ECONOMIC POLICY WITHIN THE FRAMEWORK OF REGIONAL UNION TAKING INTO ACCOUNT BUDGETARY EQUILIBRIUM AND GOVERNMENT DEBT

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ABSTRACT
Estimates were obtained in the form of a regression function of the main macroeconomic indicators of national economy by example of the economy of the Republic of Kazakhstan within the framework of its operation as a part of regional customs union and interaction with the rest of the world. After testing for spurious regression functions the econometric model was built for small open economy of the Republic of Kazakhstan and its sustainability indicator was evaluated. This model describes budgetary equilibrium conditions taking into account government debt as well as equilibrium conditions in the markets of goods, money, and capital. Macroeconomic analysis has been conducted on the basis of the model. Proposed and illustrated an approach of estimating the optimal values of economic policy instruments in the functioning of the national economy within the regional customs union and its interaction with the outside world. The task of parametric control of macroeconomic indicators of national economy based on the econometric model taking into account constrains to budget deficit, government debt and inflation is formulated and solved.

KEY WORDS
Identification; Modelling; Estimation; Parametric control; Customs union; Budgetary equilibrium; Government debt; Economic policy instruments.

1. INTRODUCTION

In open economy conditions, in which a country interacts with other countries of regional customs union as well as with the rest of the world, an actual challenge is to have a rational economic policy which allows for requirements of static equilibrium in macroeconomic markets of goods, money, labor and capital, as well as budgetary equilibrium taking into account government debt.

In macroeconomic theory, there is a known result [1] of the Nobel laureate R. Mundell, which was based on IS (Investment-Saving), LM (Liquidity preference-Money supply) and IS/LM models. R. Mundell proposed a tool for analysis of equilibrium conditions in the markets of goods, money, and capital. He also suggested an approach to the balance of payments stabilization (external equilibrium) by means of monetary policy and stabilization of internal equilibrium (on the goods market) by means of fiscal policy. The considered result does not take into account the conditions of the country's interaction within the regional customs union.

In [2] was proposed the evaluation approach for optimal values of economic policy instruments based on the econometric model of national economy which does not reflect equilibrium conditions in the macroeconomic markets of goods, money, labor, capital, and equilibrium of budget and operation of the country within the regional economic union.

In [3] there has been developed econometric model of small open economy, that does not take into account the requirements for national economy budget equilibrium considering accumulated government debt and was solved the problem of mathematical programming without constraints imposed on: accumulated government debt, state budget deficit, inflation rate.

This paper aims to estimate the optimal values of economic policy instruments (by example of the Republic of Kazakhstan) taking into account the requirements of equilibrium in macroeconomic markets of goods, money, labor, capital and state budget taking into account government debt on the basis of econometric model of small open economy, interacting with countries of customs union (by example of one country) as well as with the rest of the world.

Based on econometric model, which describes the equilibrium conditions in macroeconomic markets of goods, money, labor, capital and budgetary equilibrium taking into account government debt as well as constraints on: accumulated government debt, state budget deficit and inflation rate, the work proposes the approach to evaluate optimal values of economic policy within the framework of a small open economy (by example of the Republic of Kazakhstan), interacting with countries of regional customs union (composed of the Republic of Kazakhstan, Russian Federation, Belarus) as well as with the outside world.
2. ECONOMETRIC MODEL OF SMALL OPEN ECONOMY, OPERATING AS A PART OF A REGIONAL CUSTOMS UNION TAKING INTO ACCOUNT BUDGETARY EQUILIBRIUM AND GOVERNMENT DEBT

In this paper the model for small open economy [4] that describes equilibrium conditions in macroeconomic markets of goods, money, labor, capital is developed by including budgetary equilibrium, taking into account its interaction with customs union member-countries and the rest of the world. This model is presented by the following relations:

Equilibrium in the goods market of the Republic of Kazakhstan is presented by the formula:

\[ Y^D = Y^S, \]  

(1)

where \( Y^S \) – real supply of goods in the Republic of Kazakhstan, in billions of tenge (national currency of the Republic of Kazakhstan); \( Y^D = C + I + G + NE \) – real demand for goods in the Republic of Kazakhstan, in billions of tenge; \( NE = NW + NE^{RU} \) – real volume of goods net export from the Republic of Kazakhstan, in billions of tenge; \( NE^{RU} = E^{RU} - e^{-1}Im^{RU} \) – real net export of goods from the Republic of Kazakhstan to the Russian Federation, in billions of tenge (indicator, that takes into account the terms of cooperation of the Republic of Kazakhstan within the regional customs union); \( E^{RU} \) – real volume of exports of goods from the Republic of Kazakhstan to the Russian Federation, in billions of tenge; \( Im^{RU} \) – real volume of imports of goods to the Republic of Kazakhstan from Russian Federation, in billions of tenge; \( e^{-1} = e^{PW}/P \) – real exchange rate in the Republic of Kazakhstan, tenge/US dollar; \( P \) – the general price level in the outside world; \( e^{-1} \) – exchange rate of national currency in the Republic of Kazakhstan, tenge/US dollar; \( NW = E^{W} - e^{-1}Im^{W} \) – real net export of goods from the Republic of Kazakhstan to the rest of the world, in billions of tenge (indicator that takes into account the terms of cooperation between the Republic of Kazakhstan and the rest of the world); \( E^{W} \)– real volume of exports of goods from the Republic of Kazakhstan to the rest of the world, in billions of tenge; \( Im^{W} \)– real volume of imports of goods to the Republic of Kazakhstan from the rest of the world, in billions of tenge; \( G \) – real volume of government expenditures in the Republic of Kazakhstan, in billions of tenge; \( I \) – real gross domestic product (GDP) in the republic of Kazakhstan, in billions of tenge; \( Y \) – real gross domestic product (GDP) in the Republic of Kazakhstan, in billions of tenge; \( N \) – number of employed people in the Republic of Kazakhstan, in thousands of persons.

