SUMY STATE UNIVERSITY
DEPARTMENT OF MARKETING

**Oleksii Lyulyov, Tetyana Pimonenko, Yurii Bilan**

# PATH FROM ENVIRONMENTAL, SOCIAL, AND ECONOMIC CONTRADICTIONS TO CONVERGENT MODEL: FORECAST OF THE MACROECONOMIC STABILITY

**MONOGRAPH**

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**Monograph**

**2020**

**Reviewers:**

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Prof. Kobushko Ihor

Prof. László Vasa

This publication has been approved by the Editorial Board of the Centre of Sociological Research Publishing House to be issued as a scientific monograph.

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Centre of Sociological Research
Szczecin, 2020

**Bibliographic information of The National Library of Poland**

The National Library of Poland / Biblioteka Narodowa lists this publication in the Polish national bibliography; detailed bibliographic data are on the internet available at <https://www.bn.org.pl>.

ISBN: 978-83-952923-9-2

DOI: 10.14254/ 978-83-952923-9-2/2020

First edition, 2020
Publishing House: Centre of Sociological Research
http://www.csr-pub.eu
Szczecin, Poland 2020


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# INTRODUCTION

In the conditions of systemic transformation of the world economy the role of theoretical and methodological substantiation of macroeconomic stability of the national economy noticeably grows. With the current globalization processes and the negative consequences of the global financial recession, it becomes important to strengthen Ukraine's position in the international economy, find ways to revive its productive potential, further transformation in the socio-economic sphere, reforming the financial system. This includes, among other things, the development of concepts for the effective use of such macroeconomic regulators of the national economy, which would help to intensify the business activity of economic entities and accelerate economic growth. There is a need to develop such a long-term strategy of state building, which would be focused on accelerating the pace of economic development and at the same time providing funding for social guarantees. In connection with the above, there is also an urgent need to strengthen the role of macroeconomic regulation of the national economy to stabilize it and ensure the appropriate level of development.

Well-known domestic and Russian scientists, such as: A. Amosha, G. Balabanov, S. Bandur, V. Besedin, B. Burkinsky, devoted their works to the development of methodology and theory of macroeconomic stability of the national economy and economic regulation of complex socio-economic systems. Varnaliy, A. Galchinsky, V. Geets, S. Doroguntsov, M. Dolishniy, A. Epifanov, T. Zayats, S. Zlupko, S. Ilyashenko, B. Kvasnyuk, O. Lapko, E. Libanova, I. Lukinov , S. Levochkin, P. Melnyk, V. Palamarchuk, D. Stechenko, V. Tochilin, O. Chelintsev, M. Chumachenko and others. L. Abalkin, V. Amitan, O. Arkhipova, A. Baranovsky, P. Belova, I. Binko, E. Bukhvald, O. Vlasyuk, B. Gubsky, M. made a significant contribution to the study of the components of the

mechanism of macroeconomic regulation of national economy development. Yermoshenko, J. Zhalilo, M. Kyzym, O. Kyrylenko, O. Kuzmin, M. Makarenko, M. Malik, L. Melnyk, V. Muntian, G. Pasternak-Taranushenko, V. Stolyarov, L. Tarangul, O. Telizhenko and others.

Among the representatives of the Western neoclassical scientific school, which for a long time were looking for ways to effectively macroeconomic regulation of the national economy, it should be noted the research of J. Alexander, R. Barro, M. Bell, K. Blackburn, J. Boyd, J. Buchanan, R. Goldsmith, J. Greenwood, W. Edvares, D. Johnson, E. Domar, O. Jovanovich, S. Capasso, D. Campbell, R. Levine, R. Lucas, R. McKinnon, J. Martinez-Vazquez, J. Robinson, P. Romero, R. Solow, B. Smith, G. Feldman, R. Harrod, J. Schumpeter, and others.

The search for the concept of effective use of economic, and especially financial, levers of macroeconomic stability of the national economy to ensure a sustainable pace of socio-economic development of Ukraine and its regions continues to this day.

At the same time, despite significant scientific results, further improvement requires theoretical and methodological approaches to assessing and forecasting the socio-economic development of the state and regulating macroeconomic development of the national economy, improving mechanisms for its regulation, substantiation of relevant priorities, intensification of investment processes. Further research is also needed in the preconditions and logic of the development of macroeconomic regulation in order to strengthen the national economy and other complex socio-economic systems. The system of financial support for macroeconomic regulation of the national economy also remains imperfect. Theoretical and practical problems of this nature have become decisive in substantiating the relevance of the research topic, determined its purpose, objectives and content.

# Chapter 1. Development of EU country and Ukraine: macroeconomic indicators

The research conducted in the previous sections confirms the relationship between the level of macroeconomic stability and economic growth of the country. In addition, the results of the analysis of methods for calculating world indices that determine the place and role of the country on the world stage (Global Competitiveness Index, World Competitiveness Yearbook, Ease of Doing Business Index, Human Development Index, Hunger Index, IT Competitiveness Index, International Property Index, Index corruption, the country's Environmental Efficiency Index, the Sustainable Development Index, etc.) show that all these indices contain a set of indicators that characterize the country's macroeconomic stability.

In order to determine Ukraine's place in the world market and identify weaknesses that hinder the economic growth of the national economy, the importance of Ukraine was analyzed by indices: global competitiveness, ease of doing business, corruption, and social progress for Ukraine and world leaders.

The results of the study show that according to a number of world indices shown in Figures 1.1-1.2, Ukraine ranks last. At the same time, the weakest points of Ukraine are:

- low values of macroeconomic indicators;
- low level of trust in the government;
- high level of corruption in the country, etc.

Thus, the results of the study show that the highest levels of corruption are in such countries as India, China and Ukraine. At the same time, Denmark, Switzerland and Sweden have the lowest levels of corruption.

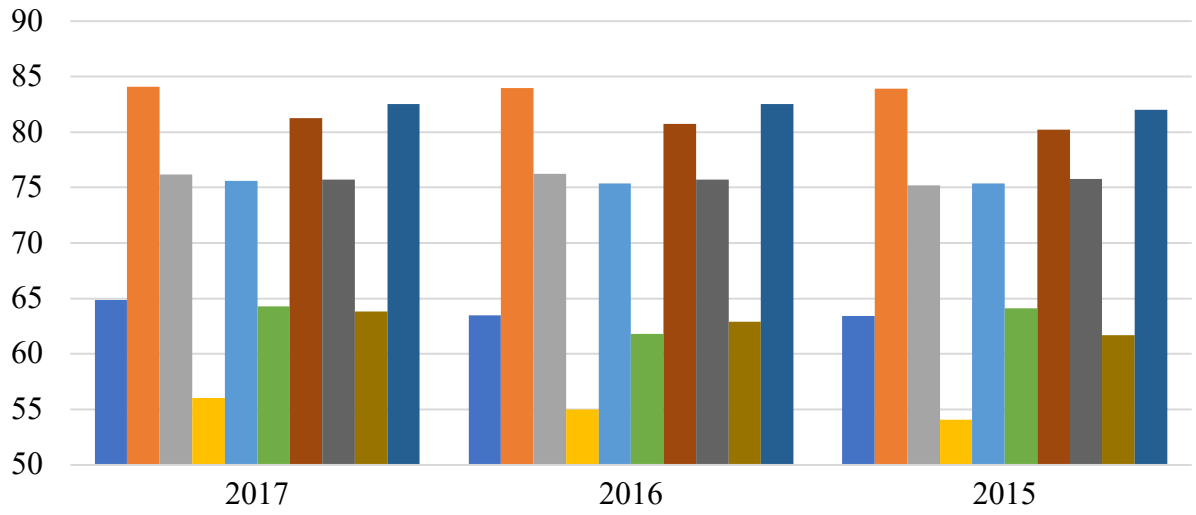



Figure 1.1 - Dynamics of the ease of doing business index 2015-2017

Source: systematized and based on (World Economic Forum, 2018)

The analysis of the main macroeconomic indicators of economic development of Ukraine for 2007-2017 shows the systemic and structural nature of the crisis in which the national economy operates.

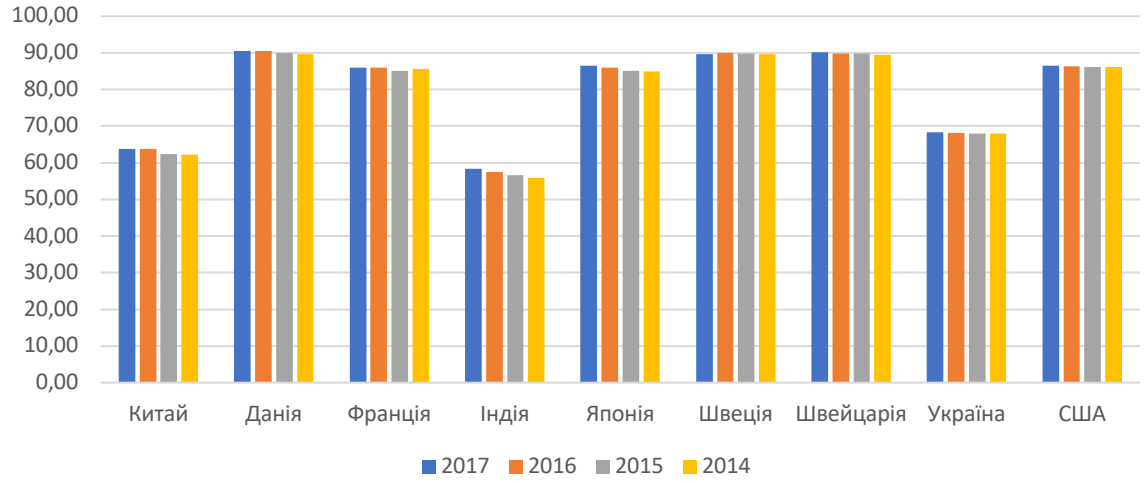



Figure 1.2 - Dynamics of the social progress index 2014-2017

Source: systematized and built on (Social, 2018)

In the analyzed period, the ratio of public debt to GDP showed a rapid increase in annual budget debt, both in absolute and relative terms (Table 1.1).

Table 1.1

Dynamics of indicators of macroeconomic stability of Ukraine

| Indicators-indicators | Year | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 2007 | 2009 | 2011 | 2013 | 2014 | 2015 | 2016 | 2017 |
| Public direct and guaranteed debt: in billion UAH in% to GDP | 88.7 12.3 | 317.9 35.3 | 473.1 36.3 | 584.4 40.6 | 1100.8 70.3 | 1571.8 79.4 | 1929.7 81.0 | 2141.6 71.8 |
| Deficit (-) / surplus (+) of the State Budget of Ukraine: in billion UAH in% to GDP | -9.8 1.4 | -35.5 3.9 | -23.6 1.8 | -64.7 4.4 | -78.1 5 | -45.1 2.28 | -70.1 2.94 | -45.1 1.60 |
| Average annual growth rate of inflation index,% | 112.8 | 115.9 | 108.0 | 99.7 | 112.8 | 148.7 | 113.9 | 114.4 |
| GDP,% to the previous year | 108.2 | 84.9 | 105.5 | 100.0 | 93.4 | 90.2 | 101.5 | 102.5 |

Source: calculated d by the authors.

However, until 2014, the corresponding increase did not lead to overcoming the maximum allowable value of Ukraine's public debt-to-GDP ratio at 60% in accordance with the Maastricht criteria and corresponded to the trends of the Eurozone countries (Fig. 1.3).

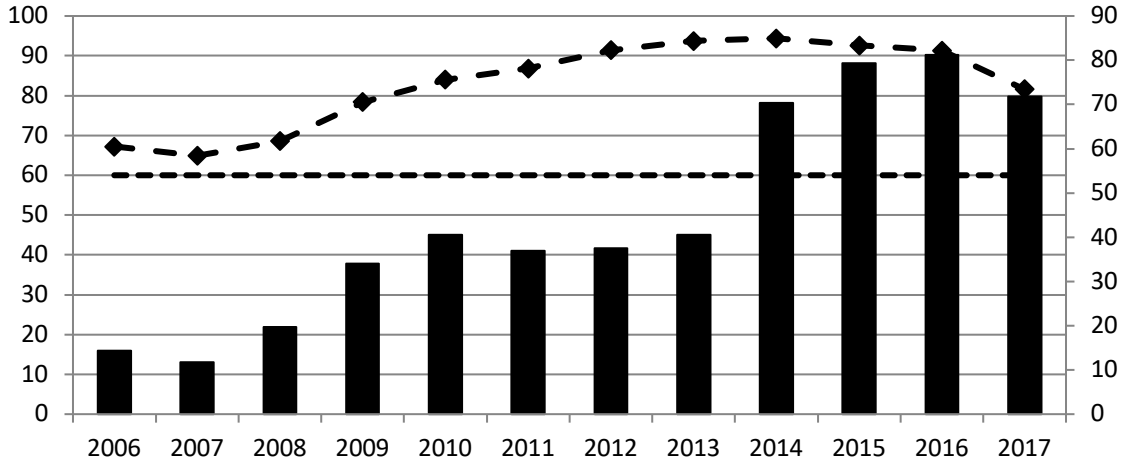



Figure 1.3 - The trend of changes in the ratio of public debt to GDP

The growth of public debt is a consequence of the growing state budget deficit, on the one hand, and low nominal GDP growth on the other. The state budget is a reflection of the economic situation in the country, so the creation, adoption and implementation is not only in the interests of the executive and legislature, but also in the interests of economic entities and the public.

As can be seen from Figure 1.4, the dependence of the amount of public debt on the size of the state budget deficit is 89% (the coefficient of determination is R2 = 0.89), and only 11% - the influence of other factors.

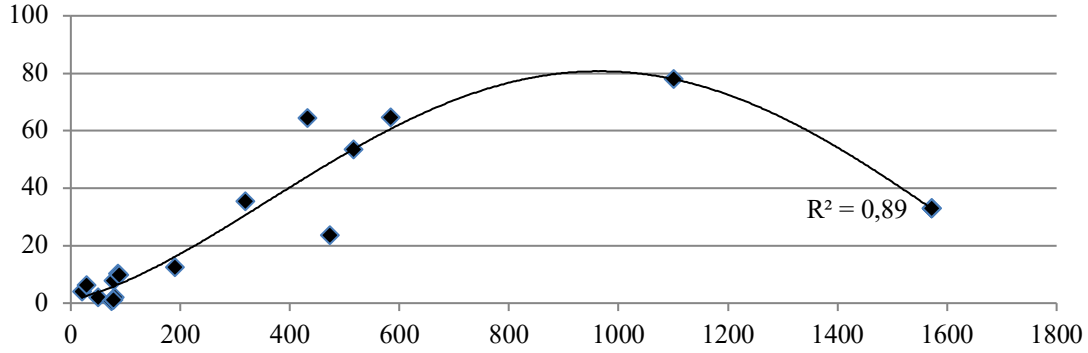



Figure 1.4 – Dependence of the amount of public debt of Ukraine on the volume of the state budget deficit of Ukraine in the period from 1996-2017.

Source: calculated and constructed by the author according to the data (State Statistics Service of Ukraine, 2018)

The ratio of public debt deficit to GDP does not have a destabilizing effect on the country's economy if it does not exceed the threshold of 3% of GDP, but in 2014 the State Budget deficit of Ukraine more than seven times exceeded its volume in 2007 and amounted to UAH 78.1 billion. or 5% of GDP (State Statistics Committee of Ukraine, 2018). The sharp change in the dollar in the winter of 2015 led to a decrease in nominal GDP growth by 41190 million US dollars or 31.3% from the previous 2014. At the same time, Ukraine's share in world GDP compared to 1990 for the period 2010-2014 decreased by almost three times and amounted to 0.38% and this is one of the worst indicators among the post - Soviet countries (Zgurovsky, 2015). At the same time, real GDP in 2015

decreased by 9.9%, while in the European Union (EU-28) this indicator increased by 1.8%, and in the Eurozone - by 1.5% (State Statistics Service of Ukraine, 2018). One of the key indicators of oversaturation of the country's economy with money supply, which does not correspond to the real volume of trade is the rate of inflation. An increase in this indicator leads to the depreciation of the currency and a gradual rise in prices. According to the Ministry of Finance of Ukraine, the dynamics of the average annual growth rate of the inflation index in the period from 2000 to 2015 is typical for creeping and galloping inflation, from 0.8% in 2002 to 48.7% in 2015. It should be noted that the peaks of inflation coincide with the simultaneous decrease in GDP growth (Figure 1.5), which coincides with the peaks of financial, political and economic instability in 2004, 2007 and 2014-2015. According to advanced research by a number of domestic and foreign scientists, the European integration processes that have already begun in Ukraine are one of the ways to restore the country's macroeconomic balance, overcome its technological backwardness, and open access to new sources of foreign investment.

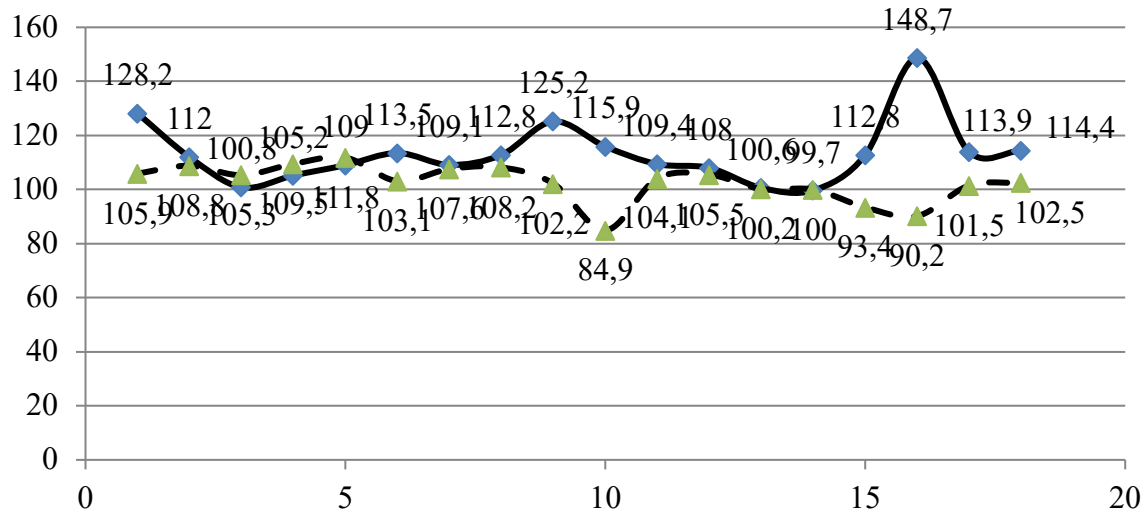



Figure 1.5 - Dynamics of the inflation and GDP index in Ukraine

Source: calculated and constructed by the author according to the data (State Statistics Service of Ukraine, 2018)

In particular, after joining the EU in 2004, the average annual growth rate of the Estonian economy began to grow rapidly, primarily due to the inflow of new foreign investment. Since 2008, the Estonian economy has been characterized by negative trends related to the global financial and economic crisis. Thus, there was a decline in GDP (Figure 1.6) and industrial production, which also affected Estonia's position in the Global Competitiveness Index, in 2006 Estonia ranked 25th [394], and in 2008 lost 7 positions - 32nd [396].

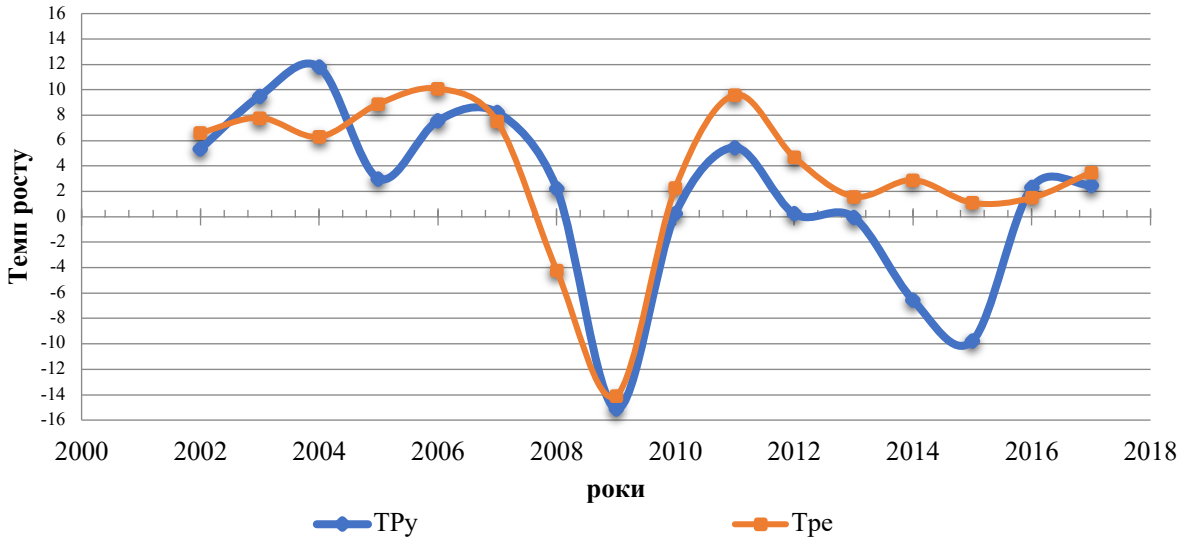



Figure 1.6 - GDP growth rates of Estonia and Ukraine 2002-2017

Source: built by the authors on the basis of data (World Bank, 2017)

Such negative changes have provoked the Estonian government to take appropriate action. First of all, a study commissioned by the State Development Fund "Estonia's Competitiveness Now and in the Future" was conducted by a group from the University of Tartu. The results of the study showed that Estonia is developing in the economic way of Greece, ie preferences were given to hotel services, trade and unproductive construction, rather than industry, financial intermediation and high-performance commercial services. The obtained results

became the basis for the development and implementation of relevant reforms to reorient the development of Estonia.

Thus, according to official statistics, in the period from the 3rd quarter of 2009 until the 4th quarter of 2010 there was a consistent growth of GDP. Real exports in the 4th quarter of 2010 increased by 53%. In 2010, GDP growth was 3.1%. Thus, in 2010, the Estonian economy emerged from the crisis. Estonia's accession to the EU has been a major catalyst for economic reorganization, deep reforms and economic growth. The experience of the Visegrad Group countries (Czech Republic, Hungary, Poland, Slovak Republic) also shows the positive impact of their integration into the EU (2004) - a significant increase in GDP compared to 2000 (Table 1.6).

Table 1.6

Comparative dynamics of GDP in Ukraine, Moldova and the Visegrad Four countries (compared to 2000),%

| **Country** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** |
|---|---|---|---|---|---|---|---|---|---|
| Moldova | 6% | 14% | 22% | 31% | 41% | 48% | 52% | 64% | 54% |
| Czech Republic | 3% | 5% | 9% | 14% | 21% | 30% | 37% | 40% | 34% |
| Hungary | 4% | 9% | 13% | 18% | 23% | 28% | 29% | 30% | 21% |
| Poland | 1% | 3% | 6% | 12% | 16% | 23% | 32% | 37% | 41% |
| Slovakia | 3% | 8% | 14% | 20% | 27% | 38% | 53% | 62% | 53% |
| Ukraine | 9% | 15% | 26% | 41% | 45% | 55% | 68% | 71% | 46% |
| **Country** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | |
| Moldova | 65% | 76% | 74% | 91% | 100% | 99% | 111% | 109% | |
| Czech Republic | 37% | 39% | 38% | 37% | 40% | 46% | 40% | 39% | |
| Hungary | 22% | 24% | 22% | 24% | 29% | 33% | 30% | 31% | |
| Poland | 46% | 53% | 55% | 57% | 63% | 68% | 57% | 57% | |
| Slovakia | 61% | 65% | 68% | 70% | 75% | 81% | 77% | 78% | |
| Ukraine | 52% | 60% | 60% | 60% | 50% | 35% | 14% | 15% | |

*Color - after the integration period*

Source: built by the author based on (World Bank, 2017)

At the same time, according to the report on the global competitiveness of the World Economic Forum (World Economic Forum, 2018), the value of GDP

per capita in Ukraine in 2017 at the level of 2639.82 dollars. USD (2016 - USD 2185.72, 2015 - USD 2124.66), indicates that the national economy is in transition from a resource-oriented to an efficiency-oriented economy which by 40-60% depends mainly on basic factors competitiveness:

– institutes;
– infrastructure;
– macroeconomic stability;
– health care and primary education (Table 1.7).

Table 1.7

Classification of factors of the Global Competitiveness Index according to the methodology of the World Economic Forum

| **GLOBAL COMPETITIVENESS INDEX** | | | | | |
|---|---|---|---|---|---|
| Basic factors: | | Efficiency factors: | | Innovative factors: | |
| – institutes;<br>– infrastructure;<br>– macroeconomic stability;<br>– health care and primary education | | – higher professional education;<br>– labor market efficiency;<br>– financial market development | | – business competitiveness;<br>– innovation | |
| Resource-oriented economy | | Effectively oriented economy | | Innovative economy | |
| **STAGES OF COMPETITIVENESS DEVELOPMENT** | | | | | |
| | **AND** | **I → II** | **II** | **II → III** | **III** |
| GDP per capita, dollars USA | <2,000 | 2,000–2,999 | 3,000–8,999 | 9,000–17,000 | > 17,000 |
| weight for basic factors | 60% | 40-60% | 40% | 20-40% | 20% |
| weight for efficiency factors | 35% | 35-50% | 50% | 50% | 50% |
| weight for innovative factors | 5% | 5-10% | 10% | 10-30% | 30% |

Source: developed by the author based on (World Economic Forum, 2018)

According to the Global Competitiveness Reports, the World Economic Forum (WEF) defines competitiveness as “the set of institutions, policies and production factors that shape a country’s productivity” (World Economic Forum, 2018).The main components of the Global Competitiveness Index (GCI) are 12 groups of factors that determine national competitiveness: government institutions, infrastructure, CU, health and primary education, higher education

and training, efficiency of commodity markets, labor market efficiency , development of financial markets, technological readiness, market size, compliance of business with modern requirements, innovations. Thus, productivity can be seen in the context of the ability of countries to maintain a stable level of prosperity in the economy, market advantage in the acquisition of factors of production and the ability to produce higher levels of income for their citizens. One of the strategic indicators of the implementation of the Sustainable Development Strategy "Ukraine 2020" is the entry into the 40 best countries in the world according to the Global Competitiveness Index (Sustainable Development Strategy "Ukraine 2020", 2015). However, according to the Global Competitiveness Report 2017-2018, Ukraine dropped by 30 points (121st place) in terms of macroeconomic stability compared to 2008-2009 (91st place), losing an average of 3 positions in each annual Global Competitiveness Rating Report. countries (Fig. 1.7).

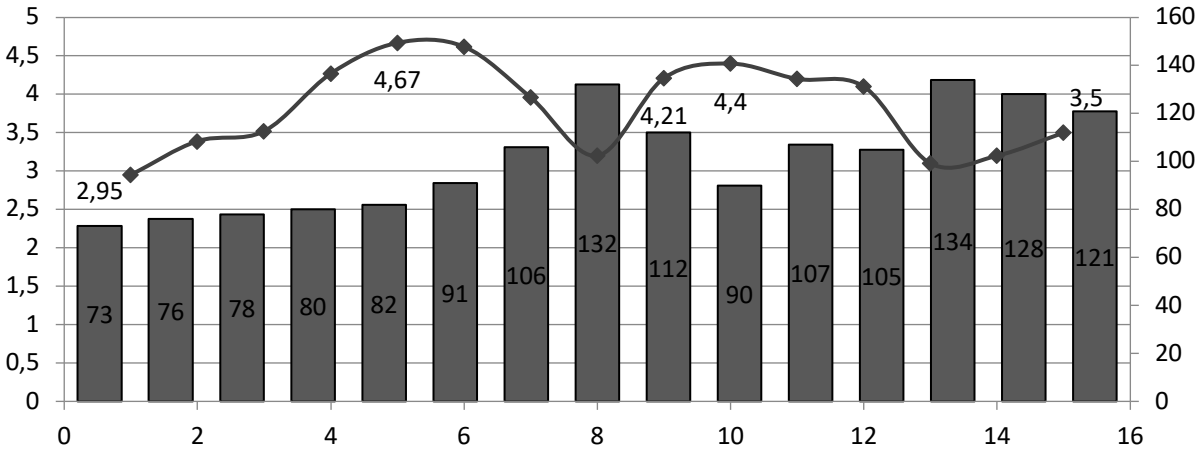



Figure 1.7 - Dynamics of the sub-index of macroeconomic stability of Ukraine according to the rating of global competitiveness, according to reports 2000-2018.

Source: developed by the author based on (World Economic Forum, 2018)

In general, according to the index of global competitiveness of the national economy, Ukraine took 81st place among 137 countries, losing 9 positions (72nd place) compared to the report of 2008-2009, 2014-2015 - 5 positions (76th place) (World Economic Forum, 2018) .

One of the main deterrents to increasing the level of competitiveness was the macroeconomic stability of the national economy, which for the last 15 observations had an upward trend (Fig. 1.8).

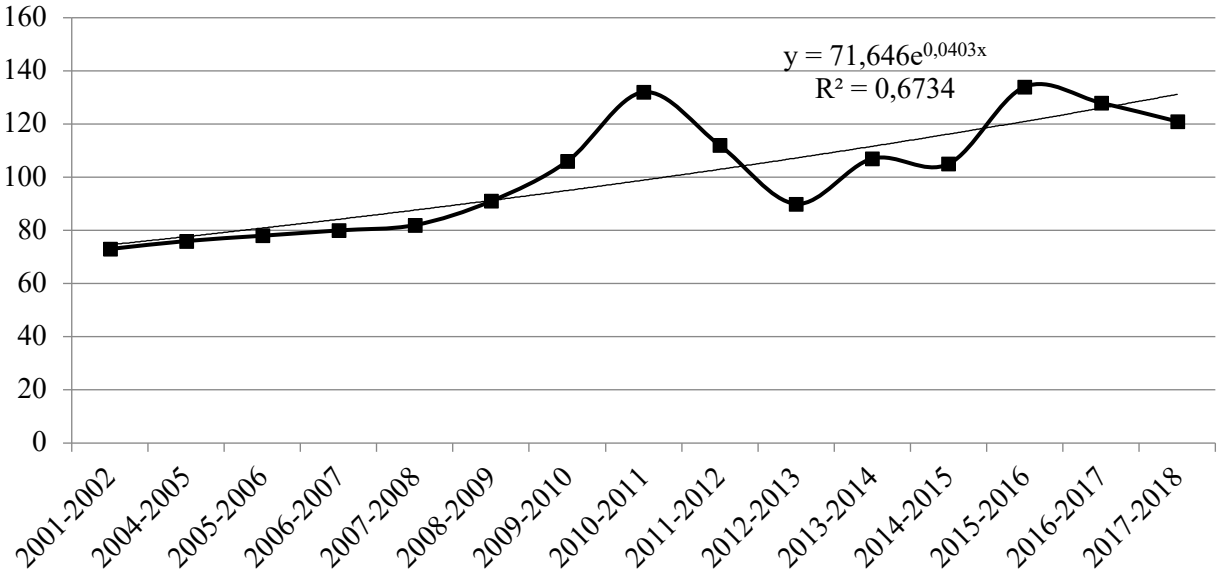



Figure 1.8 - Trend of changes in the sub-index "macroeconomic stability" for Ukraine in the period from 2000-2016.

Source: built by the author based on (World Economic Forum, 2018).

The analysis of the components of the Global Competitiveness Index of Ukraine (Table 1.8.) Showed the inconsistency of the existing trends of sub-indices. State institutions, infrastructure, efficiency of commodity markets, development of financial markets, development of financial markets, technological readiness, and compliance of business with modern requirements have the most stable dynamics, which is characterized by insignificant variation of features, within 10%.

