PARAMETRIC CONTROL OF REGIONAL UNIONS ON THE BASIS OF THE ECONOMETRIC MODELS

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ABSTRACT
There have been built econometric models of the regional Customs Union and the Common Economic Space between Russian Federation, the Republic of Belarus and the Republic of Kazakhstan which interact with each other as within the appropriate economic unions, so with the rest of the world. The econometric model of the Customs Union consists of econometric models of single countries, built on the basis of descriptions of equilibrium conditions in macroeconomic markets of goods, money, labor and conditions of zero balance of payment, balance of state budget of countries of the union by pertinent regression functions. The econometric model of the Common Economic Space represents an econometric model of the regional Customs Union and the description of macroeconomic policy coordination conditions. Stability indicators of constructed econometric models for the discussed unions are estimated. Based on the constructed mathematical models for the regional unions, there is carried out a macroeconomic analysis of influence of external and internal factors on the indicators of single countries and regional unions. Relevant problems of parametric control for the Customs Union are defined and solved to make recommendations in the field of economic policy for the considered regional unions.

KEY WORDS
Identification and estimation, Optimization, Parametric control, Regional economic union.

1. Introduction
Formation of various regional unions of countries is observed in the world economy in recent years, which aim the creation of effective conditions for development of national economies and counteraction to negative effects of external and internal shocks. Selection and implementation of productive economic policy in the considered regional unions of countries are an actual problem. One of the ways to solve the discussed problem is use of econometric models of the regional unions made of models of single countries of the regional unions as interacting with each other within the respective unions so interacting with the rest of the world.

In macroeconomic theory is known the result of R. Mundell, a Nobel laureate who on the basis of IS, LM models' development suggested an instrument to analyze equilibrium conditions in markets of goods, money, capital and an approach to stabilization of payment balance (external equilibrium) by monetary policy tools and stabilization of internal equilibrium (in goods market) by fiscal policy tools. The considered result does not take into account the conditions of countries' interaction within the regional Customs Union (hereinafter CU).

In [3], there is suggested an approach to estimation of optimal values of economic policy instruments based on the econometric model of a national economy which does not indicate the equilibrium conditions in macroeconomic markets of goods, money, and labor, zero balance of payment and functioning of a country within the regional economic union.

In [4, 5], the problem of evaluating an effective economic policy is discussed using an econometric model of one country in the regional union.

In [1], issues of state policy like relevant rules and effects evaluation of different shocks are discussed on the basis of dynamic stochastic models of general equilibrium which do not describe the conditions of zero balance of payment and balance of state budget.

In this paper, for the first time the actual problem of evaluating the economic policy in the framework of a regional union is discussed in terms of parametric control problems based on econometric model of the CU between the Russian Federation (hereinafter RF), the Republic of Belarus (hereinafter RB) and the Republic of Kazakhstan (hereinafter RK).

2. Econometric Models of Regional Customs Union and Common Economic Space
As we mentioned in Introduction, the econometric model of the regional CU consists of econometric models of single countries, which interact with each other as within the appropriate economic unions, so with the rest of the world.

An algorithm for building an econometric model of the country \( j = 1,2,3 \) can be shown as following:

1) Choosing required equilibrium conditions in \( j \) national economy in terms of equilibrium conditions in...
macroeconomic markets of goods, money, labor and conditions of zero balance of payment and balance of state budget by pertinent regression functions.

2) Building regression functions for indicators in chosen equilibrium conditions:

2.1) Selection of explanatory factors in terms of corresponding time series for regression function of considered equilibrium conditions;

2.2) Selection of lag structure and estimation of parameters of the regression function;

2.3) Testing for spuriousness [7] of the built regression function by the ARDL-method [8] and statistical analysis of residuals from regression functions;

2.4) Either acceptance of built regression function or back-off to the previous subparagraphs of paragraph 2, depending on the results of subparagraph 2.3.

3) Building the econometric model of the country j on the basis of tested regression functions, chosen equilibrium conditions and zero balance of payment and balance of state budget, and the concept of small open economy.

The following equilibrium conditions and conditions of zero balance of payment and balance of state budget of the country j of considered regional union are assumed in the paper:

Goods market equilibrium for the country j is:

\[ Y_j^D = Y_j^S, \]  
(1)

where \( j = 1, 2, 3 \) – hereinafter is a serial number of the country \((1 – \text{RK, } 2 – \text{RF, } 3 – \text{RB})\), \( Y_j^D \) – real goods supply in the country j; \( Y_j^S \) – real goods demand in the country j; \( C_j \) – real consumption of households in the country j; \( I_j \) – real investments into fixed assets in the country j; \( G_j \) – real government consumption in the country j; \( NE_j = NE_j^W + NE_j^k \) – net export of goods of the country j; \( k = 1, 2, 3 \) – serial number of the country, \( k \neq j \); \( NE_j^W = Y_j^D – I_m^j \) – net export of goods of the country j to the rest of the world; \( E_x^j \) – real export of goods of the country j to the rest of the world; \( I_m^j \) – real import of goods of the country j to the rest of the world; \( NE_j^k \) – real net export of goods from the country j to the country k; \( E_x^k \) – real import of goods from the country k to the country j; \( Y_j^D, Y_j^S, C_j, I_j, G_j, NE_j \), and all components of net export are in billion USD.