Equilibrium in the capital market:

\[ PNE = NKE, \]  

(4)

where \( NKE \) – net capital export nominal volume from the Republic of Kazakhstan, in billions of tenge. Budgetary equilibrium:

\[ G^{exp} = G^{inc} \]  

(5)

where \( G^{exp} \) – expensive part of the budget of the Republic of Kazakhstan, which depends on national revenues and the saved-up government debt, in billions of tenge, \( G^{inc} \) – budget revenues of the Republic of Kazakhstan, in billions of tenge.

Let’s introduce additional notations for economic indicators used in development of a model: \( M^{RU} \) – real money supply in Russian Federation (in billions of tenge) and \( G^{RU} \) – real volume of government expenditures in Russian Federation (in billions of tenge), indicators allowing for conditions of operating of a country as part of regional customs union; \( e^{-1} \) – exchange rate of tenge to ruble of Russian Federation; \( P^{RU} \) – the price level in the Russian Federation; \( i \) – the average interest rate of banks for loans in the Republic of Kazakhstan; \( i^{W} \) – interest rate of the outside world (Market yield on U.S. Treasury securities at 3-month constant maturity, quoted on investment basis); \( P^{avg} = 0.6P + 0.4e^{PW}/e^{1999Q1} \) – weighted average price level in the Republic of Kazakhstan, 1999Q1 – exchange rate in the Republic of Kazakhstan for the 1st quarter of 1999 (tenge/US dollar); \( P^{oil} \) – average oil price (in thousands of tenge for a barrel); \( G^{debt} \) – saved-up government debt of the Republic of Kazakhstan, in billions of tenge; \( \Delta \) – first difference operator for the time series: \( \Delta X = X - X_{-1} \), where \( X_{-1} \) – lag variable.

Preliminary econometric analysis showed the possibility for evaluation of macroeconomic indicators of equilibrium conditions in macroeconomic markets \( C, L, W, I, Y, E^{W}, Im^{W}, E^{RU}, Im^{RU}, NKE, G^{exp}, G^{inc} \) as a function of the regression on the basis of the following set of time series: \( Y, C, L, i, W, N, P^{avg}, I, P^{oil}, NKE, M^{RU}, \)

where \( L \) – real cash balances in the Republic of Kazakhstan, in billions of tenge; \( M \) – nominal money supply in the Republic of Kazakhstan (in billions of tenge), defined by the [5].

Equilibrium in the labor market of the Republic of Kazakhstan:

\[ PdY/dN = W, \]  

(3)

where \( W \) – nominal wage rate in the Republic of Kazakhstan, in thousands of tenge; \( dY/dN \) – marginal productivity of labor in the Republic of Kazakhstan; \( Y \) – real gross domestic product (GDP) in the republic of Kazakhstan, in billions of tenge; \( N \) – number of employed people in the Republic of Kazakhstan, in thousands of persons.
The functions of the following type and seasonal adjustment of time series regression are commonly used to model seasonality – purely deterministic seasonal processes, stationary seasonal processes and integrated seasonal processes [6]. The special Hylleberg-Engle-Granger-Yoo (HEGY) [6] method, which is intended to reveal the presence of unit roots, was applied to correct seasonal adjusting of time series. According to the results of a check-up for stationarity, the seasonality type on the basis of which the appropriate method was selected is the Engle-Granger cointegration test [8, 9].