Table 1.8

Changes in Ukraine's international competitiveness indicators

| | 2013–2014 Rank (out of 148 countries) / Rating (1-7) | 2014–2015 Rank (out of 144 countries) / Rating (1-7) | 2015–2016 Rank (out of 140 countries) / Rating (1-7) | 2016–2017 Rank (out of 138 countries) / Rating (1-7) | 2017–2018 Rank (out of 137 countries) / Rating (1-7) | Average value Rank / Rating | Standard deviation Rank / Rating |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| GCI | 84 / 4.1 | 76 / 4.1 | 79 / 4.0 | 85 / 4.0 | 81 / 4.1 | 81 / 4.06 | 3.67 / 0.05 |
| State institutions | 137 / 3.0 | 130 / 3.0 | 130 / 3.1 | 129 / 3.0 | 118 / 3.2 | 129 / 3.06 | 6.83 / 0.09 |
| Infrastructure | 68 / 4.1 | 68 / 4.2 | 69 / 4.1 | 75 / 3.9 | 78 / 3.9 | 72 / 4.04 | 4.62 / 0.13 |
| ***Macroeconomic stability*** | ***107 / 4.2*** | ***105 / 4.1*** | ***134 / 3.1*** | ***128 / 3.2*** | ***121 / 3.5*** | ***119 / 3.62*** | ***12.75 / 0.51*** |
| Health care and primary education | 62 / 5.8 | 43 / 6.1 | 45 / 6.1 | 54 / 6.0 | 53 / 6.0 | 51 / 6.0 | 7.64 / 0.122 |
| Higher education and professional training | 43 / 4.7 | 40 / 4.9 | 34 / 5.0 | 33 / 5.1 | 35 / 5.1 | 37 / 4.96 | 4.30 / 0.17 |
| Efficiency of commodity markets | 124 / 3.8 | 112 / 4.0 | 106 / 4.0 | 108 / 4.0 | 101 / 4.0 | 110 / 3.96 | 8.67 / 0.09 |
| Labor market efficiency | 84 / 4.2 | 80 / 4.1 | 56 / 4.3 | 73 / 4.2 | 86 / 4.0 | 76 / 4.16 | 12.13 / 0.11 |
| Development of financial markets | 117 / 3.5 | 107 / 3.5 | 121 / 3.2 | 130 / 3.0 | 120 / 3.1 | 119 / 3.26 | 8.28 / 0.23 |
| Technological readiness | 94 / 3.3 | 85 / 3.5 | 86 / 3.4 | 85 / 3.6 | 81 / 3.8 | 86 / 3.52 | 4.76 / 0.19 |
| Market size | 38 / 4.6 | 38 / 4.6 | 45 / 4.5 | 47 / 4.4 | 47 / 4.5 | 43 / 4.52 | 4.64 / 0.08 |
| Compliance of business with modern requirements | 97 / 3.7 | 99 / 3.7 | 91 / 3.7 | 98 / 3.6 | 90 / 3.7 | 95 / 3.68 | 4.2 / 0.04 |
| Innovations | 93 / 3.0 | 81 / 3.2 | 54 / 3.4 | 52 / 3.4 | 61 / 3.4 | 68 / 3.28 | 17.99 / 0.18 |

Source: built by the author based on (World Economic Forum, 2018)

However, the average value of the rank for most of these components of the Competitiveness Index of Ukraine was assessed as weak: state institutions - 129th place, commodity markets efficiency - 110th place, financial markets development - 119th place, business compliance with modern requirements - 95th place, technological readiness - 86th place . At the same time, the most restraining components of Ukraine's rating growth over the past 5 years have been state institutions, macroeconomic stability and the development of financial markets.

Of all the components of the Competitiveness Index of Ukraine, only higher education and training corresponded to the above strategic indicator of the implementation of the Sustainable Development Strategy "Ukraine 2020" (average rank in the world - 37th place). At the same time, according to the WEF Global Competitiveness Report 2017-2018, the most restraining components of the rating growth were state institutions (118th place out of 137 countries assessed or 3.2 points out of 7 possible), macroeconomic stability (121- e place or 3.5 points) and the development of financial markets (120th place or 3.1 points).

Achieving the goals of the implementation of the Sustainable Development Strategy "Ukraine 2020" requires a balanced development of the national economy in all components of the Global Competitiveness Index. Therefore, securing 40th place in the macroeconomic stability rating requires Ukraine to reach a level of approximately 5.22 with this sub-index, which is 1.6 more than the existing level. According to this index, Ukraine achieved the largest growth in 2010-2011 - 1.01, but such dynamics was observed only simultaneously throughout the study period.

On average, the sub-index of macroeconomic stability grows annually for Ukraine by only 0.03 points. Therefore, reaching the target value of 5.22 points under the optimistic scenario (growth of 1.01 points per year) will take 2 years to meet the goals of the Sustainable Development Strategy "Ukraine 2020", and in

the case of the pessimistic scenario (growth only at 0.03 items annually) for about 50 years.

Focusing on the initial position in the ranking of 2013-2014 on the level of macroeconomic stability of the national economy (107th place, 4.2 points), as the basic values in the adoption of the Sustainable Development Strategy "Ukraine 2020", Ukraine should increase by 1.02 points per 5 years. However, the maximum growth for any 5-year period from 2005-2006 did not exceed 0.44.

Examining 243 observations of changes in the level of the macroeconomic stability sub-index of the Global Competitiveness Index over a 5-year period for the EU country, growth of more than 1 point was observed in less than 5% of cases, including Ireland, Bulgaria, Romania, Croatia, Estonia, Latvia, Poland and Slovakia. Slovenia, Czech Republic.

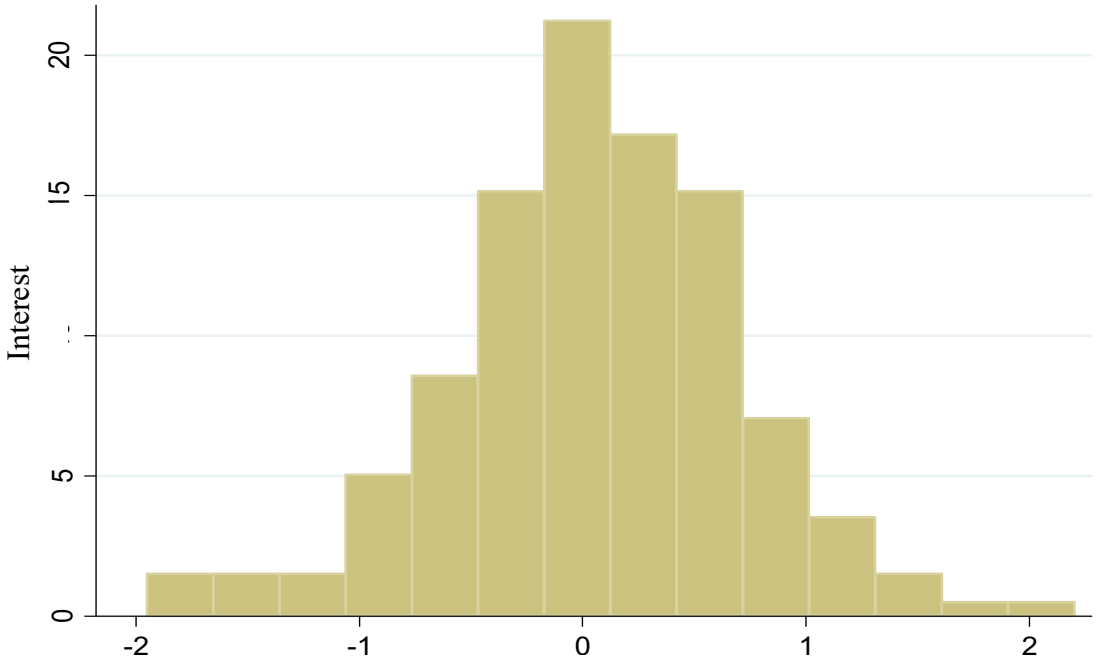



Figure 1.9 - Histogram of changes in the level of the sub-index of macroeconomic stability of the Global Competitiveness Index in a 5-year period for the EU country

Source: built by the author based on (World Economic Forum, 2018)

At the same time, improvements in the 5-year term of the position in the rating by 67 points according to this sub-index were found in only 3% of observations, in particular in Ireland, Latvia, Hungary (Fig. 1.10).

In order to achieve the above goals, it would be useful to study and analyze the experience of world leaders and post-Soviet countries, which after joining the European Union began to develop dynamically and have already reached a high level of competitiveness.

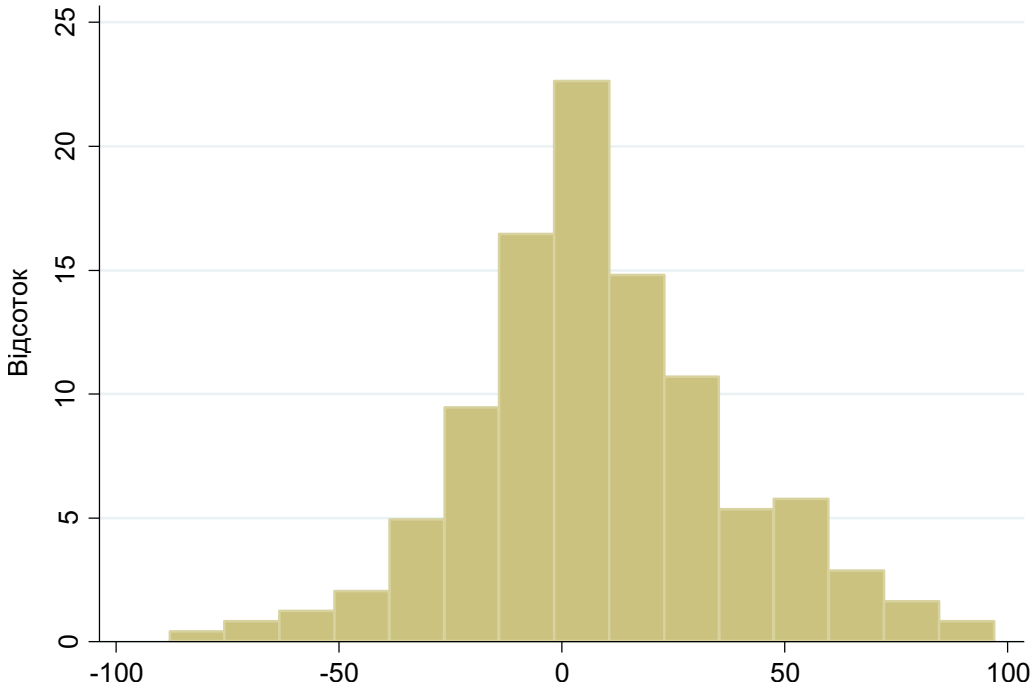



Figure 1.10 - Histogram of changes in the level of positions in the Global Competitiveness ranking by the sub-index of macroeconomic stability in the 5-year period for the EU country

Source: built by the author based on (World Economic Forum, 2018)

In the work (Pedraza, 2012) the author examines the impact of macroeconomic instability on Colombia's economic growth between 1950 and 2009. Using the production function of Kobe-Douglas, the results of the study

indicate a significant and negative impact of macroeconomic instability on the growth potential of the Colombian economy during this period.

It was found that an increase in the index of macroeconomic instability by 0.1 points leads to a decrease in economic growth of the Colombian economy by 2.25%. In this case, to calculate the macroeconomic instability index, Pedraza uses the methodology proposed under the UN Development Program to assess the Human Development Index (HDI, 2017) and is based on four macroeconomic indicators:

– inflation rate;
– government deficit in relation to GDP;
– the ratio of external debt to GDP;
– exchange rate change.

The use of this methodology is caused by the need to carry out the procedure of normalization of the components of the index of macroeconomic instability, which have different units and range of fluctuations. Therefore, the index of macroeconomic instability of MII is calculated in two stages. At the first stage, all MII subindexes undergo the procedure of normalization:

$$I_t = \frac{X_t - X_{min}}{X_{max} - X_{min}} \quad (1.1)$$

where - normalized sub-index of indicator X (inflation rate, government deficit in relation to GDP, the ratio of external debt to GDP and exchange rate change) in year t; - the actual value of X in the year t; and - the minimum and maximum value of X during the entire analyzed period.$I_t X_t X_{min} X_{max}$

In the second stage, the macroeconomic instability index of MII is calculated by finding the arithmetic mean normalized sub-indices of X (inflation

rate, government deficit to GDP, external debt-to-GDP ratio and exchange rate change) in year t (Pedraza, 2012).

Iranian scientists studying the problem of macroeconomic instability and its impact on Iran's economic growth in the period 1974-2008 (Sameti et al., 2012) conclude that there is a close correlation between macroeconomic stability and corresponding GDP growth.

The calculation of the macroeconomic instability index, which combines inflation (inf), budget deficit (bd), exchange rate volatility (ex), as well as the trade balance (tot) is carried out according to a modified methodology of the Human Development Index: $MII$

$$MII_{\mathrm{t}} = \alpha\left(\frac{\mathrm{inf}_t - \mathrm{inf}_{min}}{\mathrm{inf}_{max} - \mathrm{inf}_{min}}\right) + \beta\left(\frac{\mathrm{bd}_t - \mathrm{bd}_{min}}{\mathrm{bd}_{max} - \mathrm{bd}_{min}}\right) + \gamma\left(\frac{\mathrm{ex}_t - \mathrm{ex}_{min}}{\mathrm{ex}_{max} - \mathrm{ex}_{min}}\right) + \varphi\left(\frac{\mathrm{tot}_t - \mathrm{tot}_{min}}{\mathrm{tot}_{max} - \mathrm{tot}_{min}}\right) \quad (1.2)$$

where.$\alpha + \beta + \gamma + \varphi = 1$

The study of the ratio of the two variables and economic growth shows a significant negative correlation (-0.6) for Iran during the analyzed period 1974-2008.

Using a similar work (Sameti et al., 2012) method of calculating macroeconomic instability authors (Haghighi et al., 2012) the example of Iran also proves the existence of a long-term relationship between economic growth and macroeconomic instability.

These long-term relationships between economic growth and macroeconomic instability have been studied by scientists using the Kobe-Douglas production function, which after all the transformations takes the form given in formula 1.3.

$$PCRYG_t = \eta_1 ELG_t + \eta_2 PIY_t + \eta_3 GIY_t + \eta_4 SSER_t + \theta_1 MII_{\ t} + \varepsilon_t, \quad (1.3)$$

where PCRYG - GDP growth per capita; ELG - total population growth rate (working population); PIY - the volume of private investment as a percentage of GDP; GIY - the volume of public investment as a percentage of GDP; SSER - the level of human capital development; MII - index of macroeconomic instability.

The study of the impact of macroeconomic instability on economic growth using the modified Kobe-Douglas production function was also reflected in the works (Ali & Rehman, 2015; Antwi et al., 2013).

Empirical conclusions (Ali & Rehman, 2015)The work shows that both short-term and long-term macroeconomic instability has a significant and negative impact on the economic growth of Pakistan's economy.

The main factors of the studied model (1.4) scientists include: gross domestic product (GPD), number of people enrolled in high school (SSE), financial development (FIN), labor force (TLF), macroeconomic instability (MII), foreign direct investment ( FDI).

$$\mathrm{GPD}_t = \alpha_0 \mathrm{SSE}^{\alpha_1} \mathrm{FIN}^{\alpha_2} \mathrm{TLF}^{\alpha_3} \mathrm{MII}^{\alpha_4} \mathrm{FDI}^{\alpha_5} e^{t\alpha_6} \quad (1.4)$$

At the same time, the verification of the causal relationship between the time series of the proposed factors of the model (1.4) using the Granger test showed the existence of causal links between Pakistan's GDP and all independent variables. This confirms that achieving the target level of economic growth of the country should be accompanied by appropriate policies to ensure macroeconomic stability, financial development and appropriate education.

As an indicator of macroeconomic stability similar to the work (Treisman, 2000; King & Ma, 2001; Neyapti, 2004; Shah, 2006; Thornton, 2007),

researchers at Jiangsu University in China studying the impact of macroeconomic factors on Ghana's economic growth in the period 1980-2010. use inflation (Antwi et al., 2013). The authors note that inflation and economic growth are the two most important and most close macroeconomic changes (Antwi et al., 2013).

At work (Šokčević & Štokovac, 2011) analyzed economic growth in some European countries with economies in transition (Hungary, Estonia, Latvia, Lithuania, Poland, Slovakia, Slovenia, Czech Republic) in 1991-2008. The analysis was carried out using regression equations which depending on the study period 1991-2000 and 2001-2008 included various independent variables.

Thus, for the first period as explanatory variables the authors chose inflation, budget deficit, foreign direct investment, exports of goods per capita and current account balance, and for the second period - unemployment, foreign direct investment per capita, exports of goods per capita and productivity.

The obtained results allowed to confirm theoretical hypotheses about the direction and significance of inflation, budget deficit, current account balance, unemployment rate, foreign direct investment, exports of goods and labor productivity on the economic growth of the studied countries.

The positive relationship between economic growth and macroeconomic stability is confirmed by the results of the analysis for seventy developed countries (Sirimaneetham & Temple, 2009). According to the authors, the increase in the level of economic growth by 0.5-0.7% is due to a one-point improvement in the level of macroeconomic stability.

ININ economics, the Cobb-Douglas functional form of production functions is widely used to represent the ratio of output from two factors of production — capital and labor. A common function built by American scientists Cobb and Douglas in 1928(Melnyk et al., 2014) based on data from the US economy for 1899-1922, given in formula 1.5.

The results of the report on the global competitiveness of the World Economic Forum showed the need, given the level of economic growth in

Ukraine, to take into account when building the production function of the basic driver of increasing the country's competitiveness - the level of macroeconomic stability. Evaluated by the sub-index "macroeconomic stability" of the Global Economic Competitiveness Index of the World Economic Forum.

$$Q = AL^{\alpha}K^{\beta} \quad (1.5)$$

where Q is total production (GDP); L - labor costs; K - capital costs; α and β- coefficients of elasticity, respectively, of capital and labor; A - coefficient of proportionality or scale, which allows you to compare the volume of the product of different periods.

Along with these indicators, the results of the study of variations in the use of models of economic development (Skrypnychenko, 2012) indicate the need to take into account the openness of the economy as an indicator of the impact of exogenous factors on the state of the economy and its growth. It is believed that openness to international trade leads to increased GDP volatility (Francesco, 2015).

Along with the openness of the economy, foreign direct investment also has a strong and statistically significant impact on the country's macroeconomic stability and economic growth (Alfaro et al., 2006; Khaliq & Noy, 2007; Melnyk et al., 2014). A review of the economic literature on the relationship between foreign direct investment and economic growth in the work (Almfraji & Almsafir, 2014) confirms the presence of a positive and statistically significant relationship between these indicators in the vast majority of studies conducted during 1994-2012. At the same time, the openness of the economy, along with the market structure and human capital, are important factors for assessing the impact of foreign direct investment on the economic growth of the national economy.

Thus, the form of the Cobb-Douglas equation taking into account the above factors and using the basic principles of correlation-regression analysis adopted in the works (Pedraza, 2012; Sameti et al., 2012; Haghighi et al., 2012; Antwi et al., 2013 ; Ali & Rehman, 2015) is defined as:

$$GDP_t = a_0 + a_1 K_t + a_2 L_t + a_3 MS_t + a_4 Open_t + a_5 \mathrm{FDI}_t + e_t \quad (1.7)$$

where - the logarithm of GDP per capita in the period; - logarithm of capital expenditures in the period (gross fixed capital formation); - logarithm of labor costs (economically active population aged 15 and older); - macroeconomic stability in the period; - openness of the economy in the period (logarithm of the share of exports and imports in GDP); - foreign direct investment at the moment (logarithm of foreign direct investment$\mathrm{GDP_t tK_t tL_t MS_t tOpen_t tFDI_t t}$ as a percentage of GDP).

Based on the World Economic Forum's (WEF) Global Competitiveness Report, European countries at the stage of resource-oriented to efficient-oriented economies were selected to assess the relationship between economic growth and selected impact factors (Table 1.9).

Table 1.9

Distribution of analyzed countries by GDP per capita

| **Type of economy** | **Resource-oriented economy** | **Effectively oriented economy** |
|---|---|---|
| Criterion | ***GDP per capita, USD USA*** | |
| | 2000 <GDP <3000 | 3000≤ВВП <9000 |
| Countries | Ukraine (UKR); Georgia (GEO); Macedonia (MKD); Romania (ROU); Serbia (SRB) | Moldova (MDA); Armenia (ARM); Bulgaria (BGR); Croatia (MNE); |

Source: built by the author based on (World Economic Forum, 2018).

Statistical analysis of the mean value, standard deviation and coefficient of variation of the variables of equation (1.7) for different countries are presented in Table 1.10.

Table 1.10

Descriptive statistics of variables used in logarithms for 2000-2016

| Country | Statistical indicators | GDP | K | L | MS | Open | FDI |
|---|---|---|---|---|---|---|---|
| **UKR** | Mean | 25.27086 | 23,638 th most common | 16.903 | 3.81933 | 4.63427 | 1.19521 |
| | Std. Dev. | 0,5928598 | 0.61712 | 0.0282 | 0.58047 | 0.0781 | 0.6549 |
| | CV | 0,0234602 | 0.02611 | 0.0016 | 0.18596 | 0.0168 | 0.54794 |
| **BGR** | Mean | 24,28228 | 22.7915 | 15.044 | 5,01142 th most common | 4.6420 | 2.02737 |
| | Std. Dev. | 0,5345565 | 0.64753 | 0.02197 | 0.55116 | 0.20217 | 0.72181 |
| | CV | 0.02201426 | 0.02841 | 0.00146 | 0.11982 | 0.04355 | 0.35603 |
| **GEO** | Mean | 22.83506 | 21,413 th most common | 14.5674 | 2.90164 | 4.44244 | 2.04982 |
| | Std. Dev. | 0,6248025 | 0.58684 | 0.02813 | 0.22986 | 0.1615 | 0.46765 |
| | CV | 0.02736154 | 0.02741 | 0.00193 | 0.07922 | 0.03635 | 0.22814 |
| **SRB** | Mean | 24.09262 | 22.4162 | 14.9831 | 3.47166 | 4.28955 | 1.5757 |
| | Std. Dev. | 0,5686582 | 0.70272 | 0.03797 | 0.46109 | 0.33763 | 0.7424 |
| | CV | 0.023603 | 0.033135 | 0.00253 | 0.13282 | 0.07871 | 0.47115 |
| **MKD** | Mean | 22.70882 | 21.2088 | 13.7153 | 3.54905 | 4,53441 th most commo n | 1.33408 |
| | Std. Dev. | 0,3999435 | 0.45968 | 0.0534 | 0.12937 | 0.17907 | 0.71043 |
| | CV | 0.01761181 | 0.02167 | 0.00389 | 0.03645 | 0.03949 | 0.53253 |
| **MNE** | Mean | 21.75154 | 20.1594 | 12.4188 | 4.55857 | 4.64572 | 2.45026 |
| | Std. Dev. | 0,5447627 | 0.74651 | 0.00492 | 0.38848 | 0.14098 | 0.772 th most common |
| | CV | 0.02504479 | 0.03703 | 0.0004 | 0.03604 | 0.03035 | 0.31507 |

Continued table 1.10

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **ROU** | Mean | 25.46288 | 24.0898 | 16.0897 | 4.67142 | 4.31909 | 1.16765 |
| | Std. Dev. | 0.6180559 | 0.75861 | 0.07627 | 0,6219678 | 0.08118 | 0.60582 |
| | CV | 0,02427282 | 0.03149 | 0.00474 | 0.20887 | 0.01879 | 0.51883 |
| **MDA** | Mean | 22.08651 | 20.5927 | 14.1056 | 2.70711 | 4.85492 | 1.72174 |
| | Std. Dev. | 0,6381159 | 0.83473 | 0.06286 | 0.42451 | 0.07671 | 0.43701 |
| | CV | 0.02889166 | 0.04054 | 0.00446 | 0.15681 | 0.0158 | 0.25382 |
| **ARM** | Mean | 22,53387 | 21,179 th most common | 14,1081 th most common | 3.06783 | 4.24523 | 1.61949 |
| | Std. Dev. | 0,6741747 | 0.83752 | 0.03718 | 0.13285 | 0.1144 | 0.43124 |
| | CV | 0.02991828 | 0.03954 | 0.00264 | 0.0433 | 0.02695 | 0.26628 |

Source: calculated by the author

One of the important indicators for estimating volatility is the standard deviation and the coefficient of variation. For example, in (Acemoglu et al, 2003) the authors assess macroeconomic instability using the standard deviation of GDP and trade volumes. Giovanni and Levchenko in their work (Giovanni & Levchenko, 2010) also use the standard deviation of GDP per capita and exports as indicators of macroeconomic instability.

Among the analyzed countries, Armenia (0.0299183) and Moldova (0.02889166) have the highest coefficient of GDP variation due to a high degree of uncertainty in economic growth, as shown in Figure 1.23.

On the other hand, the lowest variability among all analyzed factors of equation (1.7) are the indicators of economically active population (coefficient of variation for Croatia is 0.0004) and foreign direct investment (coefficient of variation for Moldova is 0.0158). Ukraine has the highest dispersion rate of foreign direct investment relative to their average value (0.54794), along with Ukraine, Romania (0.51883) and Macedonia (0.53253) also have a high level of this indicator. At the same time, a coefficient of variation of less than 33% is observed for the data set,,,,, which indicates their homogeneity.GDPKLMSOpen The use of equations (1.7) in natural logarithms avoids problems associated with

the dynamic properties of a series of panel data. The results of the single root test using Levin, Lin & Chu (LLC) tests, Breitung, Hadri LM, Im-Pesaran-Shin (IPS) methods for the variables are shown in table 1.11.GDPKLMSOpenFDI

Table 1.11

Panel data by single root criterion

| Indicator | Unit root test | | | | |
|---|---|---|---|---|---|
| | Levin, Lin & Chu (LLC) | Power | Hadri LM | Im-Pesaran-Shin (IPS) | |
| | | | | Level | First difference |
| GDP | -5.5171 (0.0000) * | -3.0822 (0.0010) * | 23.0478 (0.0000) * | -2.7732 (0.0028) * | -2.1586 (0.0154) ** |
| K | -4.3649 (0.0000) * | -4.2202 (0.0000) * | 19.1760 (0.0000) * | -1.9968 (0.0229) ** | -2.6678 (0.0038) * |
| L | -4.3710 (0.0000) * | -4.6683 (0.0000) * | 21.7481 (0.0000) * | -0.0008 (0.4997) | -4.2810 (0.0000) * |
| MS | -4.7392 (0.0000) * | -1.8425 (0.032) ** | 10.4880 (0.0000) * | -2.0667 (0.0194) ** | -2.8062 (0.0025) * |
| Open | -2.2972 (0.0108) ** | -3.6758 (0.0001) * | 14.4808 (0.0000) * | -1.3383 (0.0904) *** | -4.9680 (0.0000) * |
| FDI | -2.6829 (0.0036) * | -5.9422 (0.0000) * | 5.563 (0.0000) * | -1.1399 (0.1272) | -5.1298 (0.0000) * |

Note: *, ** and *** represent significance at the level of 1%, 5% and 10% respectively

Source: calculated by the author

All tests, except Im-Pesaran-Shin (IPS), reject the null hypothesis of nonstationarity of variables. The results of research conducted in (Hlouskova & Wagner, 2006) show that the Breitung test confirms a statistically significant effect and the smallest size of the scatter.

As can be seen from Table 1.11 GDP per capita, gross fixed capital formation, economically active population, openness of the economy, foreign direct investment according to the Breitung test have a stationary level of 1%, and macroeconomic stability has a stationary level of 5%.

According to the Hadri LM test, all variables have a stationary level of 1%. The obtained results allow us to estimate statistically significant coefficients for the independent variables, equation (1.7).$a_1 a_2 a_3 a_4 a_5$KLMSOpenFDI

The coefficients, for the independent variables equation (1.7) were estimated using the usual least squares method (OLS), fixed effects and random effects models. The evaluation results are given in tables 1.12–1.14.$a_0a_1a_2a_3a_4a_5$KLMSOpenFDI

The coefficient of determination R-squared, regardless of the chosen model for estimating economic growth, is at a high level. Table 4 shows that 98.31% of the variation in GDP is due to changes in selected factors (R-squared = 0.9831). Test (F) shows that all the coefficients in the models of table. 1.12-1.14 are different from zero. Thus, for the usual least squares method (OLS) - Prob> F = 0,000, fixed effects - Prob> F = 0.0000, random effects Prob> chi2 = 0.0000.

The three variables in OLS regression models are significant at 1%, including gross fixed capital formation, the economically active population, and the openness of the economy. Macroeconomic stability is significant at 10%, and foreign direct investment - 5%. The ratio has a negative sign - this means that the openness of the economy has a negative impact on GDP growth, while the other ratios,,, (gross fixed capital formation, economically active population aged 15 and older, macroeconomic stability and foreign direct investment) have a positive sign and impact on GDP growth.$a_4a_1a_2a_3a_5$.

Table 1.12

The least squares method of the regression model of GDP for panel data of selected countries for analysis

| GDP | Coef. | Std. Err. | t | P> t | [95% Conf. Interval] | |
|---|---|---|---|---|---|---|
| **K** | 0.896041 | 0.0194005 | 46.19 | 0.000 | 0.85768 | 0.934401 |
| **L** | 0.090735 | 0.0234183 | 3.87 | 0.000 | 0.04443 | 0.13704 |
| **MS** | 0,123836 | 0.0670929 | 1.85 | 0.067 th most common | -0.00883 | 0.256499 |
| **Open** | -0.09524 | 0.0240847 | -3.95 | 0.000 | -0.14286 | -0.04761 |
| **FDI** | 0.094548 | 0.0375187 | 2.52 | 0.013 th most common | 0.020362 | 0.168734 |
| **const** | 1,771336 | 0.4792369 | 3.70 | 0.000 | 0.82374 | 2,718933 |
| F (5, 138) = 1600.85; Prob> F = 0.000; R-squared = 0.9831; Adj R-squared = 0.9824; Root MSE = 0.18726 | | | | | | |

Source: calculated by the author

Table 1.13

Model of fixed effects of the regression model of GDP for panel data of selected countries for analysis

| GDP | Coef. | Std. Err. | t | P> t | [95% Conf. Interval] | |
|---|---|---|---|---|---|---|
| **K** | 0,8036575 | 0.0214127 | 37.53 | 0.000 | 0.761295 | 0,8460201 |
| **L** | -0.8152515 | 0,3109556 | -2.62 | 0.010 | -1.43044 | -0.200063 |
| **MS** | 0,1963446 | 0.0780659 | 2.52 | 0.013 th most common | 0.0419006 | 0,3507886 |
| **Open** | -0.1116702 | 0.0202456 | -5.52 | 0.000 | -0.1517236 | -0.071616 |
| **FDI** | 0.0309958 | 0.0393868 | 0.79 | 0.433 | -0.0469263 | 0,1089179 |
| **const** | 16.97208 | 4,573408 | 3.71 | 0.000 | 7,924144 | 26,02002 |
| **sigma_u** | 1,3113731 | | | | | |
| **sigma_e** | 0,13773699 | | | | | |
| F (8, 130) = 15.63 Sample> F = 0.0000 | | | | | | |

Source: calculated by the author.

The negative sign of the coefficient in the analysis of European countries that are at the stage from resource-oriented to efficient-oriented economies, confirms the theoretical hypothesis (Francesco, 2015) on the growth of GDP volatility.

Table 1.14

Model of random effects of the regression model of GDP for panel data of selected countries for analysis

| GDP | Coef. | Std. Err. | t | P> t | [95% Conf. Interval] | |
|---|---|---|---|---|---|---|
| **K** | 0,8420492 | 0.0202257 | 41.63 | 0.000 | 0,802408 | 0,88169 |
| **L** | 0,1280253 | 0.0332761 | 3.85 | 0.000 | 0.062805 | 0.19325 |
| **MS** | 0.1163215 | 0.0739674 | 1.57 | 0.116 | -0.02866 | 0.26129 |
| **Open** | -0.1116877 | 0.0212246 | -5.26 | 0.000 | -0.15329 | -0.0701 |
| **FDI** | 0.0152942 | 0.0371561 | 0.41 | 0.681 | -0.057530 | 0.08812 |
| **const** | 2,710085 | 0,5705435 | 4.75 | 0.000 | 1.59184 | 3.82833 |
| **sigma_u** | 0,08565822 | | | | | |
| **sigma_e** | 0,13773699 | | | | | |
| **rho** | 0,27889253 | | | | | |
| R-sq: within = 0.9419, between = 0.9899, overall = 0.9819; Prob> chi2 = 0.0000 | | | | | | |

Source: calculated by the author

It is also worth noting the statistically insignificant impact of foreign direct investment in models with fixed and random effects: P> t is 0.433 and 0.681, respectively. For macroeconomic instability, the random effect model determines that P> t is 0.116. The assessment of the elasticity of macroeconomic stability is positive and statistically significant, which is confirmed by the results of using the least squares method (OLS) and the model of fixed effects, at 10% and 5% and ranges from 0.123836 to 0.1963446.

The results of table 1.14 show that an increase in K by 1% leads to an increase in GDP per capita by 0.896041%, an increase in the economically active population aged 15 years and older by 1% leads to an increase in GDP per capita by 0.090735% , 1% increase in foreign direct investment by 0.094548%.

An increase in macroeconomic stability by 1% will lead to an increase in GDP per capita by 0.123836%, 0.1163446% and 0.1163215 depending on the chosen model (Table 1.12-1.14). It is noteworthy that a 1% increase in macroeconomic stability has a more positive impact on GDP growth compared to foreign direct investment, which indicates the need to implement appropriate macroeconomic policies of governments to ensure the prospects for economic growth in the studied countries.

Thus, the obtained results of calculations of macroeconomic stability assessment confirm the urgency of reorientation of state policy in order to increase the level of competitiveness and growth of the national economy. In addition, the results of the assessment of the level of macroeconomic stability by the modified Kobe-Douglas production function suggest that the growth of macroeconomic stability of the national economy has a more significant positive impact on GDP growth compared to foreign direct investment.

# Chapter 2. Bibliometric analysis of the models of economic development: social, economic and ecological parameters of stability

Current trends in the national economy of Ukraine, which occur in conditions of uncertainty and extreme variability, necessitate the identification of qualitative and quantitative criteria of macroeconomic stability of the national economy in order to timely assess and level the negative effects of their convergent and divergent interactions.

Timely detection of negative trends in the change of qualitative and quantitative criteria of macroeconomic stability allows to respond in a timely manner to internal and external shocks and increase the level of competitiveness and accelerate economic growth. An important issue in this context is the problem of selecting a set of indicators that indicate the level of macroeconomic stability.

The results of the research in the previous section give grounds to conclude that there is no unified terminological apparatus on the essence of the concept of macroeconomic stability, which is, in turn, one of the reasons for the lack of a single, recognized by all researchers and specialists solution of the set of indicators. macroeconomic stability of the national economy.

