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Macroeconomic Analysis and General Economic Equilibrium of Kazakhstan

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Abstract. The paper studies general equilibrium in the economy of Kazakhstan. The purpose of the study is to estimate the equilibrium real interest rate for the economy within current frameworks. The IS-LM-BP curves are plotted based on corresponding regression models of the real output measured by GDP. The exogenous variables are taken for the regressions according to the theoretical propositions. The quarterly data for 2008Q1-2022Q4 published in the datasets and bulletins of the Committee for Statistics and the National Bank of the Republic of Kazakhstan were used. Some consequences of the change in the exchange rate regime and in macroeconomic policy framework on macroeconomic relationships were revealed. Effectiveness of using interest rate as an instrument in maintaining inflation targeting policy is still ambiguous for the case of Kazakhstan. This study demonstrates the general equilibrium state of the national economy and specifications of the curves listed above. The results can be used to assign further the nominal interest rate using Taylor type rules.

Keywords: IS-LM-BP model, macroeconomic equilibrium, economic policy, interest rate, econometric modelling

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Introduction

The government implements economic policy to enhance the well-being of its citizens. For this, the government uses various tools such as interest rates, open market operations, tax rates and many others. To predict the outcomes of a certain measure, policymakers use theoretical models like the Mundell-Fleming (MF) model. This is a workhorse model in macroeconomics and is used by economists and economic policymakers despite the fact it was elaborated more than half a century ago. Since there is a tradeoff between monetary autonomy, financial integration, and flexible exchange rates, the search for optimal economic policy is an ongoing process per se.

In the context of the complex dynamics shaping the Kazakh economy, this research paper undertakes a comprehensive macroeconomic analysis, focusing particularly on the application of the Mundell-Fleming model. Recently, even though inflation targeting might not work for Kazakhstan since it is a developing country with two-digit inflation rate [1], this country's National bank (NB) turned to the inflation targeting macroeconomic policy framework [2]. And the main instrument used by the National bank is the interest rate. Therefore, the value of the interest rate set by NB is of main concern. To understand the relationship between the interest rate and the main macroeconomic indicators the theoretical framework involving equilibrium in the markets for goods and services and for money is still useful.

The macroeconomic landscape of Kazakhstan has been subject to extensive analysis by scholars employing various models and methodologies. Mukhamediyev [3] provides a nuanced analysis by estimating a DSGE model for Kazakhstan's oil-producing economy, focusing on the implications of oil price fluctuations. This focus on the oil sector's dynamics offers insights into how exogenous shocks, such as changes in oil prices, affect the broader macroeconomic environment. While the study offers valuable insights into the challenges of managing resource-rich economies, its narrow focus on the oil sector limits its applicability to the broader macroeconomic landscape examined in this paper.

Adilkhanova [4] delves into microlevel analyses of parameters within the Dynamic Stochastic General Equilibrium (DSGE) model, offering valuable insights into the structural characteristics of the Kazakh economy. While Adilkhanova's focus lies primarily on parameter estimation, the findings provide essential groundwork for understanding the transmission mechanisms of monetary and fiscal policies. However, the study's limitations include its narrow scope, which may not capture the full complexity of Kazakhstan's macroeconomic dynamics.

Konebayev in [5], on the other hand, extends the DSGE framework to a small open economy context, incorporating external sector dynamics into the model. By doing so, Konebayev provides a comprehensive analytical tool for policymakers to evaluate the impact of external shocks and policy interventions on key macroeconomic variables. While Mukhamediyev's study [3] focuses primarily on the oil sector, Konebayev's analysis broadens the scope to encompass the entire economy, considering factors such as exchange rate mechanisms and international trade dynamics.

Baikulakov [6] explores the equilibrium level of credits in the Kazakh economy, shedding light on the interplay between credit dynamics and macroeconomic stability. Baikulakov's empirical analysis underscores the importance of prudential regulation in managing credit

cycles. However, the study's narrow focus on credit dynamics limits its broader applicability to macroeconomic analysis, particularly in the context of the IS-LM-BP model.

Tazhibayeva et al. [7] investigate the drivers of economic growth in Kazakhstan, emphasizing the role of fixed capital investment, consumer price index, and small and medium enterprises (SMEs). The study's empirical analysis highlights the determinants of economic expansion, offering valuable insights for policymakers. However, its narrow focus on specific determinants may overlook the broader macroeconomic interactions captured by the IS-LM-BP model.