The model of small open economy (by example of the Republic of Kazakhstan) based on the equilibrium conditions in macroeconomic markets of goods, money, labor, capital, and equilibrium of budget (1-5) and based on the built regression functions (6) for year $t$ and quarter $j$ has the following form:

$$ Y^{D}_{t,j} = 941.7 + 0.02^{B_{t,j}} + 6.82^{P_{t,j}} + 1.33^{l_{t,j-1}} + 1.38^{G_{t,j}} - 3.15^{e_{t,j}} + 53.81^{P_{t,j-1}} + 39.6^{P_{t,j-3}} + 19.3^{P_{t,j-4}} + 0.84^{W_{t,j}} - 1.37^{m_{t,j-1}} - 0.08^{R_{t,j}} + 0.99^{E_{t,j-1}} - 4.1^{I_{t,j-1}} + 0.003^{\Delta_{t,j-1}} - 40.13^{e_{t,j}} + 0.47^{Y_{t,j-3}} + 0.52^{Y_{t,j-4}} - 53.1^{D_{t,j}^{0103Q1}} - 69.1^{D_{t,j}^{2011Q2}}, $$

$$ Y^{BP}_{t,j} = 8104.6 - 38.2^{e_{t,j}} + 651.4^{P_{t,j}} + 79.5^{P_{t,j-1}} + 233.2^{P_{t,j-3}} + 9.7^{W_{t,j}} - 16.6^{l_{t,j-1}} - 97^{G_{t,j}} + 49.4^{P_{t,j}} + 12.01^{E_{t,j-1}} - 49.64^{D_{t,j}}, $$

$$ Y^{BB}_{t,j} = 642.78^{D_{t,j}^{2010Q3}} - 383.67^{D_{t,j}^{2011Q2}}, $$

$$ Y^{BP}_{t,j} = 8091.6^{W_{t,j}} - 4.45^{G_{t,j}} + 1^{P_{t,j}} + 30.25^{M_{t,j}} - 9363.51 - 132.1^{l_{t,j-1}} - 136.8^{G_{t,j}} + 313.5^{e_{t,j}} - 5350.3^{P_{t,j-1}} - 3937.8^{P_{t,j-3}} - 1915.4^{P_{t,j-4}} - 79.7^{W_{t,j}} + 136.5^{M_{t,j}} + 8016^{R_{t,j}} - 98.8^{E_{t,j-1}} - 407.72^{D_{t,j}}, $$

$$ Y^{BB}_{t,j} = 0.33^{M_{t,j}} + 3990.4^{R_{t,j}} + 46.3^{Y_{t,j-3}} - 52.1^{Y_{t,j-4}} - 5279.1^{D_{t,j}^{2010Q3}} + 6871.5^{D_{t,j}^{2011Q2}} + 5911.24^{P_{t,j}} , $$

$$ Y^{BB}_{t,j} = 5.9^{\Delta_{t,j}} + 4.9^{G_{t,j}} + 9.1^{e_{t,j-1}} - 1532.1, $$

where values in brackets – $P$-value statistic for coefficient of regression and $R^2$ – $R$-squared statistic; $D_{t,j}^{2010Q1}$ – dummy variable, is 1 for the 3 quarter of 2010, in other cases is 0. $D_{t,j}^{2011Q2}$ – dummy variable, is 1 for the 2 quarter of 2011, in other cases is 0.

The results of a check-up for stationarity and seasonal adjustment of time series regression functions of the following type $C = C(Y)$, $L = L(Y, i, \beta^\nu)$, $W = W(N, \beta^\nu)$, $\text{NKE} = \text{NKE}(i, i, G^{RU}, \beta^\nu)$, $\text{Im}^W = \text{Im}^W(Y, W, \beta^\nu)$ where $\beta^\nu$ is the coefficient of regression and $\text{Im}^W$ is the coefficient of regression where values in a brackets – $P$-value statistic for coefficient of regression and $R^2$ – $R$-squared statistic; $D_{t,j}^{2010Q1}$ – dummy variable, is 1 for the 3 quarter of 2010, in other cases is 0. $D_{t,j}^{2011Q2}$ – dummy variable, is 1 for the 2 quarter of 2011, in other cases is 0.

Spurious regressions functions where corresponding seasonal adjusted time series are stationary with respect to the determined trend were checked by the $T$-test [7]. Spurious regressions functions where seasonal adjusted time series were non-stationary were checked by the Engle-Granger cointegration test [8, 9].

According to the results of a check-up for stationarity and seasonal adjustment of time series regression functions of the following type $C = C(Y)$, $L = L(Y, i, \beta^\nu)$, $W = W(N, \beta^\nu)$, $\text{NKE} = \text{NKE}(i, i, G^{RU}, \beta^\nu)$, $\text{Im}^W = \text{Im}^W(Y, W, \beta^\nu)$ where $\beta^\nu$ is the coefficient of regression and $\text{Im}^W$ is the coefficient of regression where values in a brackets – $P$-value statistic for coefficient of regression and $R^2$ – $R$-squared statistic; $D_{t,j}^{2010Q1}$ – dummy variable, is 1 for the 3 quarter of 2010, in other cases is 0. $D_{t,j}^{2011Q2}$ – dummy variable, is 1 for the 2 quarter of 2011, in other cases is 0.
The quality of the researched econometric model of the small open economy is assessed by the sustainability indicator [10], which characterizes a change in the equilibrium solutions by small deviations of the input parameters used. If the sustainability indicator of the model takes a small value for a small deviation of input variables used, it is considered that the model is qualitative in the sense of stability [10].