According to the theory of image recognition, the main requirements for the criteria for selecting a set of indicators are:

1. Regulatory and compliance with recognized and adopted regulations, which provide not only the fact of fixing them in official statistics, but also regulatory approval of the methodology of their collection (regardless of whether these indicators are statistics, sociological research or observation materials).
2. Possibility of empirical measurement. That is, the criteria should be such that it is possible to quantify.

They have a high level of reactive informativeness, which ensures the provision of fast and timely information on the activation of possible factors.

Have the property of holistic, ie, on the one hand, are self-sufficient for the indicative reflection of a manifestation of a threat, but, on the other hand, in combination with other indicators can indicatively reflect other manifestations of a threat that can not be reflected no separate indicator.

In addition, taking into account the basic principles of traditional theory of economic analysis, the selected indicators must be objective, not duplicated, reliable and real, which in turn will ensure the adequacy of assessing macroeconomic stability of the national economy and timely identification of existing divergent and convergent relationships. can cause a number of shocks, and, as a consequence, the ineffectiveness of the adjusted state policy of managing the national economy in the context of ensuring its growth.

In international practice, in particular, the following criteria are used to calculate the sustainable development index (ILO & UNDESA, 2015):

- first, the set of indicators should cover issues related to sustainable development in most countries;
- second, each of the indicators must provide important information that is not available from other key indicators;
- thirdly, the methodology for calculating indicators should be the same for all countries whose data are either readily available or can be provided within a reasonable period of time and at great cost.

In his report on the international experience in calculating macroeconomic indicators and their use, Sanjay Kalre identifies the following criteria:

- indicators should take into account the specifics of the country;
- have a clear economic significance;
- wide statistical coverage;
- take into account cyclical behavior (Kalra, 2012).

Issues related to the development, selection of requirements (criteria) for indicators are the subject of research by many domestic scientists.

Suntsova O. O. in her work (Suntsova, 2012) proposes to choose the parameters of assessing the macroeconomic stability of the national economy on the basis of assessing the macro-financial stability of the state and conduct it in the following stages:

1. Polycriteria assessment of the level of socio-economic development.
2. Grouping of main macrofinancial indicators.
3. Evaluation of exogenous and endogenous effects.

Interpretation of the obtained results and development of recommendations (table 2.1) (Suntsova, 2012). The starting point for the analysis of selected indices is: International Financial Statistics (International Financial Statistics), official data of the Ministries of Statistics of a particular country and statistics of central banks of the respective countries (Suntsova, 2012).

Table 2.1

Stages of assessing macroeconomic stability through assessing the macro-financial stability of the country (Suntsova, 2012)

| STAGE | NAME THE STAGE | CHARACTERISTIC |
|---|---|---|
| Stage 1 | Polycriteria assessment of the level of socio-economic development of a country | Formation of the socio-economic rating of the country by the level of its development |
| Stage 2 | Grouping of main macrofinancial indicators | The importance of macro-financial indicators for assessing the macro-financial stability of the country is determined according to its rating of socio-economic development. |
| Stage 3 | Evaluation of exogenous and endogenous effects on macrofinancial indicators | Empirical impact assessment |
| Stage 4 | Interpretation of the obtained results and development of recommendations | Identification of bottlenecks in order to minimize the negative impact on the financial system of the state |

Radionova I.F. proposes to evaluate the results of macroeconomic policy by deviations from the equilibrium values of macroeconomic variables, based on the neoclassical idea of general equilibrium as a result of the interaction of aggregate markets (Radionova & Malkovskaya, 2017).

At the same time, Radionova I.F. notes that "the implementation of such an approach involves certain stages of analysis, namely: the formation of time series of variables, construction of regression equations and evaluation of their quality, determination of equilibrium values of variables and evaluation of deviations from them actual values macroeconomic variables (Radionova & Malkovskaya, 2017).

In their work (Radionova & Malkovskaya, 2017), scientists propose the following model for assessing the macroeconomic stability of the national economy.

$$\begin{cases} I = I(r) \\ S = \left(Y, r, \frac{T_H}{Y_H}\right) \\ S = I \\ M^D = (Y, r) \\ M^D = M^S = \bar{M} \end{cases} \quad (2.1)$$

where I and S - respectively investment and savings;

$M^D, M^S$ - respectively the demand and supply of money;

Y - GNP;

r - aggregate interest rate;

$\frac{T_H}{Y_H}$ - the share of taxes in household income;

$\bar{M}$ - a monetary aggregate that is under the influence of the national bank.

Based on the results of the study in the previous section and the analysis of world and domestic experience of theoretical and methodological approaches to

assessing macroeconomic stability makes it possible to generalize two main approaches:

- the first approach is based on a fundamental assessment of the macroeconomic stability of the national economy based on a system of indicators, taking into account their dynamics and compliance with regulatory / criteria values;
- the second approach is based on the assessment of an integrated (aggregated) indicator, which demonstrates the overall degree of macroeconomic stability (instability) of the national economy.

In the study of the impact of macroeconomic instability of the national economy on the volume of private investment in Iran, the authors (Abdolmajid Ahangari et al., 2014) use the index of macroeconomic instability, which is based on the analysis of four components:

- inflation rate ();$INF$
- the ratio of government deficit to GDP ();$BD$
- external debt to GDP ();$FD$
- exchange rate (Abdolmajid Ahangari et al., 2014).

Thus under instability, the author understands accumulation of sequence of fluctuations of levels (deficit and surpluses) of changes of the specified indicators as a result of macroeconomic management, in other words, instability is increase or decrease in values of a variable around values characterizing tendencies of change of process.

Thus, the instability index of each of the indicators is calculated using the formula:

$$IX_t = X_t - TX_t, \qquad (2.2)$$

where is the index of instability of the variable $IX_t X_t$

$X_t$ - the actual value of the variable at the time t

$TX_t$ - the estimated value of the variable depending on the specific form of the equation of the trend of the process X

The equation of the tendency of changes in the values of the variable takes the form:X

$$TX_t = a_0 + a_1 t + a_2 t^2 + a_3 t^3 + \ldots + a_n t^n + e_t, \quad (2.3)$$

where – time t $a_0$ - free member; $a_1 \ldots a_n$ - regression coefficients; $e_t$ - coefficient characterizing the influence of various random factors on the growth rate of variable values.X

Then the general index of macroeconomic instability is as the arithmetic mean of the four components of the indices of instability:

$$MII_{tn} = \frac{\sum(IINF_{tn}, IBD_{tn}, IFD_{tn}, IRO_{tn})}{N} \quad (2.4)$$

where - index of macroeconomic instability;$MII_{tn}$

$IINF_{tn}$ - index of inflation instability;

$IBD_{tn}$ - index of instability of the ratio of government deficit to GDP;

$IFD_{tn}$ - index of instability of the external debt to GDP indicator;

$IRO_{tn}$ - index of instability of the indicator of the ratio of free to the official exchange rate.

Given the above proposed requirements for many indicators of macroeconomic stability of the national economy (Fig. 2.1) in the paper proposed as an indicator that characterizes the stability or instability of the exchange rate

to use in accordance with the Maastricht criteria exchange rate deviation to the previous period.

As part of the study, in order to test the above approach and these provisions, the author assessed the level of macroeconomic stability of the national economy. Thus, the use of data from 1995 to 2017 of these indicators for the module nonlinear evaluation of the STATISTICA program allowed to obtain the equation of the trend of each of the indicators:

$$IINF_{tn} = 841{,}826 - 644{,}725\text{t} + 186{,}208\text{t}^2 2 - 26{,}022\text{t}^3 + 1{,}886\text{t}^4 - 0{,}068\text{t}^5 + 0{,}01\text{t}^6, \text{R2} = 0.98 \quad (2.5)$$

$$TBD_{tn} = 6{,}24177 + 3{,}0229\text{t} - 2{,}09951\text{t}^2 + 0{,}39874\text{t}^3 - 0{,}03393\text{t}^4 + 0{,}00136\text{t}^5 - 0{,}00002\text{t}^6, \text{R2} = 0.85 \quad (2.6)$$

$$TFD_{tn} = 38{,}1722 - 36{,}0579\text{t} + 19{,}5117\text{t}^2 - 3{,}9015\text{t}^3 + 0{,}3605\text{t}^4 - 0{,}0155\text{t}^5 + 0{,}0003\text{t}^6, \text{R2} = 0.98 \quad (2.7)$$

$$TRO_{tn} = 8{,}10036 - 6{,}70701\text{t} + 2{,}07818\text{t}^2 - 0{,}30648\text{t}^3 + 0{,}02309\text{t}^4 - 0{,}00086\text{t}^5 + 0{,}00001\text{t}^6, \text{R2} = 0.93 \quad (2.8)$$

Tables 2.2–2.3 present the results of the calculation of the macroeconomic instability index according to the proposed method on the example of Ukraine in the period 1995-2017. The value of the macroeconomic instability index () should be set at zero, while the impact of crises or booms will affect its decrease or increase, respectively $MII_{tn}$

The results of the correlation matrix (Table 2.4) show that the macroeconomic instability index () during 1996-2017, on the one hand, has a positive and significant correlation with changes in the subindex of inflation instability (0.924), the subindex of instability ratio to the previous exchange rate (0.917), on the other hand, has positive but insignificant links with the sub-index

of instability of the government deficit-to-GDP ratio (0.128) and the sub-index of instability of the external debt-to-GDP ratio (0.3788).$MII_{tn}$

Table 2.2

Calculation of the macroeconomic instability index in the example of Ukraine in the period 1995–2002

| Year | $IINF_{tn}$ | $IBD_{tn}$ | $IFD_{tn}$ | $IRO_{tn}$ | $MII_{tn}$ |
|---|---|---|---|---|---|
| 1995 | 17.6407 | 0.36930 | -0.58972 | 0.310446 | 4,432688 |
| 1996 | -36.7633 | -1.67754 | 3.22987 | -0.648081 | -8.96477 |
| 1997 | -1.9047 | 2.35394 | -3.68688 | -0.061348 | -0.82475 |
| 1998 | 16.7085 | -0.77968 | -4.90277 | 0.323542 | 2,837394 |
| 1999 | 21.0394 | -0.02721 | 8.49635 | 0,530863 | 7,509856 |
| 2000 | 12.2895 | -0.55348 | 4.32756 | 0.007697 | 4,01783 th most common |
| 2001 | -12.6784 | 0.06520 | -7.56314 | -0.361244 | -5.1344 |
| 2002 | -23.8979 | -0.33950 | -2.63516 | -0.275610 | -6.78705 |

Source: built by the author

Table 2.3

Calculation of the macroeconomic instability index in the example of Ukraine in the period 2003–2017

| **Year** | $IINF_{tn}$ | $IBD_{tn}$ | $IFD_{tn}$ | $IRO_{tn}$ | $MII_{tn}$ |
|---|---|---|---|---|---|
| **2003** | -12.8662 | -0.49326 | -2.39765 | -0.1112172 | -3.96733 |
| **2004** | -0.1330 | 2.27053 | 11,93591 | 0.042354 | 3,528954 |
| **2005** | 11.0885 | 0.27562 | -7.40698 | 0.110635 | 1,016942 |
| **2006** | 8.1899 | -1.11535 | 1.47732 | 0.144124 | 2,173498 |
| **2007** | 7.9329 | -0.91584 | 1.99355 | 0.078735 | 2,272325 |
| **2008** | 12,5603 | -0.68546 | -7.45757 | -0.016333 | 1,100233 |
| **2009** | -4.3754 | -0.02488 | 8.66533 | 0.282015 | 1,136771 |
| **2010** | -13.7207 | 3.17433 | -3.53119 | -0.250922 | -3.58212 |
| **2011** | -9.8239 | -1.61704 | -0.59095 | -0.226915 | -3.06471 |
| **2012** | -4.2594 | -0.49561 | 1.08600 | -0.089462 | -0.93962 |
| **2013** | 7.8377 | -0.13992 | -1.25243 | 0.034663 | 1.619994 |
| **2014** | 14.2589 | 0.48994 | 1.20347 | 0.370127 | 4,08061 |
| **2015** | -9.1233 | -0.13207 | -0.40094 | -0.193116 | -2.46236 |
| **2016** | -10.1283 | -0.15644 | -0.78944 | -0.345677 | -3.10349 |
| **2017** | -9.43567 | -1.33245 | -0.88732 | -0.367833 | -3.24312 |

Source: calculated by the author

At the same time, the sub-index of exchange rate instability to the previous period has a positive and significant correlation with the sub-index of inflation instability (0.8820), which indicates almost 90% coincidence of fluctuations in these sub-indices.

Table 2.4

Correlation matrix of dependence of the macroeconomic instability index and its sub-indices on the example of Ukraine in the period 1995-2015.$MII_{tn}$

| | $\boldsymbol{IINF_{tn}}$ | $\boldsymbol{IBD_{tn}}$ | $\boldsymbol{IFD_{tn}}$ | $\boldsymbol{IRO_{tn}}$ | $\boldsymbol{MII_{tn}}$ |
|---|---|---|---|---|---|
| $\boldsymbol{IINF_{tn}}$ | 1.0000 | | | | |
| $\boldsymbol{IBD_{tn}}$ | 0.0438 | 1.0000 | | | |
| $\boldsymbol{IFD_{tn}}$ | 0.0571 | 0.0378 | 1.0000 | | |
| $\boldsymbol{IRO_{tn}}$ | 0.8820 | 0.0936 | 0.2942 | 1.0000 | |
| $\boldsymbol{MII_{tn}}$ | 0.9425 | 0.1282 | 0.3788 th most common | 0.9170 | 1.0000 |

Source: calculated by the author

Although the ratio of the sub-index of instability of the government deficit-to-GDP ratio to the macroeconomic instability index appears to be statistically significant at 13 percent, the amplitude estimate is so small that it can be considered economically insignificant. The overall estimated results show that all variable models of the macroeconomic instability index have a positive correlation, ie an increase in the level of one of the sub-indices is accompanied by an increase in the level of the macroeconomic instability index $MII_{tn}$MII$_{\text{tn}}$MII$_{\text{tn}}$

The dependence of the dynamics of change in the index of macroeconomic instability of Ukraine in the period 1995-2015 with the corresponding values of the indicator of economic growth (GDP growth) is shown in Fig. 2.2.

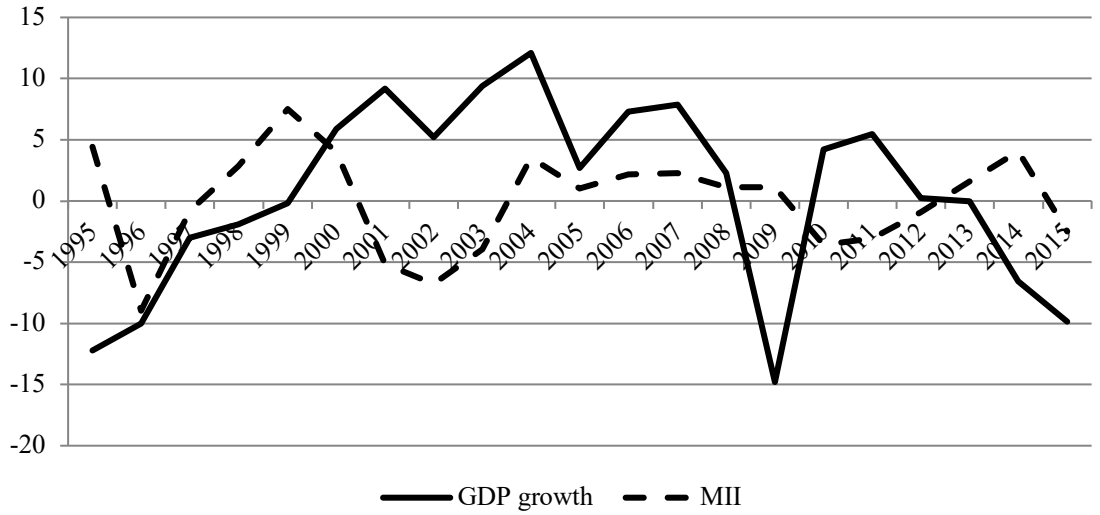



Figure 2.2 - Index of macroeconomic instability and economic growth of Ukraine

Source: calculated by the author

The most significant decline in the index of macroeconomic instability in Ukraine was observed in 1996 (-8.96), when the corresponding values of the indicator (GDP growth) was -10%. In 1999, the rate of decline of Ukraine's economy compared to previous periods, in 1997 and 1998, respectively, -3% and -1.9%, almost stopped (-0.2%) and the index of macroeconomic instability reached its maximum positive value (7.51).$MII_{tn}$

During the period of general economic growth of Ukraine's economy in 2000-2004, when the economic growth curve accelerated to the maximum level reached in 2004 (+ 12.1%), the index of macroeconomic instability ranged from 4.02 in 2000 to 3.53 in 2004 $MII_{tn}$

One of the most influential sub-indices in this period, which restrained economic development, is the instability of the external debt to GDP ratio (approximately 4.33 in 2000 and 11.94 in 2004). Thus, since 2004, excessive raising of funds (137% of GDP in 2015) on insufficiently favorable terms, along with the irrationality of their use, hinder long-term economic growth and reduce the amplitude of fluctuations in the country's macroeconomic stability.

During the global financial and economic crisis of 2007-2010 and the post-crisis period of 2011–2017, together with debt, the growth rate of inflation in the

economy of Ukraine increased significantly, the level of which reached double digits during the analyzed period. Thus, in particular, in 2015 the inflation rate rose to 48.72.

The data in Table 2.5 show the inverse dependence of these indicators, in other words, the growth of GDP leads to a decrease in the index of macroeconomic instability. Thus, it can be argued that changes in the macroeconomic instability index will be associated with an increase (decrease) in economic growth in the long run.

Table 2.5

Linear regression of the index of macroeconomic instability and the corresponding values of the indicator (GDP growth) of Ukraine$MII_{tn}$

| $MII_{tn}$ | Coef. | Std. Err. | t | P> \| t \| | [95% Conf. Interval] |
|---|---|---|---|---|---|
| **GDP growth** | -0.0295725 | 0,1241744 | -0.24 | 0.814 | -, 2894724, 2303275 |
| **Const.** | 0.0197592 | 0,9300215 | 0.02 | 0.983 | -1.926798 1.966317 |

Source: calculated by the author

The main disadvantages of the proposed model for assessing macroeconomic instability are:

– high dependence of the obtained results on the choice of the equation of the tendency of changes in the values of the index components;

– incomparability range of changes in indicators;

– characterizes only the amplitudes of fluctuations in the levels of the time series without taking into account the necessary optimal trend;

– lack of interpretation of the macroeconomic instability index.

In their work (Sancak & Jaramillo, 2007), Laura Jaramillo and Chemile Sanchak examine the macroeconomic instability index, which combines

inflation, budget deficits, exchange rate volatility, and international reserve losses using the formula:

$$mi_{it} = \frac{\ln\left(\frac{cpi_{it}}{cpi_{i,t-1}}\right)}{\sigma_{cpi}} + \frac{\ln\left(\frac{er_{it}}{er_{i,t-1}}\right)}{\sigma_{er}} - \frac{\ln\left(\frac{res_{it}-res_{i,t-1}}{bm_{i,t-1}}\right)}{\sigma_{res}} - \frac{\ln\left(\frac{fbal_{it}}{gdp_{it}}\right)}{\sigma_{fbal}} \qquad (2.9)$$

where - the index of macroeconomic instability for the country at the time $mi_{it}it$;

cpi - inflation rate index;

er- exchange rate of national currency up to 1 dollar. USA;

res - international reserve of the country;

bm - money supply base;

$fbal_{it}$ - state budget deficit;

$gdp_{it}$ - gross domestic product of the state;

σ - standard deviation of each of the indicators.

In order to eliminate the incomparability of the range of changes in indicators, the authors propose to carry out the logarithm procedure, but based on equation (2.8) for countries with a negative growth trend of gold and foreign exchange reserves (ZVR) calculation of macroeconomic instability index becomes impossible.

Thus, in particular, in Ukraine in the period from 2010 to 2014 there is a decline in gold and foreign exchange reserves from 34.58 billion dollars. US in 2010, to 7.53 billion dollars. USA, in 2014, or 4.6 times (Fig. 2.3).

However, in 2016, this figure rose to 15.54 billion dollars. US or 2.2 billion more than in the previous period.

According to the press service of the National Bank of Ukraine, such growth is due to foreign exchange intervention of the National Bank, the receipt of the third tranche from the International Monetary Fund and related to the IMF official

financing program, while this figure was lower than the official forecast of the NBU. Inflation report at the end of October (Ministry of Finance of Ukraine, 2018).

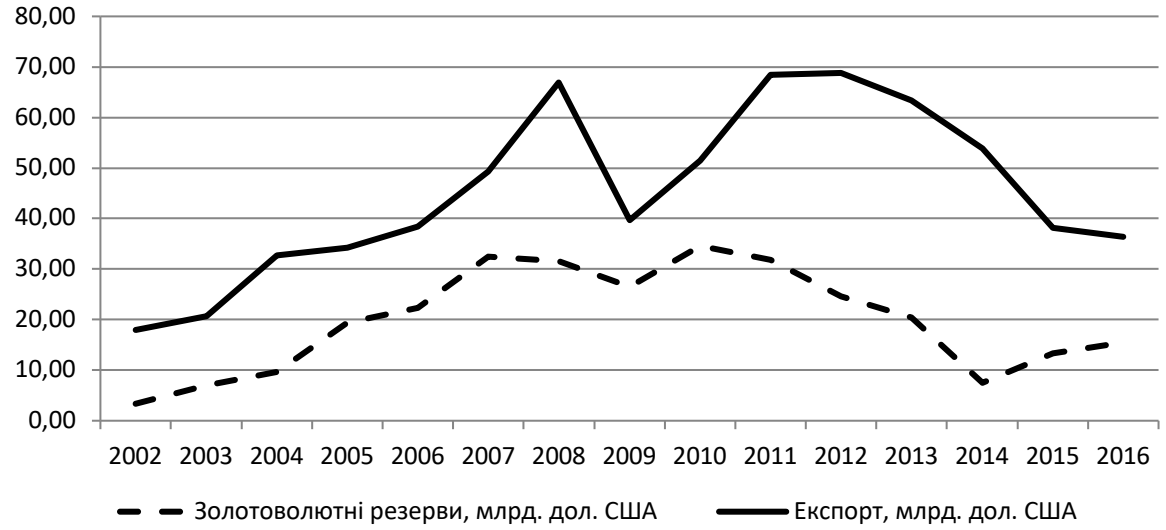



Figure 2.3 - Dynamics of gold and foreign exchange reserves and exports of Ukraine for 2002-2016

Source: calculated by the author

In the scientific domestic and foreign literature, foreign exchange reserves of countries are considered as an insurance reserve that prevents the negative impact of exogenous shocks, so their assessment is carried out through the relationship with other macroeconomic parameters: GDP, imports, external debt, money supply. Thus, in the works of domestic scientists (Bereslavska, 2014; Zhmurko, 2012; Bogdan, 2012) an analysis of modern approaches to assessing the optimal amount of international reserves of the state, the main of which are: the criterion of import coverage, J. Reddy's criterion, P. Guidotti's criterion and A. Greenspan, the ratio of international reserves to the money supply M2, the IMF criterion.

The essence of the criterion of import coverage is that the amount of gold and foreign exchange reserves is considered optimal if they cover three months

of imports, in case of temporary suspensions of export earnings and other inflows of foreign currency.

However, as noted by members of the German Advisory Group Veronica Movchan, Robert Kirchner, Ricardo Giucci, this criterion is used more as a guide rather than a clear criterion, as this indicator lacks a theoretical and empirical basis (Movchan et al., 2009).

In determining the optimal size of international reserves by the criterion of J. Reddy, the amount of payments for imports of goods and services and payments for repayment and servicing of long-term external debt is taken into account. In the analytical report of Kharazishvili Yu.M. and Dron E.V (2014) for Ukraine the following threshold values of the gold and foreign exchange reserve optimality indicator have been determined:

– lower threshold of sufficiency - 3;
– lower optimal value - 6;
– the upper optimal value is 10;
– the upper threshold of sufficiency is 12 months of import of goods and services of the state.

Former Deputy Minister of Finance of Argentina Pablo Guidotti proposed the following rule: the amount of reserves is sufficient if the country can refrain from external borrowing for at least one year.

Alan Greenspan, the former head of the US Federal Reserve, has expanded this rule, according to which gold reserves must exceed all payments on short-term external borrowing.

In the study of O. de Beaufort Weinhold and E. Keptein (2001) the ratio of international reserves to the money supply M2 is considered optimal if the gold reserves cover 5-10% of the money supply M2 for countries with a floating currency regime and 10-20% - for countries with a fixed currency regime.

IMF experts suggest estimating the optimal size of international reserves for countries with fixed and floating exchange rates, focusing on four specific

sources of risk: exports of goods and services, money supply, short-term external debt, other portfolio liabilities, which in crisis conditions turn into channels for withdrawal of international reserves, according to the formulas (Afonso et al., 2017; Nathan Porter et al., 2015):

$$OPT\ (fix) = 0{,}3 \times STED + 0{,}2 \times OPL + 0{,}1 \times \mathrm{M2} + 0{,}1 \times \mathrm{EXP} \quad (2.10)$$

where OPT (fix) - the optimal level of international reserves for fixed currency regimes;

*STED* - short-term external debt of the state;

*OPL* - other portfolio liabilities;

*M2*- money supply M2; EXP - export of goods and services.

$$\mathrm{OPT\ (float)} = 0.3 * \mathrm{STED} + 0.1 * \mathrm{OPL} + 0.05 * \mathrm{M2} + 0.05 * \mathrm{EXP} \quad (2.11)$$

where OPT (float) - the optimal level of international reserves for floating currency regimes.

Thus, the optimal amount of gold reserves is in the range of 100–150% of the proposed adequacy indicator.

Therefore, in order to determine the impact of international reserves on macroeconomic stability, we propose to use indicators (Table 2.6):

– international reserves as a percentage of money supply M2;

– international reserves as a percentage of short-term external debt;

– international reserves in the months of import of goods and services;

– the optimal volume of gold reserves according to the IMF methodology.

These indicators were chosen based on the fact that they are officially researched and collected by the IMF database, which satisfies the first

requirement for the criteria for selecting a set of indicators in accordance with the theory of image recognition.

The results of the assessment of the adequacy of Ukraine's international reserves on a set of indicators are presented in Table 2.6–2.7.

Table 2.6

Adequacy of Ukraine's international reserves on various indicators, 2000-2008

| Indicator / Year | MR / IMPORT | MR / MONEY SUPPLY | MR / EXTERNAL DEBT | MR APPROACH IMF |
|---|---|---|---|---|
| **2001** | 1.81 | 0.36 | 0.32 | 0.51 |
| **2002** | 2.47 | 0.36 | 0.41 | 0.49 |
| **2003** | 3.01 | 0.39 | 0.58 | 0.65 |
| **2004** | 3.15 | 0.4 | 0.79 | 0.69 |
| **2005** | 5.32 | 0.51 | 0.95 | 1.07 |
| **2006** | 5.01 | 0.43 | 0.83 | 0.94 |
| **2007** | 5.4 | 0.41 | 0.85 | 1.31 |
| **2008** | 3.79 | 0.32 | 0.69 | 0.74 |

Source: calculated by the author

Researchers from the University of Malta use statistical databases from the IMF and the World Bank to calculate the macroeconomic stability index and the possibility of comparing it between countries according to a single criterion, and all components of the index undergo normalization (Briguglio et al., 2009):

$$XS_{ij} = \frac{X_{ij} - MinX_j}{MaxX_j - MinX_j} \quad (2.12)$$

where is the normalized value of the j-th criterion for the studied country and; $XS_{ij}$

$X_{ij}$ - the current value of the corresponding j-th criterion for the country under study and;

$MaxX_j$ , $MinX_j$ - respectively the maximum and minimum value of the studied j-th criterion.

Table 2.7

Adequacy of Ukraine's international reserves on various indicators, 2009-2016

| INDICATOR / YEAR | MR / IMPORT | MR / MONEY SUPPLY | MR / EXTERNAL DEBT | MR APPROACH IMF |
|---|---|---|---|---|
| **2009** | 5.66 | 0.42 | 0.71 | 0.74 |
| **2010** | 5.67 | 0.46 | 0.73 | 0.82 |
| **2011** | 3.85 | 0.37 | 0.53 | 0.66 |
| **2012** | 2.82 | 0.25 | 0.34 | 0.48 |
| **2013** | 2.52 | 0.18 | 0.35 | 0.53 |
| **2014** | 1.28 | 0.09 | 0.2 | 0.24 |
| **2015** | 3.29 | 0.29 | 0.41 | 0.5 |
| **2016** | 5.05 | 0.46 | 0.65 | 0.75 |

Source: calculated by the author

In this case, the index of macroeconomic stability is calculated as the arithmetic mean of normalized indicators:

– the ratio of government deficit to GDP;

– the amount of unemployment and inflation;

– the ratio of external debt to GDP.

In contrast to the previously described method, the method of scientists of the University of Malta fully satisfies the requirement to choose a set of indicators regarding the identity of the calculation method and the availability of information on macroeconomic index components for all countries studied, which makes this method easy to apply. Also, this technique allows the degree of macroeconomic stability of the studied state correlates with the degree of stability of other states. The results of averaging the three components of the macroeconomic stability index are shown in Table 2.7.

Table 2.7

Calculation of the macroeconomic stability index according to the methodology of scientists from the University of Malta

| Country | Year | | | | | |
|---|---|---|---|---|---|---|
| | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** |
| **Ukraine** | 0.618 | 0.706 | 0.705 | 0.692 | 0.272 th most common | 0.208 |
| **Latvia** | 0.134 th most common | 0.334 th most common | 0.511 | 0.594 th most common | 0.490 | 0.426 |
| **Lithuania** | 0.699 | 0.666 | 0.771 th most common | 0.894 th most common | 0.887 th most common | 0.787 th most common |
| **Poland** | 0.766 | 0.636 | 0.709 | 0.699 | 0.754 th most common | 0.711 |
| **Czech Republic** | 0.899 th most common | 0.697 th most common | 0.846 | 0.917 th most common | 0.778 th most common | 0.791 th most common |
| **Romania** | 0.684 | 0.596 th most common | 0.705 | 0.868 | 0.894 th most common | 0.825 |
| **Croatia** | 0.606 | 0.493 | 0.438 | 0.220 | 0.480 | 0.408 |
| **Armenia** | 0.557 th most common | 0.665 | 0.704 | 0.591 th most common | 0.655 th most common | 0.484 |
| **Georgia** | 0.519 th most common | 0.737 th most common | 0.798 th most common | 0.689 | 0.680 | 0.559 |
| **Moldova** | 0.792 th most common | 0.730 | 0.762 th most common | 0.791 th most common | 0.788 | 0.552 th most common |
| **Belarus** | 0.992 | 0.668 | 0.859 | 0.871 th most common | 0.926 | 0.900 |
| **Serbia** | 0.521 | 0.572 th most common | 0.244 th most common | 0.304 | 0.424 | 0.545 th most common |

Source: calculated by the author

Comparison of the obtained rankings of countries according to the results of the Macroeconomic Stability Index according to the methodology of the

University of Malta with a similar index published by the World Economic Forum showed a significant discrepancy between the results (Table 2.8) despite the use of almost similar approaches to component selection. Thus, when calculating the component of the global competition index - macroeconomic stability, experts use indicators that characterize primarily the financial situation in the country. In particular, the balance of the state balance in% to GDP, the rate of accumulation in% to GDP, the inflation rate in%, the amount of public debt in% to GDP, as well as the country's credit rating from 0 to 100 (best value) are taken into account.

Table 2.8

Comparison of the rank of countries obtained by the method of scientists of the University of Malta and the World Economic Forum (World Economic Forum)

| **Country** | **2015** | | **2014-2015** | | |
|---|---|---|---|---|---|
| | **rating** | **rank** | **rating** | **rank** | **rank within the studied countries** |
| Ukraine | 0.208 | 12 | 3.12 | 134 | 11 |
| Latvia | 0.426 | 10 | 5.56 | 31 | 3 |
| Lithuania | 0.787 th most common | 4 | 5.56 | 30 | 2 |
| Poland | 0.711 | 5 | 5.11 | 46 | 5 |
| Czech Republic | 0.791 th most common | 3 | 5.97 | 21 | 1 |
| Romania | 0.825 | 2 | 5.44 | 34 | 4 |
| Croatia | 0.408 | 11 | 4.19 | 107 | 9 |
| Armenia | 0.484 | 9 | 4.71 | 72 | 8 |
| Georgia | 0.559 | 6 | 4.95 | 51 | 6 |
| Moldova | 0.552 th most common | 7 | 4.86 | 55 | 7 |
| Belarus | 0.900 | 1 | - | - | - |
| Serbia | 0.545 th most common | 8 | 3.6 | 125 | 10 |

Source: calculated by the author

Summarizing the above approaches to assessing the level of macroeconomic stability of the national economy, the main factors that cause differences in the results include:

– use of the arithmetic mean formula when calculating the overall index of macroeconomic stability, which causes the risk of underestimating the deterioration of macroeconomic stability in connection with the compensation of the negative impact on one aspect by improving the assessment on another;

– loss of part of the information due to its excessive generalization;

– high multicollinearity of the components of the macroeconomic stability index.

The results of assessing the level of the relationship between the factors influencing the level of macroeconomic stability of the studied countries (Table 2.9-2.10).

