Humanities and Social Sciences **2019**
HSS, vol. XXIV, 26 (2/2019), p. 7-26 **April-June**

Monika BOLIŃSKA[1]
Olesia CHORNENKA[2]

SPATIAL DIVERSITY OF UNEMPLOYMENT IN UKRAINE

The aim of this study is to analyze the spatial differentiation of unemployment rate in the regions in Ukrainian oblasts. Based on the definition of the unemployment rate, the determinants of unemployment rates registered in Ukraine were featured. To analyze the spatial diversification of unemployment rate, the method of spatial econometrics with the use of panel data and fixed effect method was applied. The results show that in Ukrainian economy one can distinguish two breakthrough moments that influenced the formation of unemployment rates in the oblasts discussed. The first of these was the period of the gas conflict with the Russian Federation in 2008 and 2009, the next difficult period for the Ukrainian economy in 2014–2015, when the annexation of the Crimean Peninsula and the military conflict with the Russian Federation took place. In both cases, the Ukrainian economy has been negatively affected, with GDP *per capita* declining with an increase in unemployment rate.

Keywords: unemployment rate, Ukraine, GDP.

1. INTRODUCTION

Economic development depends on many economic, social and political factors. Analysing the history of international relations, we can distinguish another factor, no less important for the development of the economy, i.e. the geopolitical factor. This factor plays an important role in the creation of internal and external state policy.

Looking at the Ukrainian economy, a strong influence of the geopolitical factor on its development can be seen. First of all, it is related to the unique geographical location in the central part of Eastern Europe, on the border between Europe and Asia (Міхель, 2009).Ukraine covers an area of over 600,000 km^2 and is the second largest country in Europe[3]. In addition to significant territory, Ukraine has access to the Black Sea and the Azov Sea in the south and a large number of developed transport connections with other countries.

From the historical point of view, the territory of Ukraine was not only a crossroads of migration routes, but also of trade routes. In antiquity, trade routes ran through the territory

[1] Monika Bolińska, MA of Economics, PhD student of the Jagiellonian University, Jagiellonian University, Cracow Łojasiewicza St. 4, 30-348 Cracow, Poland; e-mail: monika.bolinska@doctoral.uj.edu.pl (correspondent author). ORCID: 0000-0003-0361-7148.

[2] Olesia Chornenka, MA of Economics; e-mail:alicechornenka@gmail.com, ORCID: 0000-0002--2057-519X.

[3] According to the ranking: https://www.worldatlas.com, not including the area of the Russian Federation.

of modern Ukraine between the Baltic States and the Mediterranean countries, and between Western, Eastern and Central Europe, which had a positive impact not only on the development of trade but also on international relations (Міхель, 2009).

Apart from Poland, Ukraine borders on the west with Hungary and Slovakia, through whose territory the shortest road to Western and Central Europe leads. To the east and north it borders Russia, to the southwest Moldova and Romania, and Belarus, through which it has access to the Baltic States to the north.

Ukraine is divided into 24 oblasts (*область*), the Autonomous Republic of Crimea (*Автономна Республіка Крим*)and two cities with special status (*містозіспеціальним статусом*), Kiev, which is the capital of the state and Sevastopol on the Crimean Peninsula (map 1).In connection with the occupation of the Autonomous Republic of Crimea and Sevastopol by the Russian Federation, the Ukrainian statistics office data: *Державної служби статистики України* for the Autonomous Republic of Crimea and Sevastopol relate to the years 2004-2013.

The oblasts with the largest area include Odessa (33.3 thousand km^2, 5.5% of the country), Chernihiv and Dnipropetrovsk (31.9 thousand km^2, 5.3% each) and Kharkiv (31.4 thousand km^2, 5.3%), the smallest in turn are: Chernivsti (8.1 thousand km^2, 1.3%), Transcarpathia (12.8 thousand km^2, 2.1%), Ternopil' (13.8 thousand km^2, 2.3%) and cities with special status: Sevastopol (0.9 thousand km^2, 0.1%) and Kyiv (0.8 thousand km^2,0.1%)[4].

Map 1. Ukrainian oblasts

Source: own elaboration based on data http://database.ukrcensus.gov.ua; via https://paintmaps.com.

