI	Net inflow of direct investment	Difference between inflow and outflow of net investment, $ mln.
FA	Financial account	The balance of the country's financial account (excluding the reserve assets of the NBK$ mln.
Debt	External debt	Accumulated external debt, $ mln.
D_Debt	Increase in external debt	Increase in external debt, $ mln.
Int_Debt	Domestic debt	The total domestic debt of the government and the National Bank at the reporting date, $ bn.
RI	Average interest rate on domestic debt	The share of payment of internal debt to the accumulated amount of domestic debt, in %.
IID	Interest payments on domestic debt	Multiplying the accumulated domestic debt by the average interest rate on it, $ bn.
Kurs	Exchange rate	Weighted average exchange nominal exchange rate, tenge to US dollar.

III. Results and Discussion

As can be seen from the correlation matrix (Table 1), most explanatory variables are not strongly dependent on each other. The exception is the variable of external debt (DEBT) and the interest on domestic debt (IID), as well as money supply, the correlation between which are 89.8% and 80.6%, respectively. Also, a high correlation is observed between the interest on internal debt (IID) and money supply - about 60.7%, as well as between the growth of external debt (D_Debt) and the growth rates of money supply (MM) - 61.8%, and also between money supply and money multiplier (K). Therefore, the variable of internal debt (IID) when used with variables external debt (DEBT) and money supply (M), the variable of the increase in external debt (D_Debt) when used with money supply (M) or its growth rate (MM), as well as money supply when used with a money multiplayer (K), can give the wrong signs.

Table 2: Correlationmatrix

	KURS	M	MM	K	YY	DB	IID	CAB	D_DEBT	DEBT	DI	FA
KURS	1.000	0.097	-0.305	-0.171	-0.291	0.215	0.710	-0.239	-0.162	0.582	0.127	0.047
M	0.097	1.000	-0.291	0.687	0.040	0.073	0.607	0.289	-0.223	0.806	0.133	0.191
MM	-0.305	-0.291	1.000	-0.101	0.341	0.301	-0.316	0.029	0.618	-0.468	0.196	-0.382
K	-0.171	0.687	-0.101	1.000	0.156	-0.099	0.229	0.268	-0.120	0.336	0.083	0.385
YY	-0.291	0.040	0.341	0.156	1.000	-0.093	-0.139	0.025	0.127	-0.165	0.166	0.021
DB	0.215	0.073	0.301	-0.099	-0.093	1.000	0.282	0.043	0.231	0.187	0.294	-0.669
IID	0.710	0.607	-0.316	0.229	-0.139	0.282	1.000	-0.075	-0.190	0.898	0.137	0.041
CAB	-0.239	0.289	0.029	0.268	0.025	0.043	-0.075	1.000	-0.167	0.036	0.193	-0.277
D_DEBT	-0.162	-0.223	0.618	-0.120	0.127	0.231	-0.190	-0.167	1.000	-0.294	0.000	-0.331
DEBT	0.582	0.806	-0.468	0.336	-0.165	0.187	0.898	0.036	-0.294	1.000	0.151	0.135
DI	0.127	0.133	0.196	0.083	0.166	0.294	0.137	0.193	0.000	0.151	1.000	-0.128
FA	0.047	0.191	-0.382	0.385	0.021	-0.669	0.041	-0.277	-0.331	0.135	-0.128	1.000

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Based on the available data for Kazakhstan for the period from the 1st quarter of 2004 to the 4th quarter of 2016, we obtained the following models (Table 2). The calculations were carried out using the method of least squares. The Generalized Method of Moments (GMM) was also used to verify the correctness of the calculations. All models, except the first one, are statistically significant. This is evidenced by a high coefficient of determination after adjustment (about 0.95), high F statistics (147 to 205), as well as Durbin-Watson statistics - within the allowed intervals.

The first model included almost all the variables that were presented in the functional mathematical model we tested (Table 3). The exception was the average maturity of internal and external debt and the rate of external debt, for which data were not available. In addition, for better testing the model of the equilibrium nominal exchange rate (1), we created the variable MMY (= M*(mm-yy)). In theory, it should show a positive correlation with the exchange rate.

Virtually all variables (model 1) show theoretically expected signs. This indicates the correctness of the proposed theoretical model. Exception are observed by variables such as net sale of government securities (DB), the net inflow of direct investment (DI), and the balance of the financial account (FA). They show the wrong sign due to the high multi-collaterality with the variable of exchange rate of tenge to US dollar. However, these are the results of the observed situation in Kazakhstan for the analyzed period of time (from 2004 to 2016), and not the short comings of the model itself (Table 2). According to theory, the net sale of government securities, reducing the money supply in the economy, should have led to a depreciation of the national currency. The same trend would have to be observed with respect to the inflow of foreign investment (DI) or the financial account (FA).

The first wrong sign of net sale of government securities (DB) is explained by the fact that the off-balance sheet operations of the National Bank are most likely not reflected in the data used. The second wrong sign was unexpected, since everyone was used to believe that the inflow of foreign currency into the country favorably affects the balance of payments and the stability of the national currency. Although attracting foreign direct investment in the early years of oil and gas development (in the 1990s) led to a significant inflow of foreign currency into the country, but the situation has changed radically now. At the present time, the rate of inflow of foreign direct investment has slowed considerably. This is due to an ever larger net outflow of dividends on previously invested investments. Hence, the conclusion that the emphasis on foreign investment in order to support the stability of the tenge has not proved itself in the long term. At the same time, certain problems of autocorrelation of residuals and heteroskedness were characteristic for this model (low Durbin-Watson = 0.615), which led to a decrease in the efficiency of regression coefficients and reduced the statistical reliability of the main parameters of the model (as R-squared, t statistics, F statistics and etc.). Therefore, in subsequent models, we used first-order AR (1) regression models in order to eliminate these problems.

