Original Paper

doi 10.15826/recon.2021.7.4.022
UDC 330.35
JEL O11, O47, O57

Comparative structural analysis of economic growth in countries of the Eurasian Economic Union

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ABSTRACT
Relevance. The development of the Eurasian Union means economic integration between its member countries (Armenia, Belarus, Kazakhstan, Kyrgyzstan, and Russia). For more efficient coordination of this process, it is necessary to analyze national models of economic growth and adjust the Union's economic policy accordingly.
Research objective. The study aims to identify the national models of economic growth by applying the structural analysis method and building regression models of GDP growth.
Data and methods. The study relies on the structural analysis of GDP growth and regression analysis of the impact of macroeconomic policy instruments.
Results. The study provides an overview of the research literature on the factors affecting economic growth (e.g. the financial structure, government expenditures. Based on the results of the structural analysis, a classification of the models of economic growth in terms of expenditures and sectors is proposed. This classification can be used to devise measures stimulating cooperation and integration within the Eurasian Union.
Conclusions. The study has revealed the differences between the national models of economic growth by looking at each country's reaction to the crises of 2009 and 2015. These differences correspond to the peculiarities of each country's economic policy and need to be taken into account in the Union's policy-making.

KEYWORDS
Eurasian Economic Union, economic growth, GDP structure, structural analysis, GDP growth rate, sectoral economic structure, regression analysis, economic policy

FOR CITATION
Sukharev, O.S., & Voronchikhina, E.N. (2021) Comparative structural analysis of economic growth in countries of the Eurasian Economic Union. *R-economy*, *7*(4), 244–265. doi: 10.15826/ recon.2021.7.4.022

Сравнительный структурный анализ экономического роста стран Евразийского экономического союза

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АННОТАЦИЯ
Актуальность. Развитие Евразийского союза означает экономическую интеграцию между его странами-членами (Арменией, Беларусью, Казахстаном, Кыргызстаном и Россией). Для более эффективной координации этого процесса необходимо проанализировать национальные модели экономического роста и соответствующим образом скорректировать экономическую политику Союза.
Цель исследования. Исследование направлено на выявление национальных моделей экономического роста путем применения метода структурного анализа и построения регрессионных моделей роста ВВП.
Данные и методы. В основе исследования лежат структурный анализ роста ВВП и регрессионный анализ влияния инструментов макроэкономической политики.
Результаты. В исследовании представлен обзор исследовательской литературы по факторам, влияющим на экономический рост (например, финансовая структура, государственные расходы. На основе результатов

КЛЮЧЕВЫЕ СЛОВА
Евразийский экономический союз, экономический рост, структура ВВП, структурный анализ, темпы роста ВВП, отраслевая структура экономики, регрессионный анализ, экономическая политика

Online ISSN 2412-0731

структурного анализа предлагается классификация моделей экономического роста с точки зрения расходов и секторов. Эта классификация может быть использована для разработки мер, стимулирующих сотрудничество и интеграцию в рамках Евразийского союза.
Выводы. Исследование выявило различия между национальными моделями экономического роста, проанализировав реакцию каждой страны на кризисы 2009 и 2015 годов. Эти различия соответствуют особенностям экономической политики каждой страны и должны быть приняты во внимание в политике Союза.

ДЛЯ ЦИТИРОВАНИЯ
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Introduction

Prospects for the development of Eurasian integration and economic cooperation within the Eurasian Economic Union (EurAsEC) should be considered in the light of the current stagnation and recession, which increases the significance of the task of stimulating economic growth in member countries. Each of the countries of the EurAsEC (Armenia, Belarus, Kazakhstan, Kyrgyzstan, Russia), both before and after the formation of the Union, had their own economic dynamics determined by resource opportunities (including the size of the country), institutional changes, the external environment (location), economic policies and many other reasons and factors. The creation of the Union and the special customs regime as well as the reduction of resource exchange costs (capital and labor) have given a new impetus to the development of the member countries (Mostafa & Mahmood, 2018). There is, however, a question as to what are the characteristics of the current growth models of the Union's member states and whether they contribute to the development of the Union or, on the contrary, impede it. On the one hand, within the Union, the economic development of each country should influence other countries, thereby supporting the general growth trend, but when a recession occurs, the crisis processes spread across the Union. On the other hand, the growth model of member states may limit this negative impact. It is, therefore, important to gain a better understanding of the nature and mechanisms of the mutual influence between the countries. Identification of the particular features of economic development in each country will help reveal their mutual influence and the differences between national growth patterns for further analysis.

There is significant body of research on structural changes in national economies. However, within the framework of growth theories, these changes remain an underexplored question (Alonso-Carrera & Raurich, 2015, 2018; Romano & Trau, 2017; Vu, 2017). Much of the work in this area uses aggregate models, while the structural approach takes a back seat. Scientific and technological progress, not structural dynamics, is usually considered as the most important factor (Gabardo & Pereima, 2017).

Modern studies of economic growth and its structure discussed above do not give a full picture of the contribution of various components of GDP to GDP growth rate. Changes in the structure of national economies and their impact on economic growth have been underexplored in economic growth theories.

The aim of the study is to develop a method of structural analysis and to describe the current structural dynamics of member countries of the Eurasian Union (by GDP component and by sector).We also intent to propose a methodology for comparative analysis of the macroeconomic dynamics of the countries under consideration, taking into account their patterns of economic development and the impact of macroeconomic policy instruments.

The structural approach, as noted above, does not fit into modern theories of economic growth (Romano, Trau, 2017, Vu, 2017). The theoretical framework is represented by modern views on economic growth, but it has to be modernized by including the factor of structural dynamics. It is precisely the differences in the structure of the economy and its dynamics that impede the efforts to stimulate integration and expand cooperation within the Union.

In the following section, we will review the main theoretical works devoted to economic growth and changes in the economic structure, identifying their main content and tasks to be solved in order to show other possibilities of structural analysis. In the third section, we will proceed to the research methodology, describing the main method, data and algorithm of analysis. The proposed methodology will be tested by using the data of the Eurasian Union's member

Online ISSN 2412-0731

countries. The results of the analysis will show the structural dynamics in these countries' economies in comparison with other members of the Union and can thus be used to improve the efficiency of the cooperation within the Union.

Theoretical framework

This study relies on the concept of structural dynamics, which is understood as changes in the elements of the system and their roles in the overall economic growth. The analysis of structural dynamics helps governments build an evidence-based macro-economic policy and strategies of economic development. An example of such a study is the analysis of structural dynamics in China over the past decades (Brondino, 2019).

Modern structural changes are large-scale, which leads scholars to reconsider their views of depression as a situation when the economy functions for a long time at a level below its potential (Tase, 2019). Such situations create the need to invest in transformations of the economic structure and to take measures ensure productivity growth (Samaniego and Sun, 2016; Oreiro and Silva, 2020). Table 1 presents a brief overview of research literature dealing with the factors of economic growth.

As Table 1 shows, Chu (2020) focuses on the impact of the financial structure and uses panel data for 99 countries for 1971–2015 to investigate whether it affects economic growth, the emergence of a banking crisis, and economic volatility. The main result is that the positive effect of the development of the securities market is significantly weakened if the financial structure is not balanced.

Based on the extended neoclassical growth model, the endogenous mechanism between financial structure and economic growth is investigated (Liu and Zhang, 2020). The theoretical analysis shows that there is an optimal financial structure necessary to meet the various needs of the real sector. Their empirical results show that the financial structure has a significant impact on economic growth. However, the impact of the financial structure on regional economic growth is different and has an inverse U-shape. These results confirm the evolving influence of the financial structure on economic growth at different stages of economic development.

The impact of banking sector on the structure of economy and economic growth is considered J. Tongurai & Ch. Vithessonthi (2018), who showed the different impact of the banking sector on the development of the industrial and agricultural sectors. The development of the banking sector has a negative impact on the development of the agricultural sector, but it does

Table 1

Review of the international research on the impact of certain factors on economic growth

Studies	Factors of economic growth	Description
Chu, 2020; Liu, Zhang, 2020; Benczúr et al., 2019	Financial structure	Non-linear influence of the financial structure on economic growth: the influence is different and has an inverse U-shape. The positive effect of the development of the securities market is significantly weakened if the financial structure is not balanced.
Tongurai, Vithessonthi, 2018	Banking sector	Negative impact on the development of the agricultural sector (in countries with developed banking sector), but no impact on the development of the industrial sector.
Facchini, Seghezza, 2018; Olaoye et al., 2020	Government expenditure	The cumulative effect of expansionary government spending shocks on economic growth is positive. The cumulative effect of government spending cuts has a negative impact on economic growth. The existence of an inverted U-shaped relationship between government spending and economic growth is proved. Spending to protect property rights and health care costs contribute to the growth of production.
Zhao, Tang, 2018	Manufacturing, transaction sector	The acceleration of economic growth in China in 2003-2008 compared to 1996-2002 was due to an increase in the contribution of the manufacturing sector and, to a lesser extent, the service sector, while in Russia the growth driver was the service sector, then the primary sector.
Čadil, et al., 2014.	Human capital	Human capital is not a guarantee of economic stability and a quick exit from the crisis. Regional economies reacted differently to the 2014 economic crisis: asymmetric responses are based on structural differences and human capital availability.

Source: compiled by authors.

Online ISSN 2412-0731

not have any impact on the development of the industrial sector. At the same time, the negative impact of the banking sector on the development of agriculture is observed only in countries with a developed banking sector. The results also show that the development of the agricultural sector has a negative impact on the development of the banking sector, while the development of the industrial sector has a positive impact on the development of the banking sector.

Benczúr et al. (2019) focus on the groups of high-income countries (OECD, EU, and the EU Economic and Monetary Union to show the non-linear nature of the impact that funding has on economic growth is robust in relation to the structure of financial sources (bank credit, debt securities, stock market) and recipients of finance (households, non-financial and financial corporations). First, the non-linear effect of total bank credit is more pronounced than that of either household credit alone or the amount of bank credit, debt securities, and stock market financing. Second, loans to non-financial corporations tend to have a positive impact on economic growth and loans to households, a negative impact. Third, debt securities and equity financing have different effects on economic growth.

There is extensive literature on the impact of various functional components of government spending on economic growth. Facchini & Seghezza (2018) focus on the impact of the structure of public spending on economic growth in France in 1870–2010. It is shown that the only functional component of expenses that contributes to the growth of French production is expenses aimed at protecting property rights. On the other hand, government intervention to support the economy has no effect on economic growth. As far as social spending is concerned, only health spending contributes to production growth. Thus, in the case of France, empirical evidence seems to support not only the critical importance of property rights protection emphasized by neoinstitutional theory, but also Smith's minimal state hypothesis: limiting the size of the state and delineating its main functions usually contributes to the growth of production.