[4] Data published by Державну Службу Статистики України http://database.ukrcensus.gov.ua/MULT/Dialog/statfile_c.asp.

Map 2. Diversification of the demographic potential of Ukraine's oblasts (2004-2016)

Source: own elaboration based on data http://database.ukrcensus.gov.ua; via https://paintmaps.com.

From Map 2 we can conclude that the five oblasts with the highest demographic potential are: Donetsk (4,254.6 thousand people, 10%of the country's population), Dnipropetrovsk (3,242.7 thousand people, 7.6%), Kyiv (2,916.2 thousand people, 6.8%), Kharkiv (2,709.9 thousand people, 6.4%), Lviv (2,534.1 thousand people, 5.9%). The least populated oblasts were: Volyn (1,041.8 thousand people, 2.4%), Chernihiv (1,039.2 thousand people, 2.4%), Kirovorohrad (969.5 thousand people, 2.3%), Chernivtsi (909.0 thousand people, 2.1%) and Sevastopol (384.7 thousand people, 0.9% in 2013).Among the 5 largest cities of Ukraine in terms of population, we can count: Kyiv (2,916.2 thousand inhabitants), Kharkiv (1,449.7 thousand inhabitants), Odessa (1,010.8 thousand inhabitants), Dnieper[5] (983.8 thousand inhabitants) and Donetsk (929.1 thousand inhabitants).

The oblasts with the highest incomes[6] (excluding the Crimean Autonomous Republic) in 2016 were Kyiv (338,1 billion hryvnia, 16.5% of total economy incomes), Dnipropetrovsk oblast (188,8 billion hryvnia, 9.2%), Kharkiv oblast (135,7 billion hryvnia, 6.6%), Odessa[7] (118,5billion hryvnia, 5.8%), Donetsk[8] (117.7 billion hryvnia, 5.7%) and Lviv (116.3 billion hryvnia, 5.7%).

[5] Until 2016 Dnepropetrovsk.

[6] Incomes according to the methodology of calculation include remuneration in monetary and natural form (including those obtained from abroad), profit and mixed income, property income, social assistance and other transfers.

[7] Incomes according to the methodology of calculation include remuneration in monetary and natural form (including those obtained from abroad), profit and mixed income, property income, social assistance and other transfers.

[8] In the case of the Donetsk oblast the territory occupied by the Russian Federation was not taken into account.

Due to the considerable diversity of Ukrainian oblasts, they have been divided into 5 groups:

1. Central Ukraine, i.e. the following oblasts: Cherkasy, Dnipropetrovsk, Kirovohrad, Poltava and Vinnitsa.
2. Western Ukraine composed of the following oblasts: Khmelnytskyy, Chernivtsi, Ivano-Frankivsk, Lviv, Rivne, Ternopil`, Volyn and Transcarpathia.
3. Eastern Ukraine, i.e. Kharkiv, Donetsk, Luhansk and Zaporizhyaoblasts.
4. Southern Ukraine: Autonomous Republic of Crimea, Kherson, Nikolayev and Odessa oblasts, and Sevastopol.
5. Northern Ukraine: the city of Kyiv and the following oblasts: Chernihiv, Kyiv, Sumy and Zhytomyr oblasts.

The main objective of the study is to illustrate the spatial differentiation of unemployment rates in 27 Ukrainian oblasts. The analysis also covered the dynamics of unemployment, moreover, basing on the method of spatial econometrics, the main determinants of increases in unemployment rates were determined basing on panel data. The analysis period covered the years 2004-2016, which was dictated by the availability of relevant statistical data on the website: http://www.ukrstat.gov.ua.

2. DIVERSIFICATION OF GDP *PER CAPITA* IN GROUPS OF OBLASTS IN UKRAINE

Figure 1 and Table 1 show the GDP *per capita* in Ukraine's oblasts in the years 2004––2016.The level of GDP *per capita* was divided into two sub-periods 2004–2009 and 2010–2016, while GDP growth rates in the analysed period were divided into three sub-periods: 2004–2008, 2009–2014, 2015–2016 in order to capture the impact of crises, both economic and political, on GDP developments.