Money market equilibrium for the country j is:

\[ M_j/P_j = L_j, \]  
(2)

where \( L_j \) – real cash balances in the country j; \( M_j \) – nominal money supply in the country j, which is determined by [6]; \( P_j \) – consumer price level in the country j; \( L_j \) and \( M_j \) are in billion USD.

Labor market equilibrium for the country j is:

\[ P_j dY_j/dN_j = W_j, \]  
(3)

where \( W_j \) – nominal wage rate in the country j, thousand USD; \( dY_j/dN_j \) – marginal labor productivity in the country j (USD/[(people per year)]; \( Y_j \) – real gross domestic product (hereinafter GDP) in the country j; \( N_j \) – number of employed people in the country j, thousand people per year.

The condition of zero balance of payment for the country j is:

\[ P_j NE_j + CF_j + OBP_j = 0, \]  
(4)

where \( CF_j \) – nominal value of capital flow balance into the country j; \( OBP_j \) – nominal value of other items of balance of payment of a central bank of the country j according to [9]. \( CF_j \) and \( OBP_j \) are in billion USD.

Balance of state budget for the country j is:

\[ G_j^{open} = G_j^{inc} + G_j^{def}, \]  
(5)

where \( G_j^{open} \) – government spending of the country j, which depends on government income and accumulated government debt; \( G_j^{inc} \) – government income of the country j; \( G_j^{def} \) – government deficit of the country j. \( G_j^{open}, G_j^{inc}, \) and \( G_j^{def} \) are in billion USD.

Let’s introduce signs for economic indicators used for model building: \( e_j \) – nominal rate of US dollar to national currency of the country j, dollar/[national currency of the country j]; \( e_j^{2000} \) – nominal rate of US dollar to national currency of the country j for the year 2000, dollar/[national currency of the country j]; \( p^W \) – price level in the rest of the world; \( r^j \) – interest rate of second-tier commercial banks for 1-year credits in the country j; \( r^W \) – interest rate in the rest of the world (Market yield on U.S., Treasury securities at 1-year constant maturity, quoted on investment basis); \( p^{avg} = 0.6P_j/e_j^{2000} + 0.4p^W \) – weighted price level in the country j; \( e_j^{2000} \) – nominal rate of US dollar to national currency of the country j for the year 2000, dollar/[national currency of the country j]; \( p^W \) – world oil price; \( G_j^{deb} \) – accumulated government debt of the country j; \( Ex_{ten} = Ex_{rub} + CF_j \) – real export of goods from the RK to the country j, billion tenge (currency of the RK); \( Im_{ten} = Im_{rub} \) – real import of goods from the country j to the RK, billion tenge; \( Ex_{rubj} = Ex_{rub} + CF_j \) – real export of goods from the country j to the RF, billion rubles (currency of the RF); \( Im_{rubj} = Im_{rub} + CF_j \) – real import of goods from the country j to the RF, billion rubles; \( Ex_{rub} = Ex_{rub} + CF_j \) – real export of goods from the RK to the country j, billion Belarusian rubles (currency of the RB); \( Im_{rub} = Im_{rub} + CF_j \) – real import of goods from the RB to the country j, billion Belarusian rubles (currency of the RB), \( Y_{ten} = Y_{ten} + Y_{rub} \) – GDP of the RK, billion tenge; \( Y_{rub} = Y_{rub} \) – GDP of the RF, billion rubles; \( G_j^{rub} = G_j^{rub} \) – real exchange rate of the national currency of the country j to the national currency unit of the country k, {national currency of the country j}/[national currency of the country k}; hereinafter there will be used a designation of an indicator with lag in index \( t \), as the lag variable. All real indicators were discounted to the year 2000.
The econometric model for the country \( j \) is built on the basis of conditions (1-5) and of proposed algorithm. General view of this model is as follows (and its specific view is given in Appendix 1):

\[
\begin{align*}
Y^D_j &= Y^D_j, \\
Y^S_j &= Y^S_j(e_j, P_j), \\
Y^{BP}_j &= Y^{BP}_j(e_i, e_j, e_3, P_1, P_2, P_3, r^W, P^W, P_{oil}, M_j), \\
Y^{BB}_j &= Y^{BB}_j(G^{debt}_j, P_j, M_j), \\
Y^D_j &= Y^S_j = Y^{BP}_j = Y^{BB}_j, j=1,2,3.
\end{align*}
\]

Coordination condition of macroeconomic policy for the country \( j \) is as follows:

\[
\begin{align*}
G^{debt}_j &\leq 0.5Y_j, \\
G^{spem}_j - G^{in}_j &\leq 0.03Y_j, \\
\frac{e_j}{P_j} - \frac{e^{*}_j}{P^{*}_j} &\leq 0.05.
\end{align*}
\]

Here \( P^C \) – price level of the country-member of regional CU with the lowest price growth, discounted to the year 2000. Sources for all data are shown in Appendix 2.

The quality of econometric models is assessed by the stability indicator [10], which characterizes an equilibrium solutions’ change for small deviations of used input parameters. If the stability indicator of the model has a small value at small deviation of used input parameters, then the model is considered qualitative in terms of indicator's stability.