Assessment of sustainability indicators is made by the following algorithm:
1. Choose a vector of input factors: \( x_0 = \{M_0, G_0, P^W_0, i^W_0, P^{ill}_0, M^{RU}_0, G^{RU}_0, P^{RU}_0 \} \).
2. Vector of values \( x_0 \) with the help of generator of random values disturbs \( m \) times in the sphere with a radius of 1% and with a center-point \( x_0 \). As a result \( m \) (\( m=100 \)) random points of \( \{x_k, k = 1, ..., m\} \), lying in the sphere, are being defined.
3. As a result of solving the system (7) we obtain \( m+1 \) equilibrium values \( (z_k = \{Y_k, e_k, P_k, G^{debt}_k\}, k = 0, ..., m) \) of the model for a small open economy.
4. Obtained \( m+1 \) equilibrium solutions to the model for open small economy are normalized with respect to initial vector of values.
5. Through obtained normalized \( m \) solutions and the initial solution (after normalization the initial solution has the coordinates \( r_0=(1,1,1,1) \)) to the model for small open economy the sustainability indicator of the following type is evaluated:

\[ \beta = \max(\rho(r_k, r_0)), j = 1, ..., m, \]

where \( r_k \) – normalized vector, corresponding to the perturbed vector \( x_k \), \( \rho(r_k, r_0) \) – Euclidian distance between the normalized vector \( r_k \) and the initial vector \( r_0 \).

Conducted by the authors the computing experiments show that deviations of equilibrium solutions up to 2% correspond to the deviations of input factors within 1%. This confirms the fact that the considered econometric model of small open economy is a qualitative model in sense of stability according to [10].

3. MACROECONOMIC ANALYSIS OF NATIONAL ECONOMIC INDICATORS BASED ON THE ECONOMETRIC MODEL OF A SMALL OPEN ECONOMY

In the process of macroeconomic analysis based on the econometric model of a small open economy equilibrium values of the main economic indicators are being assessed along with the way the tools of economic policy and a number of uncontrollable factors affect them.

By solving the system (7), we define equilibrium values of the GDP \( Y^* \), price level \( P^* \), national currency exchange rate \( e^* \), interest rate on loans of banks \( i^* \) for the given values of the external economic indicators \( P^W, i^W, P^{ill}, M^{RU}, G^{RU}, P^{RU} \) and economic instruments \( M \) and \( G \) for corresponding quarters of considered years and for example for the 4th quarter of 2011. Equilibrium values for the corresponding quarters of considered years and for the year 2011 of the remaining indicators are calculated by the formulas. Table 1 presents calculated equilibrium and actual values of the main economic indicators of the Republic of Kazakhstan for the 4th quarter of 2011 (where \( X^* \) – equilibrium value, \( X \) – actual value).

We give a graphical interpretation of the obtained equilibrium solutions for the 4th quarter of 2011. Figure 1 shows the condition of general economic equilibrium, where the point of intersection IS-LM-BP corresponds to the general equilibrium in the markets of goods, money and labor at full employment and a zero balance of payments for the 4th quarter of 2011.

All combinations of gross domestic product and the rate of interest, other that equilibrium, represent the different types of non-equilibrium states. In Figure 1, the point "2" represents the actual state of the economy of the Republic of Kazakhstan in the 4th quarter of 2011. Kazakhstan, according to the plotted charts has unemployment and deficiency of the balance of payments. Note that, according to official statistics, Kazakhstan had a deficiency of the balance of payments in the 4th quarter of 2011 (source: http://www.nationalbank.kz).

Figure 1. Graphical representation of general economic equilibrium state

Below we assessed the effects of economic instruments - money supply and government expenditures - on the overall economic balance and the balance of payments, using the following algorithm:
1) Having changed the value \( M \) by \( \Delta M = 0.01 M \) and having leave the values of \( G, i^W, P^W, P^{ill}, M^{RU}, G^{RU}, P^{RU} \) unchanged, we obtain the values \( (M \Delta Y)(Y^*), (M \Delta P)(P^*), (M \Delta e)(e^*), (M \Delta i)(i^*) \), which show by how many percent the equilibrium values of \( Y^*, P^*, e^*, i^* \) change, when \( M \) changes by 1%.
2) Having changed the value \( G \) by \( \Delta G = 0.01 G \) and having leave the values of \( M, i^W, P^W, P^{ill}, M^{RU}, G^{RU}, P^{RU} \) unchanged, the values of \( (G \Delta Y)(Y^*), (G \Delta P)(P^*), (G \Delta e)(e^*), (G \Delta i)(i^*) \) were obtained, which show by how many percent the
equilibrium values of \( Y^*, P^*, e^*, i^* \) change, when \( G \) changes by 1%.