Comparing the sources of economic growth and the nature of changes in the industrial structure of China and Russia, Zhao & Tang (2018) show that in the period from 1995 to 2008, the Chinese economy was more concentrated in the manufacturing sector and relatively less in the service sector than the Russian one. In addition, the article concludes that in Chine the rates of GDP growth and labor productivity were higher in the period from 1996 to 2008 than in Russia. The acceleration of economic growth in China in 2003–2008 compared to 1996–002 was mainly due to an increase in the contribution of the manufacturing sector and, to a lesser extent, the service sector, while in Russia it was the service sector, followed by the primary sector managed by the mining and oil and gas industries. These results indicate that the Chinese and Russian economies complement each other, which bodes well for further economic cooperation and trade between the two countries.

The phenomenon of asymmetry between public spending and growth in the West African economic community (Olaoye et al., 2020) shows that in this group of countries, the response of economic growth to public spending shocks varies depending on the nature of the shocks, i.e., the cumulative effect of expansionary public spending shocks on economic growth is positive and statistically significant. The cumulative effect of government spending cuts has a negative and statistically significant impact on economic growth. In addition, the existence of an inverted U-shaped relationship between government spending and economic growth is proved.

Human capital as a factor of economic growth is considered by Čadil, et al. (2014). Human capital alone is not a guarantee of economic stability and a quick exit from the crisis. Human capital should reflect the economic structure that promotes economic growth. Otherwise, it can only lead to an increase in the unemployment rate due to the effect of displacement and imbalances in the labor market. Regional economies reacted differently to the 2014 economic crisis: asymmetric responses are based on structural differences and human capital availability.

To sum up, it can be noted that the methodology for comparative analysis of structural dynamics by GDP components, including the impact of certain parameters of macroeconomic policy and the stability of growth, is not sufficiently developed. The above-described research identifies a factor or group of factors that influence growth but does not provide an overall picture of the changes in the structure of GDP. These are the research gaps that this study seeks to address.

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Method and data

Structural analysis is a suitable for studying the complex relationships that arise between the elements of the economy. This method helps not only establish the emerging patterns, but also reveal the influence of elements on the changes in the economic system. With regard to the problem of economic growth, it is possible to determine the contribution of different components of GDP to the overall GDP growth rate and the connection between these components (the method of paired correlations or principal components). In addition, it is possible to determine how much a particular sector dominates, including its contribution to the growth rate, and also estimate the stability of growth rates both for an individual element and for the entire economic system. From a broader perspective, structural analysis allows us to study resource allocation between economic sectors: its toolbox includes the 'input-output' method, the method of direct empirical assessment of the movement of capital and labor between sectors, which is less labor-intensive in application, as well as the method of institutional compositions, etc. (Afonso & Neces, 2020; Bayramov & Breban, 2019; Teixera & Queiros, 2016; Brancaccio & Garbellini, 2018).

Therefore, regarding the quality of economic growth, it is necessary to assess the structure of growth (Ciarli & Valente, 2016; Demir & Hall, 2017; Harada 2015; Hardt & Barett, 2021). The distribution of resources affects structural changes and should be considered as a central issue of structural change and growth structure (Freire, 2019; Kirham, 2016). This or that component of GDP by expenditure (e.g. gross consumption, investment or net exports) can be crucial for the GDP growth rates.This contribution may change over time, and another component of GDP may become dominant, or the impact of some components will be commensurate with the contribution to the rate, so it will not be possible to determine the dominance of one of them over the given period. The selected structural composition is a model of economic dynamics which indicates the component that generates most growth. The same analysis applies to economic sectors or activities. Analysis of the countries of the EurAsEC will allow us to get a better understanding of the economic growth in these countries, which will inevitably affect their economic integration.

The structural formula for estimating the contribution of elements to the growth rate of national GDP is presented below.

To measure GDP by expenditure we are going to use the formula: $Y = C + I + G + NX$, that is, the sum of consumer and investment spending, government spending, and net exports. The growth rate of each component of GDP is denoted as gC, gI, gG, gNX while the share of each component in GDP is denoted as C, i, g, nx. Thus, the structural formula will look the following way:

$$g_Y = g_C \cdot c + g_I \cdot i + g_G \cdot g + g_{NX} \cdot nx. \quad (1)$$

The contribution to the growth rate of each component is determined by the product of its growth rate and its share in the GDP (according to Formula (1)). Thus, we have four contributions to the GDP growth rate by expenditure (Sukharev, 2020).

Similarly, the contribution of sectors that add up to GDP is determined. The growth rate of each sector multiplied by the sector's share of GDP is the sector's contribution to the economic growth rate, and the sum of the contributions gives the overall growth rate.

The research algorithm comprises the following stages. First, we will devise a formula to measure the structure of economic growth in the countries of the Eurasian Union. Then we will calculate the growth structure by GDP expenditure and by the sectors that make up GDP (raw materials, processing and transaction sectors). We will rank the countries depending on the stability of their economic growth and conduct a regression analysis of the impact on the growth rate of certain parameters of macroeconomic policy: the key rate, level of monetization, oil prices, inflation.

These parameters, in our opinion, give a general idea of the current macroeconomic policy and its features, mainly monetary, since budget expenditures with the exception of Kazakhstan did not make the greatest contribution to economic growth. However, this exception outweighs the impact of other countries on this component of GDP. In the panel data, as will be shown below, the weighting factor of budget expenditures is the largest. A special parameter of economic policy is the world oil prices, whose changes provoke crises, in particular in the Russian economy.

The study interval covers the period from 2001 to 2019. The data source is the official statistics of the World Bank. The data are given in 2010 prices.

We will further analyze the economic growth models in the structure of GDP by expenditure and sectors for the EurAsEC countries in order to determine the current type of economic

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dynamics. This will shed light on the possibilities of integration, for example, the harmonization of development models. We can also identify the features of these models that may affect the format of further cooperation and strengthen or weaken the relationships within the Union.

Our research findings will be useful for developing further measures of economic cooperation between the Eurasian countries.

Results

Assessment of the economic growth structure of the Eurasian Economic Community

We apply the structural formula to make a quantitative assessment of the economic growth structure in the countries of the EurAsEC, considering the dynamics of GDP by expenditure and sectors. The calculation results are shown in Figures 1–6. The contribution of the sectors until 2018 was estimated by using the available statistics.

Figure 1 shows that Armenia and Belarus have mixed models of economic growth, which means that there is no single dominant component of GDP. However, in Belarus, investment spending makes a more significant contribution to growth than in Armenia, along with gross consumption. Net exports have a significant impact on the economy, unlike in Belarus, where gross consumption is also significant in terms of its impact on the rate, but net exports have a more modest impact. So, two components – gross consumption and investment spending – ensure the growth of these economies, and for Armenia, a third component is added – net exports. Thus, the growth model is mixed, because the contribution of these components is comparable over a significant period of time (Fig. 1). A significant impact of net exports on economic dynamics has been formed since 2009, and until that time, net exports were likely to slow down growth in both Armenia and Belarus. Since 2011, in Armenia, and since 2014, in Belarus, the growth in investment spending has been slowing down. Thus, these two components of GDP – net exports and investment spending – have gradually begun to change places after 2009, which determined the peculiarities of the structural models of economic growth in these countries. Government spending does not make a significant contribution to the growth rate for these countries.

Kazakhstan and Kyrgyzstan (Fig. 2) also have a rather mixed growth model, although in Kyrgyzstan the largest contribution to the growth rate is still made by gross consumption, so we can consider the current model as dominated by consumption. In 2009 and 2015, like in Russia (Fig. 3), in Kyrgyzstan, net exports were essentially resisting the crisis, that is, they accounted for a large part of the growth rate. The same is true for Armenia and Belarus, but not for Kazakhstan (Fig. 2, left). For Kazakhstan, government spending makes a more significant contribution to the growth rate than in other countries. This is a specific feature of the current model of growth and state regulation of the economy in Kazakhstan. Moreover, this model determines the overall result for the group of countries in terms of the impact of government spending on the growth rate, as will be shown below.

The Russian economy also has a consumer-driven growth model: its gross consumption has a major impact on the rate of economic growth (Fig. 3). Investment spending is the second most important contribution to the growth rate. In Kazakhstan, investment spending and net exports account for a large part of the rate of gross consumption and determine economic growth in some years (Fig. 2, left).

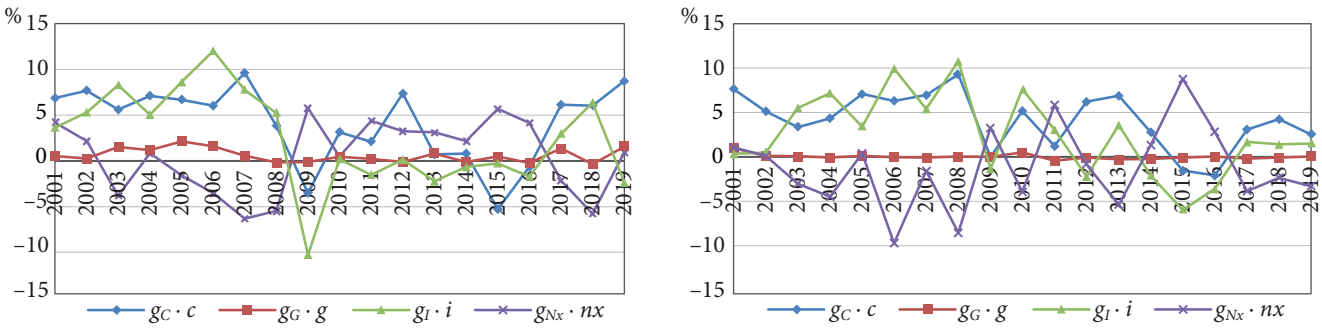

Figure 1. *Structural dynamics of GDP by expenditure in Armenia (left) and Belarus (right), 2001–2019*

Source: the authors' calculations were based on the official data from the World Bank.
Retrieved from: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD (Accessed: 17.08.2021)

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In 2009, the growth rate of the countries decreased, but only in Armenia and Russia this decline was very significant (the rate was extremely negative). Figures 4–5 show the accuracy of our calculations, which is quite acceptable, given that the UN statistics also states that the error can reach 5–10% in accounting, which can increase the discrepancy when calculating at certain points. However, the accuracy verified by the growth rate by comparing the actual and calculated values is acceptable (Figs. 4–5).

A very high accuracy of the calculations was achieved for the Russian economy (Fig. 5, right). Thus, the application of the structural formula allows us to identify the features of structural dynamics and the resulting model of economic growth. If we consider the three main growth models in the light of the dominance of the GDP component by contribution to the growth rate, we can distinguish between the mixed, investment-based and consumption-based models. Table 2 summarizes growth models of the countries of the EurAsEC.