Table 2.9

Correlation matrix for assessing the level of the relationship between the factors influencing the level of macroeconomic stability for Ukraine and Armenia

| **Variables** | **Government deficit (% of GDP)** | **Unemployment rate** | **Inflation rate** | **External debt (% to GDP)** |
|---|---|---|---|---|
| | **Ukraine** | | | |
| government deficit (% of GDP) | **1** | | | |
| unemployment rate | -0.1914 | **1** | | |
| inflation rate | -0.4283 | **0.892 th most common** | **1** | |
| external debt (% of GDP) | -0.4809 | **0.764 th most common** | **0.970** | **1** |
| | **Armenia** | | | |
| government deficit (% of GDP) | **1** | | | |
| unemployment rate | **-0.8394** | **1** | | |
| inflation rate | -0.0131 | 0.0409 | **1** | |
| external debt (% of GDP) | 0.1739 th most common | **-0.5262** | **-0.7188** | **1** |

Source: calculated by the author

Table 2.10

Correlation matrix for assessing the level of the relationship between factors influencing the level of macroeconomic stability for Serbia

| | **Serbia** | | | |
|---|---|---|---|---|
| government deficit (% of GDP) | **1** | | | |
| unemployment rate | -0.4384 | **1** | | |
| inflation rate | -0.0042 | **0.5202** | **1** | |
| external debt (% of GDP) | -0.1964 | -0.2181 | 0.4110 | **1** |

Source: calculated by the author

In the works (Iqbal, & Nawaz, 2010; Martínez-Vázquez & McNab, 2006) as the main parameters of macroeconomic stability, scientists use the Misery index (English Misery index), which is the sum of unemployment and inflation (2.13):

$$\mathrm{MI} = \mathrm{UR} + \mathrm{INF} \tag{2.13}$$

where MI - Misery Index; UR - unemployment rate; INF - inflation rate.

The use of this index is a theoretical assumption of the negative effects of relatively high inflation and rising unemployment on economic growth of the national economy. R. Najarzadeh and VS Shahri (2008) propose to use the GDP volatility indicator as an indicator of macroeconomic stability:

$$VolGDP_t = \frac{\sqrt{VarGDP_t}}{E(GDP_t)} \tag{2.14}$$

M. Ismihan (Ismihan, Metin-Ozcan, & Tansel, 2005) proposes to assess the level of macroeconomic stability using unified indicators of inflation, public debt, foreign debt and exchange rate volatility. An increase in the level of the ISI index

found by the sum of these unified parameters indicates a decrease in the level of macroeconomic stability of the national economy.

Of course, the disclosure of the fundamental features of the processes and assessment of the impact of parameters on the state of the economic system is impossible without a systematic approach to analysis, taking into account the synergy of different components of transformations of modern socio-economic space.

The synergetic approach defines as an axiom the impossibility of a complete description in adequate terms of the behavior of a complex system and the process of its development (Zang, 1999). However, it allows to outline the determinism, general and specific patterns, principles and features of the dynamics of the economic system. Thus, the use of synergetic models in describing macroeconomic processes makes it possible to study the trajectory of changes in the economic system at different values of input parameters and finding the optimal solution.

The Lotka-Volterra equations are a mathematical description of the Darwinian principle of the struggle for existence, also known as nonlinear first-order predator-victim differential equations (Trubetskov, 2011). Darwin was a supporter of Malthus's ideas, extending them to all living things: in nature there is a struggle for life, a struggle for existence, in which the worst and weakest organism dies first, and the more developed forms, healthier and more adapted, win. It is these individuals that continue the genus and development. Organisms adapt more quickly to environmental conditions if such cases of struggle are repeated at certain intervals. Similar processes occur in economic systems. For example, countries compete for investment resources, grants from international funds, and so on. At the same time, a more competitive economic system survives. The system of equations describing the interaction can be expressed as:

$$\frac{dN}{dt} = a_n N - b_n N^2 \pm c_{nm} NM, \quad (2.15)$$

$$\frac{dM}{dT} = a_m M - b_m M^2 \pm c_{mn} MN. \quad (2.16)$$

Recently, the processes occurring in the economy are being actively studied in terms of self-organization, behavior theory, chaos, etc. (Hacken, 1985; Olemskaya, 2003; Olemskaya et al., 2004), which allows you to create high-quality mathematical models. To describe evolutionary processes, a whole concept of synergetic economics is proposed, which is based on the physical theory of open systems with pronounced nonlinear connections. For example, the influence of random factors can be reduced to the constant action of fluctuations (noise), the intensity of which can be set by the researcher. According to this approach, the stability of the economic system is reflected by a synergetic model of macroeconomic parameters which reach equilibrium over time. In particular, the effect of the law of supply and demand can be represented in the form of equations:

$$\dot{\eta} = -\eta + h^{-1}, \quad (2.17)$$

$$\theta \dot{h} = h(1 - \eta h S), \quad (2.18)$$

$$\delta \dot{S} = (S_e - S) - \eta h^{-1}, \quad (2.19)$$

where $S$ is the price, h - demand, η - proposal.

The solution of these equations illustrates the achievement of stability in economic systems over time depending on the initial conditions (Fig. 2.4).

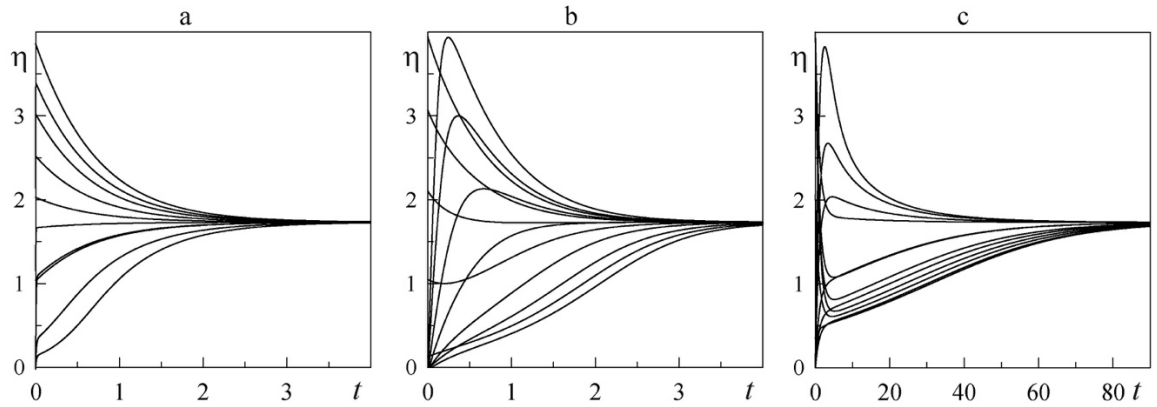



Figure 2.4 - Graphical interpretation of achieving stability in economic systems

Source: calculated by the author

At the same time, it should be noted that such models are rather descriptive in nature and cannot be used in the management of macroeconomic processes.

Based on the results of the analysis of domestic scientific and methodological approaches and tools for assessing the level of macroeconomic stability of the national economy, we can conclude that there is no systematic research on the classification of methods, models, groups of approaches, etc. in this area.

Based on this, the author proposes the following typology of approaches to assessing the level of macroeconomic stability of the national economy:

1. Dynamic-equilibrium approach.
2. Static-interval approach.
3. Static-comparative approach.

The dynamic equilibrium approach combines methods that assess the macroeconomic stability of the national economy through the level of volatility over time, namely the deviation from the average value or trend. That is, the national economy is considered stable, which quickly returns to equilibrium after deviating in response to the disturbance. At the same time, low volatility is a sign of high macroeconomic stability of the national economy, and the direction of the trend is not important, the results significantly depend on the choice of type of function that describes the trend of macroeconomic stability of the national

economy as a whole and its individual components. It should be noted that this approach takes into account only the amplitude of fluctuations in the levels of the time series, while the targets for change are ignored.

Static-interval approach - assesses the level of macroeconomic stability of the national economy not from the standpoint of stability over time, but because of the possibility of maintaining the optimal level in a given range. That is, the macroeconomic stability of the national economy may have a significant level of volatility at different points in time, but if in each period the deviations do not exceed the established range, the national economy is considered stable. Scientific and methodological approaches to assessing the level of macroeconomic stability of the national economy within this classification group evaluates the level of macroeconomic stability of the national economy as a static rather than dynamic phenomenon that ignores the objective cyclical nature of fluctuations of most macroeconomic parameters.

It should be noted that the static-comparative approach assesses the level of macroeconomic stability of the national economy of the studied country not because of the dynamics of this indicator in time for the same country, but through comparison with a similar indicator of the reference country at a fixed time. In this case, the reference country is determined depending on various parameters. This approach does not take into account the deviation of the parameters of macroeconomic stability of the national economy from their dynamic equilibrium, as well as the ability of the national economy to overcome the imbalances that cause such deviations. It should be noted that the application of this approach can lead to an underestimation of the level of macroeconomic stability of the national economy, and the adequacy of the results largely depends on the choice of the reference country.

A comparative analysis of the theoretical basis for assessing the level of macroeconomic stability of the national economy showed that to the greatest extent the requirement for ensuring the reliability of the comparison of different

countries and achieving the main goals of the stabilization policy of the state is performed using the concept of the pentagon macroeconomic stability.

As a kind of analysis of macroeconomic stability, the director of the Institute of Finance in Warsaw, Professor of Economics Grzegorz W. Kolodko (Kolodko, 1993) proposed a model of the pentagon of macroeconomic stability "Macroeconomic stabilization Pentagon" (MSP). This model is designed to assess the level of economic development, taking into account internal and external imbalances. The model of the pentagon of macroeconomic stability is based on the calculation of five key indicators that reflect the five signs of macroeconomic stability, namely:

– GDP growth rate (r), which reflects the processes of development in the real economy. The author notes that achieving and maintaining economic stability in conditions of persistent stagnation and crisis trends is not possible;

– unemployment rate (U), which reflects the extent to which the country's human potential is used. The value of this indicator should be as low as possible;

– inflation rate (CPI). It should be noted that inflation should not provoke a restraint on the growth of production and affect the redistribution of wealth or income on a socially unacceptable scale;

– the state budget balance to GDP (G). At the same time, the state budget must be balanced and show a certain surplus of revenues over expenditures. This surplus - given the fiscal deficit, which usually exists before stabilization - should be maintained at a level that guarantees the maintenance of domestic public debt to the extent that can be financed, possibly by non-inflationary means. Given the above, it is necessary to systematize the requirements imposed on EU countries under the planned monetary union. It is believed that the budget balance should guarantee a reduction of total public debt to less than 60% of GDP within 10 years. At the same time, the paper proposes to estimate through the ratio of the budget balance to GDP;

– balance of current turnover to GDP (CA). The current account balance should provide a full and efficient service of external debt and at the same time create a chance for gradual reduction and elimination of debt over a period of time (for example, 10 or 25 years) (Kolodko, 1993).

The essence of the SME model is to assess the country's achievement of five goals of macroeconomic stability: 1) stable economic growth, measured by the growth rate of gross domestic product; 2) increase in employment, ie decrease in unemployment; 3) increasing the internal balance, which is understood as reducing inflation, 4) a balanced state budget, which can support the financing of domestic debt without inflationary effects 5) the current account balance must be maintained at a level that will reduce external debt.Each of the five above indicators is the vertex of the pentagon (Figure 2.5).

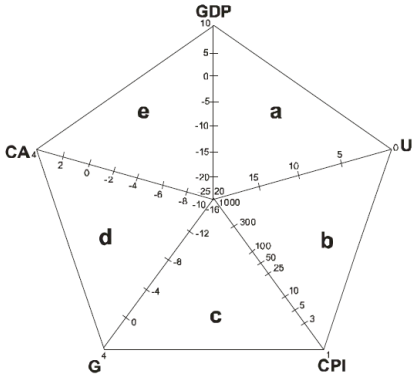



Figure 2.5 - Pentagon of macroeconomic stability "Macroeconomic stabilization Pentagon"

Source: based on (Kolodko, 1993)

In this case, the synthetic indicator MSP, which is a measure of the surface defined by the vertices, is calculated based on the ratios of the above five indicators (vertices). So MSP is proposed to calculate the formula 2.18.

$$MSP = a + b + c + d + e = [(r \times U) + (U \times CPI) + (CPI \times G) + (G \times CA) + (CA \times r)] \times k \quad (2.18)$$

a, b, c, d, e- the area of the corresponding triangles of the pentagon of macroeconomic stability "Macroeconomic stabilization Pentagon"; k = 1/2 sin 72°

It should be noted that the area of the triangle characterizes the indicator of the real sphere of the economy and is defined as the product of the level of GDP growth and unemployment. The area of the triangle $b$ depends on the level of unemployment and inflation and is defined as an indicator of stagflation. The area of the triangle *c,* characterizes the indicator of the budget and inflation and is defined as the product of the level of inflation and the state budget balance. The area of the triangle*d* estimates the financial balance and is calculated as the product of the state budget balance and the balance of current turnover to GDP. The area of the triangle*e* or the triangle of the external sector, reflects the product of the balance of the current turnover to GDP and the level of GDP growth.

With $a, b, c, d, e$ calculated by formulas (2.19–2.24).

$$a = r \times U \times k \quad (2.19)$$

where $r$- GDP growth rate; - unemployment rate $U$

$$b = U \times CPI \times k \quad (2.20)$$

where $CPI$- inflation rate; - unemployment rate $U$

$$c = CPI \times G \times k \quad (2.21)$$

where $CPI$- inflation rate; - the state budget balance to GDP $G$

$$d = G \times CA \times k \quad (2.22)$$

where $CA$- the balance of current turnover to GDP; - the state budget balance to GDP $G$

$$e = CA \times r \times k \quad (2.23)$$

where $CA$- the balance of current turnover to GDP; - GDP growth rate $r$

$$k = 1/2\ sin\ 72° \quad (2.24)$$

The interpretation of the formed pentagon on the basis of the proposed indicators is based on the analysis of the surface and shape of the pentagon, as well as the value of MSP. It is believed that the level of overall macroeconomic stability of the country is directly proportional to the surface area of the pentagon, while the degree of balance of the shape of the pentagon indicates the level of coordination of individual vectors of regulatory policy. To ensure positive economic growth and economic stability, it is desirable to maintain the value of the synthetic MSP indicator at the highest possible level. For a more detailed analysis of the impact of internal and external factors on the macroeconomic stability of the country, equations (2.18) are presented in the form:

$$MSP = MSP1 + MSP2 \quad (2.25)$$

where - an indicator that characterizes the impact of internal factors on the macroeconomic stability of the country; - an indicator that characterizes the influence of external factors.$MSP1MSP2$

In this case, and are calculated by the formulas:$MSP1MSP2$

$$MSP1 = \text{a} + b + c \quad (2.26)$$

$$MSP2 = d + \text{e} \quad (2.27)$$

The value of the MSP indicator should not exceed 1, the area of each of the triangles is 0,200. The maximum length of the side of the triangle is $0.6485.5 \times 0{,}200 = 1$

Analysis of macroeconomic stability of Ukraine in the period 1997-2016, taking into account the structure of influence of internal (sum of surfaces of triangles a, b and c) and external factors (sum of surfaces of triangles d and e) at different stages of the economic cycle: formation of post-Soviet economic system

1998), the pre-crisis period (1999-2007), the crisis period (2008-2013) and the post-crisis period (2014-2016) demonstrate the chaotic process of economic stabilization and the different direction of the country's macroeconomic proportions (Fig. 2.6).

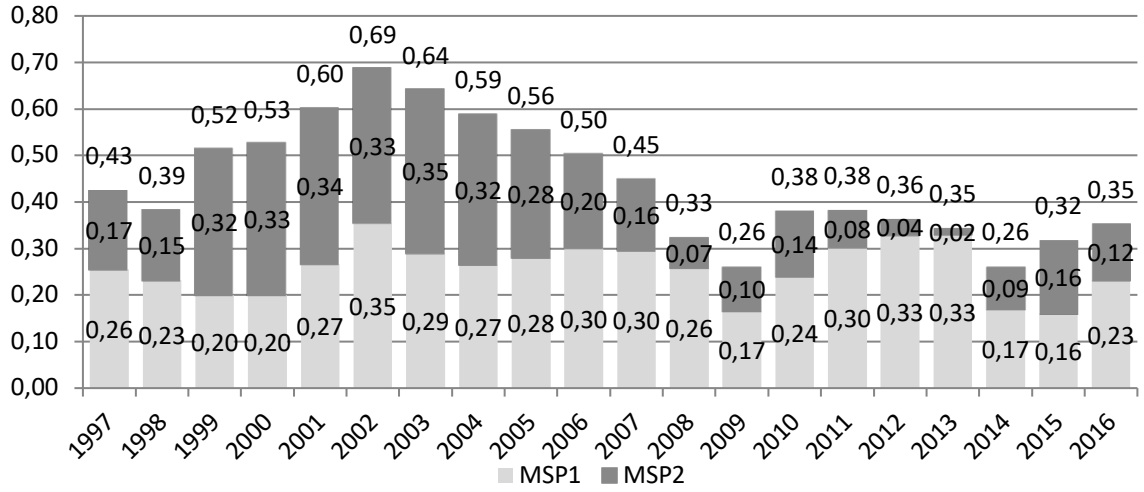



Figure 2.6 - Indicators of the impact of internal and external factors on the macroeconomic stability of Ukraine in 1997-2016

Source: built by the author

The maximum value of MSP (0.69) in Ukraine was reached in 2002 when there was a relative balance between MSP1 (0.35) and MSP2 (0.33). From 1997 to 2003, the triangles of financial equilibrium and the external sector grew steadily (Fig. 2.7) and in 2003 the MSP2 index was the highest among all analyzed years (the level of the MSP2 sub-index increased from 0.17 in 1997 to 0.35 in 2003). p., or 105%).

It should be noted that during the entire time interval from 1997 to 2016, a sufficient level of macroeconomic stability above 0.5 was demonstrated by the country only in the pre-crisis period from 1999 to 2007. During this period, with the exception of 1999 and 2000, internal factors (fields of triangles a, b and c) had a large share in the structure of SMEs during the analyzed period and ranged from 38% (1999) to 65% (2007). p.).

In 2008, the deterioration was mainly due to external factors (the level of MSP2 was 0.07), and this was primarily due to the significant impact of the global financial and economic crisis.

Throughout the crisis period of 2008-2013, the size of the MSP2 sub-index decreased and reached its minimum in 2013 (0.02 or 5% of the MSP value). The large share of the MSP1 sub-index in 2008-2013 indicates that the macroeconomic situation in the country depends primarily on domestic production.

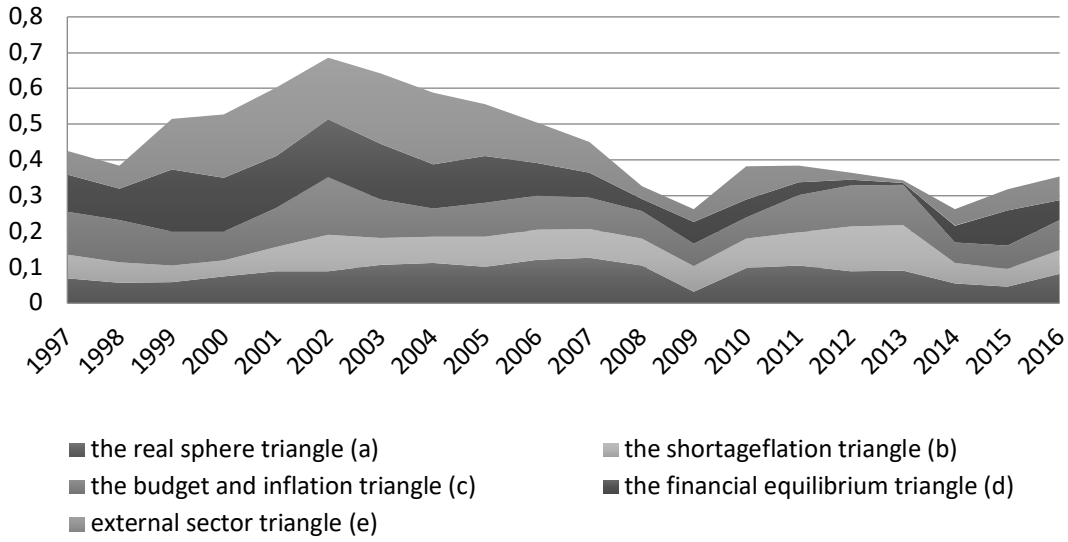



Figure 2.7 - Distribution of SME values for Ukraine in 1997-2016

Source: built by the author

In the process of stabilization in the post-crisis period, both external factors and, to a greater extent, internal factors contributed to the increase in the level of macroeconomic stability. Four triangles (a, b and d, e) out of five characterized the positive dynamics, but the large share of domestic factors (about 66% in 2016) indicates a gradual policy of restoring the openness of their markets and increasing GDP growth (Fig. 2.8) .

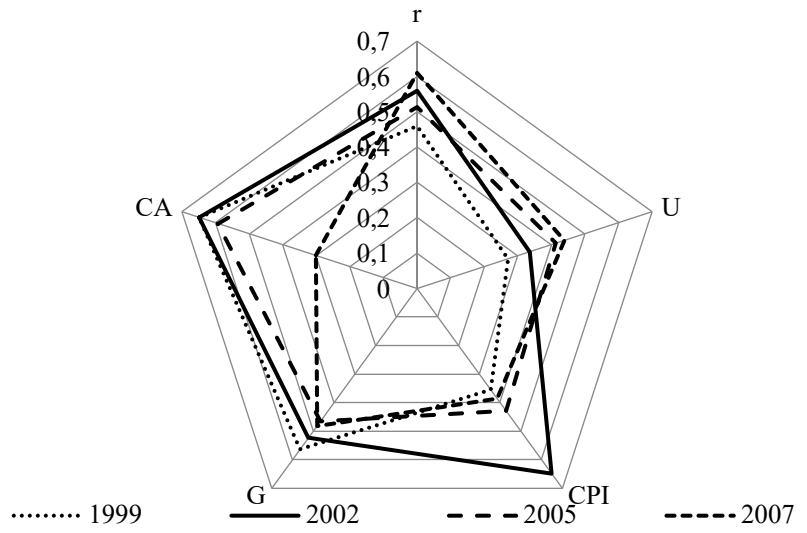



Figure 2.8 - Profile of the index of macroeconomic stability of the national economy in the pre-crisis period 1999-2007.

Source: built by the author

In 2016, the level of SMEs (0.353) was higher by 0.027 points compared to 2008 (0.326) and by 0.09 in 2009, while the fields of the real economy, stagflation, the budget triangle and inflation decreased by 0.008 compared to 2013. 0.061 and 0.029 points, respectively. It should be noted that the level of SMEs in 2014-2016 did not reach the minimum value achieved in the pre-crisis period from 1999 to 2007 (0.451 in 2007).

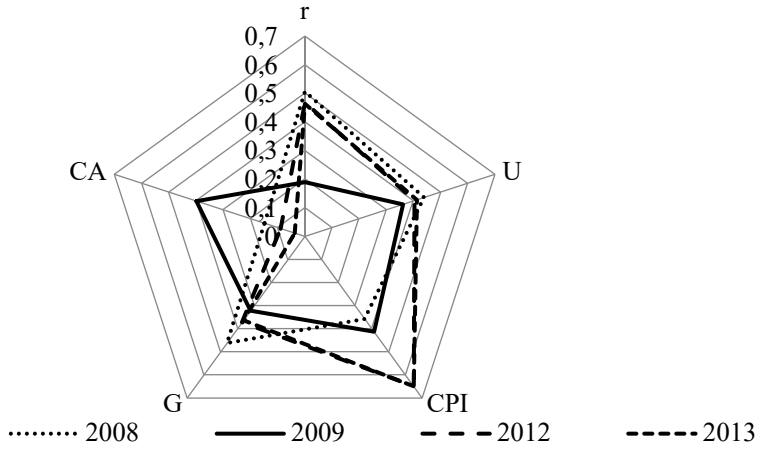



Figure 2.9 - Profile of the index of macroeconomic stability of the national economy in the crisis period of 2008-2013.

Source: built by the authors.

Figures 2.8–2.11 present a graphical interpretation of the obtained calculations in terms of the following periods: pre-crisis, crisis, post-crisis and forecast. The average value of the areas of the triangles of the synthetic indicator MSP during the entire analyzed period did not exceed the optimal value of 0.1: the average value of the area of the triangle a - 0,086, the average value of the area of the triangle b - 0,076; the average value of the area of the triangle c - 0,094; the average value of the area of the triangle d is 0.089; the average value of the area of triangle e is 0.098. Given the macroeconomic forecasts for Ukraine of GDP growth and unemployment approved on May 31 at a meeting of the Cabinet of Ministers of Ukraine and based on extrapolation of consumer price index, state budget and current account data, it can be argued (Figure 2.11) that the gradual improvement of macroeconomic stability in 2018-20 years will occur mainly due to the growing balance of external and internal factors.

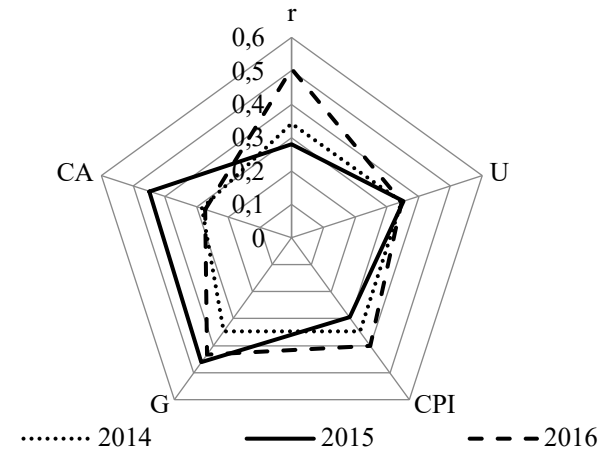



Figure 2.10 - Profile of the macroeconomic stability index of the national economy in the post-crisis period of 2014-2016.

Source: built by the author

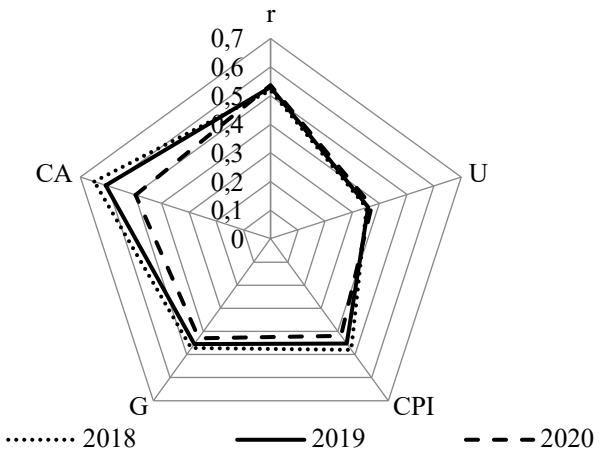



Figure 2.11 – Profile of the macroeconomic stability index of the national economy projected values (2018-2020)

Source: built by the author

The calculation of the SME indicator, as well as its components MSP1 and MSP2 allows to identify areas that determine the progressive process of stabilization or destabilization of the national economy and the level of influence of public policy.

In order to determine the best experience of public policy to increase the level of macroeconomic stability, similar calculations were made for selected EU countries.

Comparing the areas of the pentagons of macroeconomic stability makes it possible to identify the best practices of countries that have overcome the problems of macroeconomic instability (in terms of unemployment, inflation, etc.) and have taken the lead. The results of the calculations are given in tables 2.11-12.

Table 2.11

The value of the SME index and its components for the analyzed countries in the period 2000-2015 for Ukraine, Latvia, Serbia and Lithuania

| **Country** | **Indicator** | **2000** | **2002** | **2004** | **2006** | **2008** | **2010** | **2012** | **2014** | **2015** |
|---|---|---|---|---|---|---|---|---|---|---|
| Ukraine | SME1 | 0.200 | 0.354 th most common | 0.265 | 0.301 | 0.258 | 0.24 | 0.329 th most common | 0.17 | 0.161 th most common |
| | MSP2 | **0.328** | **0.333 th most common** | **0.324** | **0.203** | **0.068** | 0.142 th most common | 0.035 th most common | 0.092 | 0.158 th most common |
| | SMEs | **0.527 th most common** | **0.687 th most common** | **0.589 th most common** | 0.504 | 0.326 th most common | 0.382 th most common | 0.364 th most common | 0.263 th most common | 0.319 th most common |
| Latvia | SME1 | 0.213 | 0.268 | 0.238 | 0.335 th most common | 0.231 | ***0.039 th most common*** | 0.226 | 0.300 | 0.314 th most common |
| | MSP2 | 0.111 | 0.080 | ***0.000*** | ***0.000*** | ***0.000*** | 0.135 th most common | 0.144 th most common | 0.167 th most common | 0.192 th most common |
| | SMEs | 0.324 | 0.348 th most common | 0.238 | 0.335 th most common | 0.231 | 0.173 th most common | 0.370 th most common | 0.467 | 0.506 |
| Serbia | SME1 | 0.148 | 0.211 | 0.105 | ***0.110*** | 0.183 th most common | 0.078 | ***0.060*** | ***0.086*** | 0.141 th most common |
| | MSP2 | 0.198 th most common | 0.137 th most common | ***0.000*** | 0.009 | ***0.000*** | 0.068 | ***0.000*** | 0.064 | 0.101 |
| | SMEs | 0.346 th most common | 0.348 th most common | ***0.105*** | ***0.119*** | 0.183 th most common | 0.146 th most common | ***0.060*** | ***0.150*** | 0.242 |
| Lithuania | SME1 | 0.199 th most common | 0.272 th most common | 0.289 | 0.364 th most common | 0.312 | 0.146 th most common | 0.236 | 0.323 th most common | 0.347 th most common |
| | MSP2 | 0.094 | 0.117 | 0.057 | ***0.000*** | ***0.000*** | **0.200** | **0.197 th most common** | **0.309** | 0.170 th most common |
| | SMEs | 0.293 | 0.388 th most common | 0.346 th most common | 0.364 th most common | 0.312 | 0.346 th most common | 0.433 | **0.632** | 0.517 th most common |

Source: built by the author on the basis of his own calculations

The analysis of the data in Table 2.12 showed different rates of change in the macroeconomic stability of the national economies of the studied countries.

Table 2.12

The value of the SME index and its components for the analyzed countries in the period 2000-2015 for Poland, Armenia, Belarus, Croatia, Georgia, Moldova, Bulgaria and Romania

| **Country** | **Indicator** | **2000** | **2002** | **2004** | **2006** | **2008** | **2010** | **2012** | **2014** | **2015** |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Poland | SME1 | 0.147 th most common | ***0.108*** | ***0.099*** | 0.231 | 0.314 th most common | 0.249 | 0.267 | 0.321 th most common | 0.358 th most common |
| | MSP2 | 0.084 | 0.134 th most common | 0.089 | 0.129 | 0.066 | 0.084 | 0.123 | 0.161 th most common | 0.199 th most common |
| | SMEs | 0.231 | 0.243 | 0.188 th most common | 0.360 | 0.380 | 0.334 th most common | 0.390 th most common | 0.482 | 0.557 th most common |
| Armenia | SME1 | 0.118 | 0.118 | 0.137 th most common | 0.117 | 0.175 th most common | 0.087 | 0.167 th most common | 0.146 th most common | ***0.135 th most common*** |
| | MSP2 | ***0.000*** | 0.092 | 0.194 th most common | 0.192 th most common | ***0.000*** | ***0.000*** | ***0.000*** | 0.052 | 0.140 |
| | SMEs | ***0.118*** | 0.210 | 0.332 | 0.309 | 0.175 th most common | ***0.087*** | 0.167 th most common | 0.198 th most common | 0.275 th most common |
| Belarus | SME1 | **0.265** | 0.314 th most common | **0.377 th most common** | **0.445** | **0.423** | **0.401** | **0.342 th most common** | 0.361 th most common | 0.353 th most common |
| | MSP2 | 0.155 th most common | 0.192 th most common | 0.127 | 0.170 th most common | 0.057 | ***0.000*** | 0.160 | 0.076 | 0.138 th most common |
| | SMEs | 0.420 | 0.506 | 0.504 | **0.616** | **0.480** | **0.401** | **0.502** | 0.437 th most common | 0.491 |
| Croatia | SME1 | ***0.078*** | 0.115 | 0.141 th most common | 0.187 th most common | 0.239 | 0.146 th most common | 0.115 | 0.128 | 0.154 th most common |
| | MSP2 | 0.149 th most common | ***0.062*** | 0.124 | 0.078 | 0.026 | 0.155 th most common | 0.178 th most common | 0.222 | **0.255 th most common** |
| | SMEs | 0.226 | ***0.176 th most common*** | 0.265 | 0.265 | 0.265 | 0.301 | 0.294 | 0.349 th most common | 0.409 |

Continuation of the table. 2.12

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|
| Georgia | SME1 | 0.259 | 0.224 | 0.233 | 0.225 | ***0.157 th most common*** | 0.129 | 0.247 | 0.252 th most common | 0.236 |
| | MSP2 | 0.088 | 0.078 | 0.073 | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** |
| | SMEs | 0.347 th most common | 0.302 | 0.305 | 0.225 | *0.157 th most common* | 0.129 | 0.247 | 0.252 th most common | ***0.236*** |
| Moldova | SME1 | 0.237 th most common | **0.364 th most common** | 0.286 | 0.283 | 0.372 th most common | 0.293 | 0.323 th most common | 0.370 th most common | 0.284 th most common |
| | MSP2 | 0.053 | 0.228 | 0.202 | 0.000 | ***0.000*** | 0.056 | 0.049 | 0.104 | 0.099 |
| | SMEs | 0.290 | 0.592 th most common | 0.489 | 0.283 | 0.372 th most common | 0.350 th most common | 0.372 th most common | 0.474 th most common | 0.383 th most common |
| Bulgaria | SME1 | 0.127 | 0.166 th most common | 0.271 th most common | 0.322 th most common | 0.359 th most common | 0.237 th most common | 0.249 | 0.268 | 0.323 th most common |
| | MSP2 | 0.159 th most common | 0.220 | 0.144 th most common | ***0.000*** | ***0.000*** | 0.154 th most common | 0.192 th most common | 0.195 th most common | 0.206 |
| | SMEs | 0.286 | 0.386 th most common | 0.416 | 0.322 th most common | 0.359 th most common | 0.392 th most common | 0.441 | 0.462 th most common | 0.529 th most common |
| Romania | SME1 | 0.203 | 0.249 | 0.295 th most common | 0.324 | 0.325 th most common | 0.242 | 0.292 | **0.380** | **0.381 th most common** |
| | MSP2 | 0.139 th most common | 0.162 th most common | 0.060 | ***0.000*** | ***0.000*** | 0.079 | 0.100 | 0.202 | 0.192 th most common |
| | SMEs | 0.342 th most common | 0.411 | 0.356 th most common | 0.324 | 0.325 th most common | 0.320 | 0.392 th most common | 0.582 th most common | **0.573 th most common** |

Source: built by the author on the basis of his own calculations

Thus, in particular, Ukraine in the period from 2000 to 2008 showed the highest level of the MSP indicator, with almost the entire period of vital importance in shaping the degree of stabilization played external factors (triangles d, e) while Belarus during the global financial crisis of 2007-2010, the

main factors that provided the highest level of stabilization among the studied countries were domestic (fields of triangles a, b, c).