3) Having changed the value \( M \) by \( \Delta M=0.01M \), the value \( G \) by \( \Delta G=0.01G \) and having leaved the values of \( i^W, P^W, P^{RU}, M^{RU}, G^{RU} \) and \( P^{RU} \) unchanged, the values \( 100\Delta Y^*/Y^*, 100\Delta P^*/P^*, 100\Delta e^*/e^* \) and \( 100\Delta i^*/i^* \) were obtained, which show by how many percent the equilibrium values of \( Y^*, P^*, e^*, i^* \) change when \( M, G \) jointly change by 1%.

The results of calculations for the 4th quarter of 2011 on the above algorithm are shown in Tables 2, 3 and 4, respectively. The results of influence of \( M \) and \( G \) on equilibrium state of the national economy for period 2006Q1-2011Q3 were obtained in the similar way.

Table 2
Impact of money supply tool on national economy equilibrium state in the 4th quarter of 2011 for \( \Delta M=0.01M \)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Actual value</th>
<th>Equilibrium value</th>
<th>Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price level</td>
<td>2.6</td>
<td>1.1</td>
<td>-1.5</td>
</tr>
<tr>
<td>National currency exchange rate</td>
<td>147.9</td>
<td>122.4</td>
<td>-25.6</td>
</tr>
<tr>
<td>GDP</td>
<td>2603.0</td>
<td>2666.5</td>
<td>63.5</td>
</tr>
<tr>
<td>Interest rate on loans of banks</td>
<td>12.0</td>
<td>13.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Export to the rest of the world</td>
<td>1221.6</td>
<td>1285.5</td>
<td>63.9</td>
</tr>
<tr>
<td>Import from the rest of the world</td>
<td>511.2</td>
<td>533.7</td>
<td>22.5</td>
</tr>
<tr>
<td>Consumption of domestic goods</td>
<td>1120.9</td>
<td>1165.4</td>
<td>44.4</td>
</tr>
<tr>
<td>Number of employed people</td>
<td>8442.3</td>
<td>8661.0</td>
<td>218.7</td>
</tr>
<tr>
<td>Wage</td>
<td>269.7</td>
<td>246.8</td>
<td>-22.9</td>
</tr>
<tr>
<td>Investments in fixed assets</td>
<td>482.8</td>
<td>498.6</td>
<td>6.8</td>
</tr>
<tr>
<td>Export to Russian Federation</td>
<td>93.7</td>
<td>144.4</td>
<td>50.7</td>
</tr>
<tr>
<td>Import from Russian Federation</td>
<td>208.0</td>
<td>210.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Government debt</td>
<td>749.6</td>
<td>802.7</td>
<td>53.1</td>
</tr>
<tr>
<td>National expenses</td>
<td>700.0</td>
<td>629.0</td>
<td>-71.0</td>
</tr>
<tr>
<td>National revenues</td>
<td>660.6</td>
<td>629.0</td>
<td>28.2</td>
</tr>
</tbody>
</table>

Here \( Y^*, P^*, e^*, i^* \) - equilibrium values for the 4th quarter of 2011, \( \Delta Y^*/Y^*, \Delta P^*/P^*, \Delta e^*/e^*, \Delta i^*/i^* \) - equilibrium values at \( M=M_{2011Q4}+\Delta M \).

According to macroeconomic theory growth of money supply has the following impact on the equilibrium state of the national economy for period 2006Q1-2011Q3:

Table 3
Impact of government expenditures tool on equilibrium state of national economy in the 4th quarter of for \( \Delta G=0.01G \)

<table>
<thead>
<tr>
<th>Indicator (Y*/Y*)</th>
<th>( G\Delta Y^*/(Y^*G) )</th>
<th>( G\Delta P^*/(P^*G) )</th>
<th>( G\Delta e^*/(e^*G) )</th>
<th>( G\Delta i^*/(i^*G) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>-0.24</td>
<td>0.29</td>
<td>-0.26</td>
<td></td>
</tr>
</tbody>
</table>

Here \( \Delta Y^*=Y_{G^*}-Y^*, \Delta P^*=P_{G^*}-P^*, \Delta e^*=e_{G^*}-e^*, \Delta i^*=i_{G^*}-i^* \), where \( Y_{G^*}, P_{G^*}, e_{G^*}, i_{G^*} \) - equilibrium values at \( G=G_{2011Q4}+\Delta G \).

According to macroeconomic theory increase in government expenditures has the following impact on the equilibrium state of the national economy for period 2006Q1-2011Q3:

Table 4
Influence of money supply and government expenditure tools on equilibrium state of national economy in the 4th quarter of 2011

<table>
<thead>
<tr>
<th>Indicator (Y*/Y*)</th>
<th>( 100\Delta Y^<em>/Y^</em> )</th>
<th>( 100\Delta P^<em>/P^</em> )</th>
<th>( 100\Delta e^<em>/e^</em> )</th>
<th>( 100\Delta i^<em>/i^</em> )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>0.23</td>
<td>0.70</td>
<td>-0.48</td>
<td>0.55</td>
</tr>
</tbody>
</table>

Here \( \Delta Y^*=Y_{MG^*}-Y^*, \Delta P^*=P_{MG^*}-P^*, \Delta e^*=e_{MG^*}-e^*, \Delta i^*=i_{MG^*}-i^* \), where \( Y_{MG^*}, P_{MG^*}, e_{MG^*}, i_{MG^*} \) - equilibrium values at \( M=M_{2011Q4}+\Delta M \) and \( G=G_{2011Q4}+\Delta G \).