Overall, the reviewed literature offers diverse perspectives and methodological approaches to understanding Kazakhstan's macroeconomic dynamics. While each study contributes valuable insights, their limitations underscore the need for a holistic approach that integrates theoretical frameworks with empirical observations. In the context of this paper's objectives, synthesizing findings from these studies can provide a comprehensive framework for macroeconomic analysis and policy formulation in Kazakhstan, bridging the gap between theory and empirical evidence.

The significance of applying the Mundell-Fleming model to the Kazakh economy lies in its openness to international trade and capital flows, as well as its currency regime. Kazakhstan operates within a managed floating exchange rate system, allowing its currency, the tenge, to fluctuate within a certain range determined by the central bank. Furthermore, the country's extensive trade relationships and reliance on oil exports render it susceptible to external shocks and global economic conditions.

There is a bulk literature on macroeconomic analysis, particularly using IS-LM model with various extensions. However, for empirical evidence or application of the theoretical propositions are used the data for developed countries or developing countries like China, India, Russia [8], Latin American or Eastern-European economies. Little done for Central Asian economies, especially for Kazakhstan. Although several profound work done by A.Ashimov and his co-authors [9,10]. Since, the research [10] uses data for Kazakhstan till 2011, we decided to study the Kazakh economy with updated data till 2022. Moreover, we use quarterly data which increases the numbers of observations. It is well known that in 2015 Kazakhstan switched from exchange rate targeting to inflation rate targeting macroeconomic policy. Hence, this implies not only updating model specifications by recent data, but also an analysis of macroeconomic condition in a changed macroeconomic policy framework.

This study uses the theory of common general equilibrium and IS-LM-BP to analyze the economy of Kazakhstan. It aims to do namely: a) to build IS-LM-BP model of Kazakh economy, b) to investigate whether theoretical propositions hold for empirical data, and c) interpret the results of it with some recommendations.

Methodology

Currently macroeconomic analysis and economic policymaking is mostly based on IS-LM-BP model as the model of common economic equilibrium of a small open economy [11]. Here we build the regression models for the general equilibrium on the market for goods and services, for money and for the balance of payments. The main purpose is to estimate the equilibrium

real interest rate for the economy. Since the nominal interest rate consists of the real interest rate and inflation, for the National Bank the key decision is to determine the value of the real interest rate. An interest rate is used as an instrument of monetary policy to stimulate/restrain certain economic activities of economic agents.

Equilibrium in the market of goods and services is presented by IS curve as equilibrium state of aggregate demand and aggregate supply. Equilibrium in the money market expressed by LM curve as balanced state of the demand for money and money supply. And an external equilibrium is expressed by balanced current account and capital account. We use OLS technique to build regressions. The coefficients of determination, F-statistics for regression models and t-statistics of independent variables with p-values were used as criteria for testing models. Since there are a lot of factors affecting a macroeconomic indicator the values of the coefficients of determination can be small. However, we still can use the models if the independent variable is significant.

The data for variables were taken for the period from 2008Q1 to 2022Q4. Sources of dataset are from Committee for Statistics of the RK and the National Bank of the RK were used. From the website of the Committee on Statistics, data from Express Information by quarter were used for the indicator "Gross Domestic Product by Spendings" and Consumer Price Index (CPI). The values of the broad money, the interest rates, and exchange rates were taken from the database of the National Bank of the RK, particularly, "Monetary base and broad money aggregates" and the Statistical Bulletin of the NB RK issued monthly.

Findings

Let us introduce notations as follows: Y is the GDP, I is the investment, NX is the net export, *R* is the real interest rate of commercial banks on loans, *RER* is the real exchange rate as units of KZT per one USD, calculated as *RER=eP*/P,* and *M3* is the broad money which includes cash in circulation, that is, outside the banking system, deposits of non-bank legal entities and households in tenge and foreign currency.

Descriptive statistics for the time series of variables used in the study are given in Table 1.

Table 1.

Descriptive statistics for variables

	Y	I	NX	R	RER	M3
Mean	6427.114	1743.622	716.7423	5.996879	201.0469	16121.57
Standard Error	213.1453	75.1523	51.67221	0.661356	7.328804	994.7006
Standard Deviation	1651.016	582.1272	400.2512	5.07997	56.76867	7704.917
Sample Variance	2725854	338872.1	160201.1	25.8061	3222.682	59365752
Minimum	4054.261	764.3126	-341.663	-18.71	130.7367	4815.185
Maximum	11150.09	2897.738	1629.83	12.14561	286.6927	34295.96
Count	60	60	60	59	60	60

Note: Calculated by authors based on datasets in [12,13].