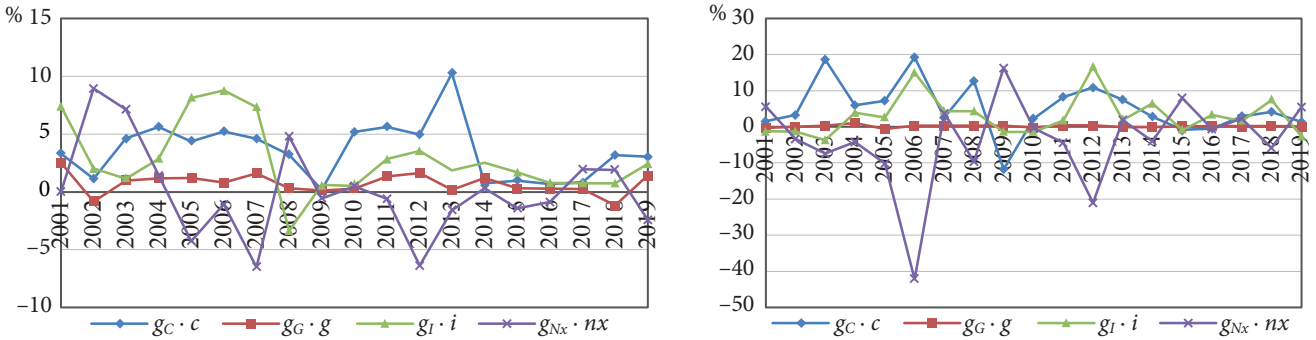

Figure 2. *Structural dynamics of GDP by expenditure in Kazakhstan (left) and Kyrgyzstan (right), 2001–2019*

Source: the authors' calculations were based on the official data from the World Bank.
Retrieved from: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD (Accessed: 17.08.2021)

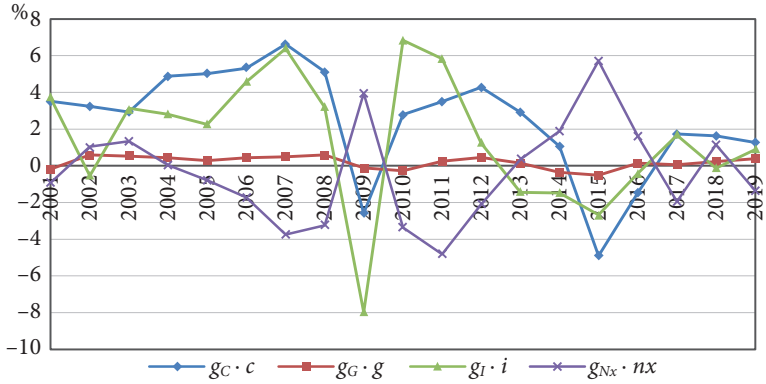

Figure 3. *Structural dynamics of GDP by expenditure in Russia, 2001–2019*

Source: the authors' calculations were based on the official data from the World Bank.
Retrieved from: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD (Accessed: 17.08.2021)

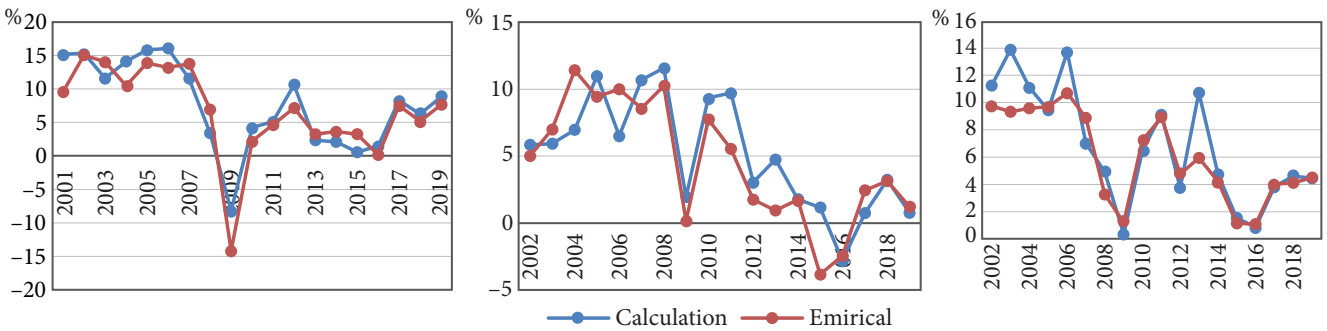

Figure 4. *The accuracy of the calculations for Armenia (left), Belarus (center) and Kazakhstan (right)*

Source: the authors' calculations were based on the official data from the World Bank.
Retrieved from: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD (Accessed: 17.08.2021)

Online ISSN 2412-0731

As can be seen from Table 1 and Figures 1–5, net exports in many countries are the component that constrains growth, since the contribution of this component to the overall rate of this component is often negative. However, during the crisis of 2009 and even in the recession of 2015, it is net exports that resisted the crisis, that is, their contribution to the rate became positive in Russia, Kazakhstan, Armenia, and Belarus. Moreover, growth was generated first by investment spending in Armenia and Belarus, then by net exports, since 2009 for Armenia and since 2014 for Belarus. In fact, these two components change roles. For Kyrgyzstan, net exports mainly inhibit growth, but during the crises of 2009 and 2015 it was the net exports that resisted the recession.

Thus, the countries of the EurAsEC demonstrate not only different growth models but also respond differently to crises: four countries out of five through net exports, and Kazakhstan through investment spending. In addition, only Kazakhstan has the most significant contribution to the growth rate of government spending.

Now we are going to look at the sectoral dynamics of GDP, revealing the dominance of sectors in their contribution to the growth rate (Figs. 6–7).

Figures 8–9 confirm the fairly high accuracy of the calculations of the sectoral contribution to the GDP growth rate of the Eurasian countries.

Table 3 shows the current growth patterns based on the dominance of the sector structure, which makes it possible to rank countries according to the current growth model.

As can be seen from Table 2, Armenia shows a mixed pattern of growth, Belarus has an industrial-service model. Kazakhstan and Russia have a service model as the service sector makes the largest contribution to the growth of transaction sector. Kyrgyzstan has a service model and since 2016, an industrial-service model, as the country's manufacturing sector's contribution became the most significant. Therefore, in the given the period, the growth model can be described as service-industrial, although the negative dynamics of the industrial sector in Kyrgyzstan, as will be shown below, is very high.

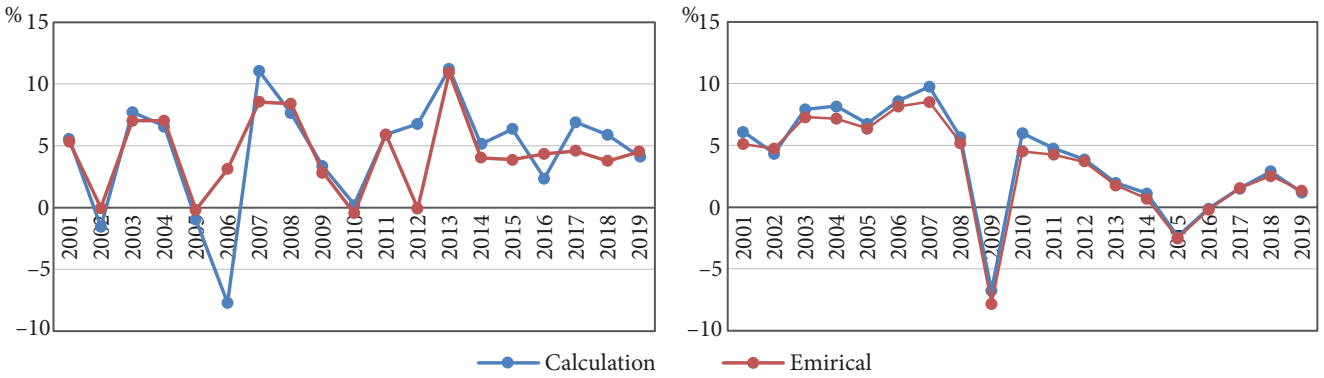

Figure 5. *The accuracy of the calculations for Kyrgyzstan (left) and Russia (right)*

Source: the authors' calculations were based on the official data from the World Bank. Retrieved from: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD (Accessed: 17.08.2021)

Table 2

Models of economic dynamics of the EurAsEC countries by GDP components, 2000–2019

Country	Main generator of growth	Component restraining the growth	Component that resisted the crisis of 2009	Economic dynamics model: consumption-based; investment-based; mixed
Armenia	Gross consumption, investment spendings, net exports	Net export	Net exports	Mixed
Belarus	Gross consumption, investment spendings, net exports	Investment expenses	Net exports	Mixed
Kazakhstan	Gross consumption, investment spendings, net exports	Net exports	Net exports	Mixed
Kyrgyzstan	Gross consumption	Investment expenses	Investment expenses	Mixed
Russia	Gross consumption	Net exports	Net exports	Consumption-based

Source: the authors' calculations were based on the official data from the World Bank. Retrieved from: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD (Accessed: 17.08.2021)

Online ISSN 2412-0731

Thus, the above-described structural features of economic dynamics should be taken into account in policy-making. They should also be given due regard in the light of the economic integration within the Union. The factors that need to be considered are the current growth model, national economies' responses to recession and the role played by government spending in maintaining the growth rate. Only in Kazakhstan this influence is quite significant. It also matters which sectors dominate the economy. For instance, before 2008–2009, in Armenia and Belarus, the economies had been dominated by the manufacturing sectors (see Fig. 6 above), while the transaction sector was second, and the contribution to the growth rate of the raw materials sectors was not high. Since 2010, the situation has changed dramatically, the contribution of the manufacturing sector to the growth rate has sharply declined and it now plays

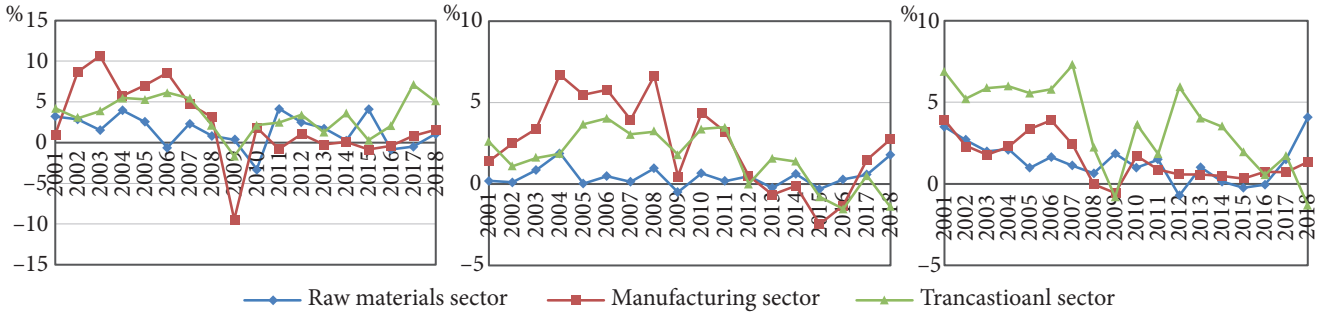

Figure 6. *Structural dynamics of GDP by sectors in Armenia (left), Belarus (center) and Kazakhstan (right), 2001–2018*

Source: the authors' calculations were based on the official data from the World Bank.
Retrieved from: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD (Accessed: 17.08.2021)