Results of joint influence of tools show that according to the developed model (7) equilibrium values of GDP, price level, and interest rate will grow, whereas exchange rate will decrease.
The results of influence of $i^W$, $p^W$, $P^{oil}$, $M^{RU}$, $G^{RU}$ and $p^{RU}$ on equilibrium state of the national economy in the 4th quarter of 2011 were obtained in the similar way.

4. PARAMETRIC CONTROL OF A SMALL OPEN ECONOMY TAKING INTO ACCOUNT THE REQUIREMENTS OF ENSURING EQUILIBRIUM IN THE MACROECONOMIC MARKETS AND CONDITIONS OF CARRYING OUT THE COORDINATED MACROECONOMIC POLICY

Based on the fact of dependence of the solution of algebraic equations on its the coefficients, we propose an approach to parametric control of national economy evolution taking into account the requirements for equilibrium on macroeconomic markets, which comes down to making recommendations based on the optimal values of economic tools in the form of solutions of mathematical programming based on the econometric model of a small open economy.

Let us consider the possibility of estimating the optimal values of $M$ and $G$ tools of economic policy for each quarter of past period 2011Q1-2011Q4 for the given (or forecasted values for new tasks) values of the uncontrollable input parameters $p^{oil}$, $i^W$, $p^W$, $M^{RU}$, $G^{RU}$ and $p^{RU}$ within the framework of the model (7) (built on statistics for the quarters of the years 1994-2011) in sense of the maximum (or minimum) criterion:

$$K^Ex = \sum_{j=1}^{4} E_{t,j},$$  

or

$$K^Im = \sum_{j=1}^{4} I_{t,j},$$  

Here $E_{t,j} = E_{t,j}^W + E_{t,j}^{RU}$ – the function of total exports of goods, $I_{t,j} = I_{t,j}^W + I_{t,j}^{RU}$ – the function of total imports of goods; $t$ – parameter corresponding to considered year (below the problem of mathematical programming is solved for a case $t = 2011$); $j$ – parameter corresponding to the quarter of considering year $t$.

The stated estimate can be obtained by solving one of the following problems of mathematical programming.

**Problem 1.** Based on the mathematical model (7) find values $(M_{t,j}, G_{t,j}; j = 1, \ldots, A)$ for the year $t$, that provide maximum to the criterion (8) under the constraints:

$$\left| M_{t,j} - M^*_{t,j} \right| \leq 0.1M^*_{t,j},$$
$$\left| G_{t,j} - G^*_{t,j} \right| \leq 0.1G^*_{t,j},$$
$$\left| P_{t,j} - P^*_{t,j} \right| \leq 0.1P^*_{t,j},$$
$$\left| e_{t,j} - e^*_{t,j} \right| \leq 0.1e^*_{t,j},$$
$$\left| i_{t,j} - i^*_{t,j} \right| \leq 0.1i^*_{t,j},$$
$$\left| Y_{t,j} - Y^*_{t,j} \right| \leq 0.1Y^*_{t,j}$$  

and also under the conditions demanding coordination of macroeconomic policy in the future within development of the Customs union in Unified Economic Space and providing deficiency of the state budget aren't higher than 3 % of GDP, the government debt isn't higher than 50 % of GDP, a rate of inflation not exceeding more than on 5 percentage points a rate of inflation of the participating country of the Customs union with the smallest rise in prices:

$$\left\{ \begin{array}{l}
G_{t,4}^{debt} - G_{t-1,4}^{debt} \leq 0.03 \sum_{j=1}^{4} Y_{t,j} \\
G_{t,4}^{debt} \leq 0.5 \sum_{j=1}^{4} Y_{t,j} \\
p_{t,4}^{E} - p_{t-1,4}^{E} \leq 0.05
\end{array} \right\}$$  

Here $M^*_{t,j}$ and $G^*_{t,j}$ - accepted values of money supply and government expenditures for the quarter $j$ of the year $t$; $Y_{t,j}$, $P_{t,j}$, $e_{t,j}$, $i_{t,j}$ - basic equilibrium solutions of the system (7) for the quarter $j$ of the year $t$; $P_{t,j}^E$ - prices level of the Customs union member country with the smallest rise in prices given for 1 quarter of 2000; $G_{t,4}^{debt}$ - optimal equilibrium solution of the system (7) for the 4th quarter of the year $t$; $Y_{t,j}$, $P_{t,j}$, $e_{t,j}$, $i_{t,j}$ - solutions of the problem (8), (10) for the quarter $j$ of the year $t$.

**Problem 2.** Based on the mathematical model (7) find values $(M_{t,j}, G_{t,j}; j = 1, \ldots, A)$ for the year $t$, that provide minimum of the criterion (9) under the constraints (10) and (11).