Based on the estimation algorithm of stability indicators [3, 4] and selection of input factors’ set \( \{M_1, G_1, M_2, G_2, M_3, G_3, P^W, r^W, P_{oil}\} \) and output equilibrium solutions’ set \( \{Y_1, e_1, P_1, G_1^{debt}, Y_2, e_2, P_2, G_2^{debt}, Y_3, e_3, P_3, G_3^{debt}\} \) for the econometric model of the regional CU and the econometric model of the Common Economic Space (hereinafter CES), values of stability indicators are estimated for the years 2006-2013.

Computational experiments, which have been carried out, show that deviations of the equilibrium solutions up to 2 percent correspond to the input factors’ perturbation within one percent. This justifies that the econometric models of the regional CU and the CES are qualitative in terms of stability by [10].

### 3. Macroeconomic Analysis of Indicators of Customs Union and Common Economic Space

The equilibrium values of main endogenous economic indicators and the effect of economic policy tools and of some uncontrollable factors on the indicators are being estimated during the process of macroeconomic analysis based on the econometric models of the regional CU and CES.

By solving the system (6), we define equilibrium values of the gross domestic product \( Y_j^* \), the price level \( P_j^* \), the exchange rate of the national currency \( e_j^* \), the interest rate of second-tier commercial banks for credits \( r_j^* \) and government debt \( G^{debt}_j \) for the corresponding years at given values of external economic indicators \( P^W, r^W, P_{oil} \) and economic tools \( M_j \) and \( G_j \) (where \( j=1,2,3 \)) for the corresponding years and for example for 2012.

The Table 1 presents deviations of equilibrium values from actual observations for 2012 computed by the formula 100 \((X^*-X)/X\), where \( X^* \) – designation of equilibrium values, \( X \) – designation of actual values.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Deviations of equilibrium values from actual observation for the year 2012 (in percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RK</td>
<td>0.0000</td>
</tr>
<tr>
<td>RF</td>
<td>0.0000</td>
</tr>
<tr>
<td>RB</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

Results of the macroeconomic analysis for the model of the regional CU are given.

Consider an impact of economic policy tools on equilibrium values of the main economic indicators of the econometric model for the regional CU. Below, there is an example of assessment of the effects of economic tools – money supply and government consumption – on general economic equilibrium and payment balance for the country \( j \) of CU for 2012, using the following algorithm:

1) By changing the value \( M_j \) (where \( j=1,2,3 \)) by \( \Delta M_j=0.01M_j \) and having the given values \( G_j, r^W, P^W, P_{oil}, M_1 \) and \( G_1 \) left intact (here \( k=1,2,3, k\neq j \)), we obtain the values \((M_j\Delta Y^*_j)/(Y^*_j\Delta M_j), (M_j\Delta P^*_j)/(P^*_j\Delta M_j), (M_j\Delta e^*_j)/(e^*_j\Delta M_j) \) and \((M_{1}\Delta r^*_j)/(r^*_j\Delta M_j) \), which indicate by how many percent the equilibrium values of indicators \( Y_j^*, P_j^*, e_j^*, r_j^* \) change, when \( M_j \) changes by one percent.

2) By changing the value \( G_j \) (where \( j=1,2,3 \)) by \( \Delta G_j=0.01G_j \) and having the given values \( M_j, r^W, P^W, P_{oil}, M_1 \) and \( G_1 \) left intact (here \( k=1,2,3, k\neq j \)), we obtain the values \((G_j\Delta Y^*_j)/(Y^*_j\Delta G_j), (G_j\Delta P^*_j)/(P^*_j\Delta G_j), (G_j\Delta e^*_j)/(e^*_j\Delta G_j) \) and \((G_{1}\Delta r^*_j)/(r^*_j\Delta G_j) \), which indicate by how many percent the equilibrium values of indicators \( Y_j^*, P_j^*, e_j^*, r_j^* \) change, when \( G_j \) changes by one percent.

The results of calculations on the above algorithm are shown in Tables 2 and 3 for the corresponding country \( j \).
Here $Y^*_j, P^*_j, e^*_j, r^*_j$ – equilibrium solutions for the year 2012, $\Delta Y^*_j = Y_{M}^* - Y^*_j, \Delta P^*_j = P_{M}^* - P^*_j, \Delta e^*_j = e_{M}^* - e^*_j, \Delta r^*_j = r_{M}^* - r^*_j$, where $Y_{M}^*, P_{M}^*, e_{M}^*, r_{M}^*$ – equilibrium solutions at $M_j = M_{2012} + \Delta M_j$.

According to the macroeconomic theory increase in money supply has the following impact on equilibrium solutions for single countries of the system (6): GDP and the price level must increase, but the national currency exchange rate and the interest rate – decrease. Obtained in the Table 2 results of effect of the money supply tool on the national economy's equilibrium state of a single country of the CU in 2012 coincide with theoretical assumptions except for the national currency exchange rate.