It should be noted that despite the high level of macroeconomic stability of Ukraine in the period from 2000-2008, the rate of its decline from 0.527 in 2000 to 0.326 in 2008 allows us to conclude that there is a lack of proper coordination of economic policy pursued by Ukraine to achieve a high level. macroeconomic stability of external factors. Croatia and Romania in the post-crisis period showed the best indicators of macroeconomic stabilization, it should be noted that these countries joined the EU in 2013 and 2007, respectively. At the same time, the Croatian economy before joining the EU showed one of the lowest levels of overall macroeconomic stability of MSP and MSP2, in particular in 2002 MSP = 0.176 and MSP2 = 0.062, and after joining the EU the value of MSP2 grew rapidly and reached its maximum value among the analyzed countries in 2015 it amounted to 0.255.

Similar trends were demonstrated by the Romanian economy, which in 2015, thanks to an increase in the level of stabilization of internal factors by 87%, from 0.203 MSP1 in 2000 to 0.381 in 2015, managed to achieve the best level of macroeconomic stability.

In terms of macroeconomic stabilization, the best SME indicator for the entire analyzed period was achieved by Belarus in 2005, with a level of macroeconomic stability of 0.711. At the same time, the lowest level of macroeconomic stabilization of 0.06 was recorded in 2012 by Serbia.

The main disadvantage of the analysis of the synthetic indicator MSP is the limited interpretation. That is, it allows only to determine the direction of change of stabilization processes and to obtain partial information about the level of economic stability on the basis of comparison with either the previous period or with data for another country.

The paper (Zaman & Drcelic, 2009) proposed a slightly different approach to solving the problem we study, which allows using the macroeconomic stabilization indicator (IMS) to identify five main levels.

However, the analysis of macroeconomic stability only for The MSP or IMS is static in nature, as it does not take into account the fluctuations of each component of the MSP / IMS indicator and the risks of losing their stability.

It should be noted that the results of research of previous sections indicate the presence of interaction and interdependence of indicators of macroeconomic stability of the national economy, which are cyclical.

Based on the basic research the concept of the pentagon of macroeconomic stability assessment developed by GJ. Kolodko and its modifications proposed by K. Zaman (2009), B. Derlik (2009), G. Gurduzeu (2015), MI Lazar (2015), A. Malina (2014), D. Miersva (2014), J. Pera (2012), RO Ionita (2015) and others. it can be concluded that the above concepts do not take into account the cyclical fluctuations of indicators for assessing the macroeconomic stability of the national economy.

At the first stage, the static component of macroeconomic stability of the national economy is determined according to the modified model of the pentagon proposed in the paper (Zaman & Drcelic, 2009).

$$MS_i = \sum_{j=1}^{n} A_j = \sum_{j=1}^{n} \left(\frac{X_j - X_{min}}{X_{max} - X_{min..}) \times 10}\right) \qquad (2.28)$$

where - normalized values of the j-th element of the synthetic indicator MS; - the actual value of the j-th element of the synthetic indicator MS; and - the maximum and minimum value of the element of the synthetic indicator MS.$\mathrm{A_j} X_j X_{max} X_{min}$

Relevant components synthetic indicator MS have their ranges, namely:

– the change in the level of GDP (g) has a range from 0 to 10;
– unemployment zone range (u) from 5 to 25;
– change in inflation (p) from 0.92 to 4.61;
– budget deficit in% to GDP (bd) is from -10 to 2;
– external debt (fd) is from 10 to 65.

Taking into account the results of the study of domestic and foreign scientists, the author proposes to distinguish the following main levels of the statistical indicator MS: very stable economy; the economy is stable; medium stable economy; low level of economic stability; extremely unstable economy.

The maximum level of the static indicator of macroeconomic stability can reach 50, and the value of each sub-index cannot exceed the level of 10. The limits of the level of the static indicator are presented in Table 2.13.

Measuring macroeconomic stability involves estimating the equilibrium values of variables and their deviations from the actual, reference values. In this case, equilibrium means the presence of a constant state or trend, to which the variables usually return after the deviation in response to the perturbation. Therefore, statistically, the assessment of macroeconomic stability should include a comparison of the value of MS with the standard deviations of its components.

Table 2.13

Limits of the level of the static indicator MS

| **Borders** | **Level** |
|---|---|
| *MS* ] [40; 50] | very stable economy |
| *MS* ] [30; 40] | the economy is stable |
| *MS* ] [20; 30] | medium stable economy |
| *MS* ] [10; 20] | low level of economic stability |
| *MS* ≤10 | extremely unstable economy |

Source (Zaman & Drcelic, 2009)

In the second stage, the deviations of the actual values of the variables from the equilibrium are calculated, using the Godric-Prescott filter, the cyclic component of each of the elements of the synthetic indicator of macroeconomic stability of the national economy is selected. In this case, the arithmetic mean of the standard deviations which allows to take into account the negative deviations of the equilibrium values of the parameters from the optimal value.

Taking into account the standard deviations of the variables will take into account the negative trends that can be offset by the achieved stabilization of all other components and ensures that all MS components have equal sample volatility, so that changes in the index are not exclusively controlled by the most stable components.

At the same time, additional consideration of the indicators of asymmetry or the degree of excess distribution and the rate of occurrence of extreme deviations. allow to analyze the reaction of economic agents to the action of positive or negative shocks. In addition, this approach allows us to take into account the nature of the distribution of values of sub-indices of the integrated macroeconomic indicator around the trend: characterized by frequent shocks on a limited scale; mostly dominated by rare shocks on a large scale.

Thus, the mathematical formalization of the calculation of these indicators involves the use of formulas (2.29 and 2.30).

$$Skewness_j = 100 \times \frac{\frac{1}{n}\sum_{i=1}^{n}\left(\frac{x_i-\bar{x}}{\bar{x}}\right)^3}{\left(\frac{1}{n}\sum_{i=1}^{n}\left(\frac{x_i-\bar{x}}{\bar{x}}\right)^2\right)^{3/2}} \quad (2.29)$$

where is the asymmetry index of the j-th component of the macroeconomic stability indicator (MS); - the value of the corresponding component of the macroeconomic stability indicator (MS) in the i-th period; - the average value of the relevant component of the macroeconomic stability indicator (MS) for the analyzed period; n is the number of analyzed periods.Skewness$x_i\bar{x}$

$$Kurtosis_j = 100 \times \frac{\frac{1}{n}\sum_{i=1}^{n}(\frac{x_i-\bar{x}}{\bar{x}})^4}{(\frac{1}{n}\sum_{i=1}^{n}(\frac{x_i-\bar{x}}{\bar{x}})^2)^2} \quad (2.30)$$

where - the rate of extreme deviations of the j-th component of the macroeconomic stabilization indicator (IMS).

A value close to zero will indicate a symmetrical distribution of the j-th component of the macroeconomic stability indicator (MS), while the impact of crises or booms will affect its decrease or increase, respectively. Skewness

Thus, the non-zero value of the asymmetry index (positive or negative) indicates instability, ie the predominance of positive (negative) shocks.

The analysis of the indicator together with allows to fully demonstrate the impact of sharp unusual fluctuations in the country on the components of the macroeconomic stability indicator (MS). In this case, in the case of a symmetrical distribution of the individual components of the macroeconomic stabilization indicator (MS), the indicator is equal to 3 or 300%, the value of more or less than the specified level indicates the tendency of the variable to extreme values.Skewness$KurtosisKurtosis$

In the framework of the author's approach to assessing the macroeconomic stability of the national economy, it is proposed to calculate the cyclic component by the formula (2.31)

$$MS_{cyc_i} = \left(\sum_{j=1}^{n}\sqrt{\frac{1}{T}\sum\left(c_{tj} - mean(c_{tj})\right)^2}\right)/n \quad (2.31)$$

where is the cyclic component$c_t$the value of the j-th element of the synthetic indicator MS; mean (- cyclic component of the value of the j-th element of the synthetic indicator MS; T = 1… t - research period.$c_t$)

$$c_t = X_t - \tau_t \qquad (2.32)$$

where - the actual data $X_t$the value of the j-th element of the synthetic indicator MS; - trend component.$\tau_t$

Trend component is extracted from the actual data set by solving the expression:$y_t$

$$\min_{\tau_t} \sum_{t=1}^{T}((y_t - \tau_t)^2 + \lambda((\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1}))^2) \qquad (2.33)$$

At the last stage, the ratio of static and cyclical indicators of macroeconomic stability of the national economy is calculated, which allows to assess the conversion of state regulatory policy.

In order to get a clear idea of the level of macroeconomic stability, it is necessary to provide a graphical interpretation of the pentagon of macroeconomic stability, compare the MS indicator with the sum of standard deviations of MS subindexes taking into account distribution asymmetry and extreme deviations.

In order to test the approach proposed in the previous section to assess the level of macroeconomic stability, the author conducted a modeling of the integrated index for assessing the level of macroeconomic stability in Ukraine.

At the first stage, to empirically confirm the need to take into account the cyclical component, the author assessed the level of macroeconomic stability of the country using the basic concept of the pentagon of assessing the macroeconomic stability of the country. In this case, the subjects of the study were Ukraine, neighbouring countries and countries that have recently joined the EU. During the calculation, the method described in subsection 2.2 and the applied statistical analysis program Stata 14 were used.

Tables 2.14–2.16 present an analysis of the MS indicator at different stages of the economic cycle: pre-crisis period (2000–2006), crisis period (2007–2010) and post-crisis period (2011–2017).

Table 2.14

MS index for low and middle income economies for the period 2000-2006 (pre-crisis period)

| Year | Countries | | | | | |
|---|---|---|---|---|---|---|
| | Ukraine | Latvia | Lithuania | Poland | Croatia | Romania |
| 2000 | 29.78 | 26.95 | 29.85 | 26.35 | 20.13 | 24.19 |
| 2001 | 38.19 | 28.41 | 31.89 | 23.15 | 22.55 | 28.93 |
| 2002 | 38.63 | 30.08 | 34.98 | 23.38 | 23.76 | 30.79 |
| 2003 | 41.36 | 30.71 | 38.84 | 22.69 | 24.00 | 32.14 |
| 2004 | 37.94 | 29.28 | 35.21 | 24.98 | 22.96 | 36.37 |
| 2005 | 33.05 | 32.62 | 36.52 | 26.13 | 23.25 | 32.18 |
| 2006 | 33.17 | 34.48 | 34.76 | 30.78 | 26.10 | 35.96 |
| | Bulgaria | Georgia | Moldova | Armenia | Belarus | Serbia |
| 2000 | 22.21 | 24.53 | 22.03 | 25.78 | 32.36 | 22.40 |
| 2001 | 24.09 | 29.44 | 31.55 | 28.84 | 31.92 | 23.66 |
| 2002 | 27.00 | 26.40 | 35.11 | 26.54 | 34.16 | 30.04 |
| 2003 | 28.20 | 31.56 | 30.17 | 25.10 | 35.78 | 25.84 |
| 2004 | 32.25 | 28.86 | 30.06 | 29.87 | 41.43 | 28.53 |
| 2005 | 31.71 | 35.07 | 32.44 | 32.49 | 43.54 | 22.44 |
| 2006 | 32.35 | 36.49 | 27.42 | 32.03 | 45.39 | 23.08 |

Source: own calculations

The obtained results (Tables 2.14–2.16) show different rates of change in the macroeconomic stability of the national economies of the studied countries in different periods.

Table 2.15

MS index for economies of low and middle income countries for the period 2007-2010 (crisis period)

| Year | Countries | | | | | |
|---|---|---|---|---|---|---|
| | Ukraine | Latvia | Lithuania | Poland | Croatia | Romania |
| 2007 | 29.51 | 33.05 | 35.01 | 33.38 | 25.46 | 33.09 |
| 2008 | 19.28 | 19.62 | 26.57 | 29.51 | 25.30 | 32.85 |
| 2009 | 20.20 | 13.70 | 21.84 | 24.73 | 21.05 | 18.66 |
| 2010 | 25.56 | 12.75 | 20.91 | 23.99 | 18.57 | 18.59 |
| | Bulgaria | Georgia | Moldova | Armenia | Belarus | Serbia |
| 2007 | 32.58 | 32.31 | 26.52 | 31.24 | 39.83 | 23.65 |
| 2008 | 32.44 | 22.13 | 32.90 | 33.50 | 42.76 | 24.77 |
| 2009 | 26.67 | 15.44 | 22.70 | 13.75 | 28.61 | 17.57 |
| 2010 | 21.03 | 21.19 | 28.92 | 16.09 | 33.57 | 14.48 |

Source: own calculations

Table 2.16

MS index for low and middle income economies for the period 2011-2017 (post-crisis period)

| | Ukraine | Latvia | Lithuania | Poland | Croatia | Romania |
|---|---|---|---|---|---|---|
| 2011 | 23.99 | 24.35 | 26.21 | 26.02 | 18.28 | 23.72 |
| 2012 | 20.53 | 26.63 | 26.88 | 24.55 | 17.07 | 23.54 |
| 2013 | 19.72 | 27.23 | 27.87 | 23.84 | 16.38 | 28.98 |
| 2014 | 19.83 | 25.93 | 28.78 | 26.91 | 17.87 | 29.74 |
| 2017 | 17.97 | 26.73 | 27.93 | 28.89 | 19.59 | 31.40 |
| | Bulgaria | Georgia | Moldova | Armenia | Belarus | Serbia |
| 2011 | 25.55 | 29.50 | 29.71 | 22.33 | 26.78 | 14.18 |
| 2012 | 24.00 | 29.30 | 25.06 | 27.64 | 26.45 | 9.17 |
| 2013 | 23.73 | 25.69 | 34.26 | 22.61 | 25.55 | 17.48 |
| 2014 | 23.37 | 27.36 | 30.09 | 22.52 | 27.95 | 15.69 |
| 2017 | 27.46 | 24.79 | 22.15 | 20.66 | 25.76 | 19.43 |

Source: own calculations

Thus, in particular, in the pre-crisis period, most countries except Croatia and Serbia showed a stable level of macroeconomic stability. As can be seen from Table 1.10, the level of IMS achieved in Ukraine in 2003 was the highest in

comparison with other analyzed countries and amounted to 41.36. Profiles of macroeconomic stability of the analyzed countries are presented in Figures 2.13–2.18.

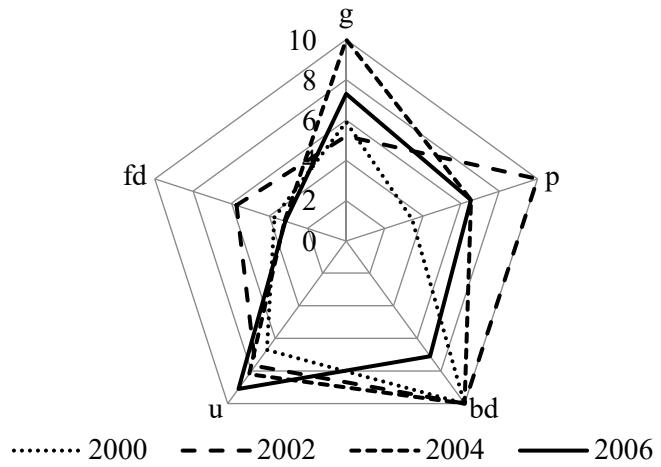



Figure 2.13 - Pentagon of the macroeconomic stability index of Ukraine in the period 2000–2006

Source: own calculations

At the same time, for the entire pre-crisis period of 2000-2006, the best dynamics of macroeconomic stability was demonstrated by Belarus (the level of the IMS indicator increased from 32.36 in 2000 to 45.39 in 2006).

It should be noted that in terms of macroeconomic stability, the best IMS during the entire analyzed period was achieved by Belarus in 2006.

Considering the intensity of the crisis in the period from 2007 to 2010 through the prism of violating the acceptable range of macroeconomic stability, it is clear that the economies of the studied countries can be divided into: countries resistant to crises: Belarus; countries with moderate resilience to crises: Ukraine, Lithuania, Poland, Bulgaria, Georgia, Moldova; countries with low resilience to crises: Latvia, Croatia, Romania, Armenia and Serbia.

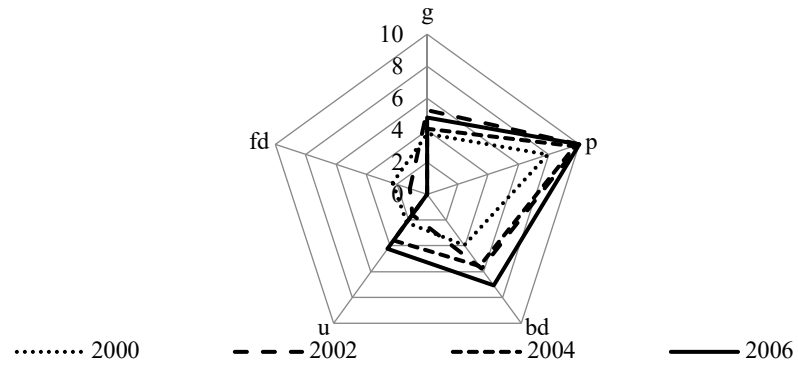



Figure 2.14 - Pentagon of Croatia's macroeconomic stability index 2000-2006

Source: own calculations

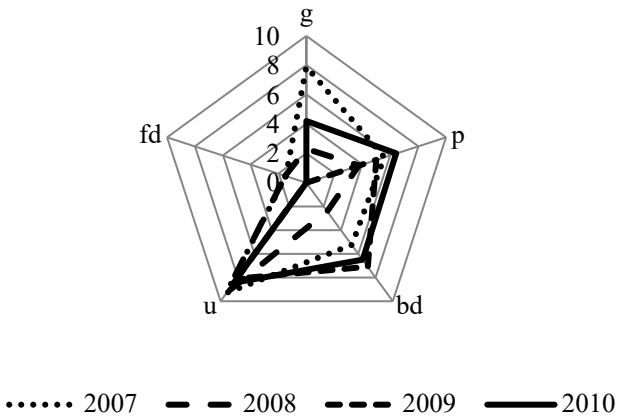



Figure 2.15 - Pentagon of the macroeconomic stability index of Belarus in the period 2007-2010

Source: own calculations

A comparison of the macroeconomic stability of the European Union with the use of the IMS indicator shows that the economies of Latvia, Lithuania, and Poland have become more stable every year since joining the European Union in 2004. This situation was observed until 2008, but the crisis in the financial markets also negatively affected the stability of the economies of the analyzed countries.

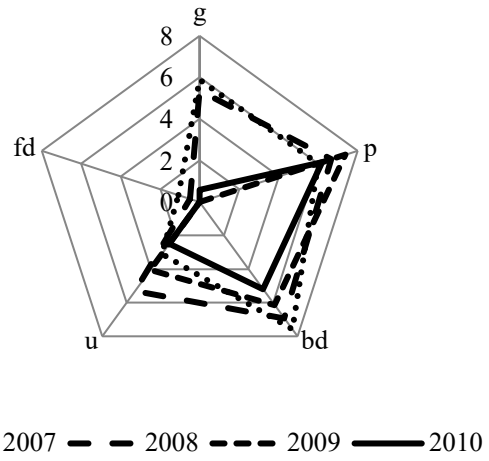



Figure 2.16 - Pentagon of the macroeconomic stability index of Serbia in the period 2007–2010

Source: own calculations

From 2011 to 2017, Romania, Poland, and Lithuania significantly reduced the gap between IMS values achieved in the pre-crisis period (2000-2006). This process was the fastest in Romania, whose economy can be described as moderately stable - 31.40. Despite the low level of the IMS indicator in Croatia (in 2015 it was 19.59), the country's economy since joining the European Union in 2013 shows a tendency to significantly improve macroeconomic stability.

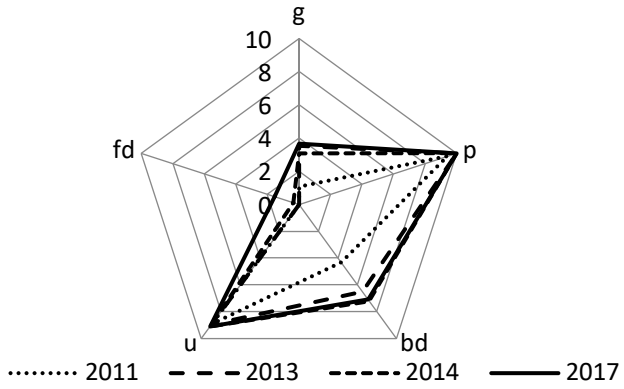



Figure 2.17 - Pentagon of the Macroeconomic Stability Index of Romania in the period 2011–2017

Source: own calculations

The largest decrease in IMS in the period 2011-2017 was registered in Ukraine (17.97), Croatia (19.59), Serbia (19.43).

Since 2006, Ukraine's macroeconomic stability has deteriorated. The situation began to change in 2010-2012, but after 2012 macroeconomic stability began to deteriorate significantly and reached its minimum in 2015.

Thus, comparing the macroeconomic stability in 2000-2006 with 2011-2017, we can see that the area of the pentagon we analyzed in 2017 reached a minimum value (Fig. 2.18).

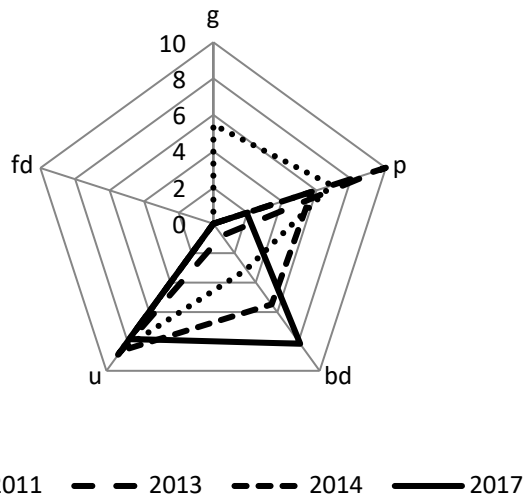



Figure 2.18 - Pentagon of the macroeconomic stability index of Ukraine in the period 2011–2017

Source: own calculations

The data in Table 2.17 show the similarity of macroeconomic stability trends for the analyzed countries. According to the data obtained, the highest effects of similarity of macroeconomic stability trends were recorded between Lithuania and Latvia (0.89), Georgia and Latvia (0.88), Bulgaria and Croatia (0.8), Belarus and Croatia (0.86), which indicates about almost ninety percent coincidence of the pace of economic development.

Armenia, Belarus, and Serbia are among the countries with the largest number of positive pairwise correlation coefficients exceeding 0.7. Negative values in the table indicate an inverse relationship, ie the upward trend of one country is accompanied by a downward trend of another.

Table 2.17

Matrix of paired correlation coefficients MS 12 European countries for the period 2000-2017

| | **Ukraine** | **Latvia** | **Lithuania** | **Poland** | **Croatia** | **Romania** | **Bulgaria** | **Georgia** | **Moldova** | **Armenia** | **Belarus** | **Serbia** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ukraine** | 1.00 | | | | | | | | | | | |
| **Latvia** | 0.55 | 1.00 | | | | | | | | | | |
| **Lithuania** | **0.79** | **0.89** | 1.00 | | | | | | | | | |
| **Poland** | -0.26 | 0.26 | 0.11 | 1.00 | | | | | | | | |
| **Croatia** | 0.60 | 0.40 | 0.63 | 0.42 | 1.00 | | | | | | | |
| **Romania** | 0.42 | **0.77** | **0.79** | 0.41 | 0.63 | 1.00 | | | | | | |
| **Bulgaria** | 0.28 | 0.45 | 0.57 | 0.57 | **0.80** | **0.75** | 1.00 | | | | | |
| **Georgia** | 0.52 | **0.88** | **0.78** | 0.26 | 0.37 | 0.64 | 0.44 | 1.00 | | | | |
| **Moldova** | 0.33 | 0.20 | 0.32 | -0.31 | 0.17 | 0.37 | 0.15 | 0.25 | 1.00 | | | |
| **Armenia** | 0.42 | **0.70** | 0.69 | 0.41 | 0.63 | **0.76** | 0.66 | **0.70** | 0.35 | 1.00 | | |
| **Belarus** | 0.53 | 0.36 | 0.57 | 0.41 | **0.86** | 0.61 | **0.78** | 0.46 | 0.27 | **0.71** | 1.00 | |
| **Serbia** | **0.72** | 0.45 | **0.71** | 0.09 | **0.80** | 0.68 | 0.59 | 0.23 | 0.35 | 0.51 | 0.65 | 1.00 |

Source: own calculations

The results of research on macroeconomic stability have shown an imbalance in the shape of the surfaces of pentagons, which indicates the growth of key macroeconomic indicators of countries at different rates. Thus, in particular, the highest average GDP growth in 2000-2017 remained at the level of 6.92% of annual growth, which was demonstrated by the Armenian economy.

However, despite the peak growth of this indicator in 2003 to 14.04, the total value of IMS was 25.10, which corresponds to a moderately stable economy. Among other EU countries, this result is impressive, but it should be noted that it was achieved against the background of low unemployment, which for the period 2000-2005 reached more than 30%.

The lowest average GDP growth in 2000-2015 was recorded in Croatia (1.68%), but it should be noted the positive GDP growth in 2015 against the background of a steady decline in 2009-2014 (approximately -7.4% in 2009 and - 0.4% in 2014).

Along with Croatia, Latvia and Lithuania have experienced the largest recessions in the EU. The Latvian economy shrank by 21% in 2008-2010, and the Lithuanian economy shrank by 12% in 2008-2009.

The average GDP growth in Ukraine for 2000-2017 was at the level of 4.03% annual growth. The period of significant decline in GDP dynamics was 2009 and 2010, respectively by 14.33% and 3.78%. Also for the analyzed period we can note the years: 2005, 2006, 2007, when the economy showed growth of this indicator at a high level - up to 10% per year.

It is worth noting that as a result of the financial crisis, macroeconomic stability has deteriorated in each of the analyzed aspects. Thus, in particular, the high level of unemployment (about 29%) contributed to the deterioration of the situation in Armenia, and the high level of budget deficit in% of GDP (-12%) and external debt (168% of GDP) to the Latvian economy. The highest inflation rate in the period from 2007 to 2010 among the analyzed countries was in Ukraine.

Analyzing the growth rate of inflation in the economy of Ukraine, we can see that this is a big problem, because in the analyzed period its level reached double digits.

Thus, in particular, in 2015 the inflation rate rose to 48.72. At the same time, as noted in the study (Vasilyeva et al., 2013), one of the key factors in weakening the country's economic productivity is inflation itself, which was supported by expanding consumer lending to households, which does not correspond to the macroeconomic level of economic development.

As follows from the table (table 2.18), two of the five indicators of macroeconomic stability of Ukraine are distributed with left-wing asymmetry: real GDP (-1.05); budget deficit (-0.26).

However, the greatest negative impact on macroeconomic stability has the indicator of real GDP, as the value of the asymmetry coefficient, which is less than 0.5, can be ignored (Kolodizev & Maksimova, 2016).

In addition, it is appropriate to emphasize the presence of right-wing asymmetry (Table 2.18) of each of the indicators of macroeconomic stability in Poland, which indicates a high probability of favorable deviations in the future.

Table 2.18

Calculation data for 12 European countries for the period 2000-2017

***SkewnessKurtosis***

| | **GDP (%)** | | **Inflation rate (%, aa)** | | **Budget deficit (% Of GDP)** | | **Unemployment rate (%)** | | **External debt (% Of GDP)** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ***S*** | ***K*** | ***S*** | ***K*** | ***S*** | ***K*** | ***S*** | ***K*** | ***S*** | ***K*** |
| Ukraine | -1.05 | 3.27 | 1.58 | 5.43 | -0.26 | 2.05 | 0.69 | 2.71 | 0.98 | 3.73 |
| Latvia | -1.38 | 4.66 | 0.97 | 3.22 | 1.70 | 4.75 | 0.20 | 2.41 | -0.18 | 1.70 |
| Lithuania | -2.21 | 8.48 | 0.80 | 3.02 | 1.16 | 3.08 | -0.27 | 2.06 | -0.17 | 1.49 |
| Poland | 0.25 | 2.41 | 0.71 | 3.72 | 0.25 | 2.14 | 0.36 | 1.45 | 0.12 | 1.39 |
| Croatia | -0.98 | 3.40 | 0.21 | 2.57 | -0.38 | 2.20 | -0.26 | 2.43 | -0.27 | 1.73 |
| Romania | 1.00 | 1.00 | -1.47 | 2.56 | -1.82 | 3.92 | -1.07 | 1.20 | -1.00 | 1.00 |
| Bulgaria | -0.77 | 2.85 | 0.25 | 2.49 | -0.11 | 1.96 | 0.31 | 2.25 | -0.31 | 1.86 |
| Georgia | -0.39 | 3.30 | 0.13 | 2.59 | 1.35 | 5.04 | 0.16 | 1.99 | -0.24 | 3.13 |
| Moldova | -1.25 | 3.82 | 0.20 | 2.11 | 0.68 | 3.62 | -0.37 | 1.90 | 1.19 | 3.56 |
| Armenia | -1.55 | 5.84 | -0.16 | 1.94 | 1.21 | 3.71 | 0.31 | 1.52 | -0.13 | 1.54 |
| Belarus | -0.51 | 2.45 | 1.87 | 5.02 | 0.25 | 2.17 | 0.65 | 1.99 | 0.40 | 1.61 |
| Serbia | -0.29 | 2.00 | 3.27 | 12.48 | 0.18 | 1.94 | -0.21 | 1.96 | -0.28 | 1.69 |

*S -; K -SkewnessKurtosis*

Source: own calculations

In order to take into account the negative deviations of equilibrium values of parameters from their optimal value at the next stage, deviations of actual values of variables from equilibrium are calculated.

Analyzing the data shown in Figure 2.19, it should be noted that low values of the ratio of the static MS indicator with the sum of standard deviations of cyclic

components of its sub-indices indicate a high risk of losing macroeconomic stability and low synchronization of regulatory policies.

Table 2.19

Data for the calculation of the cyclical component of the MSc for 12 European countries for the period 2000-2017

| Year | Ukraine | Latvia | Lithuania | Poland | Croatia | Romania | Bulgaria | Georgia | Moldova | Armenia | Belarus | Serbia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2001** | 5,620 th most common | 0.896 th most common | 0.979 | 2,444 th most common | 1,430 th most common | 1,973 th most common | 2,202 th most common | 0.954 | 5,296 th most common | 1,600 th most common | 8,735 th most common | 13.53 |
| **2005** | 6,163 th most common | 2,198 th most common | 2,559 th most common | 2,306 th most common | 2,115 th most common | 3,353 th most common | 4,183 th most common | 4,100 th most common | 6,112 th most common | 4,692 th most common | 8,818 th most common | 11.57 |
| **2009** | 6,080 th most common | 4,042 th most common | 4,795 th most common | 2,430 th most common | 3,057 th most common | 4,025 th most common | 5,135 th most common | 5,524 th most common | 5,957 th most common | 6,727 th most common | 7,817 th most common | 9,229 th most common |
| **2014** | 5,683 th most common | 3,435 th most common | 3,557 th most common | 2,268 th most common | 2,926 th most common | 4,051 th most common | 4,416 th most common | 4,856 th most common | 5,084 th most common | 5,758 th most common | 8,859 th most common | 7,760 th most common |
| **2017** | 7,064 th most common | 3,432 th most common | 3,491 th most common | 2,233 th most common | 2,987 th most common | 4,218 th most common | 4,491 th most common | 4,946 th most common | 5,290 th most common | 5,735 th most common | 8,689 th most common | 7,583 th most common |

Source: own calculations

The largest level of decline in the static CU indicator for 2011-2017 was in Ukraine and Serbia.

The level of CUs in Latvia, Lithuania, and Poland has been growing annually since their accession to the EU until the crisis of 2008; Romania, Poland,

and Lithuania significantly reduced the gap between the pre-crisis level of their macroeconomic stability in 2011–2015, and this process was the fastest in Romania.