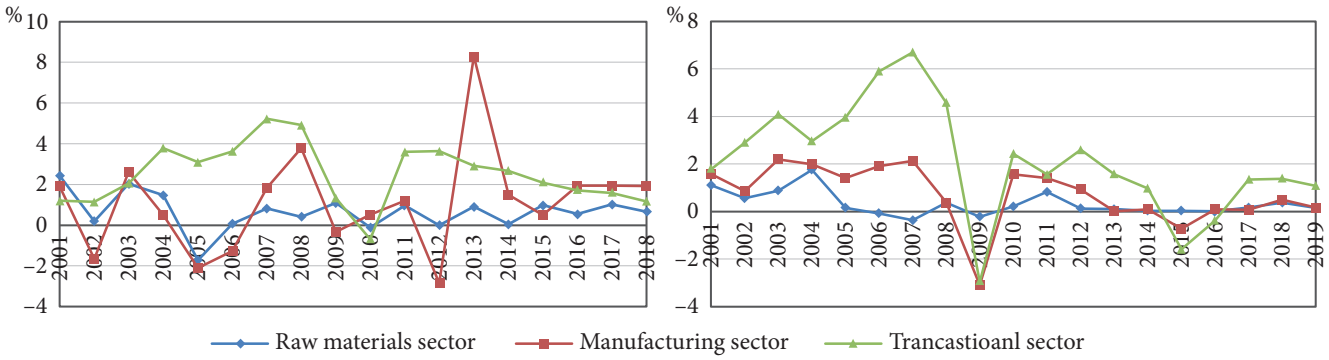

Figure 7. *Structural dynamics of GDP by sectors in Kyrgyzstan (left) and Russia (right), 2001–2018*

Source: the authors' calculations were based on the official data from the World Bank.
Retrieved from: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD (Accessed data: 17.08.2021)

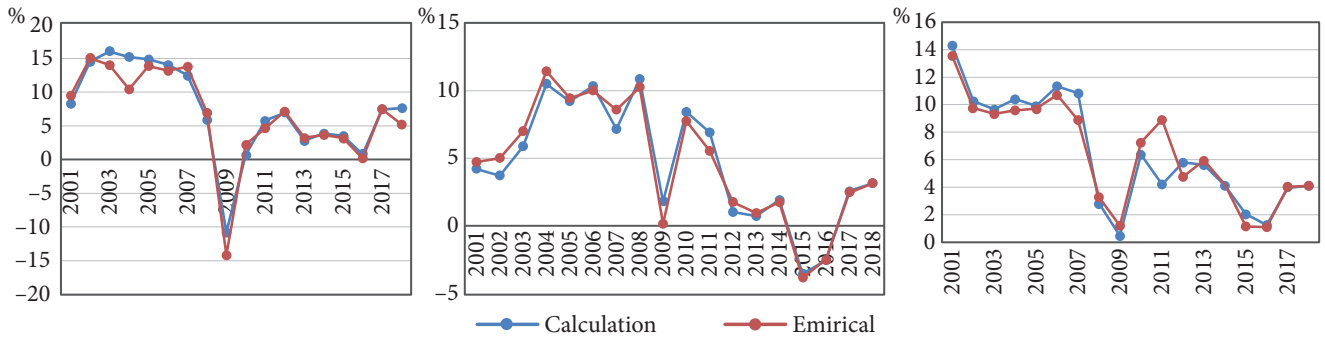

Figure 8. *Calculation accuracy by sectors of Armenia, Belarus and Kazakhstan, 2001–2018*

Source: the authors' calculations were based on the official data from the World Bank.
Retrieved from: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD (Accessed: 17.08.2021)

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but a negligible role in economic growth, while the transaction and raw materials sectors have gained significance. Only in 2017, after the stagnation in 2015–2016, manufacturing in Belarus regained its leading position in terms of the contribution to the growth rate. In Kazakhstan, the growth model is based on the transaction sector. It dominated the contribution to the growth rate in the entire period. Manufacturing is the second largest contributor, followed by the raw materials sector. In Kyrgyzstan, up to 2009 (Fig. 7, left), the dynamics had also been determined by the transaction sector, but the contribution of manufacturing was quite significant, commensurate with the contribution to the growth rate of the transaction sector. However, the contribution of the transaction sector began to fall in 2014. At the same time the role of manufacturing was increasing, and by 2016, manufacturing had become the leading sector in Kyrgyzstan. In Russia, the transaction sector dominates. It makes a much larger contribution to the growth rate than other sectors. The second largest sector is manufacturing, which proved to be more resistant to the crisis of 2015 than the transaction sector (Fig. 7, right).

Kazakhstan and Russia have similar growth models in the sectoral context. The transaction sector dominates in terms of contribution, but the models of economic growth in terms of GDP structure and spending for Kazakhstan and Russia differ significantly, including the response to crises and the importance of government spending that contributes to economic growth. Moreover, Kazakhstan has a clear advantage in this regard.

The growth models of Armenia and Belarus are somewhat similar in terms of sector contribution, but Belarus has a more developed manufacturing sector, which determines the dynamics. It should be noted that none of the countries of the EurAsEC has a model of growth based on the raw materials sector, that is, the domination of commodity sectors. Belarus has a model of industrial growth, Armenia has mixed model. Since 2010, the contribution of the raw materials sector to the growth rate has become second after the transaction, while until 2008, it was the manufacturing sector that was at the top. In Kazakhstan and Russia, there was a growth in the contribution of the services sector to GDP. Kyrgyzstan has a service-industrial model, so

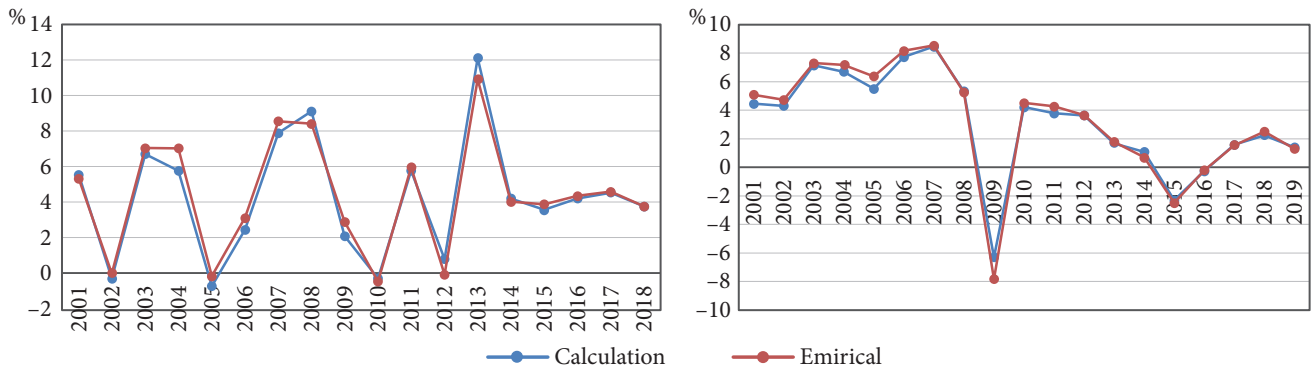

Figure 9. *The accuracy of the calculation by sectors of Kyrgyzstan and Russia, 2001–2018*

Source: the authors' calculations were based on the official data from the World Bank. Retrieved from: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD (Accessed: 17.08.2021)

Table 3

Models of economic growth of the EurAsEC countries by sector, 2000–2018

Country	Sector generating most of the growth	Prevailing model (industrial, service, raw materials, mixed)
Armenia	Until 2009 the manufacturing and transaction sectors dominated. After the 2009 crisis – raw materials and transaction sector	Mixed
Belarus	Manufacturing sector, since 2012 – transaction sector	Industrial and service
Kazakhstan	Transaction sector	Service
Kyrgyzstan	Transaction sector	Service, since 2016 industrial service
Russia	Transaction sector	Service

Source: the authors' calculations were based on the official data from the World Bank. Retrieved from: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD (Accessed: 17.08.2021)

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in 2016 the manufacturing sector played the key role in economic growth. It should be noted that these models are distinguished by the sector's contribution to economic dynamics, rather than by the sector's share in the country's GDP structure.

In the following parts of the article, we are going to apply this approach to assess the stability of the structural dynamics of growth in the countries of the EurAsEC. We will evaluate the stability of the dynamics by calculating the stability coefficient as the average largest deviation when the parameter fluctuates relative to the abscissa axis. The risk is estimated as the standard deviation of the contribution of GDP of each component and the overall growth rate for each country.

We need to estimate the coefficient of the stability of growth rates: the higher is the coefficient, the less stable is economic growth, due to the greater the average deviation from the time axis. The sum of deviations is divided by the number of corresponding largest vertices of deviations (see below). Table 4 shows the coefficient of stability of the GDP contribution by expenditure to growth rate (Table 4) and Table 5, GDP growth rate. Tables 6 shows the coefficient of stability of the sectors' contribution to GDP growth rate and Table 7, GDP growth rate. We rank countries by the stability coefficient, comparing the empirical and calculated values. The lower is the coefficient, the higher is the stability of growth rates.

As we can see from Table 5, the calculated and empirical estimates of stability differ. Armenia showed a very high level of instability. According to our calculations, there were two countries that were close in terms of stability: Belarus and Russia. In fact, Kyrgyzstan showed the most stable dynamics. This does not mean that the dynamics in Kyrgyzstan was better than in Belarus or Russia. We are talking about the average greatest deviation from the abscissa axis, that is, an assessment of the stability of growth rates. Of course, it is also necessary to take into account how much GDP has increased in terms of purchasing power parity in comparable assessment in each of the countries of the EurAsEC.

Table 6 shows the ranking of countries by the coefficient of stability of the contribution of sectors. Armenia shows high volatility regarding the contribution of the raw materials sector to GDP growth. Russia, on the other hand, is characterized by the most stable contribution of the raw materials sector to GDP among these countries. A similar situation is observed in the manufacturing sector, whose contribution to GDP was very unstable. Russia is the most stable in this sector, i.e. the sector's deviations from the abscissa axis are the smallest. In the transaction sector, there is a different trend: the largest deviations from the abscissa axis are in Kazakhstan, followed by Armenia, then Russia, Kyrgyzstan and Belarus.