<table>
<thead>
<tr>
<th>$j$</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$(G_j \Delta Y^<em>_j)/(Y^</em>_j \Delta G_j)$</td>
<td>0.0545</td>
<td>0.0969</td>
<td>0.1299</td>
</tr>
<tr>
<td>$(G_j \Delta P^<em>_j)/(P^</em>_j \Delta G_j)$</td>
<td>0.0068</td>
<td>1.7E-07</td>
<td>1.4E-06</td>
</tr>
<tr>
<td>$(G_j \Delta e^<em>_j)/(e^</em>_j \Delta G_j)$</td>
<td>0.1019</td>
<td>0.0007</td>
<td>0.4020</td>
</tr>
<tr>
<td>$(G_j \Delta r^<em>_j)/(r^</em>_j \Delta G_j)$</td>
<td>3.6726</td>
<td>0.4522</td>
<td>0.0018</td>
</tr>
</tbody>
</table>

Here $\Delta Y^*_j = Y_{G}^* - Y^*_j, \Delta P^*_j = P_{G}^* - P^*_j, \Delta e^*_j = e_{G}^* - e^*_j, \Delta r^*_j = r_{G}^* - r^*_j$, where $Y_{G}^*, P_{G}^*, e_{G}^*, r_{G}^*$ – equilibrium solutions at $G_j = G_{2012} + \Delta G_j$.

According to the macroeconomic theory increase in government consumption has the following impact on the equilibrium solutions for single countries of the system (6): GDP, the price level and the interest rate must increase, but the national currency exchange rate – decrease. Obtained in the Table 3 results of effect of government consumption tool on the national economy's equilibrium state of a single country of the CU in 2012 coincide with theoretical assumptions except for the national currency's exchange rate.

<table>
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</tr>
</tbody>
</table>

Here $\Delta Y^*_j = Y_{G}^* - Y^*_j, \Delta P^*_j = P_{G}^* - P^*_j, \Delta e^*_j = e_{G}^* - e^*_j, \Delta r^*_j = r_{G}^* - r^*_j$, where $Y_{G}^*, P_{G}^*, e_{G}^*, r_{G}^*$ – equilibrium solutions at $G_j = G_{2012} + \Delta G_j$.

Likewise, we derive impact assessments of $P^*_j, e^*_j, r^*_j$ and combinations of tools of economic policy $M_j$ and $G_j$ on the national economy’s equilibrium state of a single country of the regional CU.

4. Parametric Control of Evolution of Regional Customs Union and Common Economic Space

The results of parametric control are illustrated by the example of the regional CU model.

On the basis of solution's dependence of the system of algebraical equations on its coefficients, we propose an approach of parametric control of the regional CU's evolution taking into account the requirements of the considered equilibrium conditions and the conditions of zero balance of payments and balance of state budget. The approach leads to recommendations based on optimal values of economic tools in terms of solution of mathematical programming problems based on econometric models of the regional CU and with regard to appropriate conjuncture conditions.

The processes of parametric control are considered as part of relevant criteria at the level of a single country of regional CU (we call it a problem without coordination) and at the level of all countries of the regional CU (we call it a problem with coordination).

Consider a possibility of assessing optimal values of the tools $M_j$ and $G_j$ (where $j=1,2,3$) of economic policy at the level of one country (problem without coordination) and at the level of all countries of the regional CU (problem with coordination) for the period 2010-2013 on given and forecasted values of the input uncontrollable factors $P^W, P^W, P^{mil}$ in terms of maximum of the criteria:

$$K_j = (X_j^W + X_j^K)^{6-(k+j)}$$

$$K = \sum_{j=1}^{K} K_j$$

Table 3 portrays the obtained values.

**Problem 1.** Based on the mathematical model (6) for the country $j$, estimate the values $(M_j, G_j)$, which provide maximum of the criteria (7) under the constraints

$$|M_j - M^*_j| \leq 0.4M^*_j,$$

$$|G_j - G^*_j| \leq 0.4G^*_j,$$

$$|P_j - P^*_j| \leq 0.4P^*_j,$$

$$|e_j - e^*_j| \leq 0.4e^*_j,$$

$$|r_j - r^*_j| \leq 0.4r^*_j,$$

$$|Y_j - Y^*_j| \leq 0.4Y^*_j.$$

Here $M^*_j$ and $G^*_j$ are accepted basic values of money supply and government consumption in the country $j$ for the years 2010-2012 and forecasted 2013, respectively; $Y^*_j, P^*_j, e^*_j, r^*_j$ – basic equilibrium solutions of the system (6) for the country $j$; $Y^*_j, P^*_j, e^*_j, r^*_j$ – optimal equilibrium solutions of the system (6) for the country $j$.

**Problem 2.** Based on the mathematical model (6) estimate the values $(M_1, G_1, M_2, G_2, M_3, G_3)$, which provide maximum of the criteria (8) under the constraints (9).

Thus, we solved four maximization problems of total exports: the Problem 1 was being solved three times for each country of the regional CU and the Problem 2 once for the whole regional CU. Based on results of the Problem 1 for a single country and Problem 2 for the whole regional union, we calculated percent changes in total exports (by the formula 100*(X*-X)/X) of optimal equilibrium solutions from basic equilibrium solutions. Table 4 portrays the obtained values.