In the second model, we excluded weakly significant variables (MMY, CAB), and the variables showing incorrect signs because of multicollinearity (M, IID). The variable money supply (M) showed incorrect sign because of the inclusion of the variable D_Debt in the equation, and the variable IID - because of the inclusion of the variable Debt (Model 2). On the contrary, we included a variable of real GDP growth (yy) in the model. As a result of these actions, the basic statistical parameters of the model have improved noticeably (adjusted R-squared increased up to 95.2, Durbin-Watson statistics to 1.788, and F-statistic to 147). Signs in explaining variables are preserved, and the coefficients for explanatory variables are adjusted in favor of their greater reliability.

The model shows that the exchange rate in the previous time (KURS (-1)), money multiplier (K), the growth rate of real GDP (yy), the change in external debt (D_DEBT) and to some extent the amount of external debt (DEBT) are the main factors determining the dynamics of the equilibrium exchange rate of tenge. At the same time, the exchange rate reached in the previous time, and the amount of the external debt contributed to the weakening of the tenge, as the growth of money multiplier, the growth rate of real GDP and the growth of external debt led to the strengthening of its nominal rate.

To verify the correctness of this model, we calculated it using the Generalized Method of Moments (GMM) method. This method makes it possible to improve the normal ordinary squares in the presence of both heteroskedasticity and autocorrelation (HAC) of unknown form (Arellano and Bond, 1991). However, the basic statistical parameters of the model did not change, and only the coefficients of the explanatory variables were somewhat refined. The obtained result confirms the correctness of the specifying of the model.

Then we excluded the variable external debt (DEBT), which strongly correlated with the exchange rate of the national currency, from the model (model 3). This positively affected the model, which was reflected in the improvement of statistical coefficients. The coefficient of determination increased to 95.5, F-statistic grew to 205.4, and S.E. of regression decreased to 12.9. At the same time, the value of the regression coefficients remained approximately at the same level, and Durbin-Watson statistics improved to 1.82.The use of the GMM method did not lead to a significant change in the model. The major statistics of the model have not

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changed noticeably. The use of this method only allowed us to refine the coefficients of regression for explanatory variables.

An exception to the variable YY led to some improvement in the F-statistic model (model 4). The remaining parameters remained without significant changes. Using of the GMM method allowed refining the regression coefficients, but did not noticeably affect the basic statistical parameters of the model.

For the conclusion, it should be noted that the high statistical parameters of the models obtained indicate a correct specification of the model of the equilibrium nominal exchange rate of the tenge and an adequate choice of explanatory variables.

Table 3: Dependence of the Nominal Tenge Rate on Various Factors

	Model 1	Model 2		Model 3		Model 4	
	LS	LS	GMM	LS	GMM	LS	GMM
KURS(-1)		0.966746	0.984237*	0.997502*	1.00935*	0.971907*	0.960900*
MMY	1.44E-05						
YY		-0.340393**	-0.2152****	-0.413403*	-0.2683***		
K	-46.91161*	-15.71669**	-10.80830*	-10.95190**	-6.3441****	-13.6587***	-9.807134**
IID	148.2687*						
CAB	-0.003392						
D_DEBT	-0.001884	-0.001406**	-0.0008****	-0.001503**	-0.00091***	-0.00143**	-0.001339**
DEBT		0.000165	0.0001****				
C	190.9062*	31.6686***	18.370****	35.0731***	18.904****	45.1806***	36.47716**
AR(1)		0.31787***	0.311301**	0.32859***	0.35527**	0.44387**	0.395390*
R-squared	0.644040	0.958748	0.955857	0.962515	0.959986	0.955575	0.954808
Adjusted R-squared	0.600631	0.952235	0.948887	0.957829	0.954984	0.951241	0.950399
S.E. of regression	57.32617	13.44559	13.83140	12.90923	13.33755	13.88106	14.00042
F-statistic	14.83631	147.1954		205.4177		220.4756	
Durbin-Watson stat	0.615773	1.788414	1.657918	1.826739	1.688570	1.784562	1.650280
J-statistic			1.702504		3.660651		3.235525

*Note: * Probability is less than 1%, ** - less than 5%, *** - less than 10%, **** - less than 15%*

IV. Conclusions

An empirical test of the theoretical model of equilibrium exchange rate developed by Nurseiit (2004, p. 104) on quarterly data of Kazakhstan for the period from the 1st quarter of 2005 to the 4th quarter of 2016 show the correctness of its main conclusions. This primarily concerns the list of explanatory factors and their behaviours, as well as the features of their interactions.

From the built empirical models it follows that the most significant factors determining the equilibrium rate of the tenge are the current dynamics of the exchange rate, the size of money multiplier, the growth rates of real GDP, the amount of increase of external debt and, to some extent, the amount of accumulated external debt.

Factors such as the previous level of the exchange rate, and the accumulated amount of external debt contribute to the weakening of the tenge, and the coefficient of the money multiplier, the growth rate of the economy and the amount of increase of external debt lead to its strengthening.

As for other factors, such as the money supply, net inflow of direct investment and the size of the current account, they, as a rule, did not significantly affect the tenge's stability. This is due to the fact that the NBK artificially maintained the tenge's exchange rate in separate, rather long periods of time. In addition, the National Bank often uses the off-balance sheet operations, which are not always reflected in the official statements. In addition, in recent years there have been sharp changes in the rates of inflow of foreign direct investment. They noticeably slowed down. At the same time, in order to maintain the exchange rate of the national currency, the state not only conducted currency interventions at the expense of the previously accumulated gold and currency reserves, but also often resorted to selling part of the property of state-owned enterprises.

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