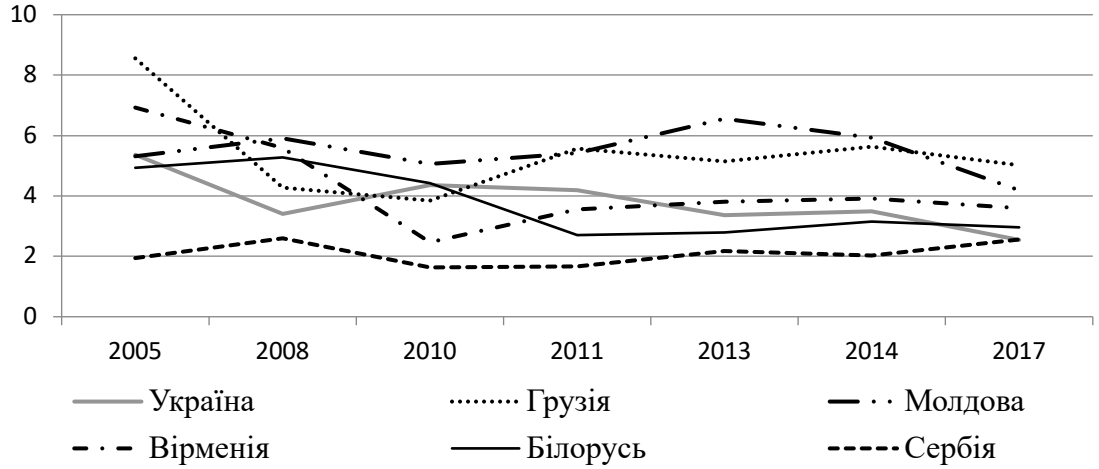



Figure 2.19 - Calculation of the level of macroeconomic stability for Ukraine, Georgia, Moldova, Armenia, Belarus and Serbia

Source: calculated by the author

Despite the low starting level of macroeconomic stability of the Croatian national economy after the accession to the EU, the dynamics of its macroeconomic stabilization has gained momentum.

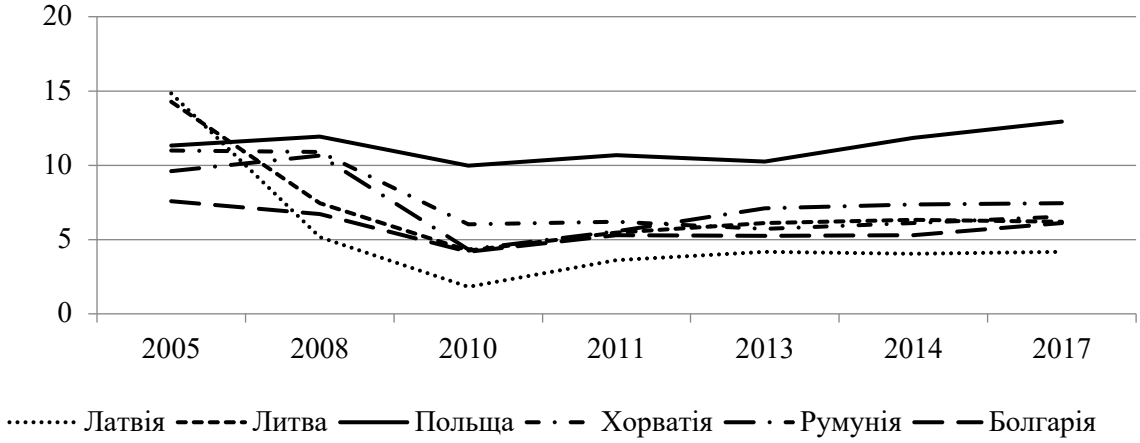



Figure 2.20 - Calculation of the level of macroeconomic stability for 6 European countries for the period 2000-2017

Source: calculated by the authors.

The low level of standard deviations of the cyclical components of macroeconomic stability of the national economy for the EU countries indicates the effectiveness of the conversion of the state policy of these countries on macrostabilization.

The second section of the monograph summarizes the existing world experience of scientific and methodological approaches to assessing the macroeconomic stability of the national economy.

The results of the research indicate the absence of a unified approach to assessing the macroeconomic stability of the national economy and the use of different approaches depending on the purpose of the analysis, time factor, reference country (base of comparison) and the characteristics of the country being analyzed. In this regard, the criteria for classifying approaches to assessing the microeconomic stability of the national economy were summarized: taking into account the time factor (dynamic / static assessment) and basic assessment parameters (volatility / consistency within a given interval / proximity to the standard).

Based on the proposed criteria, the author proposes a typology of approaches to assessing the level of macroeconomic stability of the national economy: dynamic-equilibrium approach; static-interval approach; static-comparative approach.

Empirical results of the study confirmed the need to take into account not only static but also cyclical components in assessing the level of macroeconomic stability of the national economy.

In this regard, the conceptual framework for integrated assessment of the level of macroeconomic stability of the national economy has been improved.

The methodology of integrated assessment of the level of macroeconomic stability of the national economy is proposed, which, unlike the existing ones, is based on the concept of the pentagon of macroeconomic stability and takes into account five main guidelines of state stabilization policy: GDP growth,

unemployment, inflation, external debt, state budget balance , as well as systematically combines the static component of macroeconomic stability of the national economy and its cyclical component, allows to assess the conversion of state regulatory policy to achieve macroeconomic stability of the national economy.

The results of testing the proposed approach to assessing the level of macroeconomic stability showed that the largest level of decline in the static indicator of macroeconomic stability of the national economy in 2011-2017 was in Ukraine and Serbia.

It is determined that the level of macroeconomic stability of the national economy of Latvia, Lithuania, Poland has been growing annually since their accession to the EU before the crisis of 2008. Romania, Poland, Lithuania in 2011-2015 significantly reduced the gap between pre-crisis level of macroeconomic stability of the national economy. this process was the fastest in Romania. Despite the low starting level of macroeconomic stability of the Croatian national economy, after its accession to the EU, the dynamics of its macroeconomic stabilization gained momentum.

It is established that the low level of standard deviations of the cyclical components of macroeconomic stability of the national economy for the EU countries indicates the effectiveness of the conversion of the state policy of these countries on macrostabilization.

# Chapter 3. Development of EU country and Ukraine: macroeconomic indicators

The stable social and economic development of the national economy could be achieved by developing the mechanism to solve the contradictions in the triangle: society-government-economics. In this case, the most crucial goal was synchronising and harmonisation of economics and political reforms on the target and goals. In the paper, the authors highlighted that reforming was closely connected to the foresight of political institutions impact on economic development, which emphasised the features and efficiency of the national economy.

The paper goal was to the foresight of economic growth, considering the tendency on political institutions efficiency. The generalisation of the approaches to estimate of the political institutions' role, confirmed the significant impact on the social development. Thus, political institutions structured the institutional environment and developed the stimulus on offers of production's factors, specialisation and realisation of innovations. The political competitiveness had an impact on the different parts of the neoclassical model of economic growth: the accumulation of labour and capital, the accumulation of human capital, and productivity. However, the scientists had not investigated the features of political institutions' impact on the quality and quantity parameters of economic growth mentioned above.

The study used the developed autoregressive integrated moving average model (ARIMA) for the foresight of economic growth of the selected countries considering the tendency on political institutions efficiency. The null hypothesis of the investigation was the checking of a unit root was present in a time series sample using the augmented Dickey-Fuller test. The core criteria of political institutions' efficiency were indicators developed by the World Bank – «The

Worldwide Government Indicators». The time of analysis was 2000-2019 with a forecast horizon of 10 years.

The findings confirmed the dependency of economic growth from the level of corruption and political stability at the most significant level. It means that declining corruption leads to direct and indirect positive effects: increasing the efficiency of political institutions.

Providing stable social and economic development of the national economy requires the development of effective mechanisms to overcome the contradictions in the triangle: society-government-economy (Bilan et al., 2019; Ibragimov et al., 2019). In this case, the most crucial goal is to synchronize and harmonize economic and political reforms. Thus, the first task of the social and economic system of relations that exist in the country is providing economic growth. The reforming of the national economy is closely related to the estimation of the dimensions which influenced economic growth. Besides, these dimensions identify the features and efficiency of the national economy.

The short-term analysis of the economy could be characterized by the continuing fluctuating of the production volumes, unemployment rate, price, increasing of the real production volume (Shkolnyk et al., 2018; Rekunenko et al., 2019; Jafarzadeh & Shuquan, 2019; Pavlyk, 2020). In the long-term perspectives, economic growth is a positive dynamic of the aggregate supply or potential output of goods and services, the analysis of factors and patterns of which is one of the central tasks of economic science.

The complexity and multidirectional of economic growth as a term justified the ambiguities at the stage of determining the nature and content categories (Ibragimov et al., 2019). Thus, the American economists – representatives of the classical school, P. Samuelson and W. Nordhaus, economic growth defined as the longterm tendency of increasing the real output of goods and services in the economy.

The findings of the analysis of the approach to defining "economic growth dimensions" allowed identifying the differences in the interpretation of its category. The scientists allocated the dimensions as follows as: the main factors of production that ensure GDP growth; resources involved in the production process; GDP growth determinants; sources and processes that determine economic growth, etc. Relevant scientific directions on identifying the parameters of the macroeconomic stability and its impact on economic growth formed the separate scientific school.

J.B. Sei, unlike other classical, allocated three factors of production: labour, capital and land ("The Three Factors Theory"). J. Schumpeter (2000) introduced the concept of "entrepreneurship" into economic science as the fourth factor of production. J. M. Keynes (1971) considered the volume of investments in the national economy as the main factor influencing the growth of national income. In the methodology, Keynes highlighted non-economic factors, in particular the state (political system), which should stimulate consumer demand for the means of production, investment and psychology of people (Özgür & Memis, 2017).

At the same time, Kondratiev (who developed the concept of long waves) identified the necessity to analyse of the impact on the economic growth of legal, social, political factors, as well as the role of the government in economic growth (Özgür & Memis, 2017). Further, in the second half of the twentieth century, scientists justified the institutional determinants of growth: people's interests, their behaviour, rules, norms, socio-economic relationships.

K. Marx, identifying two fundamental factors of economic growth: the personal and the real formed the basis for their classification of factors and identified the relationship with other elements of the economic system (Peterson & Jolibert, 1995). S. Kuznets (1966) did the comprehensive analysis of the economic growth and factors which boosted the fundamental understanding of

social development and its economic and social nature. He made a powerful contribution to the comparative analysis of economic growth.

In the modern economic theory, the role of the human capital was underlined in the endogenous growth models and modified models by R. Solow (1956). The model provoked the considering of the quality variables in the modelling of economic growth, which provoked the modernisation of long-term analysis of the economic growth [50]. Solow model used as the first stage of each scientific, economic investigation. Solow model analysed four variables: output Y, capital K, labour L and the level of "knowledge" E accumulated in society. Output Y could change over time only when the factors of production K, L, E change. From the standpoint of dynamics, the Solow model is considered as a closed whole, in which the manufactured universal product is fully consumable. The dynamic model considers five macroeconomic (endogenous) variables: Y is the gross domestic product (GDP); I - gross investment; C - consumption fund; K - fixed assets; L is the number of the employed population. The first three variables (Y, I, C) are performance indicators (their values accumulate over the year), the variables K, L are instantaneous variables (their values could be changed at any time).

The results of the analysis confirmed that traditional dimensions did not allow to confirm the hypothesis on the significant role of the capital in the economy. Thus, the findings in the paper (Dehmej & Gambacorta, 2017), confirmed that from 1929 to 1982 years, only 20% of the American national revenue growth was provoked by the accumulation of real capital (Dehmej & Gambacorta, 2017). In 1996 OECD published the report on knowledge economic (De Beaufort Wijnholds & Kapteyn, 2001; Sutherland & Hoeller, 2014). The scientists did not accept its theory during the few years. However, in 2000 the European Commission declared the Lisbon program which changed the scientists' views on the knowledge economy. The knowledge economy consists of:

1. Socio-political aspects of the social life of countries.

2. Civilizational and economic evolution and the emergence of a new paradigm in economics that is critical to the economic development of knowledge and innovation, which are much more important than the "classical" factors of production.

It is necessary to underline, that institutional changes had an impact on the technological progress and management, could fundamentally transform the economic system, determine the structure of economic development and macroeconomic growth (Saher et al., 2018; Meresa, 2019).

At the same time, the political institutions allow structuring and declining of the transaction costs, optimizing property relations, and, conversely, could negatively disorganize the socio-economic structure of society, while reducing the effectiveness of innovation, investment and other development processes.

The current investigations focused on the assessment of the good governance, analysis of the impact on the country's competitiveness and macroeconomic dynamic, assessment of the achieving stable balance in separate economic sectors, analysis of the dependence of the good governance from the financial and economic parameters (traditionally from GDP, inflation, unemployment, money supply, budget deficits, the stability of the national currency, balance of payments and trade, government debt, etc.) (Letunovska et al., 2017; Makarenko & Sirkovska, 2017; Nagy & Kiss, 2018; Kremen et al., 2018), environmental (Bhandari, 2017; Cebula et al., 2018; Hens et al., 2019; Kuzior et al., 2019; Bilan et al., 2019), social (Vasylieva et al., 2017) and marketing dimensions (Saher, 2015; Kwilinski et al., 2019; Bozhkova et al., 2018).

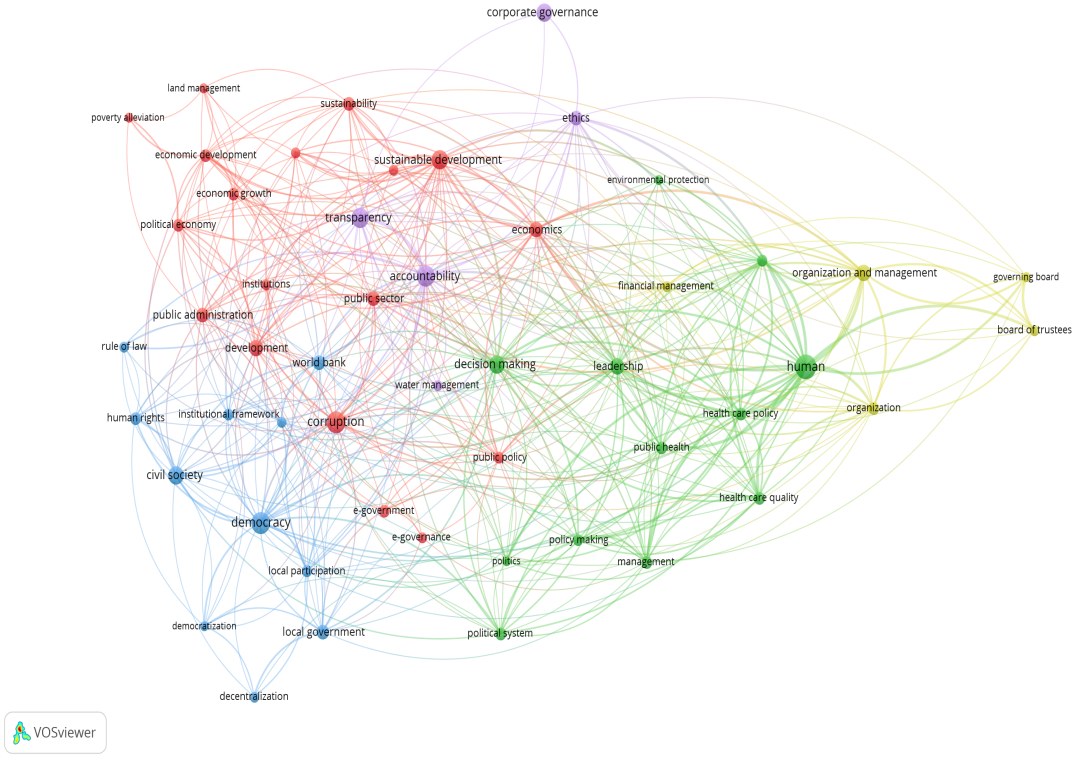



Figure 3.1. Content analysis of literature on good governance and visualization using VOSviewer

(Source: developed by the authors based on the Scopus, 2000-2020)

The findings confirmed that in the last ten years, the number of publications on analysis of the relationships between economic growth and good governance in the scientific databases – 292 documents. At this time, the annual growth of the publications on the selected theme – 12% (Figure 3.2a). The results of the analysis showed that scientists from the United States, United Kingdom, China, Spain, Germany, Netherlands, Italy, made a significant impact in the selected directions (Figure 3.2b).

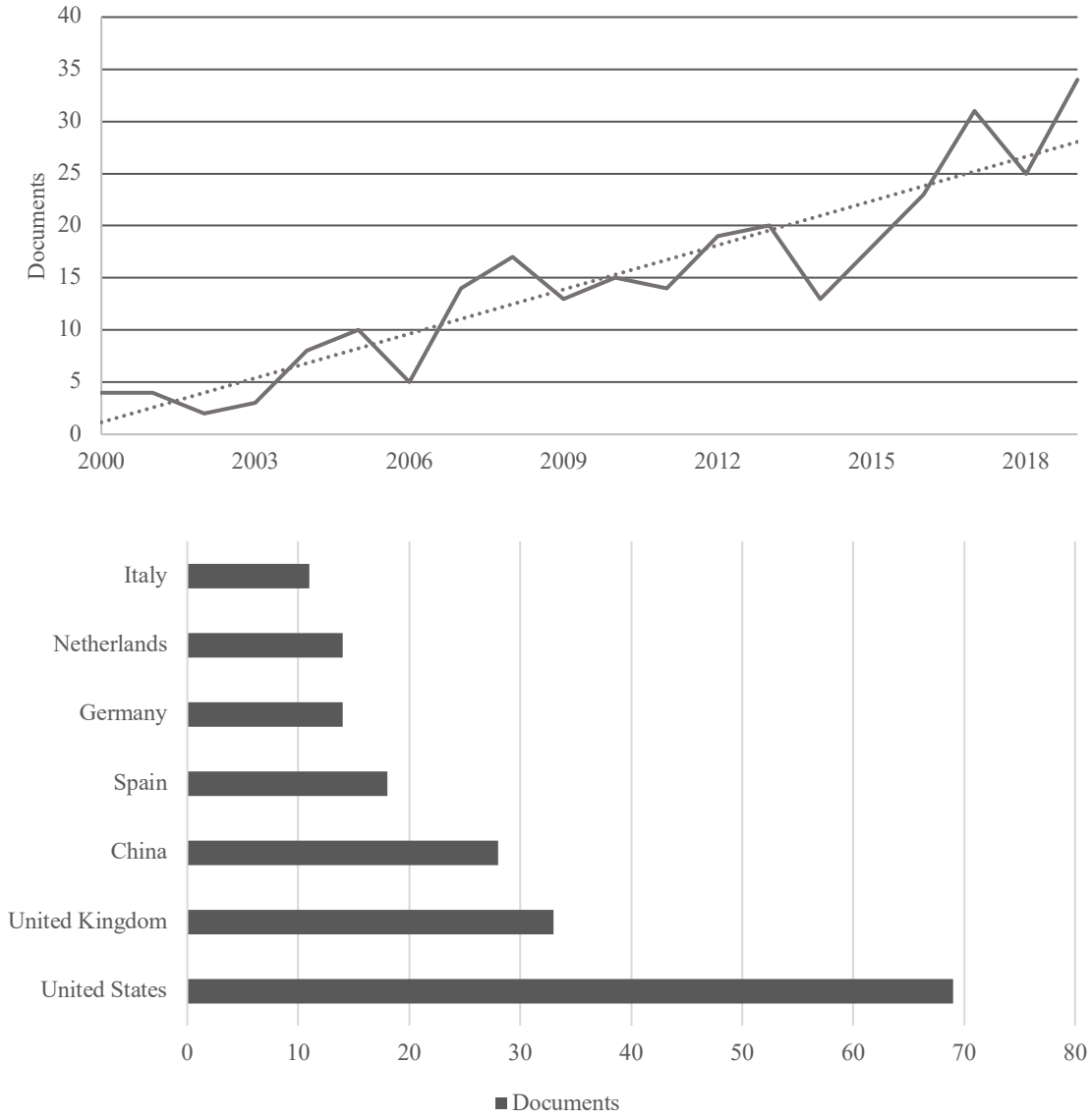



Figure 3.2. The dynamic (a) and countries' affiliation (b) of the papers on the relationships between economic growth and good governance, 2000-2019 years.

(Source: developed by the authors based on the Scopus, 2000-2020)

Table 1 showed the descriptive statistics of good governance efficiency on the indicators which developed by the experts from the World Bank (WGI, 2020) with it correlation features for countries: United States, United Kingdom, China, Spain, Germany, Netherlands, Italy: voice and accountability (vae), political stability and absence of violence (pve), control of corruption (cce), government effectiveness (gee), the rule of law (rle), regulatory quality (rqe). All indicators

for the analysed countries had a positive value, excluding cce (Minimum=-.0296416) during 2000-2018 years. Besides, all institutional variables had a positive correlation with the fluctuation of the coefficient from 0.6268 to 0.9791 for different indicators. The findings proved the significant relationship which allowed concluding that the selected countries focused on increasing the efficiency of the good governance and macroeconomic stability.

Table 3.1.

Descriptive statistics, 2000–2018

| | vae | pve | gee | rqe | rle | cce |
|---|---|---|---|---|---|---|
| Mean | 1.320909 | .8442897 | 1.345696 | 1.418939 | 1.335567 | 1.396952 |
| SD | .2256454 | .3390176 | .6106336 | .4367875 | .6021135 | .8089634 |
| Minimum | .9118239 | .2703004 | .1976259 | .6418828 | .2467615 | -.029641 |
| Maximum | 1.696608 | 1.760102 | 2.09252 | 2.098008 | 1.980403 | 2.206632 |
| Observations | 60 | 60 | 60 | 60 | 60 | 60 |
| Correlations | | | | | | |
| vae | 1.0000 | | | | | |
| pve | 0.6309 | 1.0000 | | | | |
| gee | 0.9292 | 0.7520 | 1.0000 | | | |
| rge | 0.9372 | 0.6268 | 0.9366 | 1.0000 | | |
| rle | 0.9252 | 0.6967 | 0.9700 | 0.9345 | 1.0000 | |
| cce | 0.9336 | 0.6938 | 0.9728 | 0.9440 | 0.9791 | 1.0000 |

Source: developed by the authors

However, the correlation matrix did not allow to confirm the role in the transformation relationships int the economic growth. In this case, the econometric models allow analysing it (Bojarko et al., 2012; Lyulyov & Pimonenko, 2017; Zergawu et al., 2018; Bilan et al., 2019; Khan & Hanif, 2020; Céspedes-González et al., 2020; Alexiou, 2020). Thus, in the paper Henisz

(2000), which the most cited papers on the analysed theme in the scientific database Scopus (777) and 1894 citations in Google Scholar, the author used OLS, GLS, and GMM estimation techniques for analysis of political institutions impact on economic growth. J. Wright (2008) analysed authoritarian institutions on economic growth and investment using the econometric model (1) and OLS estimation technique. J. Wright (2008) highlighted the different impact of political regimes on economic growth.

$$Investment = \beta_0 + \beta_1 Leg. + \beta_2 RegimeType * Leg. + \beta_3 RegimeType * NoLeg. \quad (3.1)$$

In the empirical study Kim et al. (2018), the authors confirmed the nonlinear relations between the quantity of the government, governance efficiency and economic growth. The scientists identified the government-size threshold, which influenced the country's productivity and output (increasing threshold lead to declining productivity and output). Thus, the improving of the governance in the country was the catalyst for the country's benefits from expanding government. The findings of the model (2) were similar with Fouquau et al. (2008) and confirmed the synergy effect from the impact of the government efficiency and increase of the government-size on the economic growth.

$$\Delta y_{it} = a_i + \beta_0 govsize_{ito} + \beta_1 govsize_{ito} g(q_{it0};\, \gamma, c) + \delta_0 governance_{ito} + \delta_1 governance_{ito} g(q_{it0};\, \gamma, c) + \varphi_0 y_{it0} + \varphi_1 y_{ito} g(q_{it0};\, \gamma, c) + \varepsilon_{it} \quad (3.2)$$

where y – economic growth or productivity growth, govsize - government size, governance - the level of governance, i – country indicator, t – the period index, α – country fixed effect, ε – error term.

Thus, the findings allowed confirming that context of the institutional factors of economic growth means the national wealth and ca[ital relate not only from the available resources but also from the rules and norms which regulate the using of the resources.

The core hypotheses of the investigation were:

H0: There is no statistically significant difference in the level of economic growth for countries that implement effective governance policies (values of vae, pve, cce, gee, rle, rqe are higher than zero) and countries have less than zero governance effectiveness;

H1: There is a statistically significant difference in the level of economic growth for countries that implement effective governance policies (values of vae, pve, cce, gee, rle, rqe are below zero) and countries have less than zero governance effectiveness.

The authors used, the similar tests as in the paper Shymon et al. (2020), the parametric (Two-sample t-test) and nonparametric test (Wilcoxon Rank-sum test) (Butt, 2006) with the purpose to check the abovementioned hypothesis (check for normal distribution, equality of dispersions of the studied trait).

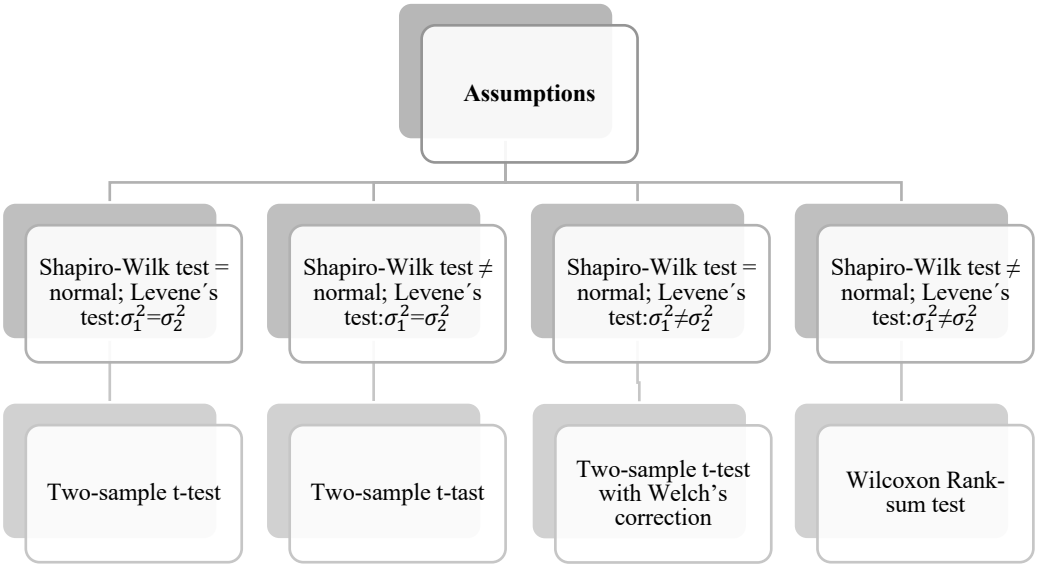



Figure 3.3. The structural scheme of the investigation

Source: developed by Shymon et al. (2020).

H2: the efficiency of the country's governance positive influences on the economic growth in the longterm.

The authors checked the H2 using the instruments of the economic growth foresight considering the governance efficiency tendency based on the autoregressive integrated moving average model (ARIMA) ARIMA model:

$$y_t = a + \beta_1 y_{t-1} + \cdots + \beta_p y_{t-p} + \mu_t \quad (3)$$

Where y – economic growth, t – the time index, $\beta_1 \ldots \beta_p$ – parameters, $\mu$ – white noise.

At the first stage model (3) checked the null hypothesis that a unit root is present in a time series sample using augmented Dickey-Fuller test (ADF) (Im et al., 2003; Levin et al., 2002).

Table 2 showed the findings of Two-sample t-test for 40 European countries for 1996-2018 years. The core dependence variable was – level of economic development per capita, dependence variables which divided countries by two groups: 1) absolute level of governance performance indicators higher than zero; 2) absolute level of governance performance indicators below zero.

The findings of Two-sample t-test in Table 3.2 confirmed the statistically significant difference in the level of countries' economic growth depending on the governance effectiveness. It allowed confirming the alternative hypothesis H1. The authors selected two countries (Poland and Ukraine) for the checking H2. Poland and Ukraine have the common border and different level of governance effectiveness by the datat of the World Bank.

Table 3.2

Results of Two-sample t-test

| Group | Results |
|---|---|
| vae | Group \| Mean Std. Err. Std. Dev. [95% Conf. Interval]<br>0 \| 2762.481 259.4981 2043.29 2243.583 3281.38<br>1 \| 22166.05 1391.615 15116.81 19410.03 24922.07<br>combined \| 15482.6 1145.713 15371.35 13221.76 17743.44<br>diff \| -19403.57 1931.529 -23215.21 -15591.93<br>Ha: diff < 0 Ha: diff != 0 Ha: diff > 0<br>Pr(T < t) = 0.0000 Pr(\|T\| > \|t\|) = 0.0000 Pr(T > t) = 1.0000 |
| pve | 0 \| 3054.822 639.0962 4825.071 1774.558 4335.085<br>1 \| 21241.81 1368.588 15178.38 18532.56 23951.07<br>combined \| 15482.6 1145.713 15371.35 13221.76 17743.44<br>diff \| -18186.99 2059.621 -22251.41 -14122.57<br>Ha: diff < 0 Ha: diff != 0 Ha: diff > 0<br>Pr(T < t) = 0.0000 Pr(\|T\| > \|t\|) = 0.0000 Pr(T > t) = 1.0000 |
| gee | 0 \| 2647.136 241.0238 1987.533 2166.05 3128.221<br>1 \| 23275.56 1390.133 14711.78 20520.92 26030.2<br>combined \| 15482.6 1145.713 15371.35 13221.76 17743.44<br>diff \| -20628.42 1795.845 -24172.31 -17084.54<br>Ha: diff < 0 Ha: diff != 0 Ha: diff > 0<br>Pr(T < t) = 0.0000 Pr(\|T\| > \|t\|) = 0.0000 Pr(T > t) = 1.0000 |
| rqe | 0 \| 2646.733 244.6481 2002.531 2158.277 3135.189<br>1 \| 23093.24 1389.786 14773.63 20339.56 25846.93<br>combined \| 15482.6 1145.713 15371.35 13221.76 17743.44<br>diff \| -20446.51 1816.704 -24031.56 -16861.46<br>Ha: diff < 0 Ha: diff != 0 Ha: diff > 0<br>Pr(T < t) = 0.0000 Pr(\|T\| > \|t\|) = 0.0000 Pr(T > t) = 1.0000 |
| rle | 0 \| 2762.481 259.4981 2043.29 2243.583 3281.38<br>1 \| 22166.05 1391.615 15116.81 19410.03 24922.07<br>combined \| 15482.6 1145.713 15371.35 13221.76 17743.44<br>diff \| -19403.57 1931.529 -23215.21 -15591.93<br>Ha: diff < 0 Ha: diff != 0 Ha: diff > 0<br>Pr(T < t) = 0.0000 Pr(\|T\| > \|t\|) = 0.0000 Pr(T > t) = 1.0000 |
| cce | 0 \| 3131.132 517.0386 4356.644 2099.931 4162.332<br>1 \| 23528.05 1400.15 14618 20752.71 26303.39<br>combined \| 15482.6 1145.713 15371.35 13221.76 17743.44<br>diff \| -20396.92 1785.822 -23921.03 -16872.81<br>Ha: diff < 0 Ha: diff != 0 Ha: diff > 0<br>Pr(T < t) = 0.0000 Pr(\|T\| > \|t\|) = 0.0000 Pr(T > t) = 1.0000 |

Source: developed by the authors.

The descriptive statistics of economic countries and governance efficiency showed in Table 3.3.

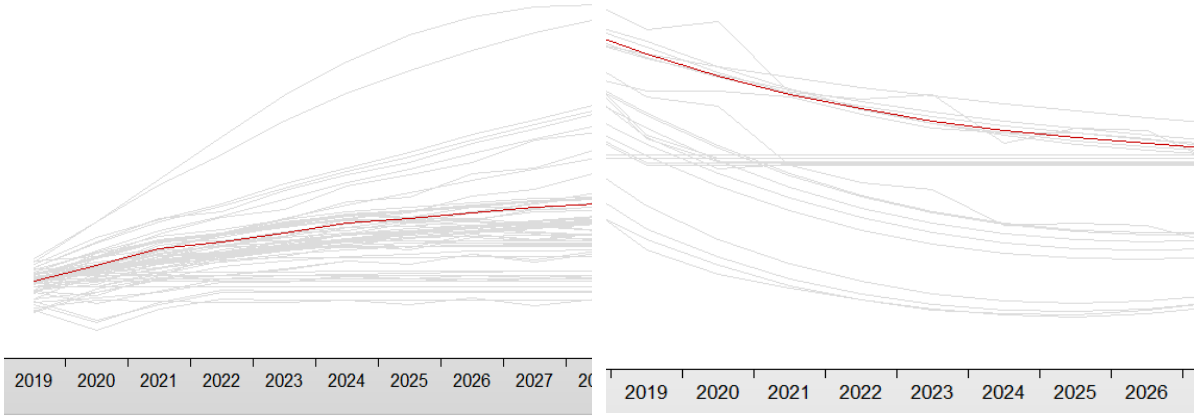
The findings of foresight in economic growth for the two countries showed in Figure 3.3.