Table 4

Ranking of countries by the stability coefficient of the contribution of GDP components by expenditure, 2001–2019

Country	$g_C \cdot c$	Country	$g_G \cdot g$	Country	$g_I \cdot i$	Country	$g_{Nx} \cdot nx$
Kyrgyzstan	9.61	Kazakhstan	1.02	Belarus	5.37	Kyrgyzstan	10.03
Armenia	5.20	Armenia	0.76	Kyrgyzstan	4.86	Belarus	5.07
Belarus	4.56	Russia	0.44	Armenia	4.21	Russia	3.59
Russia	3.84	Kyrgyzstan	0.37	Russia	3.80	Armenia	3.90
Kazakhstan	3.57	Belarus	0.17	Kazakhstan	2.75	Kazakhstan	3.26

Source: the authors' calculations were based on the official data from the World Bank. Retrieved from: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD (Accessed: 17.08.2021)

Table 5

Ranking of countries by the stability coefficient of GDP growth rate (by expenditure): empirical and calculated values

Country	Calculation	Country	Empirical
Armenia	9.30	Armenia	9.58
Kazakhstan	7.77	Belarus	6.12
Kyrgyzstan	6.43	Kazakhstan	5.81
Russia	5.88	Russia	5.54
Belarus	5.44	Kyrgyzstan	4.20

Source: the authors' calculations were based on the official data from the World Bank. Retrieved from: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD (Accessed: 17.08.2021)

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Table 6

Ranking of the countries according to the stability of their raw materials, transaction and manufacturing sectors' contribution to economic growth

Country	Raw materials sector	Country	Manufacturing sector	Country	Transaction sector
Armenia	2.22	Armenia	3.72	Kazakhstan	3.93
Kazakhstan	1.48	Belarus	3.58	Armenia	3.72
Kyrgyzstan	0.79	Kyrgyzstan	2.52	Russia	2.92
Belarus	0.60	Kazakhstan	1.35	Kyrgyzstan	2.93
Russia	0.50	Russia	1.26	Belarus	2.21

Source: the authors' calculations were based on the official data from the World Bank. Retrieved from: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD (Accessed: 17.08.2021)

Table 7

Ranking of the countries according to the stability of GDP growth rate (by sector)

Country	Calculated	Country	Empirical data
Armenia	9.30	Armenia	9.58
Kazakhstan	7.77	Belarus	6.12
Belarus	6.43	Kazakhstan	5.81
Russia	5.88	Russia	5.54
Kyrgyzstan	5.44	Kyrgyzstan	4.20

Source: the authors' calculations were based on the official data from the World Bank. Retrieved from: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD (Accessed: 17.08.2021)

We use standard deviation as a measure of risk of growth volatility in sectors' contributions to GDP growth rates in the EurAsEC in 2001–2018 (see Fig. 10). The risk is calculated as the standard deviation of the sector's contribution and growth rate of GDP, in percentage. Among the member countries, Armenia has the highest risk level in the raw materials and manufacturing sectors as well as in terms of GDP growth. Russia is characterized by the highest risk in the transaction sector. A similar level is characteristic of Kazakhstan – 2.3%.

Thus, Armenia demonstrates very unstable dynamics in manufacturing and in general economic development (shown by the stability coefficient and development risk).

The average risks of the contribution of the GDP component to GDP growth and the GDP growth rate in the EurAsEC countries in 2001–2019 are shown in Fig. 11. It is clear that Kyrgyzstan has the greatest risk in consumer spending, investment spending and net exports. However, in terms of the stability coefficient, Kyrgyzstan showed a very decent result when evaluated by sectors. Thus, there is a discrepancy not only in the empirical data and calculated estimates, but also in the assessment of structural dynamics by sectors

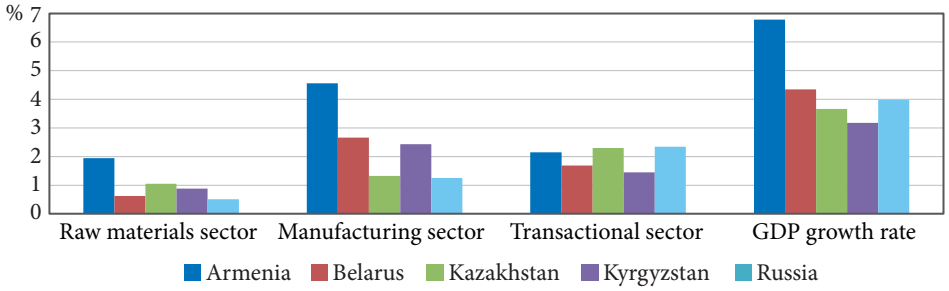

Figure 10. *Standard deviation (risk) of the sectors' contributions to GDP growth in member countries of the EurAsEC, 2001–2018*

Source: the authors' calculations were based on the official data from the World Bank. Retrieved from: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD (Accessed: 17.08.2021)

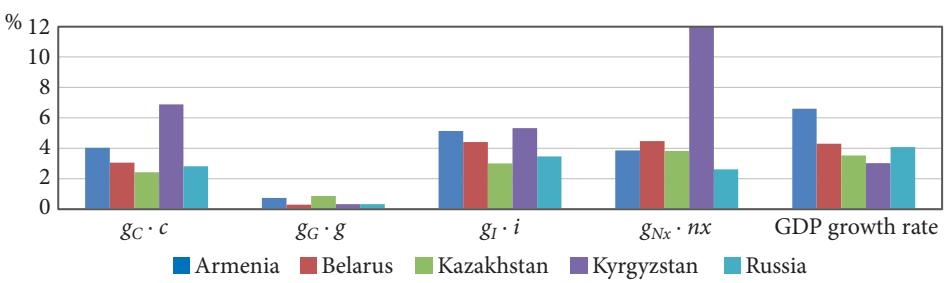

Figure 11. *Risks of the contribution of the GDP component by expenditure and GDP growth rate, 2001–2019*

Source: the authors' calculations were based on the official data from the World Bank. Retrieved from: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD (Accessed: 17.08.2021)

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and expenditure. Moreover, risk assessment may differ from the assessment made with the help of the stability coefficient. The risk may be high if the dynamics is relatively stable.

Let us now analyze the impact of some macroeconomic policy instruments on the growth rate (y) of the EurAsEC. The parameters of interest include the following: the price of Brent (brent), the key interest rate (i), the level of monetization ($M3/Y$, Y is GDP, $M3$ is money supply), and inflation (inflation). We use the Gretl 2020b software module to build a multiple regression of the growth rate for each of the countries, having 20 observation points (2000–2019), using the least squares method to obtain the regression, selecting a model with the best statistics (see Tables 7–11).

The selected models were tested and selected according to the Gretl 2020b software package, taking into account the tests shown in Appendices 1–2, to determine autocorrelation and heteroscedasticity and to evaluate the normal distribution.

Using a set of hypotheses (Greene, 2002), we test the regression models for their quality. The adequacy of the regression model to empirical data is checked based on the analysis of residuals. The analysis of the residuals shows how well the model is selected and how well the method of estimating the coefficients is chosen. According to the general assumptions of regression analysis, the residuals should behave as independent (in fact, almost independent), equally distributed random variables. The quality of regression models is estimated by the fulfillment of the OLS assumptions.

To test the regression for heteroskedasticity, the Breusch Pagan test was used. It is used if there is reason to believe that the error variance may depend on some set of observed variables. To check the first-order autocorrelation, the Breusch-Godfrey test is used, which is used to check the arbitrary-order autocorrelation in random errors of regression models. The test is asymptotic, meaning that a large sample size is required for the validity of the conclusions. To test these hypotheses, we constructed auxiliary regressions of the OLS residuals of the original model.

Table 1 in Appendix 1 presents the results of testing models (1)–(6) for heteroskedasticity using the Breusch Pagan test and first-order autocorrelation according to the Breusch-Godfrey test. The results confirm the hypothesis that all the models presented above are homoscedastic, since the critical chi-square value exceeds the test statistics in all cases. First-order autocorrelation tests confirm that there are no random errors in the autocorrelation models.

Figures 1–6 in Appendix 2 show the residue graphs for models (1)–(6). The selected regression models describe the dependence well, using independent, normally distributed random variables with zero mean, and there is no trend in their values.

To test the assumption of a normal distribution of errors, we construct normal distribution graphs based on point graphs (Fig. 7–12), on the vertical axis of which the values of the residuals are plotted, and on the horizontal axis – the corresponding quantiles of the standardized normal distribution. For the construction of these graphs, the values of the residuals are ordered in ascending order.

The data shown in Figure 7–12 does not differ too much from the normal distribution, since all points lie on or near the same straight line. The stability of the regression analysis and the small sample size suggest that the condition for the normal distribution of errors is slightly violated.

Figures 13–18 confirm that the resulting sample has a normal distribution.

The models selected according to the given criteria are arranged in alphabetical order: Armenia, Belarus, Kazakhstan, Kyrgyzstan, Russia, the models numbered from 2 to 6.

$$y_{Armenia} = 10.3 + 0.02 \cdot brent - 0.3 \cdot \% + 0.1 \cdot M3 / Y - 0.4 \cdot inflation; \quad (2)$$

$$y_{Belarus} = 15.3 + 0.1 \cdot brent + 1.1 \cdot M3 / Y - 0.1 \cdot inflation; \quad (3)$$

$$y_{Kazakhstan} = 107 + 0.3 \cdot brent - 1.8 \cdot \% + 2.3 \cdot M3 / Y - 2.5 \cdot inflation; \quad (4)$$

$$y_{Kyrgyzstan} = 0.01 - 0.0004 \cdot brent + 0.1 \cdot \% + 0.2 \cdot M3 / Y - 0.02 \cdot inflation; \quad (5)$$

$$y_{Russia} = 844 + 1.8 \cdot brent - 12.9 \cdot \% + 14.8 \cdot M3 / Y - 0.4 \cdot inflation. \quad (6)$$

Tables 1–5 (Appendix 3) by country confirm the significance of the models. The collinearity of the factors in the models were not found. The remaining criteria are shown in the tables and reflect the satisfactory selection of models from the point of view of statistical estimates.

Thus, the selected models adequately describe the real processes: the residuals are uncorrelated and normally distributed, the condition of homoscedasticity is met, i.e., all the residuals fit

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into a symmetric band relative to the zero line, then we can assume that the variance of the observation errors is constant.

The results are summarized in Table 8, which reflects the qualitative impact of the increasing parameters on the growth rate. If the impact is positive, it means that an increase in this parameter led to an increase in the growth rate. If the impact is negative, then, on the contrary, an increase in this parameter led to a fall in the growth rate. If the parameter had almost no impact, then the table adds a rating of weak positive or negative impact.

As can be seen from Table 9, a common sign of growth in the countries was the positive impact of the level of monetization on the growth rate. The increase in the price of oil contributed to the growth of the Russian economy. For other countries, this influence was negligible. For all of the countries, except for Belarus, the interest rate had a negative impact on the growth rate. Inflation had a weak negative impact on the economic growth in Russia but in Armenia and Kazakhstan an increase in inflation had a considerable negative impact on the growth rates. This difference is fundamental, since it means that these countries cannot pursue an identical policy in terms of curbing inflation, provided that a reduction in the interest rate stimulates growth and monetization in all of these countries. The reduced raw material component of growth for all the countries, with the exception of Russia, makes their growth independent of the oil prices.