As one can see from Table 1, the mean interest rate for the considered period was almost 6 percent, the exchange rate mean equals 201 tenge per USD. However, the sample variances are too large, which adds complexity to the investigation of sample dynamics.

Equilibrium in the market of goods and services assumes that national savings equal to investment. As theory suggests, the level of investment depends on the interest rate. Hence, for all possible equilibrium states in the market of goods and services we construct the following model:

$$Y_{IS} = \alpha + \beta_1 I + \beta_2 R + u_t \quad (1)$$

So, estimated IS model is:

$$\hat{Y}_{IS} = 2386 + 2.5I - 53R \quad (2)$$

Adjusted R^2 is 0.79. F statistics is 111. Table 2 gives the information about the intercept and independent variables.

Table 2

Characteristics of IS model's variables

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	2385.97	343.73	6.94	4.33E-09	1697.3	3074.5	1697.3	3074.5
I	2.49	0.17	14.48	1.37E-20	2.1	2.8	2.1	2.8
R	-52.97	19.42	-2.72	0.00853	-91.8	-14	-91.8	-14

Note: Calculated by authors

From Table 2 we can conclude that investments and the real interest rates are the main determinants of the output.

According to theory the money demand depends on the income level and the interest rate. So, we build the following regression for the equilibrium in the money market:

$$M = \alpha + \beta_1 Y + \beta_2 R + u_t \quad (3)$$

We estimated both regressions with real and nominal interest rates values. Using nominal ones gives good p-values for exogenous variables and overall test statistics. However, the sign of R is negative, which implies less demand for money at high interest rate, when we use the real interest rate. With nominal interest rates the sign of R is positive. So, by analyzing the signs of coefficients we use real interest rates.

The estimated LM model is $\hat{M}$=-18464+2.83Y-1168R. Adjusted R^2 is 0.40. F statistics is 20.6.

Table 3

Characteristics of LM model's variables

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-18464	9115.9	-2.02	0.047506	-36719	-210.05	-36719	-210.05
Y	2.83	0.47	5.99	1.44E-07	1.88	3.77	1.88	3.77
R	1167.6	624.5	1.86	0.066668	-82.92	2418.28	-82.92	2418.28

Note: Calculated by authors

From Table 3 we can conclude that output and the real interest rates are the main determinants of the broad money.

Since the National Bank doesn't control money supply itself but manipulates interest rate to attain the desired money level, we can say that M3 is responsive to the changes in the interest rate. However, there is a lack of understanding by the population of the concept of real interest rate and its values or savings to overcome cyclical volatility. When analyzing the effects of the real interest rate changes on the demand for money, one can see that there is a weak relationship.

In investigating the effect of change in interest rate we should keep in mind that "a positive interest rate shock has uncertain inflationary impact over the long run" [1] unlike well-known propositions based on data of developed countries.

The balance of payment curve characterizes the foreign market equilibrium. For the balance of payments both net export and real exchange rate were taken as an exogenous variable along with the interest rate.

$$Y_{BP} = \alpha + \beta_1 R + \beta_2 RER + u_t \quad (4)$$

$$Y_{BP} = \alpha + \beta_1 R + \beta_2 NX + u_t \quad (5)$$

However, using the p-values for explanatory variables as a criterion, we selected to use the second regression with NX (Table 4).

The estimated BP model is $\hat{Y}_{BP}$=7846-1.19 NX-89.5R. Adjusted R^2 is 0.09. F statistics is 3.77.

Table 4

Characteristics of BP model's variables

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	7845.9	546.8	14.34	2.08E-20	6750.5	8941.3	6750.5	8941.3
NX	-1.19	0.53	-2.23	0.02	-2.2	-0.12	-2.2	-0.12
R	-89.5	42.01	-2.13	0.03	-173.6	-5.35	-173.6	-5.35

Note: Calculated by authors

From Table 4 we can conclude that net export and the real interest rates are the main determinants of the output.

It is worth noting that since there was a break in RER in 2015Q3 due to the change in exchange rate regime, we tried to estimate the model before and after the break. Results show that the RER is statistically significant in determining Y under the fixed exchange rate regime rather than under floating one. Therefore, the general model is weak enough when built for the entire period. However, for the purposes of this study it is essential to consider the whole period rather than break it according to the exchange rate regime change.

Next, by taking average values for the variables I, M, RER, we calculate the values of Y for a given R values and plot the curves IS, LM, and BP (Figure 1).