Table 3.3

Descriptive statistics for Ukraine and Poland, 1996–2018

| Poland | gdp | vae | pve | gee | rqe | rle | cce |
|---|---|---|---|---|---|---|---|
| Mean | 4.08397 | .977593 | .7050882 | .6016045 | .8666326 | .6375191 | .5336866 |
| SD | 1.50515 | .1123883 | .2735542 | .1270884 | .1120842 | .1574141 | .1887703 |
| Minimum | 1.39189 | .7238377 | .1529493 | .3737843 | .7166154 | .404506 | .1388244 |
| Maximum | 7.03482 | 1.105113 | 1.072063 | .8273836 | 1.054908 | .8575056 | .8196566 |
| Ukraine | | | | | | | |
| Mean | 1.39395 | -.200909 | -.634276 | -.630719 | -.518316 | -.801832 | -.966235 |
| SD | 6.94206 | .2435141 | .7826493 | .1339378 | .1202495 | .0966547 | .150309 |
| Minimum | -14.758 | -.671051 | -2.02083 | -.875050 | -.757393 | -1.10880 | -1.26978 |
| Maximum | 12.1087 | .0906661 | .1731321 | -.413418 | -.220075 | -.681342 | -.721898 |

Source: developed by the authors.




**POLAND** **UKRAINE**

Figure 3.3 Forecast Comparison Graph

(Source: deve*loped* by the authors*)*

The graphs analysis showed that each from 100 models emphasised the cyclical structures due to the inclusion of exogenous regressors as significant indicators of governance effectiveness. It allowed confirming the hypothesis H2: high level of government efficiency lead to increasing of the economic growth in the longterm.

Thus, the providing of the reforms on improving the governance efficiency was the core factors which positively influenced economic growth. At the same time, the transparency of the theoretical and methodological approaches to develop the multigoal programs on the country's economic growth. In this case, the key indicators were: government rules and features of the institutional factors. Besides, the multigoal programs on the country's economic growth should be based on the findings using the foresight.

Nowadays, many countries face new economic challenges. In turn, the developing countries try to transform the macroeconomic policy to increase the resistance to economic shocks. Furthermore, economic growth is considered to be the condition to achieve sustainable development goals which aimed at improving economic activity, social welfare while protecting and saving the environment. Thus, the high rate of economic growth is a result of the effective macroeconomic policy conducted by the government. It worth noting that macroeconomic policy concentrates on the solving the several main tasks as follows: gaining the price stability; reaching the sustainable economic development; providing the total employment and decreasing the poverty level; reducing the balance of payment gap, etc. Developing economic strategies, the governments concentrate on gaining a high rate of economic growth without taking into account the environmental consequences and making worse the ecological situation. However, the macroeconomic policy should provide a positive or, at least, neutral environmental effect. In this case, the twin-win is achieved. However, most of the ecological and economic measures are perforce and compensative concerning the main economic measures. Thus, investigating the linking between macroeconomic policy in the context of sustainable development is a significant task.

Given that, the sustainable development goals accepted to 2030 are to provide the stable growth of people’s real income. It worth noting that the sustainable development concept consists of three main components as follows

economic, society and ecology. Thus, the measures in the field of sustainable development aimed at increasing economic growth, improving the education system and public health service, providing social protection and employment, fighting against the negative climate changes.

The EU is considered to be one of the main initiative agents in achieving sustainable development goals. Moreover, the EU investments, credits and partnership provide the economic development of many countries. Notably, the most prominent expanding process of the EU was in 2004, while 10 new countries became the EU members. Despite that it was the most extensive territorial and humanity EU expansion, this was the lowest on the GDP values. Furthermore, the financial crisis in 2008-2009 slowed down the economic growth of new EU members.

Nevertheless, the analysis of the real GDP per capita of the abovementioned countries demonstrates a positive tendency for economic growth. Following Figure 3.5, the highest value of real GDP per capita was in the Czech Republic increased by 40% in 2019 compared to 2004 (the year of EU integration). In turn, the real GDP growth per capita was in Lithuania increased by 91% compared to 2004, while in Poland – by 79%, in Latvia – by 71%, Slovak Republic – by 70% and Hungary – by 39%.

On the context of economic growth, it is necessary to monitor its impact on the environment. In view of this, the Environment Performance Index (EPI) allowed to estimate the countries' burden on the environment and analyze the rational using of natural resources. It worth noting, EPI rates the countries based on their states environment viability, saving the biological variety, reactions to climate changes, human health, the influence of economic development on the environment and government policy in the field of ecology.

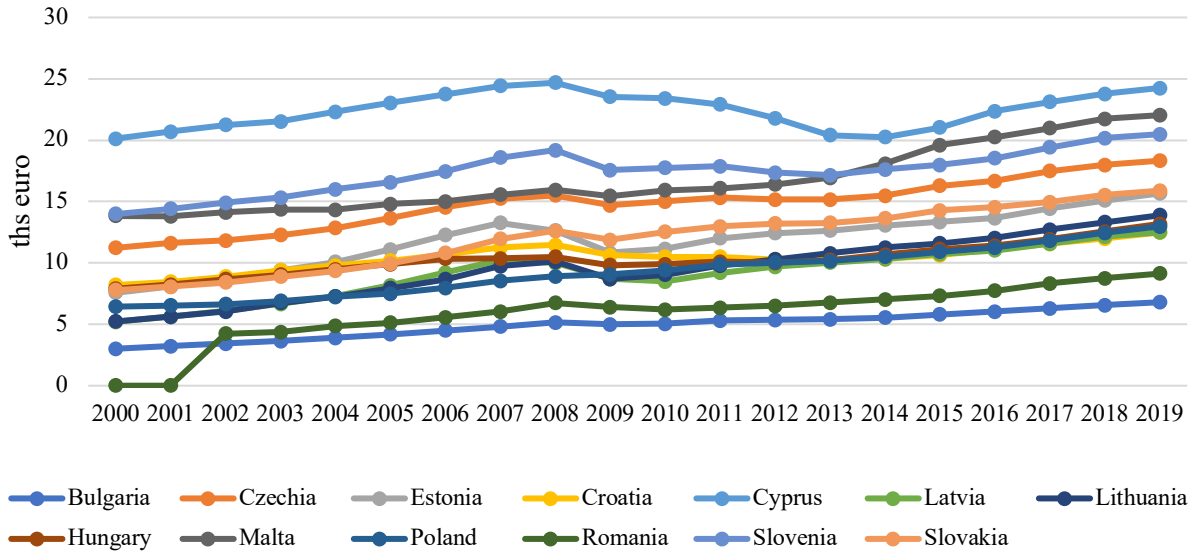



Fig. 3.5 The dynamics of real GDP per capita in the investigated EU members (2000-2019)

*Source: formulated by the authors based on Eurostat data

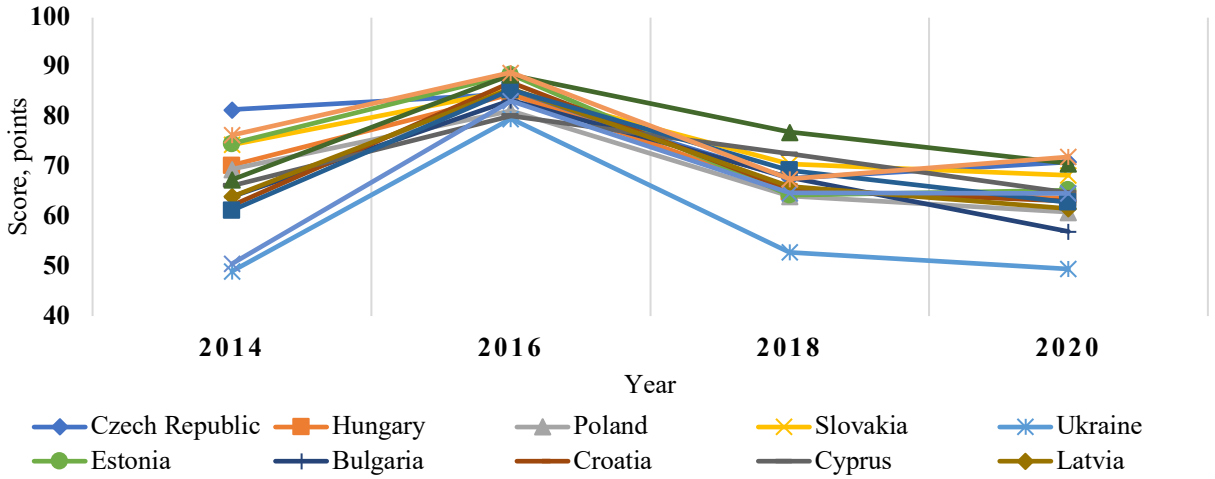



Fig. 3.6 The Environmental Performance Index dynamic of the investigated EU members (2006-2018)

*Source: formulated by the authors based on EPI, 2020.

Following Fig. 3.6, the environmental performance of the EU members (Poland, Lithuania, Latvia, Slovakia, Hungary, Malta, Cyprus, Bulgaria, Croatia,

Romania) showed the negative EPI tendency. At the same time, in the Czech Republic, Slovenia, and Estonia, the score of EPI slightly increased in 2020 compared to 2018. Notably, Ukraine loses its position. The highest decreasing of EPI among the considered countries was in Ukraine (by -26,8 points) in 2018, in 2020 its level decreased by 3.4%. Moreover, Ukraine has had the lowest position compared to the EU countries analyzed in the current research. In turn, in 2020 the EPI decreased by 1-4 % – in Hungary, Poland, Slovakia, Croatia; by 4-8 % – in Latvia, Lithuania, Malta; by about 11% – in Bulgaria. According to the mentioned above, the economic growth of analyzed countries was accompanied by increasing the environmental burden. It worth mentioning that the EU is considered to be a leader in fighting against climate change. In turn, to intensify forces and improve the level of energy-efficiency, the European Parliament and the Council accepted the Directive 2012/27/EU. Therefore, increasing energy-efficiency allows reducing environmental emissions, improving industry safety, providing better living conditions, extending the equipment and building life cycles, implementing innovations, etc.

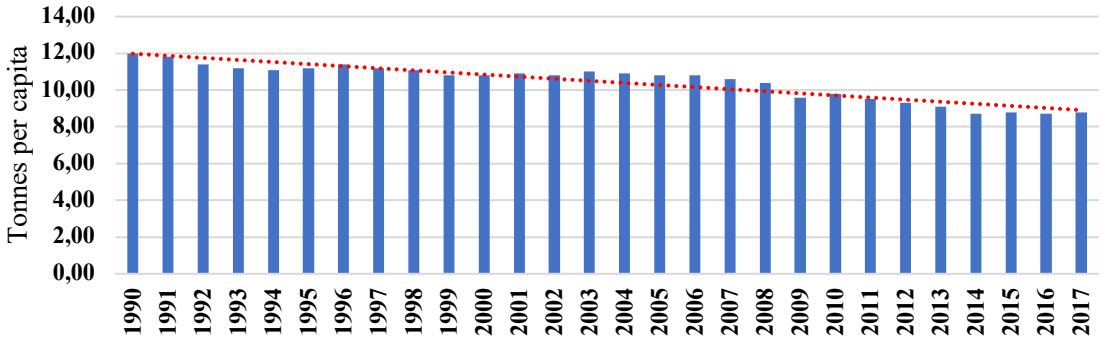



Fig. 3.7 The dynamics of greenhouse gas emission in the EU (28) (1991-2018)

*Source: formulated by the authors based on Eurostat data

The analysis of statistical data demonstrated the degrowth of greenhouse gas emission in the EU (28) (Fig. 3.7). Thus, the level of greenhouse gas emission decreased by more than 27% in 2017 compared to 1990. In turn, the obtained

results allowed assuming the achievements of the EU emission reduction goals by 2030 (at least 40% below 1990).

Under the Directive mentioned above, the level of EU energy consumption has to be decreased by 20% to 2020 (no more than 1483 Mtoe of primary energy consumption and 1086 Mtoe of final energy consumption). Furthermore, the 2030 Framework for Climate and Energy set the targets to decrease the energy consumption by 32,5% to 2030 (no more than 1273 Mtoe of primary energy consumption and 956 Mtoe of final energy consumption).

In the frame of this work, the forecast of the energy-efficiency was conducted using ARIMA (Autoregressive Integrated Moving Average) model. Notably, ARIMA*(p,d,q)* model is the model of autoregression (*AR*) and integrated moving average (*MA*), which allows describing the nonstationary series $Y_t$, which can be modelled down to stationary by taking d-tuple differences (*I*). According to the formal description of ARIMA(*p,d,q*) model is

$$(\Delta^d Y_t) = c + \sum_{i=1}^{p} a_i \, \Delta^d X_{t-1} + \sum_{j=1}^{q} b_j \varepsilon_{t-j} + \varepsilon_t, \qquad (3.1)$$

where $Y_t$ – nonstationary time series;

$\Delta^d$ – the difference operator of d-order;

$\varepsilon_t$ – the stationary time series;

$c, a_i, b_j$ – the parameters of the model.

Moreover, the short form of the abovementioned equation of ARIMA(*p,d,q*) model is

$$\varphi(B)(1 - B)^d X_t = \theta(B)\varepsilon_t, \qquad (3.2)$$

where $\varphi(\bullet)$, $\theta(\bullet)$ – polynomials of degree $p$ and $q$,

$B$ – lag operator ($B^j X_t = X_{t-j}, B^j \varepsilon_{t-j}, j = 0, \pm 1, ...$),

$d$ – sequential difference order ($\Delta X_t = X_{t-1} - X_t = (1 - B)X_t, \Delta^2 X_t = \Delta^2 X_{t+1} - \Delta X_t = (1 - B)^2 X_t, ...$).

The first approach to develop the ARIMA*(p,d,q)* model was proposed by G. Box and G. Jenkins in 1976. According to this methodology, the main steps to develop the model are identification→estimation →diagnostic checking.

It worth noting that the model includes the time series which are stationary after differencing d-times. Herewith, the first step is aimed to determine the degree of difference (*d)* to make the stationary series using the ACF (PACF) analysis, and the Augmented Dickey-Fuller unit root test, etc.

Then, the main task in time series analysis is to correctly prescribe the procedure of ARIMA*(p,d,q)* model. Therefore, it is necessary to estimate the model parameters *p* (lag order), *d* (degree of integration) and *q* (order of moving average). In turn, the autoregression model (*AR*) p-order is described as

$$Y_t = \varphi_0 + \varphi_1 Y_{t-1} + \varphi_2 Y_{t-2} + _{...} + \varphi_p Y_{t-p} + \varepsilon_t, \qquad (3.3)$$

where $Y_t$ – the level of time series at the time point *t* (dependent variable);

$Y_{t-1}$, $Y_{t-2}$,…, $Y_{t-p}$ – the levels of time series at the time points *t – 1, t – 2, …, t – p* respectively (independent variables);

$\varphi_0$, $\varphi_1$, $\varphi_2$, …, $\varphi_p$ – the estimated coefficients;

$\varepsilon_t$ – the random walks describing the variable impacts unaccounted for the model (3).

Given this, the coefficient $\varepsilon_t$ determines the constant level and related to the expected value $\mu$ formula

$$\varphi_0 = \mu\left(1 - \varphi_1 - \varphi_2 - \ldots - \varphi_p\right). \quad (3.4)$$

Using the moving average *(MA)* model provides the forecasts of functions $Y_t$ values based on the linear combination of limited value $q$ remains. In contrast, the autoregression models (*AR*) gives the forecast of $Y_t$ values based on the linear function of approximation of limited value $p$ of the previous $Y_t$ values. Herewith, the model with moving average q-order is defined the following equation

$$Y_t = \varepsilon_t - \omega_1\varepsilon_{t-1} - \omega_2\varepsilon_{t-2} - \ldots - \omega_q\varepsilon_{t-q}, \quad (3.5)$$

where $Y_t$ – the level of time series at the time point *t* (dependent variable);

$\varepsilon_{t-1}$ – the values of remains *i*-time periods (independent variables);

$\omega_1, \omega_2, \ldots, \omega_q$ – the estimated coefficients.

The combination of the autoregression model and moving average model is described as the ARMA(*p,q)* model. This model allows developing the forecast contingent on as the current and previous values of dependent values, so the current and previous values of random walks.

In the paper general form of ARMA(*p,q)* model is

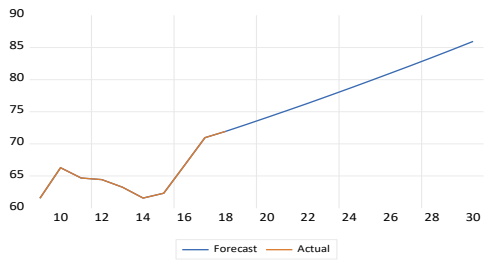
$$Y_t = \varphi_0 + \varphi_1 Y_{t-1} + \varphi_2 Y_{t-2} + \ldots + \varphi_p Y_{t-p} + \varepsilon_t - \omega_1\varepsilon_{t-1} - \omega_2\varepsilon_{t-2} - \ldots - \omega_q\varepsilon_{t-q}. \quad (3.6)$$

Thus, the characteristics of the autocorrelation function (ACF) and partial autocorrelation function (PACF) are used to specify the abovementioned parameters. Herewith, to choose the ARIMA*(p,d,q)* model it needs to analyze the time series and compare its function structure of the sample and partial

autocorrelations with known theoretical structure of ARIMA*(p,d,q)* processes. In turn, the examples of simplest ARIMA*(p,d,q)* model are the followings:

1) (*1,0,0*) – average moving;
2) (*1,0,1*) – cogeneration model of autoregression and moving average;
3) (*1,1,1*) – the nonstationary process with a linear trend.

The object of this research is countries which entered to the EU after 2004 (Poland, Cyprus, the Czech Republic, Slovakia, Slovenia, Hungary, Malta, Latvia, Lithuania, Estonia, Bulgaria, Croatia and Romania). Based on this criterion, the final energy consumption from 2000 to 2018 were analyzed to make its forecast to 2030.

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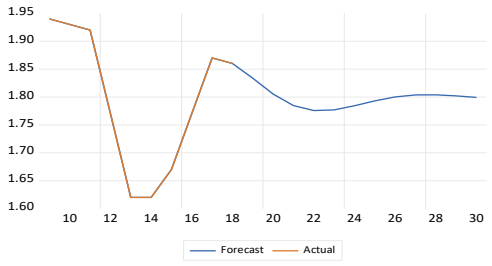


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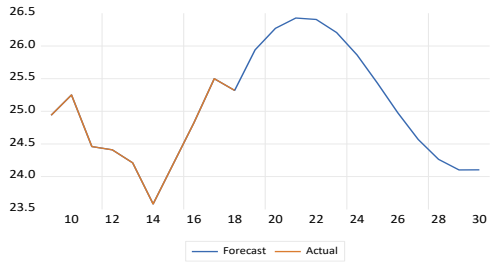


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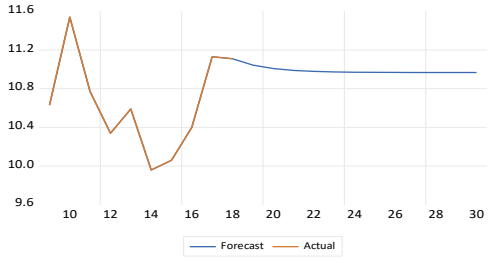


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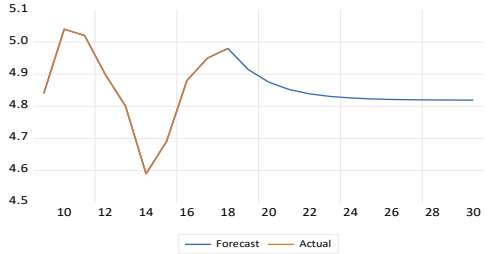


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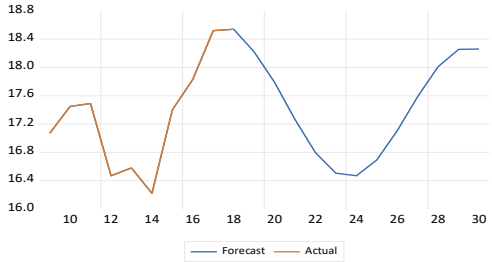


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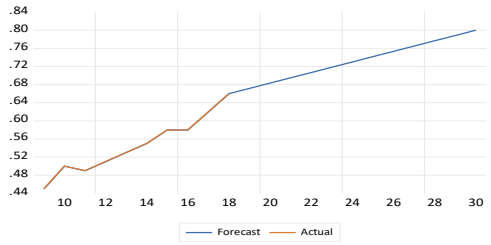


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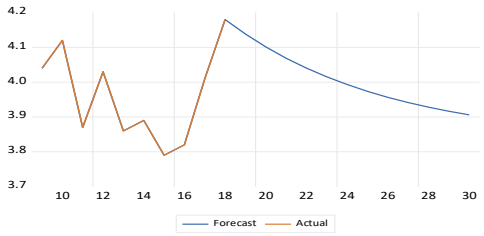


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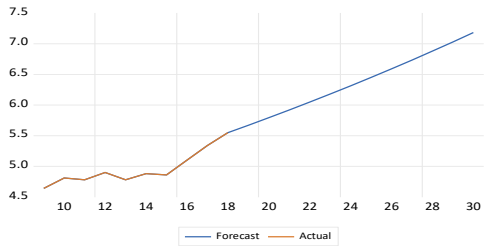


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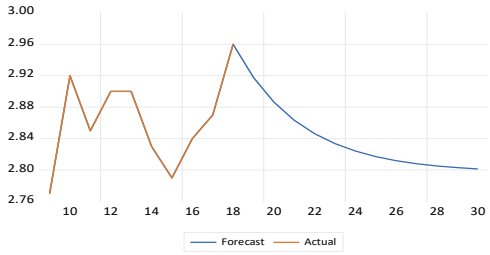


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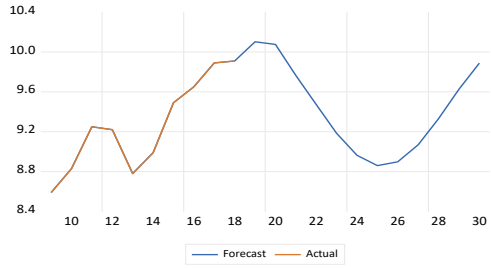


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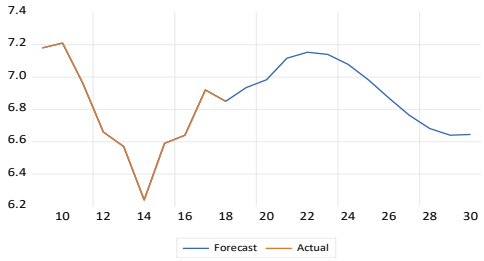


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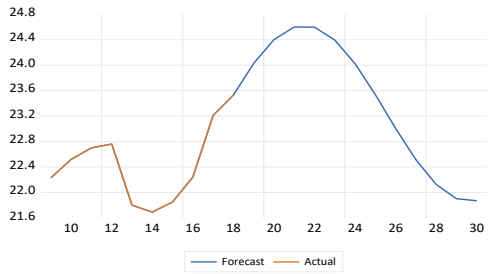


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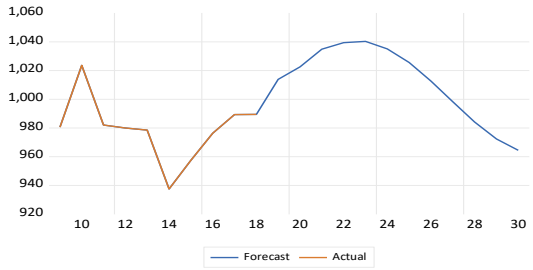


*o)*

Fig. 3.8. The forecast of final energy consumption (Mtoe) of *a)* Poland, *b)* Cyprus, *c)* the Czech Republic, *d) Slovakia*, *e)* Slovenia, *f)* Hungary, *g)* Malta, *h)* Latvia, *j)* Lithuania, *k)* Estonia, *l)* Bulgaria, *m)* Croatia, *n)* Romania, *o)* EU(27)

*Source: formulated by the authors using the Eviews software

Figure 7 demonstrates the forecast on the energy-efficiency conducted using ARIMA model. The determinate sample is total final energy consumption (Mtoe) of EU27 and, particularly, the EU members from 2000 to 2018.

The conducted forecast showed that to 2020 the primary energy consumption in EU27 would decrease. Herewith, providing the final energy consumption in 1086 Mtoe in 2020, the EU energy target would be gained (Fig.7). However, the obtained results allow prognosticating increasing the final energy consumption from 2020 to 2023.

The abovementioned allowed assuming that the EU energy policy was effective. Thus, the Ukraine energy strategy has to be concentrated on reducing energy consumption by increasing the energy-efficiency level, implementing renewable energy sources, attracting green investments, etc. The current stage of gaining world economic development indicates the high significance of macroeconomic stability. In turn, the macroeconomic stability depends on increasing the energy-efficiency, decreasing the environment emissions, improving energy productivity, etc.

Trends in modern world development are the introduction of the principles of sustainable development in all sectors of the economy at all levels. Thus, a number of countries, including Ukraine, have signed an agreement on the implementation of sustainable development goals in 2030.

The main goals are the spread of green projects, green production, raising environmental awareness, development of renewable energy sources, reducing greenhouse gas emissions and others. According to global databases, the world's leading countries, such as China, the United States, India, Russia and Japan, in 2017 ranked the top five in terms of CO2 emissions in the world (Table 3.4) [506, 419, 127].

Table 3.4

The share of CO2 in GDP in terms of world leaders

| Country | GDP, billion USD | % of GDP | $CO_2$, kton | % of world $CO_2$ | $CO_2$ per 1$ GDP |
|---|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** | **6** |
| China | 11007.72 | 14.84 | 10641788.99 | 29.51 | 1034.39 |
| USA | 18036.65 | 24.32 | 5172337.73 | 14.34 | 3487.14 |
| India | 2095.40 | 2.83 | 2454968.12 | 6.81 | 853.53 |
| Japan | 4383.08 | 5.91 | 1252889.87 | 3.47 | 3498.37 |
| Germany | 3363.45 | 4.54 | 777905.50 | 2.16 | 4323.72 |
| Korea | 1377.87 | 1.86 | 617284.88 | 1.71 | 2232.15 |
| Canada | 1550.54 | 2.09 | 555400.90 | 1.54 | 2791.74 |
| Saudi Arabia | 646.00 | 0.87 | 505565.10 | 1.40 | 1277.78 |
| Indonesia | 861.93 | 1.16 | 502961.30 | 1.39 | 1713.72 |
| Brazil | 1774.72 | 2.39 | 486229.08 | 1.35 | 3649.98 |
| Mexico | 1143.79 | 1.54 | 472017.79 | 1.31 | 2423.20 |
| Australia | 1339.14 | 1.81 | 446348.29 | 1.24 | 3000.21 |
| United Kingdom | 2858.00 | 3.85 | 398524.37 | 1.11 | 7171.46 |
| Turkey | 717.88 | 0.97 | 357157.41 | 0.99 | 2009.98 |
| Italy | 1821.50 | 2.46 | 352885.93 | 0.98 | 5161.72 |
| France | 2418.84 | 3.26 | 327787.26 | 0.91 | 7379.28 |
| Poland | 477.07 | 0.64 | 294879.37 | 0.82 | 1617.84 |
| Ukraine | 90.62 | 0.12 | 228688.17 | 0.63 | 396.24 |
| Lithuania | 41.17 | 0.06 | 12478.11 | 0.03 | 3299.44 |
| WORLD | **74152.48** | **100** | **36061709.91** | **100** | **2056.27** |

Source: formed by the author.

Thus, China produces only 14.84% of world GDP, but at the same time produces 29.51% of world CO2 emissions. Similar trends are observed in India and the Russian Federation. Their percentage of CO2 emissions is twice their share in world GDP. The opposite trend is typical for Lithuania, where CO2 emissions are twice less than its share in world GDP. It should be emphasized that in the US and most EU countries the share of world GDP is higher than the share of world CO2 emissions. Compared to other countries, Ukraine has the lowest level of the share of renewable energy sources in final consumption - 6%. During the years of Ukraine's independence, the highest level of CO2 emissions was about 630,929,352 thousand kt in 1992 [39, 220, 224, 495].

Global trends of aggravation of environmental problems lead to the urgent introduction of proactive mechanisms for their solution. Thus, the experience of EU countries shows that compared to 1990, greenhouse gas emissions in 2016 decreased significantly, although GDP per capita in 2016 was much higher than in 1990. It should be noted that a sharp decrease in greenhouse gas emissions was observed in the period from 2007 to 2009 - a period of financial crisis. At the same time, after the restoration of financial stability, greenhouse gas emissions gradually continued to decline. In this context, it is important to assess the nature of the relationship between CO2 emissions and GDP as a key indicator of economic growth. At the same time, it is expedient to analyze the experience of the EU on the mechanisms for attracting financial resources for the distribution of alternative energy sources that ensure the reduction of greenhouse gas emissions. The relationship between the growth of energy production and the load on the environment can be explained by the ecological curve of Kuznets [303]. This curve describes the relationship between economic and environmental indicators and confirms that in countries where economic indicators are growing rapidly, the burden on the environment is also increasing, and at the same time, as the country's welfare increases, the demand for cleaner and more environmentally friendly safe environment.

Using the Kuznets ecological curve on the example of 17 OECD countries during 1977-2010, Biljili F. and Ozturk Ilhan [129] empirically confirm the hypothesis of the interdependence of energy consumption generated by renewable energy sources and CO2 emissions. Thus, the authors [125, 152, 328, 330, 417, 418 483] analyzed the reasons for the increase in CO2 emissions and ways to reduce them. Scientists [207, 175, 446, 339, 449] have proved that renewable energy sources are a key factor in improving energy security.

Similar conclusions were obtained by Cypriot-Panayotou scientists studying 68 countries during the period 1980-1991 (1993) [484, 285]. As a result, scientists have confirmed the relationship between economic growth and

environmental degradation. The authors of the articles [374, 82] proved the relationship between environmental, social and economic indicators that affect the country's GDP. Scientists have proven a link between social indicators [502, 291, 333], environmental indicators, which include the efficiency of renewable energy sources [152, 207, 449, 291, 362], macroeconomic stability in low-income countries [448, 327]. It should be noted that a number of scientists, on the contrary, argue that there is no link between the implementation of energy efficiency projects and the growth of the country's main economic indicators. Thus, scientists Azam and Khan in their work analyzing the countries with different income levels for the period 1975-2014 empirically confirm the lack of relationship. In [417, 330, 88, 89, 102, 103, 104, 105, 106, 128, 209, 290, 344, 363, 372] one of the proposed assumptions is a two-way or one-way relationship of economic growth (GDP) and growth of renewable energy sources. For example, studies by Al-Mulali [88, 89], Apergis and Payne [102, 103, 104, 105, 106], Dogan [209], Menegaki [344] mathematically confirm the two-way relationship between economic growth and renewable energy sources.

Also, scientists in [428, 119, 120, 346, 507] studied the growth of renewable energy sources and linked it to CO2 emissions. Scientists Apergis [102], Bildirichi [128], Ocal-Leo [363], Ntanos, Chalikias, Arabatsis, G., Milioris, K., Chalikias, M. and Lalu, P. [155, 431] prove that there is the relationship between CO2 emissions and renewable energy sources. Studies by Menegaki [345] and Tugku [475] confirm the independence (neutrality) of these indicators. Traditionally, to test the above hypotheses, scientists use economic and mathematical methods of panel data analysis, such as: fully modified least squares method (FMOLS), dynamic least squares method (DOLS), and advanced Dickey - Fuller (ADF) test. To analyze the relationship between renewable energy sources and GDP in studies [209, 290, 475, 311], the authors used the Cobb-Douglas production function (formula 3.7):

$$Q = AL^{\alpha} * K^{\beta} \quad (3.7)$$

where Q - total production (monetary value of all goods produced during the year); L - labor intensity (total number of working hours per year); K - capital (monetary value of all machinery, equipment and buildings); A - labor productivity; α, β - elasticity of labor and capital, respectively.

Thus, the modified function (3.8) can be represented as:

$$lnY_i = \phi + \alpha lnREC + \beta lnSREC + \gamma lnK + \delta lnL + \lambda lnT + \mu \quad (3.8)$$

where α, β, λ, γ - the corresponding elasticity of labor and capital; L - labor intensity (total number of working hours per year); K - capital (monetary value of all machinery, equipment and buildings); REC - volumes of energy consumption from renewable energy sources; T - open trade; μ errors; const - constant; SREC - volumes of energy consumption from solar power plants.

It should be emphasized that when assessing the interdependence between the level of development of alternative energy sources and economic growth, it is necessary to take into account the levels of political and macroeconomic stability of the country. This is due to the fact that the development of alternative energy sources as a type of energy efficient projects is characterized by a long payback period. Therefore, when analyzing the investment attractiveness of such projects, the assessment of macroeconomic and political stability factors is more significant, as the spread of renewable energy sources depends on the effectiveness of government support and the investment climate in the country.

This study proposes to examine the causal link between the share of renewable energy sources in total energy consumption, CO2 emissions and its economic growth in order to justify for stakeholders the feasibility of alternative energy as a promising area of green investment.

EU countries, EU candidate countries and potential candidates for EU membership (Albania, Macedonia, Bosnia and Herzegovina, Turkey, Georgia, Ukraine) were selected for analysis.

Thus, the main hypotheses of the study at this stage are:

- the country's economic growth is linked to energy consumption, labor and capital;
- increasing the share of consumption of renewable energy sources in total consumption has a positive effect on economic growth;
- Renewable energy consumption is insignificant in total energy consumption and does not affect the country's economic growth.