According to the Table 4, the effect of improvement of the criteria (7) and (8) is higher when the Problem 2 is solved compared to that when the Problem 1 is solved.
and the RK (lines 13 and 1 in the Table 4) and the RF (lines 14 and 6 in the Table 4) win on it. Notice that for the RB and the RK a coordinated macroeconomic policy brings better results than those in the RF (lines 13, 14 and 15 in the Table 4). Also, the table presents evidence of that for the RB it is more beneficial not to have a coordinated macroeconomic policy (lines 11 and 15 in the Table 4). Similarly were solved problems of maximization total exports as part of the problem without coordination and the problem with coordination based on econometric models of the CES.

The algorithm for proposed approach of parametric control of the regional unions' evolution for future periods is following:

1) Selecting a mathematical model based on statistical analysis of the regression functions and evaluation of its stability indicators;
2) Setting a problem of mathematical programming;
3) Forecasting values of uncontrollable factors for the period of developing recommendations on economic policy;
4) Solving a problem of mathematical programming based on the selected mathematical model for forecasted values of the uncontrollable factors;
5) Developing recommendations on values of tools of the uncontrollable factors;
6) Setting a problem of mathematical programming based on the selected mathematical model for forecasted values of uncontrollable factors and potential supplementary information about economic conditions.

Below is illustrated the implementation of the proposed approach of parametric control by the example of the regional CU:

1) Let an econometric model of the regional CU presented by the system (6) be the mathematical model selected through the evaluation of stability indicators (less than 2 percent);
2) Setting the Problem 1 for the RK (j=1) will be accepted for setting a problem of optimization for the econometric model of the regional CU;
3) Let the year 2014 be a period for developing recommendations on economic policy. Forecasted values of uncontrollable factors $P^W$, $P_j^W$, and $P^\text{opt}$ for 2014 are obtained based on ARIMA (Autoregressive Integrated Moving Average) models of time series [11] and are equal $P^W=1.38$, $P_j^W=0.17$, and $P^\text{opt}=6.25$. Uncontrollable factors for the Problem 1 will be also $M_j$ and $G_k$ where $k\neq 1$.
4) The solution of the mathematical programming problem based on the econometric model of the regional CU and forecasted values of uncontrollable factors for 2014 is given in the Table 5, where money supply is in nominal value and government consumption is in real value. $M_j$ and $G_k$ are in billion USD where $k\neq 1$.

### Table 4

<table>
<thead>
<tr>
<th>№</th>
<th>Problem 1</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total export of the country 1</td>
<td>2.4292</td>
<td>1.7069</td>
<td>2.3693</td>
<td>2.3391</td>
</tr>
<tr>
<td>2</td>
<td>Total export of the country 2</td>
<td>0.0472</td>
<td>0.0447</td>
<td>-0.0622</td>
<td>0.0214</td>
</tr>
<tr>
<td>3</td>
<td>Total export of the country 3</td>
<td>1.4385</td>
<td>0.0510</td>
<td>-1.4501</td>
<td>-1.9280</td>
</tr>
<tr>
<td>4</td>
<td>Total export of the CU</td>
<td>0.4744</td>
<td>0.3632</td>
<td>0.3223</td>
<td>0.3780</td>
</tr>
<tr>
<td>5</td>
<td>Total export of the country 1</td>
<td>-0.2942</td>
<td>-0.0180</td>
<td>-0.1949</td>
<td>0.1525</td>
</tr>
<tr>
<td>6</td>
<td>Total export of the country 2</td>
<td>0.2682</td>
<td>0.1853</td>
<td>0.2100</td>
<td>0.2304</td>
</tr>
<tr>
<td>7</td>
<td>Total export of the country 3</td>
<td>-1.4337</td>
<td>-1.1326</td>
<td>-1.7564</td>
<td>-3.1212</td>
</tr>
<tr>
<td>8</td>
<td>Total export of the CU</td>
<td>0.1297</td>
<td>0.1157</td>
<td>0.0976</td>
<td>0.1507</td>
</tr>
<tr>
<td>9</td>
<td>Total export of the country 1</td>
<td>0.9639</td>
<td>1.0409</td>
<td>1.0459</td>
<td>0.2796</td>
</tr>
<tr>
<td>10</td>
<td>Total export of the country 2</td>
<td>0.1282</td>
<td>0.0796</td>
<td>0.0998</td>
<td>0.0940</td>
</tr>
<tr>
<td>11</td>
<td>Total export of the country 3</td>
<td>17.7338</td>
<td>13.7748</td>
<td>13.7833</td>
<td>10.6277</td>
</tr>
<tr>
<td>12</td>
<td>Total export of the CU</td>
<td>0.7473</td>
<td>0.5821</td>
<td>0.5624</td>
<td>0.3336</td>
</tr>
<tr>
<td>13</td>
<td>Total export of the country 1</td>
<td>4.3141</td>
<td>2.8074</td>
<td>3.8064</td>
<td>4.1769</td>
</tr>
<tr>
<td>14</td>
<td>Total export of the country 2</td>
<td>0.3074</td>
<td>0.2883</td>
<td>0.2824</td>
<td>0.4544</td>
</tr>
<tr>
<td>15</td>
<td>Total export of the country 3</td>
<td>12.2001</td>
<td>9.5639</td>
<td>9.6351</td>
<td>3.7966</td>
</tr>
<tr>
<td>16</td>
<td>Total export of the CU</td>
<td>1.2877</td>
<td>0.9863</td>
<td>1.0899</td>
<td>1.1550</td>
</tr>
</tbody>
</table>

### Table 5

Optimal values for state policy tools $M_j$, $G_j$ of the RK and criterion $K_j$ for 2014. Deviations of optimal values of state policy tools $M_j$, $G_j$ and of criterion $K_j$ from basic forecasted values for 2014.