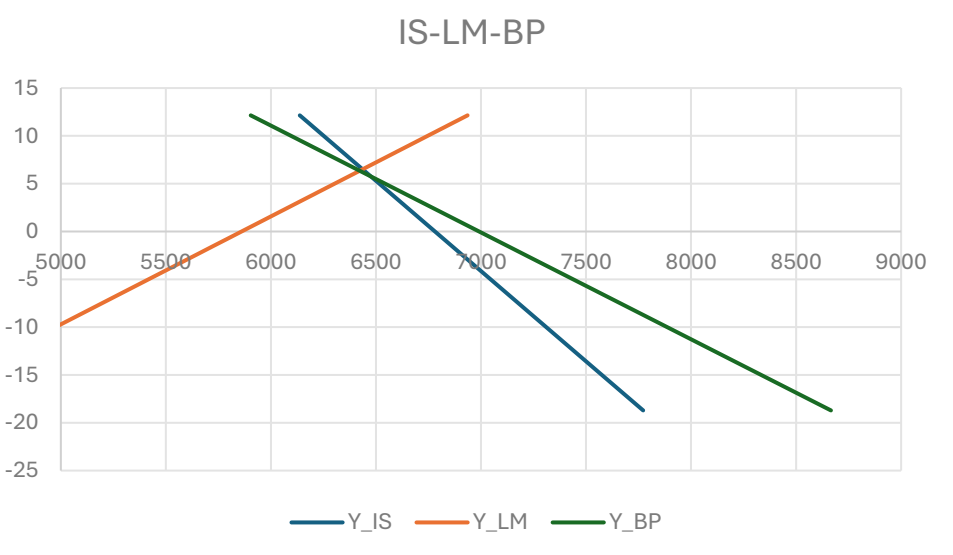

Figure 1. IS-LM-BP curves for the economy of Kazakhstan

Note: plotted by authors based on computations

General equilibrium is obtained at around 6.4 percent per annum interest rate level. For comparison: average real GDP growth level is around 3.5 percent per annum. The actual real interest rate in 2022Q4 was -2.4 percent and the real GDP was 11 150 mln tenge. Since this is the point above BP curve, according to [11] we can say there is excess employment and surplus of the balance of payments, positive net export and net capital inflow.

According to the estimates of the BP models and Figure 1 we can derive the inference that the dependence between Y and the market average interest rate appears to be negative. Hence, the increase in the domestic interest rate was accompanied by the outflow of capital from the country rather than inflow. Moreover, the slope of the curve BP is step which means there are some barriers for free capital mobility.

Conclusion

In the world of free capital flow and international trade, this optimality can be reached by obtaining general equilibrium with full employment and zero balance of payments. Otherwise, there will be any combination of unemployment/excess employment with deficit/surplus of payment account. Therefore, state economic policy aims to achieve a double equilibrium. The assessment of the equilibrium conditions of an open economy is partially considered based on a small economy model.

In theory, increasing domestic interest rate leads to capital inflow, which means the slope must be positive. But the equilibrium of the balance of payments turned out to depend on other factors. The low value of the coefficient of determination for the regression of the balance of payments supports this inference. We can assume the deviation of domestic interest rate from the world average rate, or the US interest rate could be one of the determinants. Additionally, the risk level of domestic assets is historically considered as high due to several factors like volatility of the Kazakh economy because of high dependence on external markets and oil price, multiple reforms, state controlled National bank and loosely structured discretionary economic policy.

Effectiveness of using interest rate as an instrument in maintaining inflation targeting policy is still ambiguous for the case of Kazakhstan. Even though, if the National Bank continues doing it, the equilibrium real interest rate estimated by us is around 6 percent.

Concluding from the CGE model above one can say that the years 2016 and 2020 were closest to equilibrium.

In continuation of this study, it is possible to construct alternative models for equilibria in the markets under consideration using vector models and then similarly calculate the equilibrium interest rate and compare the results obtained with each other. This approach allows one to obtain the most accurate value of the real interest rate.

The accurate determination of the National Bank's interest rate holds substantial significance for a country's economy, as it profoundly influences a multitude of economic indicators. The interest rate, set by the NB RK, serves as a critical tool for monetary policy, impacting inflation, investment, consumption, exchange rates, and overall economic growth.

Firstly, the interest rate directly affects inflation levels. By raising interest rates, the NB RK can curb excessive spending and borrowing, thereby reducing inflationary pressures. Conversely, lowering interest rates encourages borrowing and spending, which can stimulate economic activity but also risks increasing inflation if not managed prudently.

Investment is another key area influenced by the interest rate. Higher interest rates tend to increase the cost of borrowing, which can deter businesses from taking loans for expansion and capital projects. This can lead to slower economic growth as investments in infrastructure, technology, and other productive assets are reduced. On the other hand, lower interest rates make borrowing cheaper, encouraging businesses to invest more, which can boost economic growth.