Using panel data for five countries of the EurAsEC to estimate the contribution of the GDP component to the growth rate, we obtained the following model:

$$y = 0.77 \cdot g_C \cdot c + 1.26 \cdot g_G \cdot g + 0.91 \cdot g_I \cdot i + 0.69 \cdot g_{Nx} \cdot nx, \quad (7)$$

where y is the GDP growth rate; *C*, *i*, *g*, *nx* are the share of consumption, investment, government spending and net exports in GDP; *gC*, *gI*, *gG*, *gNx* are the growth rate of each of the GDP components by expenditure.

The best model showed a significant dependence of dynamics on fiscal policy and a very low dependence on net exports. Therefore, the trade relations of the Union countries are expected to develop further and their impact on the economic growth rate of the countries will also grow.

Table 8

Influence of the increasing parameters on the economic growth rates of the Union's member states, 2000–2019

Country	Oil prices	Interest rate	Level of monetization	Inflation
Armenia	Weakly positive	Negative	Positive	Negative
Belarus	Weakly positive	Absent	Positive	Weakly negative
Kazakhstan	Weakly positive	Negative	Positive	Negative
Kyrgyzstan	Weakly positive	Negative	Positively	Weakly negative
Russia	Positive	Negative	Positive	Weakly negative

Source: the authors' calculations were based on the official data from the World Bank.

Table 9

Statistics of the growth rate model of the Union member countries*

	Coefficient	Standart error	*t*-statistics	*p*-value	
Consumption	0.772508	0.0514548	15.01	< 0.0001	***
Government	1.25839	0.345555	3.642	0.0004	***
Investment	0.910725	0.0624419	14.59	< 0.0001	***
Nx	0.691936	0.0444464	15.57	< 0.0001	***

Average of the dependent variable	5.053740	Standard deviation of the dependent variable	4.670178
Sum of squared errors	346.7950	Standard error	1.952162
R^2	0.922530	R^2_{adj}	0.830848
$F(4, 90)$	270.9129	P-value (F)	1.23e-49
Loglikelihood function	–196.3049	Akaike criterion	400.6097
Schwartz criterion	410.8253	Hannan–Quinn Criterion	404.7376
Rho parametr	–0.064097	Durbin-Watson Statistics	2.046204

* The model was selected using the least squares method, 95 observations were used; 5 spatial objects were included, and the time series length was 19.

Source: the authors' calculations were based on the Gretl.

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The results also suggest that due to the differences in certain parameters and economic dynamics, it is yet impossible to apply the same tools as part of the macroeconomic policy for all the members of the Union.

Discussion

Armenia, Belarus, Kazakhstan, Kyrgyzstan and Russia have formed the Eurasian Economic Union in order to promote closer economic cooperation between the states. The Union, however, is going through a difficult period due to the marked deterioration in economic conditions as well as the ongoing conflict between Russia and Ukraine and the lack of the necessary level of trust between the member states (Mostafa and Mahmood, 2018).

After the financial crisis of 2015–2016, the fall in the oil prices and new sanctions imposed on Russia, the economies of the member countries experienced an economic downturn. The research on the Eurasian Union mainly focuses on the individual aspects of the integration – trade and customs, the effects of state ownership and business models on financial and capital stability of banks of the Union, the effect of sanctions on the economic leader of the Union – Russia, foreign economic activity or investment (Pak, 2019; Hartwell, 2013; Nurgaliyeva, 2016; Mostafa, 2013; Shibasaki et al., 2021; Saivetz, 2021; Galiakberov and Abdullin, 2014; Hale, 2010; Gurova et al., 2018; Zahorka and Sargsyan, 2014). At the same time, we have not found any works discussing the structural model of economic growth or its changes, especially involving comparative structural analysis of growth in the countries of the Eurasian Union. The lack of such research creates difficulties for the coordination of measures of macroeconomic policy, which has its own specific impact on the economies of member countries.

This study looked at the crises, especially currency crises in the member states, which affected these countries' competitiveness and trade relations, in the context of various measures for coordination of the member states' monetary policies within the Union. Moreover, unlike previous studies (see, e.g. Vinokurov et al., 2017), we included into our analysis the structure of economic growth and the impact of macroeconomic policy instruments on economic growth. The impact of the country's membership in the Eurasian Union was also estimated based on regression models, revealing low financial benefits and an increase in the trade deficit with Russia (Libman, 2006; Khitakhunov et al., 2017; Bayramov et al., 2019).

Structural analysis showed the difference in the current patterns of economic growth and regulatory methods applied in member countries. In contrast to other works (Bezrukov, 2018; Salnikov et al., 2016; Patalakh, 2018), which did not take into account the structure of growth, the impact of economic policies and stability of growth, our study investigates the structure of growth, the stability of growth rates and the influence of economic policies in the Union's member countries.

Conclusion

Our research findings can be summarized as follows.

First, the countries of the EurAsEC have different economic growth patterns, which can be seen from the analysis of their GDP dynamics, both in terms of expenditure and sectors.

Second, the stability of growth, as measured by each component of GDP or sector dynamics, also differs considerably. The Russian economy in 2001-2019 showed less stable growth than the economies of Kazakhstan and Kyrgyzstan, but more stable than the economies of Armenia and Belarus. This can be seen from the stability coefficient, which shows the magnitude of deviations when the relevant parameter fluctuates. The contribution of investment spending and gross consumption showed better stability in Kazakhstan than in other countries. The contribution of the raw materials sector was most stable in Belarus and Russia. However, the value of this contribution differs significantly. The spread of values characterizing the contribution of the manufacturing sector was smaller for Kazakhstan and Russia (the standard deviation is 1.3 for both countries). The transaction sector for Russia is the most unstable in terms of its contribution to the rate (the standard deviation is 2.4, while for other Eurasian countries it is lower).

There were also differences between the countries in terms of macroeconomic policy instruments. While the level of monetization had an equally strong impact on the countries' economies, inflation had a completely different impact: in Armenia and Kazakhstan it significantly slowed down growth, while in other countries it did not have an equal impact on the economic development. An increase in the interest rate,

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however, have always had a negative effect on the growth rate. The only country that was strongly affected by the oil prices was Russia.

Our analysis based on the proposed methodology has revealed the models of economic growth that affect the relationships between the member states of the Union. Since net exports do not determine the economic dynamics, there is a need for extra efforts on the part of member countries to stimulate trade within the Union, which was one of the Union's key goals.

These research findings can be useful for the development of the Union's strategy as they show the factors of structural dynamics and the impact of the countries' economic models on their cooperation. It is shown that coordinated macro-economic measures within the EurAsEC are required in order to ensure the Union's more balanced economic development. The question as to how the membership in the Union will affect the general dynamics of the member countries is open for debate and requires further research.

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ARTICLE INFO: received *August 18, 2021*; accepted *October 21, 2021*

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ИНФОРМАЦИЯ О СТАТЬЕ: дата поступления *18 августа 2021 г.*; дата принятия к печати *21 октября 2021 г.*

Appendix 1

Table 1

Test for heteroskedasticity and first-order autocorrelation in the EurAsEC countries

Country	Breusch-Pagan test		Breusch-Godfrey test	
	test statistics: LM	p-value	test statistics: LMF	*p*-value
Armenia	4.265364	0.371282	1.108738	0.31
Belarus	3.772477	0.437673	0.219447	0.647
Kazakhstan	3.286443	0.511083	9.771558	0.00744
Kyrgyzstan	3.824050	0.430341	0.811321	0.383
Russia	3.572844	0.466889	0.021520	0,886
EurAsEC countries	45.633547 (White test)	0.000032	20.7249	3.20236e-005

Source: the authors' calculations were based on the Gretl.

Online ISSN 2412-0731

Appendix 2

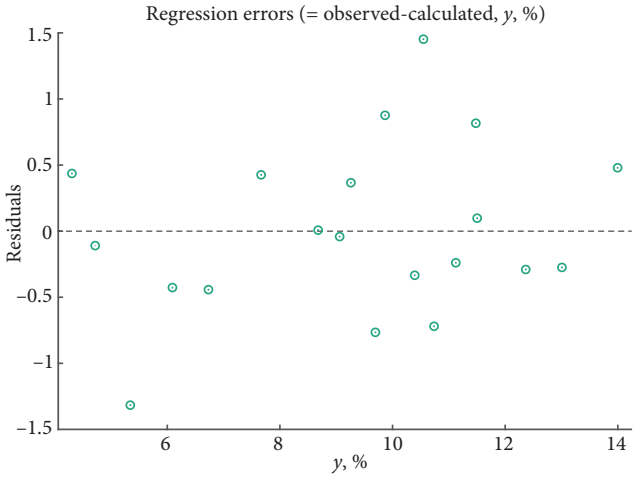

Figure 1. *Residuals in the model (Armenia)*
Source: the authors' calculations were based on the Gretl

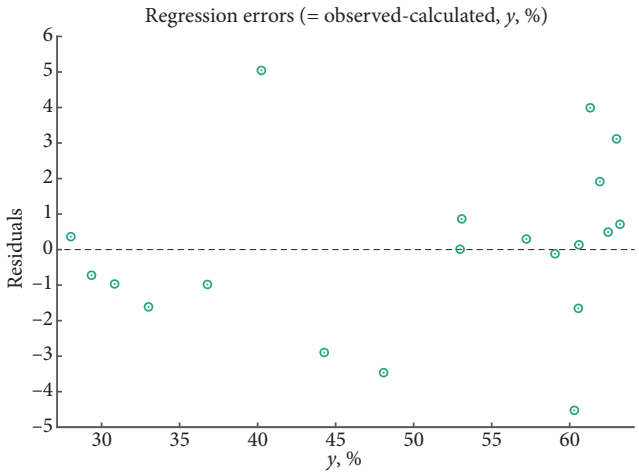

Figure 2. *Residuals in the model (Belarus)*
Source: the authors' calculations were based on the Gretl

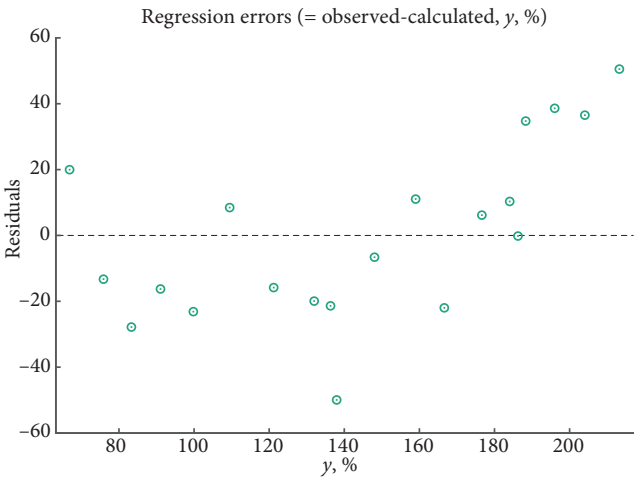

Figure 3. *Residuals in the model (Kazakhstan)*
Source: the authors' calculations were based on the Gretl