<table>
<thead>
<tr>
<th>$M_j$</th>
<th>78.83</th>
</tr>
</thead>
<tbody>
<tr>
<td>100·($M_j-M_j*$/M_j)</td>
<td>-10.00</td>
</tr>
<tr>
<td>$G_j$</td>
<td>8.68</td>
</tr>
<tr>
<td>100·($G_j-G_j*$)/$G_j$</td>
<td>12.88</td>
</tr>
<tr>
<td>$K_j$</td>
<td>32.86</td>
</tr>
<tr>
<td>100·($K_j-K_j*$)/$K_j$</td>
<td>3.10</td>
</tr>
</tbody>
</table>
where $M_i^*$, $G_i^*$ and $K_i^*$ are basic forecasted values of the considered indicators.

5) The solutions obtained from the experiment (see the Table 5) or some corrective values, which can be obtained based on an analysis of additional information about the economic conditions, can be given as recommendations.

5. Conclusion

Based on the conducted study the following conclusions can be made:

1) Econometric models of the regional Customs Union and the Common Economic Space are designed based on tested for spurious regression functions. Their stability indicators are estimated.

2) Equilibrium values of macroeconomic indicators and the effects of state policy tools and uncontrollable factors on the indicators were estimated based on econometric models of regional unions and the macroeconomic analysis.

3) There was proposed the approach for development of recommendations on economic policy, while taking into account the requirements of macroeconomic markets equilibrium and the conditions of zero balance of payment, balance of state budgets of the countries of regional union, and taking into account the values of uncontrollable external factors as well.

4) Obtained results can be used for development and implementation of economic policy both in a single country and in regional unions.

5) The listed conclusions in points 1-4 illustrate the development and application of the macroeconomic theory of analysis and parametric control of regional unions' evolution based on econometric models.

Appendix 1

The econometric model for the regional Customs Union is:

\[ Y_1^G = \begin{cases} 70.9P_1 - 23.2P(e_i/e_{1200}) - 15.5P^W + 1413.2 + 215.5W_i(-1) + 93.8W_i(-2) + 104.5W(-3) + 52.1W_{-1}(-3) + 42.3P^{m}(i \mid P) - 0.77\bar{Y}(1) \end{cases} \]

\[ Y_1^Y = \begin{cases} 1.1523C_i(-1) + 0.0118C_i(-2) + 0.0174C_i(-3) + 0.0444(M_i/P_i) - 0.0440L_i(-1) + 0.0621L_i(-2) + 0.0877L_i(-3) + 0.0086L_i(-4) + 0.0072L(-5) + 0.0072L(-6) + 0.0072L(-7) + 1.0441r_{i}(-2) - 0.9265r_{i}(-3) + 0.2808r_{i}(-4) + 0.4195r_{i}(-5) - 0.3029r_{i}(-6) + 0.8456L_i(-1) - 0.5071L_i(-2) + 1.7996P^{m} + 11.9P^{m}(-1) - 5.8423P^{m}(-2) - 16.4P^{m}(-3) - 1.7104P^{m}(-4) - 3.6348P^{m}(-5) - 263.7(e_i/P_i/P_i) + 3437.3e_i(-1) + 2395.9e_i(-2) - 2.9878e_i(-3) + 0.8363e_i(-4) + 2.6794e_i(-5) + 0.0118e_i(-6) + \end{cases} \]

\[ 0.2570E_{1}^{W}(-5) + 0.5458Im_{1}^{W}(-1) - 0.0589Im_{1}^{W}(-2) - 0.5622Im_{1}^{W}(-3) + 0.6894Im_{1}^{W}(-4) + 0.1499Y_{r}(-1) + 0.1335Y_{r}(-2) + 0.01677Y_{r}(-3) + 0.0648Y_{r}(-4) + 19.6 + [-0.0543Y_{r}(-1) + 0.0663Y_{r}(-2) + 0.0281Y_{r}(-3) - 0.0476Y_{r}(-4) - 0.0209Y_{r}(-5) + 0.0034Y_{r}(-6) + 0.0014Y_{r}(-7) + 0.0948Y_{r}(-8) - 0.2006Y_{r}(-9) + 0.1596Y_{r}(-10) - 0.1608Y_{r}(-11) - 0.1277Y_{r}(-12) + 0.4288Y_{r}(-13) - 0.4498Y_{r}(-14) + 0.4110Y_{r}(-15) + 0.1335Y_{r}(-16) + 0.1827Y_{r}(-17) + 0.2051Y_{r}(-18) + 0.4827Y_{r}(-19) + 0.9538Y_{r}(-20) + 0.8491Y_{r}(-21) + 0.1540Y_{r}(-22) + 3.2499Y_{r}(-23) + 33.5(\rho_{P}(P_i)) = 5.0879 \sigma_{1}(-1) + 5 + 3.8 \sigma_{1}(-2) + 92.5 \sigma_{1}(-3) + 500.87 \sigma_{1}(-4) + 14.04 \sigma_{1}(-5) + 1533.7 \sigma_{1}(-6) + 4446.5 \sigma_{1}(-7) + 2025.6 \sigma_{1}(-8) \}