Based on research results to test the above hypotheses as the main parameters of the production function of Cobb-Douglas, it is proposed to use:

- GDP per capita in US dollars (GDP);
- gross fixed capital formation in US dollars (K);
- economically active population (persons aged 15 and older) involved in the production of goods and services (L);
- renewable energy consumption (share of alternative energy in total energy consumption) (RE);
- CO2 emissions (metric tons per capita) (CO2).

Thus, in General, the function for the study takes the form:

$$GDP_{it} = f(K_{it}, L_{it}, RE_{it,} CO_{2_{it}}) \quad (3.9)$$

The modified function (1.3) can be written as a cointegration equation:

$$lnGDP_{\mathrm{it}} = \phi + \alpha lnRE_{\mathrm{it}} + \beta lnCO_{2_{\mathrm{it}}} + \gamma lnK_{\mathrm{it}} + \delta lnL_{\mathrm{it}} + \mu_{\mathrm{it}} \quad (3.10)$$

where α, β, γ, δ are regression parameters that estimate and explain the elasticity of the parameters RE, CO2, K, L; μ - error; i = 1,…, N; t = 1,…, T.

At the first stage, the analysis of all selected parameters of function (1.3) is performed using the method of single roots (Panel unit root tests) and tests: Im, Pesaran and Shin's [21] (IPS); Levin, Lina and Chu [31] (LLC); Fisher (ADF Fisher and PP Fisher). The above tests are based on testing the first hypothesis, which assumes the presence of a single root in the time series data panel and an alternative absence in a single root. Thus, in General, the verification of panel data per single root using the IPS test can be represented as formula 3.11:

$$\Delta y_{i,t} = \alpha_i + \rho_i y_{i,,t-1} + \sum_{j=1}^{p} \varphi_{ij} \Delta y_{i,,t-1} + \varepsilon_{i,t-1} \qquad (3.11)$$

where y is the value of each parameter of equation (1.4); Δ - first level operator; for all i - null hypotheses;$\rho_i = 0$ $\rho_i > 0$ -for one of the i - alternative hypothesis about the absence of a single root.

In the next step, provided that a single root is detected in the time series data panels, it is proposed to use the Pedroni method to verify the long-term correlation between these time series. In this case, the test of the null hypothesis (lack of cointegration in time series (H0:) can be performed using a system of statistical tests:$\rho_i = 0$

- panel v-statistics;
- panel rho-statistics;
- panel PP-statistics;
- panel ADF statistics;
- group rho statistics;
- group PP statistics;
- group ADF statistics.

Thus, provided that cointegration links are identified, the long-term relationship is proposed to be tested using the FMOLS and DOLS methods. In

the work [32] scientists emphasize that in comparison with the traditional OLS method, the above methods allow to obtain more accurate results of long-term relationships in the analyzed cointegration vectors, provided there is no homogeneity. The next step is to assess the causal links between renewable energy, CO2 emissions and economic growth using the Vector Error Correction model (VECM), which can be represented as:

$$\Delta \ln \mathrm{GDP}_{\mathrm{it}} = \sum_{j=1}^{k} \beta_{1j} \Delta \ln \mathrm{GDP}_{\mathrm{i,t-j}} + \sum_{j=1}^{k} \gamma_{1j} \Delta \ln \mathrm{RE}_{\mathrm{i,t-j}} + \sum_{j=1}^{k} \delta_{1j} \Delta \ln \mathrm{CO}_{2\mathrm{i,t-j}} + \sum_{j=1}^{k} \theta_{1j} \Delta \ln \mathrm{K}_{\mathrm{i,t-j}} + \sum_{j=1}^{k} \varphi_{1j} \Delta \ln \mathrm{L}_{\mathrm{i,t-j}} + \omega_1 ECT_{i,t-1} + \Delta \mu_{1it} \quad (3.12)$$

$$\Delta \ln \mathrm{RE}_{\mathrm{it}} = \sum_{j=1}^{k} \beta_{2j} \Delta \ln \mathrm{GDP}_{\mathrm{i,t-j}} + \sum_{j=1}^{k} \gamma_{2j} \Delta \ln \mathrm{RE}_{\mathrm{i,t-j}} + \sum_{j=1}^{k} \delta_{2j} \Delta \ln \mathrm{CO}_{2\mathrm{i,t-j}} + \sum_{j=1}^{k} \theta_{2j} \Delta \ln \mathrm{K}_{\mathrm{i,t-j}} + \sum_{j=1}^{k} \varphi_{2j} \Delta \ln \mathrm{L}_{\mathrm{i,t-j}} + \omega_2 ECT_{i,t-1} + \Delta \mu_{2it} \quad (3.13)$$

$$\Delta \ln \mathrm{CO}_{2\mathrm{it}} = \sum_{j=1}^{k} \beta_{3j} \Delta \ln \mathrm{GDP}_{\mathrm{i,t-j}} + \sum_{j=1}^{k} \gamma_{3j} \Delta \ln \mathrm{RE}_{\mathrm{i,t-j}} + \sum_{j=1}^{k} \delta_{3j} \Delta \ln \mathrm{CO}_{2\mathrm{i,t-j}} + \sum_{j=1}^{k} \theta_{3j} \Delta \ln \mathrm{K}_{\mathrm{i,t-j}} + \sum_{j=1}^{k} \varphi_{3j} \Delta \ln \mathrm{L}_{\mathrm{i,t-j}} + \omega_3 ECT_{i,t-1} + \Delta \mu_{3it} \quad (3.14)$$

where β, γ, δ, θ, φ are the regression parameters that would be estimated; - long-term effect indicator; ω is a parameter that characterized the deviation of variables from long-run equilibrium $ECT$

Data analysis for the study was obtained from official data from the World Data Bank from 1995 to 2015. Note that all variables for analysis are presented in natural logarithms. The results of checking the unit root of the panel data for all selected parameters of formula (3.14) using the test IPS, LLC, ADF Fisher and PP Fisher are presented in table 3.5.

Table 3.5

Test results for a single root for indicators GDP, K, L, RE, CO2

| Variables | Statistical tests | | (A) | | (B) | |
|---|---|---|---|---|---|---|
| | | | Value | Level | Value | The first level |
| 1 | 2 | | 3 | 4 | 5 | 6 |
| GDP | LLC | Statistic | -2.34 | -5.63 | 0.87 | -3.50 |
| | | p-value | 0.0097 * | 0.00 * | 0.81 | 0.0002 * |
| | IPS | Statistic | 3.02 | -7.63 | 3.25 | -3.81 |
| | | p-value | 1.00 | 0.00 * | 1.00 | 0.0001 * |
| | ADF Fisher | Statistic | -3.81 | 13.98 | -1.81 | 10.17 |
| | | p-value | 1.00 | 0.00 * | 0.96 | 0.00 * |
| | PP Fisher | Statistic | -3.81 | 13.98 | -1.81 | 10.17 |
| | | p-value | 1.00 | 0.00 * | 0.96 | 0.00 * |
| K | LLC | Statistic | -2.84 | -9.84 | 0.03 | -3.51 |
| | | p-value | 0.002 ** | 0.00 * | 0.51 | 0.0002 * |
| | IPS | Statistic | 1.93 | -8.19 | 1.74 | -3.76 |
| | | p-value | 0.97 | 0.00 * | 0.96 | 0.0001 * |
| | ADF Fisher | Statistic | -3.19 | 16.67 | -1.37 | 10.07 |
| | | p-value | 1.00 | 0.00 * | 0.92 | 0.00 * |
| | PP Fisher | Statistic | -3.19 | 16.67 | -1.37 | 10.07 |
| | | p-value | 1.00 | 0.00 * | 0.92 | 0.00 * |
| L | LLC | Statistic | -0.62 | -5.90 | -1.51 | -1.83 |
| | | p-value | 0.27 | 0.00 * | 0.07 *** | 0.03 ** |
| | IPS | Statistic | 4.06 | -9.01 | 1.64 | -4.32 |
| | | p-value | 1.00 | 0.00 * | 0.95 | 0.00 * |
| | ADF Fisher | Statistic | 0.58 | 26.53 | -0.12 | 19.86 |
| | | p-value | 0.28 | 0.00 * | 0.55 | 0.00 * |
| | PP Fisher | Statistic | 0.58 | 26.53 | -0.12 | 19.86 |
| | | p-value | 0.28 | 0.00 * | 0.55 | 0.00 * |
| RE | LLC | Statistic | 8.98 | -5.08 | -0.90 | -4.67 |
| | | p-value | 1.00 | 0.00 * | 0.18 | 0.00 * |
| | IPS | Statistic | 13.37 | -9.52 | 1.42 | -3.59 |
| | | p-value | 1.00 | 0.00 * | 0.92 | 0.0002 * |
| | ADF Fisher | Statistic | -4.13 | 31.66 | -1.30 | 9.18 |
| | | p-value | 1.00 | 0.00 * | 0.90 | 0.00 * |
| | PP Fisher | Statistic | -4.13 | 31.66 | -1.30 | 9.18 |
| | | p-value | 1.00 | 0.00 * | 0.90 | 0.00 * |
| CO2 | LLC | Statistic | 4.30 | -7.46 | 0.66 | -4.38 |
| | | p-value | 1.00 | 0.00 * | 0.75 | 0.00 * |
| | IPS | Statistic | 4.65 | -11.43 | 1.59 | -4.33 |
| | | p-value | 1.00 | 0.00 * | 0.94 | 0.00 * |
| | ADF Fisher | Statistic | -2.23 | 56.48 | -1.09 | 14.18 |
| | | p-value | 0.99 | 0.00 * | 0.86 | 0.00 * |
| | PP Fisher | Statistic | -2.23 | 56.48 | -1.09 | 14.18 |
| | | p-value | 0.99 | 0.00 * | 0.86 | 0.00 * |

*, **, and *** statistical significance at the levels of 1%, 5% and 10%, respectively (in bold). A - EU countries, B - candidate countries and potential candidate countries for EU membership

Source: calculated by the authors.

For EU countries, only when using the LLC test, GDP per capita in US dollars and gross fixed capital formation in US dollars were stationary. In this case, all other indicators became stationary at the first level, which thus gives grounds excluding the null hypothesis of non-stationary data for all tests.

All results are statistically significant at the level of 1% and 5%. The results allowed to test the cointegration of panel data between GDP per capita in US dollars, gross fixed capital formation in US dollars, economically active population (persons aged 15 and older) involved in the production of goods and services, renewable energy consumption (specific weight of alternative energy in total energy consumption), CO2 emissions (metric tons per capita).

The obtained data indicate cointegration between variables for EU countries at the level of 1% and 5%, as 6 out of 11 test results (4 panels and 2 groups) exclude the null hypothesis - the lack of cointegration of time series. This allows us to conclude that the variables are cointegrated and there are long-term relationships between them.

For candidate countries and potential candidate countries for EU membership, there is a co-integration ratio between GDP per capita in US dollars, gross fixed capital formation in US dollars, economically active population (persons aged 15 and over) involved in the production of goods and services, renewable energy consumption (share of alternative energy in total energy consumption), CO2 emissions (metric tons per capita). Table 3.6 presents the results of using the Pedroni cointegration panel data test.

Given that there is a variable cointegration relationship between variables, the next step is to assess the long-term relationship. Tables 3.7-3.8 show the test results using the FMOLS and DOLS methods.

Table 3.6

The results of the evaluation of the cointegration relations of the analyzed parameters using the Pedroni test

| Variables | Tests | (A) | | (B) | |
|---|---|---|---|---|---|
| | | Statistics | Prob | Statistics | Prob |
| In the group | v-statistic panel | **-0.11** | **0.54** | **0.09** | **0.47** |
| | panel rho-statistic | 2.62 | 1.00 | 1.19 | 0.88 |
| | PP-statistical panel | -2.01 | (0.02) ** | -2.73 | (0.003) * |
| | ADF-statistical panel | -3.53 | (0.000) * | -2.16 | (0.02) ** |
| | ***(weighted statistic)*** | | | | |
| | v-statistic panel | **-0.51** | **0.70** | **-0.03** | **0.51** |
| | panel rho-statistic | 2.29 | 0.99 | 0.83 | 0.80 |
| | PP-statistical panel | -2.61 | (0.004) * | -3.02 | (0.004) * |
| | ADF-statistical panel | -2.82 | (0.002) * | -1.86 | (0.03) ** |
| Between groups | group rho-statistic | 3.97 | 1.00 | 1.86 | 0.97 |
| | group PP – statistic | -3.26 | (0.000) * | -0.22 | 0.41 |
| | group ADF-statistic | -1.84 | (0.03) ** | -2.13 | (0.02) ** |

*, **, and *** statistical significance at the levels of 1%, 5% and 10%, respectively, (in bold). A - EU countries, B - candidate countries and potential candidate countries for EU membership

Source: calculated by the authors.

Table 3.7

Assessment of cointegration relations analyzed parameters using the FMOLS

| Variables | | FMOLS | | | |
|---|---|---|---|---|---|
| | | AND | | IN | |
| **Addicted** | **Not dependent** | **Long-term ratio** | **Prob** | **Long-term ratio** | **Prob** |
| **GDP** | **RE** | 15.76 | (0.00) * | -89.56 | (0.082) *** |
| | **CO2** | 21.80 | (0.006) * | 59.37 | 0.83 |
| | **K** | 0.00 | (0.0001) * | 0.00 | (0.00) * |
| | **L** | 0.00 | 0.72 | 0.00 | (0.04) ** |
| **R-squared adj.** | | 0.86 | | 0.83 | |
| **RE** | **GDP** | 0.0002 | (0.00) * | -0.0004 | 0.42 |
| | **CO2** | -2.15 | (0.00) * | -2.19 | (0.004) * |
| | **K** | 0.00 | 0.23 | 0.00 | 0.88 |
| | **L** | 0.00 | 0.25 | 0.00 | 0.79 |
| **R-squared adj.** | | 0.9587 | | 0.90 | |
| **CO2** | **GDP** | 9.59e-06 | 0.18 | 8.05e-05 | 0.47 |
| | **RE** | -0.16 | (0.00) * | -0.089 | (0.0034) * |
| | **K** | 7.30e-13 | 0.63 | -8.74e-12 | 0.27 |
| | **L** | -1.63e-07 | 0.10 | 2.77e-07 | 0.15 |
| **R-squared adj.** | | 0.96 | | 0.86 | |

*, **, and *** statistical significance at the levels of 1%, 5% and 10%, respectively, (in bold). A - EU countries, B - candidate countries and potential candidate countries for EU membership

Source: calculated by the authors.

The empirical results of the two proposed approaches are similar in terms of the sign and strength of the statistical significance of the impact of renewable energy consumption (share of alternative energy in total energy consumption), CO2 emissions (metric tons per capita), gross fixed capital formation in US dollars per GDP in US dollars for EU countries.

Table 3.8

Assessment of cointegration relations analyzed parameters using the DOLS model

| **Variables** | | **Variables** | | | |
|---|---|---|---|---|---|
| | | **AND** | | **IN** | |
| **Addicted** | **Addicted** | **Long-term ratio** | **Prob** | **Long-term ratio** | **Prob** |
| **1** | **2** | **3** | **4** | **5** | **6** |
| **GDP** | **RE** | 16.56 | (0.00) * | -33.70 | (0.0003) * |
| | **CO2** | 53.67 | (0.00) * | -21.64 | (0.00) * |
| | **K** | 0.00 | (0.000) * | 0.00 | (0.004) * |
| | **L** | 0.00 | 0.77 | 0.00 | 0.41 |
| **R-squared adj.** | | 0.99 | | 0.99 | |
| **RE** | **GDP** | 0.0002 | (0.00) * | -0.003 | (0.000) * |
| | **CO2** | -1.62 | (0.00) * | -6.31 | (0.000) * |
| | **K** | 0.00 | 0.75 | 0.00 | (0.07) *** |
| | **L** | 0.00 | 0.72 | 0.00 | 0.78 |
| **R-squared adj.** | | 0.9946 | | 0.9949 | |
| **CO2** | **GDP** | 2.90e-05 | (0.034) ** | -0.0004 | (0.00) * |
| | **RE** | -0.09 | (0.001) * | -0.11 | (0.00) * |
| | **K** | -9.74e-13 | 0.78 | 1.14e-11 | (0.05) ** |
| | **L** | -1.45e-07 | 0.52 | 0.62 | 0.54 |
| **R-squared adj.** | | 0.99 | | 0.99 | |

*, **, and *** statistical significance at the levels of 1%, 5% and 10%, respectively, (bold). A - EU countries, B - candidate countries and potential candidate countries for EU membership

Source: calculated by the authors.

Thus, an increase of 1% RE provokes GDP growth of 15.76% (for FMOLS) and 16.56% (for DOLS), an increase of CO2 by 1% leads to an increase in GDP of 21.80% (for FMOLS) and 53, 67% (for DOLS). At the same time, GDP growth of 1% on FMOLS causes growth of RE by 0.0002% and CO2 by 9.59e-06%, but for DOLS RE - 0.0002%, CO2 - 2.90e-05%. The impact of CO2

on RE is negative for both cointegration methods of FMOLS and DOLS assessment. However, for candidate and potential candidate countries for EU membership, the impact of renewable energy consumption (share of alternative energy in total energy consumption) and CO2 emissions (metric tons per capita) on GDP per capita in US dollars is different. In addition, in the long run, the results of using FMOLS showed that a 1% increase in renewable energy consumption (share of alternative energy in total energy consumption) leads to a decrease in GDP by 89.56% (results are statistically significant at 10%), but such the level of statistical significance did not allow to reject the null hypothesis. These results were not taken into account in the study. For DOLS, an increase in RE leads to a decrease in output by 33.70% (results are statistically significant at 1%). The impact of CO2 emissions (metric tons per capita) on GDP per capita in US dollars was statistically significant at 1% by the DOLS method, GDP will decrease by 21.64% if CO2 emissions increase by 1%.

The increase in GDP had a negative impact on renewable energy consumption (share of alternative energy in total energy consumption) and CO2 emissions (metric tons per capita) with a statistical significance of 1% according to the DOLS method. The results of short-term Granger tests using the VECM method based on equations (3.6) - (3.8) are shown in table 3.9. Thus, the results indicate the existence of bilateral short-term links between the indicators of CO2 emissions (metric tons per capita) and GDP for EU countries at the level of statistical significance of 1%.

At the same time, there is also a one-way short-term causal relationship, ie GDP affects RE at the level of statistical significance of 1%. In addition, the two-way relationship was confirmed between RE and CO2 at 1% and 5%. The test results (table 3.9) proved that the error is negative and statistically significant at the level of 10% only for equation (3.6).

Table 3.9

Empirical results of checking short-term and long-term bilateral relationships between the analyzed indicators using the VECM method (Panel Vector Error Correction Estimate)

| **Dependent variables** | **Short-term relationships** | | | | | **Long-term relationships** |
|---|---|---|---|---|---|---|
| | **D (GDP)** | **D (RE)** | **D (CO2)** | **D (K)** | **D (L)** | **ECMt_1** |
| **D (GDP)** | 0.18<br>(0.001) * | 7.10e-05<br>(0.01) * | -3.43e-05<br>(0.001) * | -112135.7<br>(0.77) | 1.03<br>(0.66) | -0.002<br>(0.09) *** |
| **D (RE)** | -40.02<br>(0.68) | -0.039<br>(0.40) | -0.050940<br>(0.007) * | 1.96e + 08<br>(0.78) | 286.68929<br>(0.95) | 2.77e-07<br>(0.65) |
| **D (CO2)** | 726.30<br>(0.002) * | -0.22<br>(0.05) ** | -0.089886<br>(0.05) *** | 3.15e + 09<br>(0.06) *** | 5055.37<br>(0.63) | -1.59e-07<br>(0.52) |
| **D (K)** | -9.19e-10<br>(0.90) | -3.66e-12<br>(0.29) | 7.47e-13<br>(0.59) | 0.20<br>(0.0001) * | 1.19e-06<br>(0.0002) * | 22613.53<br>(0.0136) ** |
| **D (L)** | 0.0017<br>(0.05) ** | -4.81e-07<br>(0.25) | 2.20e-08<br>(0.90) | 21242.29<br>(0.0009) * | –0.434828<br>(0.0004) * | 0.29<br>(0.00) * |
| *, **, and *** - statistical significance at the levels of 1%, 5% and 10%. | | | | | | |

Source: calculated by the authors.

Empirical results of the study confirm that the development of alternative energy as a promising area of green investment has not only a direct environmental effect (reduction of carbon dioxide emissions), but also an economic effect - GDP growth.

Thus, we can conclude that the policy of EU countries to implement the principles of sustainable development, support the development of alternative energy sources, intensify the green investment market, build a green stock market, the formation of environmental education are effective and lead to direct environmental benefits - reducing eco-destructive impact environment.

It should be noted that the spread of renewable energy sources requires additional financial resources. However, the current political and economic conflicts in Ukraine determine the direction of public funds to solve urgent problems, rather than to ensure the green growth of the country. In addition, the domestic business sector is the basis of the country's economic development.

Along with this, the growth of economic activity of the business sector is accompanied by an increase in the environmental impact on the environment. Also, the modern consumer seeks to consume environmentally friendly products. Therefore, the business sector must respond and adapt to market and consumer requirements, which in turn requires additional investment. As noted in previous sections, the experience of EU countries shows that in conditions of lack of financial resources, a promising area of attracting additional financial resources is the development of the green investment market. In this regard, it is advisable to analyze the causal links between the amount of green investment attracted by enterprises, their greenhouse gas emissions and their share in GDP growth. It should be noted that a number of scientists focus their research on isolated barriers that hinder the development of the green investment market. Based on the results of generalization and systematization of research in the field of green investment and taking into account the domestic conditions of operation of economic entities, the following main barriers to green investment can be identified: inconsistency of state regulation of the green investment market; lack of generally accepted theoretical and methodological foundations of the theory of green investments; stereotypical thinking about the unprofitability of green investments; a wide range of stakeholders with their own interests; low level of trust in the "green" brand among stakeholders; lack of a legally established mechanism for publishing non-financial statements by companies that position themselves as "green" companies in open access; lack of institutional infrastructure (green stock market, green funds, green banks, etc.); lack of unified principles of accounting for green assets; inefficient system of ecological certification and licensing of green products or services, etc. At the same time, most foreign studies are focused on identifying mechanisms for solving existing problems, which are identified in Figure 3.9.

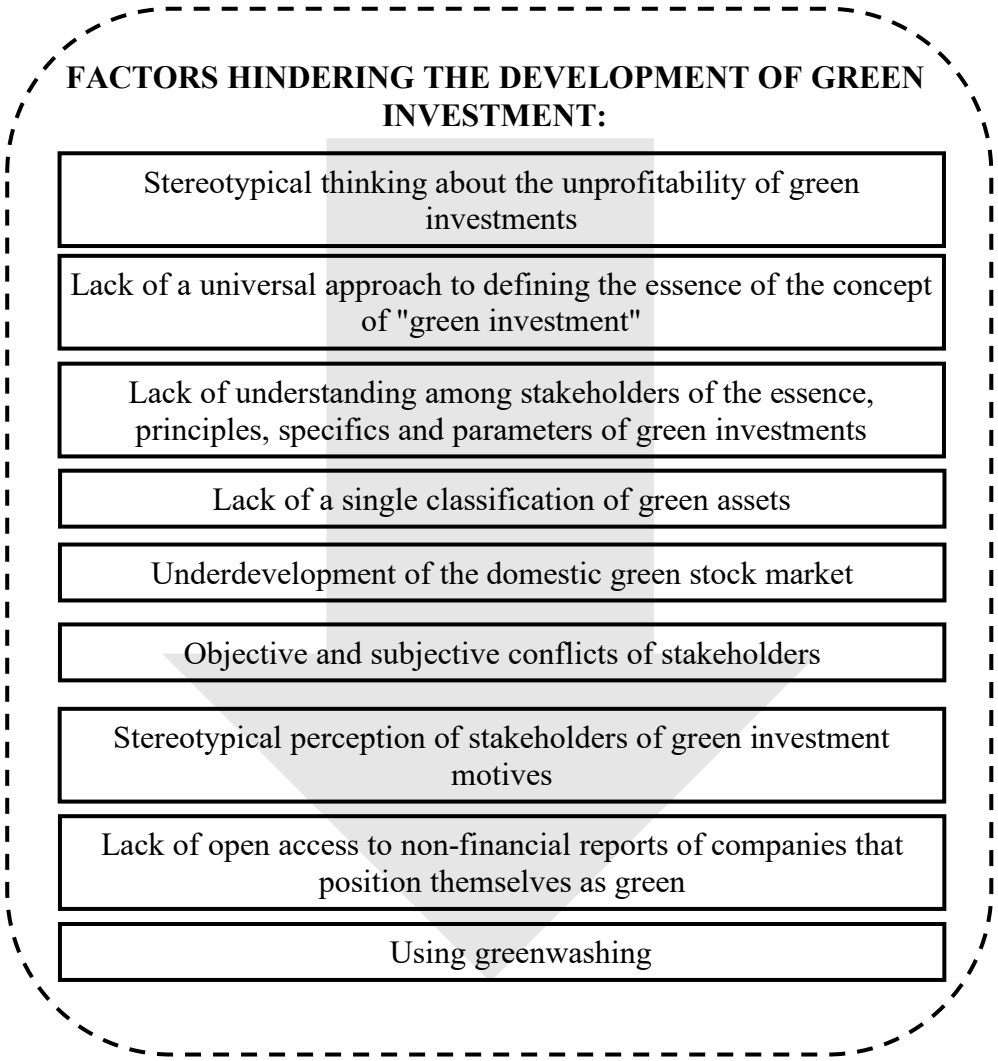


Figure 3.9 - Systematization of the main barriers to the development of green investment

Source: systematized by the authors.

In this regard, it is necessary to analyze and systematize the mechanisms for leveling the factors hindering the development of the green investment market at both the state and corporate levels.

Unlike in the EU, the domestic economy and business sector are experiencing a constant shortage of financial resources. In this regard, taking into account domestic realities, it is necessary to approve at the state level an action plan for financial support and measures to achieve the indicative goals of sustainable development.

One of the main directions of this action plan should be a roadmap for green investment through the formation of an effective management concept of green investment marketing at all levels (state, regional, business entities), which in turn is not possible without an effective mechanism of state regulation of the green market. investment.

The concept of marketing and management of green investments should be formed on the basis of the principles of systemicity and complexity, which will take into account the areas of interaction of major stakeholders of green investment, as well as the consequences of the flow of management and marketing decisions in the field of green investment.

# Conclusion

The monograph presents a theoretical generalization and a new solution to the scientific problem, which is manifested in the development of known and development of new theoretical and methodological approaches to macroeconomic stability of the national economy, taking into account the influence of social, political and marketing determinants.

All scientific approaches to determining the essence of macroeconomic stability of the national economy can be grouped as follows: 1) dynamic and equilibrium (define macroeconomic stability as the absence of abrupt changes in its components); 2) functional, productive and resource (define macroeconomic stability as the ability of the national economy to withstand shocks at a certain point in time and maintain its functional capacity); 3) structural-equilibrium and elemental (consider the macroeconomic stability of the national economy through the stability of its system-forming elements or basic determinants).

Macroeconomic stability of the national economy is a state of national economy development characterized by a low level of volatility of changes in key macroeconomic parameters in relation to the target trend, dynamically stable or progressive institutional, functional and resource capacity of the economy to mitigate the negative effects of endogenous and exogenous exogenous and exogenous.

The main economic and financial parameters that determine the macroeconomic stability of the national economy, due to the targets of the stabilization policy of the state. While the macroeconomic stability of the national economy is directly and indirectly affected by factors that have not so much financial and economic as social, cultural, political and institutional origin. Their combined convergent and divergent impact on the macroeconomic stability of the national economy is significant, so they can be considered system-forming

determinants of macroeconomic stability of the national economy: social, political and marketing. The relationship between these determinants and macroeconomic stability of the national economy is not one-sided (determinants affect the macroeconomic stability of the national economy), but mutual, ie the level of macroeconomic stability of the national economy formed in the country also largely determines social progress, effectiveness of political and social institutions. countries with international partners, etc. These relationships must be taken into account when building a management system for the national economy. All approaches to assessing the level of macroeconomic stability of the national economy can be divided into three types (dynamic-equilibrium, static-interval and static-comparative) depending on two criteria: time factor (dynamic / static assessment) and the basic assessment parameter (volatility / consistency). within a given interval / proximity to the standard).

The largest level of decline in the static indicator of macroeconomic stability of the national economy in 2011-2017 was in Ukraine and Serbia. The level of macroeconomic stability of the national economies of Latvia, Lithuania, and Poland has been growing annually since their accession to the EU until the crisis of 2008; Romania, Poland, and Lithuania significantly reduced the gap between the pre-crisis level of their macroeconomic stability in 2011–2015, and this process was the fastest in Romania. Despite the low starting level of macroeconomic stability of the Croatian national economy after the accession to the EU, the dynamics of its macroeconomic stabilization has gained momentum. The low level of standard deviations of the cyclical components of macroeconomic stability of the national economy for the EU countries indicates the effectiveness of the conversion of the state policy of these countries on macrostabilization. The level of social progress in the national economy is an important driver of macroeconomic stability of the national economy. The method of Euclidean distances and geometric mean was used for its integral measurement, and the parameters that characterize the standard of living, health,

well-being, freedom, security and equality in the country, the development of education, science and culture became components. Empirical calculations for Ukraine and the new EU member states for 2000–2017 showed that its level was low for Ukraine and Romania, and above average for Croatia, Poland, Latvia, and Lithuania. Assessment of the proximity of the vectors of social sector reforms in Ukraine and the new EU member states showed that in order to increase the level of the CU Ukraine needs to radically change the trajectory of reforms related to food security, public welfare, combating inequality and poverty, financing education, civil liberties ( clustering of these countries on the basis of the main components allowed to identify common for them social determinants of growth of the level of macroeconomic stability of the national economy). The results of the formalization of the relationship between macroeconomic stability and social progress in the national economy for 2000-2017 showed that investment in increasing social progress by 1 point leads to a decrease in macroeconomic stability of the national economy by 3 points for EU countries and 3, 5 points for Ukraine. Political instability and inefficiency of public administration in Ukraine reduces the level of macroeconomic stability of the national economy by 8 points and the level of social progress by 0.14 points.

Depending on which countries' experience Ukraine will take as a guide in carrying out reforms of the national economy management system aimed at simultaneously increasing macroeconomic stability and social progress, three strategies can be distinguished: “quasi-integration growth”, “convergent diversification” and “progressive growth”. ». The best results are achieved with the implementation of the second strategy, but for this it is necessary to ensure a significant increase in the level of Ukraine's integration into globalization processes in the world economy (by 3.6 points) and efficiency of public administration (by 1.63 points).

Based on the system of functional dependencies between the integrated indicator of the effectiveness of political institutions and macroeconomic stability

of the national economy, it is established that one of the biggest threats to macroeconomic stability of the national economy in Ukraine is a vicious circle of socio-political conflict. how Ukrainians do not want to promote the activities of ineffective political institutions. The most influential stimulators of macroeconomic stability of the national economy in the EU (Lithuania, Latvia, Croatia, Bulgaria, Poland, Romania) were indicators of public opinion in the formation of political institutions and accountability of government agencies (98% increase in CU growth), corruption control. by 69%) and governance efficiency (by 46%). Institutional environment (effective operation of political institutions and quality regulation of the national economy) is an important determinant of macroeconomic stability of the national economy, because, on the one hand, institutional constraints block opportunistic redistribution of resources, and on the other - political imbalance inhibits post-crisis recovery. economy. Increasing the level of efficiency of political institutions by 1% will lead to a 35% decrease in CU in Ukraine; in EU countries - to its growth by 5%; Belarus, Armenia - to its reduction by 46%; in Georgia, Moldova - to its reduction by 16%.

The hypothesis of a close relationship between the degree of external perception of the country (surveyed groups of respondents who are not residents of this country according to the method of FutureBrand) and the economic effectiveness of the country's use of its brand (in 2010 the value of Spearman's rank correlation coefficient was 0 , 7, in 2015 - 0.85). Stabilizing socio-value behavioral models are one of the main conditions for the transformation of the country's brand into a dynamic marketing determinant of growth of macroeconomic stability of the national economy. The country's transition from a collectivist to an individualistic model leads to an increase in macroeconomic stability of the national economy by 0.03 points (the coefficient of statistical significance is 0.077), and the transition from short-term benchmark to long-term orientation - to increase macroeconomic stability of the national economy by 0.12 points ( coefficient of statistical significance 0.013).

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Authors

© Dr. Oleksii Lyulyov Sumy State University, Ukraine

Dr. Tetyana Pimonenko Sumy State University, Ukraine

Dr. Yurii Bilan Sumy State University, Ukraine

Reviewers

Prof. Dr. Nataliia Pedchenko
Poltava University of Economics and Trade, Ukraine

Prof. Dr. Ihor Lobushko
Sumy State University, Ukraine

Prof. László Vasa
Kautz Gyula Faculty of Economics, Széchenyi István University, Hungary

The scientific monograph was performed within the framework of the research theme «Foresight-forecasting the stability of the national economy: from socio-ecological and economic contradictions to the convergent model» (Reg. No.: 0117U003932),


1st Edition
Range 367 pg (13.72 Signatures)



Suggested citation:

Lyulyov O., Pimonenko T., Bilan Yu. (2020). Path from environmental, social and economic contradictions to convergent model: forecast of the macroeconomic stability: monograph, Szczecin: Centre of Sociological Research, p. 136. 978-83-952923-9-2. DOI: 10.14254/ 978-83-952923-9-2/2020

ISBN 978-83-952923-9-2

9 788395 292392