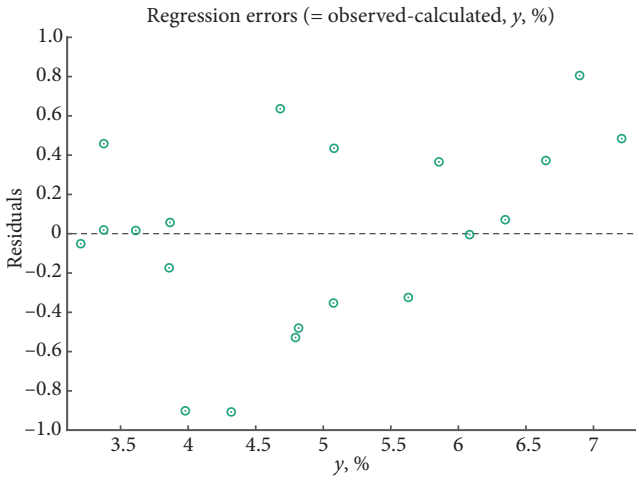

Figure 4. *Residuals in the model (Kyrgyzstan)*
Source: the authors' calculations were based on the Gretl

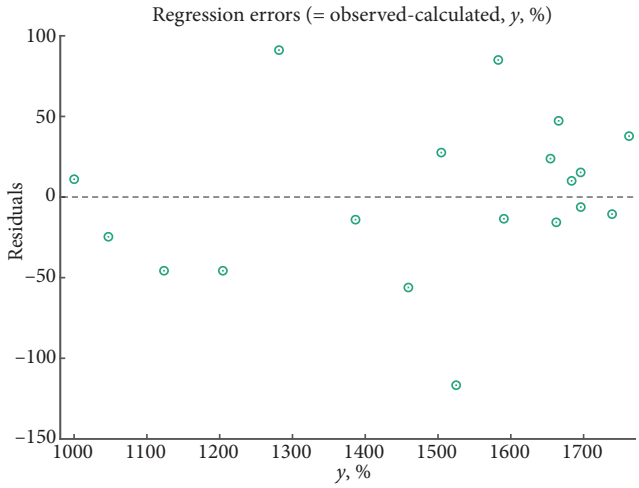

Figure 5. *Residuals in the model (Russia)*
Source: the authors' calculations were based on the Gretl

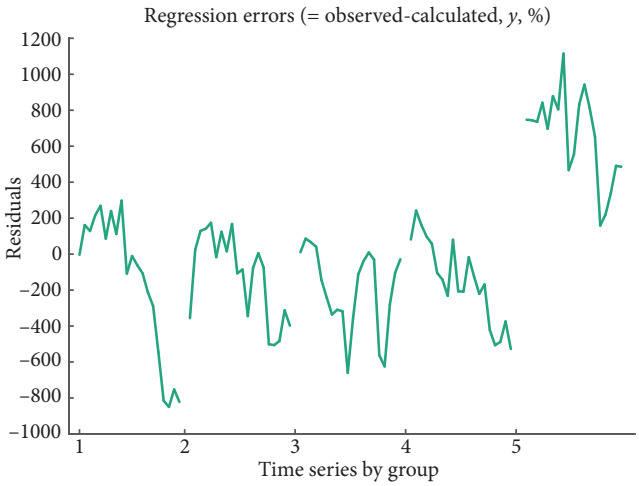

Figure 6. *Residuals in the model (EurAsEC countries)*
Source: the authors' calculations were based on the Gretl

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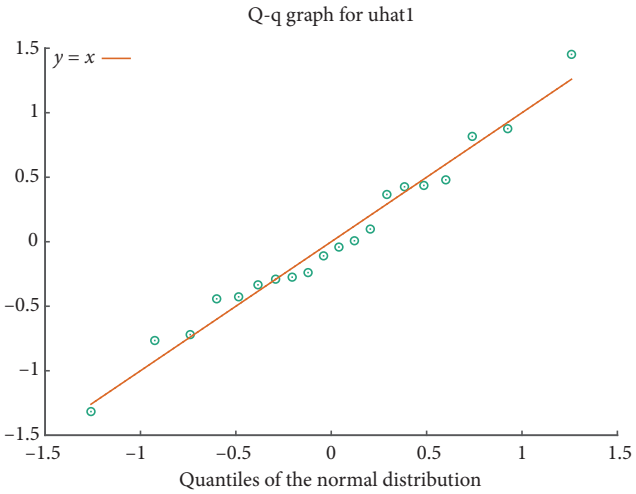

Figure 7. *Q-q plot for the model (Armenia)*
Source: the authors' calculations were based on the Gretl

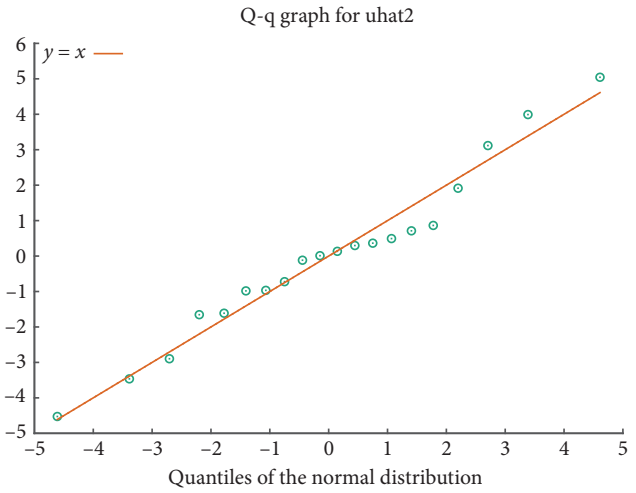

Figure 8. *Q-q plot for the model (Belarus)*
Source: the authors' calculations were based on the Gretl

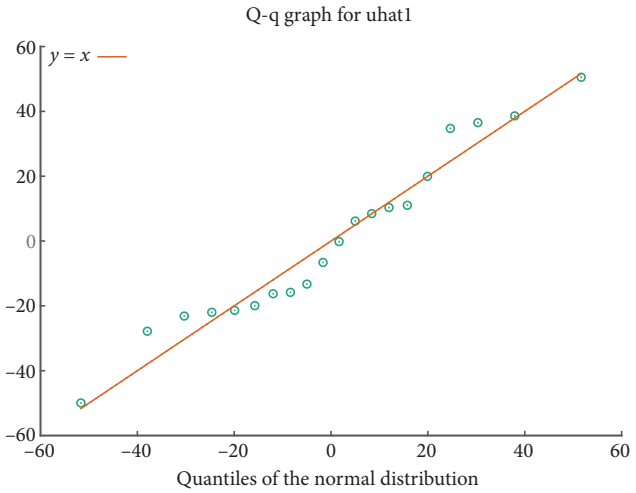

Figure 9. *Q-q plot for the model (Kazakhstan)*
Source: the authors' calculations were based on the Gretl

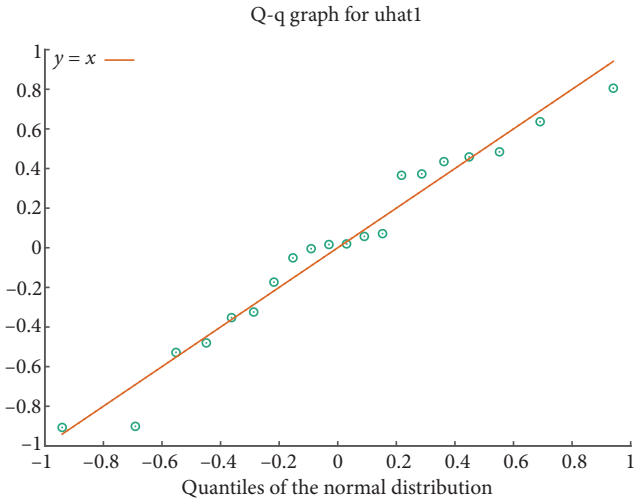

Figure 10. *Q-q plot for the model (Kyrgyzstan)*
Source: the authors' calculations were based on the Gretl

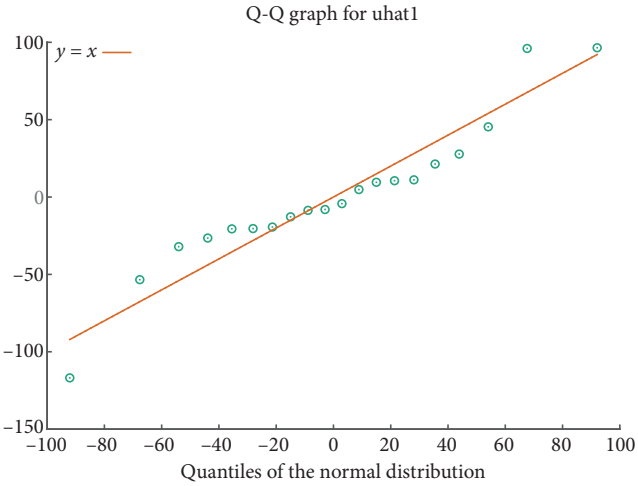

Figure 11. *Q-q plot for the model (Russia)*
Source: the authors' calculations were based on the Gretl

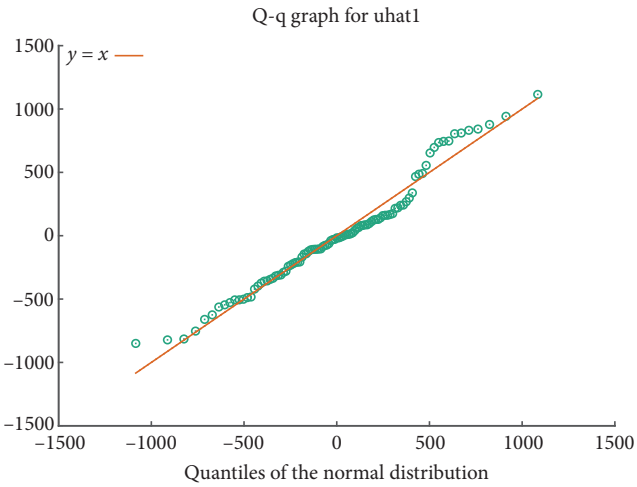

Figure 12. *Q-q plot for the model (EurAsEC countries)*
Source: the authors' calculations were based on the Gretl

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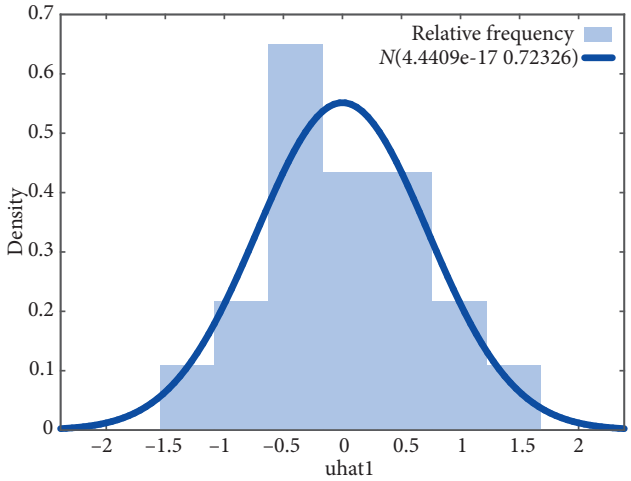