where $Y_i$ is the regional economic conditions, can be given as recommendations.
\[ Y_2^B = 1.4389 G_{\text{det}} - 1.2996 G_{\text{det}} - 2 + 2.303 G_{\text{det}} - 2 - 3.160 G_{\text{det}} - 3 + 1.441 G_{\text{det}} - 4 - 0.665 G_{\text{open}} - 1 - 9.961 G_{\text{open}} - 2 + 5.346 G_{\text{open}} - 3 - 1.341 G_{\text{open}} - 4 - 18.03 + 0.613 (M_2P_2) + 0.234L_1(-2) - 0.781L_2(-2) + 5.8685 r_1(-1) - 3.9765 r_2(-2) - 4.3205 r_3(-3) + 1.3036 r_4(-4) - 0.6867 r_5(-5) + 2.4171 r_6(-6) + 0.1119 Y_{1(-1)} + 0.4030 Y_{2(-2)} + 0.4802 Y_{3(-3)} + 0.5994 Y_{4(-4)} - 0.2386 Y_{5(-5)} + 3.2374 Y^{\text{new}}_{6(-6)} - 1.2557 G_{\text{2det}}(-2) - 0.9704 G_{\text{2open}}(-3) - 0.2634 G_{\text{2open}}(-4), \]

\[ Y_3^B = 4.43 P - 2.27 P (e_j/e_2)^{2000} - 1.51 P + 94.9 W_1(-1) + 27.2 P_{\text{avg}}(-1) - 4.9 P_{\text{avg}}(-2) - 822.7 + 0.9871 Y_1(-1) - 0.497 Y_2(-2) + 268.3 N_1(-1) - 160.7 W_1(-2) - 34.2 N_2(-3) - 70.9 N_3(-4) + 124.3 N_4(-5) + 48.2 N_6(-6), \]

\[ Y_2^B = \frac{8.26 + 0.2584 C_1(-1) - 0.7773 C_2(-2) - 0.0451 C_3(-3) - 0.1659 C_4(-4) + 0.0206 C_5(-5) + 2.25 (M_2P_2)}{1.8365 L_1(-1) - 0.2383 r_1(-1) + 0.1137 r_2(-2) - 0.1814 r_3(-3) + 0.1839 r_4(-4) - 0.1592 r_5(-5) + 0.0732 r_6(-6) - 1.232 Y_{2(-2)} + 2.323 Y_{3(-2)} - 1.35 Y_{3(-1)} - 0.3999 Y_{2(-1)} - 0.0686 Y_{1(-1)} + 0.0414 Y_{6(-1)} + 1.61 Y_{6(-2)} - 3.11 Y_{6(-3)} + 2.131 Y_{6(-4)} + 1.014 Y_{6(-5)} - 0.02 J_{6(-6)} + 0.0947 Y_{6(-1)} - 0.7707 Y_{5(-1)} - 0.8567 Y_{5(-2)} + 0.7994 Y_{5(-3)} - 0.186 Im_{6(-1)} + 0.0866 Y_{5(-2)} - 0.4235 Im_{5(-2)} - 0.0378 Im_{5(-3)} + 0.0546 Im_{6(-5)} - 0.06 Y_{6(-6)} - 295.5 (e_j P_{j} P_{j}^{\text{avg}}) - 351.1 Y_{1(-1)} - 198.5 Y_{2(-1)} + 0.0044 Y_{4(-1)} + 0.013 Y_{brub}(-2) - 0.02 Y_{brub}(-3) - 0.01 Y_{brub}(-4) + 0.01 Y_{brub}(-5) + 0.0001 Y_{brub}(-6) - 0.01 Y_{brub}(-2) + 0.01 Y_{brub}(-3) + 0.21 Y_{brub}(-4) + 0.4458 Y_{brub}(-2) + 0.0130 Y_{brub}(-3) - 0.0469 Y_{brub}(-4) + 0.3411 \text{Ex}_{brub}(-1) - 0.8331 \text{Ex}_{brub}(-1) - 1.0189 \text{Ex}_{brub}(-2) - 1.5943 \text{Ex}_{brub}(-3) - 2.058 \text{Ex}_{brub}(-4) - 0.3616 \text{Ex}_{brub}(-5) - 0.4354 Im_{brub}(-1) + 0.9815 Im_{brub}(-2) - 0.02052 \text{Im}_{brub}(-3) - 0.5323 \text{Im}_{brub}(-1) - 0.3052 \text{Im}_{brub}(-2) - 0.6841 \text{Im}_{brub}(-3) + 110.1 (e_j P_{j} P_{j}^{\text{avg}}) + 622.5 o_{1(-1)} + 172.2 o_{1(-2)} + 769.4 o_{1(-3)} + 96.5 o_{1(-4)} - 294.9 o_{1(-5)} + 1.3313 o_{1(-6)} + 83.7 (e_j P_{j} P_{j}^{\text{avg}}) + 281.7 o_{1(-2)} + 319.05 o_{2(-2)} + 74.5 o_{2(-3)} + 10.7 o_{2(-4)} + 171.5 o_{2(-5)} + 10.0 o_{2(-6)} + e_1, \]