At the solution of a problem 1 two step-by-step algorithm of finding of optimum values of tools of economic policy was used. On the first step the problem (8) and (10) for 4 quarters of considered year was solved, and on the second step performance of conditions (11) was checked.

Table 5 presents the results of the solution to the Problem 1 for the year 2011. In percentage it may give the following interpretation: change of the $M$ rather base equilibrium $M^*$ in 2011Q1 for 7.93 %, in 2011Q2 for 7.92 %, in 2011Q3 for 7.90 %, in 2011Q4 for 7.73 % and change of $G$ of rather base equilibrium $G^*$ in 2011Q1, 2011Q2, 2011Q3 for -8.11 %, and in 2011Q4 for -7.5 % will lead to increase in total exports from Kazakhstan rather base equilibrium in 2011Q1, 2011Q2, 2011Q3 for 3.29 %, 3.27 %, 2.85 % and 2.42 % respectively that gives increase in the total annual exports from Kazakhstan rather base equilibrium for 2.95 %. Basic and optimal values of economic indicators for 2010 where optimal values of tools of economic policy lead to relative base equilibrium in 2011Q1, 2011Q2, 2011Q3 and 2011Q4 for 3.29 %, 3.27 %, 2.85 % and 2.42 % respectively and increase in the total annual exports from Kazakhstan rather base equilibrium for 3.2 % are similarly received.

The problem 2 is solved similarly.
2. Statement of the mathematical programming problem;
3. Prediction of uncontrollable factors $P^W, i^W, P^{oil}, M^{RU}, G^{RU}$ and $P^{RU}$ for the period of choosing the recommendations on economic policy;
4. Solution to the mathematical programming problem based on the selected mathematical model to forecast values of uncontrollable factors;
5. Making recommendations on values of the $M$ and $G$ tools based on the analysis of the results of the mathematical programming problem for predicted values of the uncontrollable factors and possible additional information on the economic conjuncture.

Below we present two examples to illustration of the proposed approach of parametric control of the national economy evolution.

**Example 1.**
1. Let the model of a small open economy, described by system (7), be a mathematical model selected on the basis of assessment of sustainability indicators (less than 2%);
2. As a statement of the optimization problem for the model of a small open economy we take the statement of the problem 1;
3. Let the period of recommendations about economic policy will be 2012Q1-2012Q4. As there is a statistics till 2012Q3 inclusive, for the period 2012Q1-2012Q3 $F_{i,j}$ indicator in a condition (11) accepts the actual values, and on 2012Q4 it accepts the forecasted value. Table 6 presents actual and forecasted values of uncontrollable factors for 2012Q1-2012Q4.

**Table 6**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>2012Q1</th>
<th>2012Q2</th>
<th>2012Q3</th>
<th>2012Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P^W$</td>
<td>1.33</td>
<td>1.34</td>
<td>1.35</td>
<td>1.36</td>
</tr>
<tr>
<td>$i^W$</td>
<td>0.06</td>
<td>0.08</td>
<td>0.10</td>
<td>0.07</td>
</tr>
<tr>
<td>$P^{oil}$</td>
<td>16.65</td>
<td>15.24</td>
<td>15.38</td>
<td>13.94</td>
</tr>
<tr>
<td>$M^{RU}$</td>
<td>44671.89</td>
<td>44164.28</td>
<td>42537.81</td>
<td>43341.01</td>
</tr>
<tr>
<td>$G^{RU}$</td>
<td>5133.08</td>
<td>5047.75</td>
<td>4822.08</td>
<td>4750.45</td>
</tr>
<tr>
<td>$P^{RU}$</td>
<td>3.87</td>
<td>3.94</td>
<td>4.01</td>
<td>4.10</td>
</tr>
</tbody>
</table>


4. Solution to the mathematical programming problem on the basis of the model for a small open economy of the Republic of Kazakhstan and the forecasted values of uncontrollable factors for 2012Q1-2012Q4 was searched. Table 7 presents optimal values of the tools of state policy for 2012Q1-2012Q4 for criteria (8);

**Table 7**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>2012Q1</th>
<th>2012Q2</th>
<th>2012Q3</th>
<th>2012Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>$M$</td>
<td>6940.4</td>
<td>7110.4</td>
<td>7385.1</td>
<td>7252.7</td>
</tr>
<tr>
<td>$G$</td>
<td>328.9</td>
<td>346.4</td>
<td>353.3</td>
<td>354.3</td>
</tr>
<tr>
<td>$Ex$</td>
<td>1540.8</td>
<td>1572.5</td>
<td>1547.3</td>
<td>1575.4</td>
</tr>
<tr>
<td>$100 \frac{Ex - Ex^o}{Ex^o}$, %</td>
<td>1.86</td>
<td>1.45</td>
<td>1.48</td>
<td>1.09</td>
</tr>
</tbody>
</table>

5. The following can be proposed as a recommendation: a solutions obtained during the experiment $M_{2012Q1}, M_{2012Q2}, M_{2012Q3}, M_{2012Q4}, G_{2012Q1}, G_{2012Q2}, G_{2012Q3}$ and $G_{2012Q4}$, presented in Table 7, or some correcting (adjusting) values, that can be obtained on the basis of the additional data analysis on economic conjuncture.