Consumer spending is similarly affected by changes in interest rates. Higher interest rates increase the cost of consumer credit, such as loans and mortgages, which can reduce household

spending and, consequently, aggregate demand. Lower interest rates, however, reduce the cost of credit, encouraging consumers to spend more, thereby stimulating economic activity.

Exchange rates are also impacted by national interest rates. Higher interest rates attract foreign investment, leading to an appreciation of the national currency. This makes imports cheaper and exports more expensive, potentially leading to a trade deficit. Conversely, lower interest rates may result in a depreciation of the national currency, making exports more competitive and imports more expensive, which can improve the trade balance.

Lastly, the interest rate plays a crucial role in overall economic growth. By influencing borrowing costs, consumer and business spending, and investment levels, the interest rate can either stimulate or slow down economic growth. Central banks aim to strike a balance that fosters sustainable growth without triggering high inflation.

The National Bank's interest rate is a pivotal factor in shaping a country's economic landscape. It affects inflation, investment, consumer spending, exchange rates, and economic growth, making its accurate determination essential for economic stability and prosperity. Therefore, the NB RK must carefully calibrate interest rates to achieve desired economic outcomes, balancing between stimulating growth and controlling inflation.

Conflict of interest. The authors declare no conflict of interest.

Authors' contribution.

Sailaubekov N.T. – theoretical substantiation, results interpretation.

Sarkambayeva Sh.G. – model building, data collection and processing, goal statement, literature review.

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Макроэкономикалық талдау және Қазақстанның жалпы экономикалық тепе-теңдігі

Аннотация. Мақалада Қазақстан экономикасындағы жалпы тепе-теңдік зерттелген. Зерттеудің мақсаты қазіргі экономика үшін тепе-теңдік нақты пайыздық мөлшерлемені бағалау болып табылады. IS-LM-BP қисықтары нақты ЖІӨ-нің сәйкес регрессия үлгілеріне негізделген. Экзогендік айнымалылар теориялық ұсыныстарға сәйкес регрессиялар үшін алынған. Қазақстан Республикасы Статистика комитетінің және Ұлттық Банкінің деректер жинақтары мен бюллетеньдерінде жарияланған 2008 жылдың 1 тоқсаны мен 2022 жылдың 4 тоқсаны аралығындағы деректері пайдаланылды. Валюталық бағам режимінің және макроэкономикалық саясаттың шеңберінің өзгеруінің макроэкономикалық қатынастарға қатысты кейбір салдары анықталды. Инфляциялық таргеттеу саясатын қолдау құралы ретінде пайыздық мөлшерлемені пайдаланудың тиімділігі Қазақстан үшін әлі де түсініксіз. Бұл зерттеу ұлттық экономиканың жалпы тепе-теңдік күйін және жоғарыда аталған қисықтардың ерекшеліктерін көрсетеді. Нәтижелер Тейлор типті ережелерін пайдаланып номиналды пайыздық мөлшерлемені одан әрі тағайындау үшін пайдаланылуы мүмкін.

Түйін сөздер: IS-LM-BP моделі, макроэкономикалық тепе-теңдік, экономикалық саясат, пайыздық мөлшерлеме, эконометриялық модельдеу

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Макроэкономический анализ и общее экономическое равновесие Казахстана

Аннотация. В статье исследуется общее равновесие в экономике Казахстана. Целью исследования является оценка равновесной реальной процентной ставки для экономики в текущих рамках. Кривые IS-LM-BP построены на основе соответствующих регрессионных моделей реального ВВП. Экзогенные переменные берутся для регрессий в соответствии с теоретическими положениями. Использовались квартальные данные в период 1-ый квартал 2008 – 4-ый квартал 2022 годов, опубликованные в массивах данных и бюллетенях Комитета статистики и Национального Банка Республики Казахстан. Выявлены некоторые последствия изменения режима обменного курса и рамок макроэкономической политики на макроэкономические соотношения. Эффективность использования процентной ставки в качестве инструмента поддержания политики таргетирования инфляции в случае Казахстана все еще остается неоднозначной. Данное исследование демонстрирует общее равновесное состояние национальной экономики и особенности приведенных выше кривых. Результаты можно использовать для дальнейшего определения номинальной процентной ставки с использованием правил типа Тейлора.

Ключевые слова: IS-LM-BP модель, макроэкономическое равновесие, экономическая политика, процентная ставка, эконометрическое моделирование

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