\[ Y_3^B = -0.7094 + 1.9417 E_{1}(-1) - 2.161 E_{1}(-2) + 2.016 E_{1}(-3) - 0.4629 m_{1(-1)} + 0.2184 m_{1(-2)} - 1.0683 m_{1(-3)} - 0.9953 m_{1(-4)} + 0.1378 m_{1(-5)} + 0.1510 m_{1(-6)} - 0.7001 Y_{1(-1)} + 0.2376 Y_{1(-2)} + 0.2766 Y_{1(-3)} - 0.1258 Y_{1(-4)} - 0.1730 Y_{1(-5)} + 0.1045 Y_{1(-6)} - 745.4 (e_j P_{j} P_{j}^{\text{avg}}) - 885.7 e_{1(-1)} - 500.8 e_{1(-2)} + 0.0111 Y_{brub}(-1) + 0.033 Y_{brub}(-2) + 0.0475 Y_{brub}(-3) - 0.0183 Y_{brub}(-4) + 0.0249 Y_{brub}(-5) + 0.0002 Y_{brub}(-6) + 0.022 Y_{brub}(-2) + 0.0158 Y_{brub}(-3) + 0.5295 Y_{brub}(-1) + 1.1245 Y_{brub}(-2) + 0.0329 Y_{brub}(-3) - 0.1183 Y_{brub}(-4) + 8974.4 o_{2(-3)} - 1928.0 e_{1(-1)} - 1.0 (P_2)(1.182 (M_2P_2) + 0.7876Y_{2(-2)} - 0.4512L_1(-1) + 1.51L_2(-2) + 50.9 r_2(-1) - 4.09 r_2(-2) - 16.8 r_3(-3) - 28.4 r_4(-4) - 22.5 r_5(-5) - 20.5 r_6(-6) - 30.2 r_7(-7) + 426.8 r_8(-8) - 249.1 r_9(-9) - 5.8 CF_{1(-2)} + 1.7 CF_{2(-2)} - 550.6), \]
0.8604Ex_brub3(-1) - 2.1015Ex_brub2(-1) -
2.5702Ex_brub3(-2) - 4.0214Ex_brub2(-3) -
5.1913Ex_brub3(-4) - 0.9122Ex_brub3(-5) +
1.0983Im_brub3(-1) + 2.4763Im_brub3(-2) -
0.5176Im_brub3(-3) - 1.3427Im_brub3(-1) -
0.7697Im_brub3(-2) - 1.7256Im_brub3(-3) +
277.7(eP_i(eP_i)3) - 2077.8o3(-1) + 434.48o3(-2) +
1940.7o3(-3) + 243.5o3(-4) - 743.9o3(-5) -
3.36o3(-6) + 211.1(e2P_j(e2P_j)3) + 710.67o3(-1) +
804.78o3(-2) + 187.82o3(-3) + 26.93o3(-4) +
432.5o3(-5) + 25.3o3(-6) e_i + (1/P_i) (-
2.5200(M_j/P_j) + 0.0426Y_i^D + 2.0557L_i(-1) -
0.2823r_j(-1) - 0.2826r_j(-2) + 0.3491r_j(-3) -
0.2778r_j(-4) + 0.1782r_j(-5) - 0.0819r_j(-6) +
0.8472Y_j(-1) - 1.9951Y_j(-2) + 1.3908Y_j(-3) +
0.3918Y_j(-4) - 1.7179r_i^W - 2.9714CF_i(-1) -
1.2485CF_i(-2) + 3.8594CF_i(-3) + 2.364CF_i(-4) +
0.7728CF_i(-5) + 3.2638r_i^W(-1) - 1.5677r_i^W(-2) +
6.767r_i^W(-3) - 4.1) ,

\[ Y_i^{BB} = -0.2363d + 1.264G_i^{debt}(-1) - 1.848G_i^{debt}(-2) +\]
\[12.7371 - 6.7259G_i^{open}(-1) - 3.837G_i^{open}(-2) -\]
\[0.085G_i^{open}(-3) + 6.11G_i^{open}(-4) + 4.02G_i^{open}(-5) -\]
\[0.1411G_i^{inc}(-3) - 0.0425G_i^{inc}(-4) - 0.0432G_i^{inc}(-5) +\]
\[0.8556(M_j/P_j) - 0.6979L_i(-1) - 0.0969r_j(-1) +\]
\[0.15r_j(-2) - 0.16r_j(-3) + 0.072r_j(-4) - 0.062r_j(-5) +\]
\[0.0278r_j(-6) - 0.0930r_j(-1) + 0.8121Y_j(-2) -\]
\[0.4722Y_j(-3) - 0.1330Y_j(-4) ,\]

where \( Y_j^{BP} \) – function of zero balance of payment of the
country \( j \), \( Y_j^{BB} \) – function of budgetary balance
equilibrium of the country \( j \).

## Appendix 2

Statistical data for the years 1993-2011 were
collected from official websites of central banks and
statistical agencies (www.nationalbank.kz – website of
the National bank of the Republic of Kazakhstan,
www.cbr.ru – website of the Central bank of the Russian
Federation, www.nbrb.by – website of the National bank
of the Republic of Belarus, www.stat.kz – website of the
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