**Example 2.**
1. Let the model of a small open economy, described by system (7), be a mathematical model selected on the basis of assessment of sustainability indicators (less than 2%);
2. As a statement of the optimization problem for the model of a small open economy we take the statement of the problem 1;
3. Let the period of recommendations about economic policy will be 2013Q1-2013Q4. Forecasted values of uncontrollable factors $i^W, P^{oil}$ and $G^{RU}$ on 2013Q1-2013Q4
obtained on the basis of the VECM (Vector Error Correction Models) [9]. Forecasted values of uncontrollable factors $P^w$, $M^RU$ and $P^{RU}$, on 2013Q1-2013Q4 obtained on the basis of the ARIMA. Table 8 presents forecasted values of uncontrollable factors for 2013Q1-2013Q4.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>2013Q1</th>
<th>2013Q2</th>
<th>2013Q3</th>
<th>2013Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P^w$</td>
<td>1.36</td>
<td>1.37</td>
<td>1.38</td>
<td>1.38</td>
</tr>
<tr>
<td>$i^w$</td>
<td>0.18</td>
<td>0.32</td>
<td>0.39</td>
<td>0.46</td>
</tr>
<tr>
<td>$P^{RU}$</td>
<td>13.71</td>
<td>13.54</td>
<td>13.34</td>
<td>13.27</td>
</tr>
<tr>
<td>$M^{RU}$</td>
<td>42966.80</td>
<td>44314.63</td>
<td>44266.20</td>
<td>45537.36</td>
</tr>
<tr>
<td>$G^{RU}$</td>
<td>4707.98</td>
<td>4679.95</td>
<td>4645.04</td>
<td>4629.79</td>
</tr>
<tr>
<td>$P^{RU}$</td>
<td>4.17</td>
<td>4.22</td>
<td>4.28</td>
<td>4.34</td>
</tr>
</tbody>
</table>

4. Solution to the mathematical programming problem for future period 2013Q1-2013Q4 was searched. Table 9 presents optimal values of the tools of state policy for 2013Q1-2013Q4 for criteria (8);

<table>
<thead>
<tr>
<th>Indicator</th>
<th>2013Q1</th>
<th>2013Q2</th>
<th>2013Q3</th>
<th>2013Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>$M$</td>
<td>7436.5</td>
<td>7553.3</td>
<td>7618.4</td>
<td>7867.1</td>
</tr>
<tr>
<td>$100\left(\frac{M-M^<em>-M^</em>}{M^*}\right)$, %</td>
<td>8.00</td>
<td>7.90</td>
<td>7.90</td>
<td>7.90</td>
</tr>
<tr>
<td>$G$</td>
<td>357.5</td>
<td>367.4</td>
<td>381.2</td>
<td>392.9</td>
</tr>
<tr>
<td>$100\left(\frac{G-G^<em>-G^</em>}{G^*}\right)$, %</td>
<td>-7.00</td>
<td>-8.00</td>
<td>-7.90</td>
<td>-7.80</td>
</tr>
<tr>
<td>$Ex$</td>
<td>1511.2</td>
<td>1477.2</td>
<td>1444.6</td>
<td>1416.2</td>
</tr>
<tr>
<td>$100\left(\frac{Ex-Ex^<em>-Ex^</em>}{Ex^*}\right)$, %</td>
<td>1.11</td>
<td>1.08</td>
<td>1.09</td>
<td>1.11</td>
</tr>
</tbody>
</table>

5. The following can be proposed as a recommendation: a solutions obtained during the experiment $M_{2013Q1}, M_{2013Q2}, M_{2013Q3}, M_{2013Q4}, G_{2013Q1}, G_{2013Q2}, G_{2013Q3}$ and $G_{2013Q4}$, presented in Table 9.

5. CONCLUSION

Thus on the basis of the conducted research the following concluding remarks can be made:
1. On the basis of the regression functions, checked for spurious regression phenomenon, we developed the econometric model for a small open economy, interacting with countries of the regional customs union as well as with the rest of the world.
2. Econometric model of for a small open economy of the Republic of Kazakhstan describes as equilibrium conditions in the markets of goods, money, and capital as budgetary equilibrium taking into account government debt.
3. Equilibrium values of macroeconomic indicators and the way they are affected by the state policy tools and by uncontrollable factors were evaluated based on the econometric model for a small open economy and based on the macroeconomic analysis.
4. We proposed the approach to recommendations development in the sphere of economic policy taking into account the requirements for macroeconomic markets equilibrium and budgetary equilibrium taking into account government debt.
5. The obtained results can be used in the sphere of generating and implementing state economic policy.

REFERENCES