Figure 13. *Test for the normal distribution in the model (Armenia)*

Source: the authors' calculations were based on the Gretl

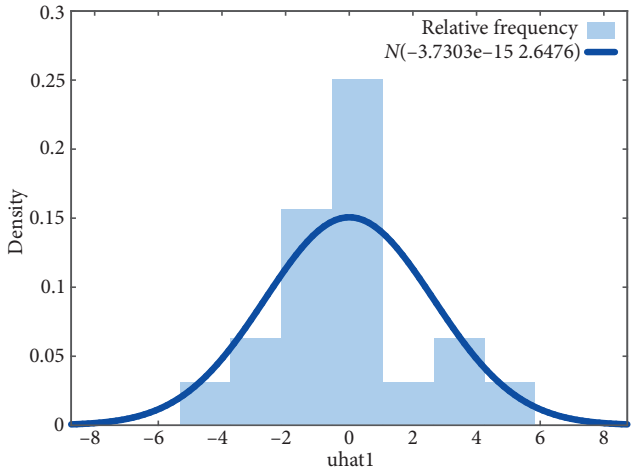

Figure 14. *Test for the normal distribution in the model (Belarus)*

Source: the authors' calculations were based on the Gretl

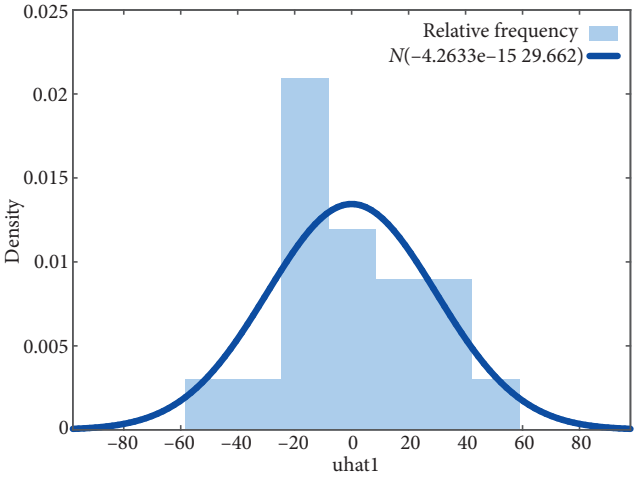

Figure 15. *Test for the normal distribution in the model (Kazakhstan)*

Source: the authors' calculations were based on the Gretl

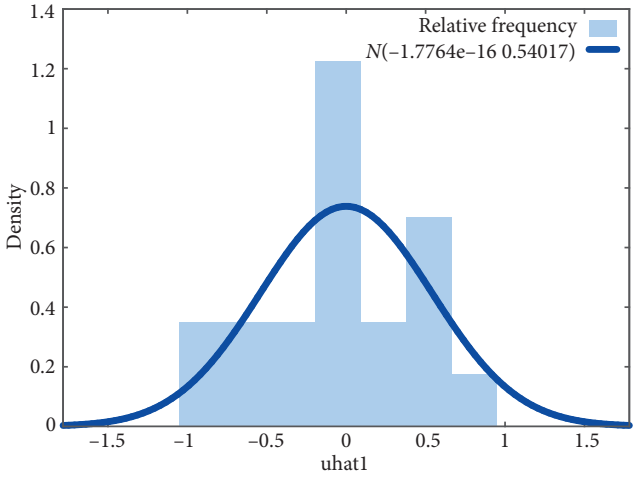

Figure 16. *Test for the normal distribution in the model (Kyrgyzstan)*

Source: the authors' calculations were based on the Gretl

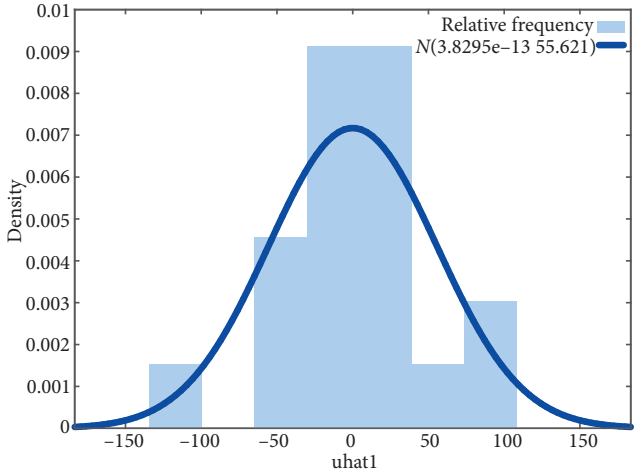

Figure 17. *Test for the normal distribution in the model (Russia)*

Source: the authors' calculations were based on the Gretl

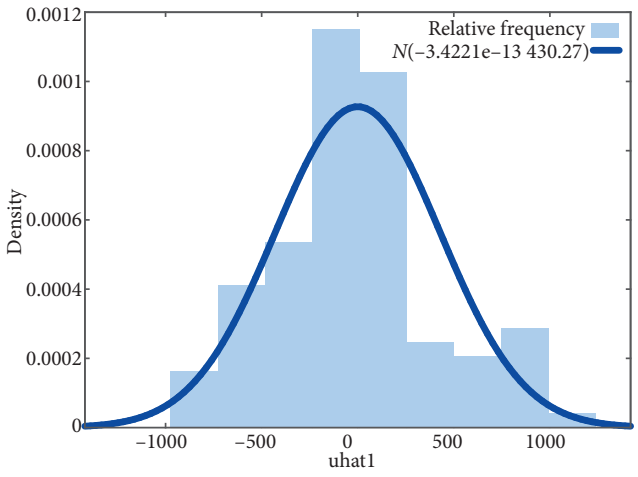

Figure 18. *Test for the normal distribution in the model (EurAsEC countries)*

Source: the authors' calculations were based on the Gretl

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Appendix 3

Table 1

Statistics of the Armenian growth rate model

	Coefficient	Standart error	*t*-statistics	*p*-value	
const	10.3191	2.13992	4.822	0.0002	***
Brent	0.0151948	0.00686416	2.214	0.0428	**
%	−0.274482	0.0676599	−4.057	0.0010	***
Broad money of GDP	0.120732	0.0290688	4.153	0.0008	***
Inflation	−0.373690	0.177579	−2.104	0.0526	*

*** – level of statistical significance 0.001; ** – level of statistical significance 0.05; * – level of statistical significance 0.01.

Average of the dependent variable	9.328621	Standard deviation of the dependent variable	2.762209
Sum of squared errors	7.846544	Standard error	0.723259
R^2	0.945873	R^2_{adj}	0.931440
$F(4, 15)$	65.53188	P-value (F)	2.56e-09
Log likelihood function	−19.02218	Akaike criterion	48.04436
Schwartz criterion	53.02302	Hannan–Quinn Criterion	49.01625
Rho parametr	0.270254	Durbin-Watson Statistics	1.421764

Source: the authors' calculations were based on the Gretl.

Table 2

Statistics of the Belarusian growth rate model

	Coefficient	Standart error	*t*-statistics	*p*-value	
const	15.3308	2.42285	6.328	< 0.0001	***
Brent	0.138603	0.0220748	6.279	< 0.0001	***
Broad money of GDP	1.06027	0.0934121	11.35	< 0.0001	***
Inflation	−0.0567762	0.0150982	−3.760	0.0017	***

Average of the dependent variable	50.31556	Standard deviation of the dependent variable	12.81771
Sum of squared errors	106.2658	Standard error	2.577133
R^2	0.965958	R^2_{adj}	0.959575
$F(3, 16)$	151.3344	P-value (F)	5.93e-12
Log likelihood function	−45.08089	Akaike criterion	98.16177
Schwartz criterion	102.1447	Hannan–Quinn Criterion	98.93928
Rho parametr	−0.079468	Durbin-Watson Statistics	2.153116

Source: the authors' calculations were based on the Gretl.

Table 3

Statistics of the Kazakhstan's growth rate model

	Coefficient	Standart error	*t*-statistics	*p*-value	
const	106.563	54.4100	1.959	0.0690	*
Brent	0.321985	0.263432	1.222	0.2405	
%	−1.83095	1.65542	−1.106	0.2861	
Broad money of GDP	2.31874	1.07418	2.159	0.0475	**
Inflation	−2.47042	1.10129	−2.243	0.0404	**

Average of the dependent variable	143.8082	Standard deviation of the dependent variable	45.45958
Sum of squared errors	13197.48	Standard error	29.66196
R^2	0.663886	R^2_{adj}	0.574256
$F(4, 15)$	7.406930	P-value (F)	0.001680
Log likelihood function	−93.29926	Akaike criterion	196.5985
Schwartz criterion	201.5772	Hannan–Quinn Criterion	197.5704
Rho parametr	0.652263	Durbin-Watson Statistics	0.724158

Source: the authors' calculations were based on the Gretl.

Table 4

Statistics of the Kyrgyz growth rate model

	Coefficient	Standart error	*t*-statistics	*p*-value	
const	0.0123861	0.941768	0.01315	0.9897	
Brent	−0.000358849	0.00625004	−0.05742	0.9550	
%	0.0607081	0.0350755	1.731	0.1040	
Broad money of GDP	0.155768	0.0233123	6.682	<0.0001	***
Inflation	−0.0197644	0.0230170	−0.8587	0.4040	

Average of the dependent variable	4.935439	Standard deviation of the dependent variable	1.255097
Sum of squared errors	4.376733	Standard error	0.540169
R^2	0.853768	R^2_{adj}	0.814773
$F(4, 15)$	21.89423	P-value (F)	4.05e-06
Log likelihood function	−13.18447	Akaike criterion	36.36895
Schwartz criterion	41.34761	Hannan–Quinn Criterion	37.34083
Rho parametr	0.156768	Durbin-Watson Statistics	1.649102

Source: the authors' calculations were based on the Gretl.

Table 5

Statistics of the Russian growth rate model

	Coefficient	Standart error	*t*-statistics	*p*-value	
const	877.087	163.215	5.374	<0.0001	***
Brent	1.79719	0.535905	3.354	0.0047	***
%	−12.8581	5.51088	−2.333	0.0351	**
Broad money of GDP	14.8467	1.85116	8.020	<0.0001	***
Inflation	−0.409906	3.06542	−0.1337	0.8955	

Average of the dependent variable	1487.630	Standard deviation of the dependent variable	244.2015
Sum of squared errors	43312.15	Standard error	55.62126
R^2	0.959650	R^2_{adj}	0.948122
$F(4, 14)$	83.24162	P-value (F)	1.34e-09
Log likelihood function	−100.4115	Akaike criterion	210.8229
Schwartz criterion	215.5451	Hannan–Quinn Criterion	211.6221
Rho parametr	0.030295	Durbin-Watson Statistics	1.905639

Source: the authors' calculations were based on the Gretl.

Online ISSN 2412-0731