Table 1. GDP *per capita* in Ukraine's oblasts

Oblast	GDP in thousands of hryvnias (fixed prices in 2016)*		Average annual growth rate of GDP *per capita* in %		
	2004-2009	2010-2016**	2004-2008	2009-2014	2015-2016**
Autonomous Republic of Crimea	84.89	91.54	4.66	0.94	-
Cherkasy	91.42	109.08	5.32	2.91	-1.75
Chernihiv	87.11	97.26	1.96	2.26	-0.87
Chernivtsi	67.37	63.18	2.58	-1.21	-7.38
City of Kyiv	345.10	386.46	4.03	2.57	-1.45
Dnipropetrovsk	165.96	184.17	11.02	-0.43	-5.87
Donetsk	159.82	160.98	2.78	-5.81	31.76
Ivano-Frankivsk	100.83	103.75	0.68	1.84	-8.89
Kharkiv	124.02	124.91	5.92	-1.41	-0.86
Kherson	74.96	82.22	1.57	0.78	2.4
Khmelnytskyy	79.34	89.75	2.01	3.44	-2.12
Kirovohrad	87.53	107.67	1.82	4.3	1.39
Kyiv Oblast	123.92	168.27	6.36	4.5	-0.77
Luhansk	111.02	99.99	5.49	-9.94	36.17

Table 1 (cont.). GDP *per capita* in Ukraine's oblasts

Oblast	GDP in thousands of hryvnias (fixed prices in 2016)*		Average annual growth rate of GDP *per capita* in %		
	2004-2009	2010-2016**	2004-2008	2009-2014	2015-2016**
Lviv	96.18	105.74	2.23	2.34	-1.79
Mykolaiv	105.34	111.22	1.45	0.82	0.72
Odessa	122.48	120.96	4.51	-1.99	-0.22
Poltava	151.38	179.79	1.26	3.81	4.16
Rivne	89.62	85.86	0.51	1.6	-7.62
Sevastopol	97.48	109.71	4.72	2.31	-
Sumy	87.05	96.68	2.98	1.83	-2.76
Ternopil	73.99	77.89	2.29	1.73	-4.96
Transcarpathia	71.22	71.48	1.91	0.49	-7.45
Vinnytsya	82.02	97.68	2.15	4.09	2.5
Volyn	86.15	89.04	2.35	1.27	-1.09
Zaporizhya	139.94	132.45	4.62	-1.33	1.28
Zhytomyr	75.91	88.25	2.53	2.62	0.39

* alculated as an arithmetic mean of the real GDP *per capita* in subsequent years.
** for the Autonomous Republic of Crimea and Sevastopol data available until 2013.

Source: own elaboration based on data from http://database.ukrcensus.gov.ua.

When analysing the level of GDP *per capita* in Ukraine's oblasts in the years 2004–2016 it can be seen that the period of prosperity in the Ukrainian economy was 2004–2008.The growth rate of this variable in all oblasts was positive and amounted to 3.3% on average in the whole Ukraine, while in more developed oblasts such as Dnipropetrovsk, Kiev and Kharkiv, the GDP growth rate was about 8.0% on average. The highest GDP *per capita* growth rate in 2004–2008 was recorded in Dnipropetrovsk oblast at 11.0%, as opposed to Rivne (0.51%), Ivano-Frankivsk (0.68%) and Poltava (1.26%), which had the lowest growth rate of this variable.

In 2009–2014, i.e. after the global financial crisis and the gas conflict with Russia (2008–2009), only 20 of Ukraine's 27 oblasts achieved GDP growth. Throughout Ukraine, the growth rate was still positive and fluctuated around 0.5% annually. The oblasts with the highest GDP *per capita* growth rate were: Kyiv (4.5%), Kirovorohrad (4.30%), Vinnitsa (4.1%), Poltava (3.8%) and Khmelnytskyy (3.4%).In this period, the crisis was most noticeable in the following oblasts: Zaporizhya (1.3%), Kharkiv (-1.4%), Odessa (-2.0%), Donetsk (-5.8%) and Luhansk (-9.9%).We can therefore see that the oblasts with a lower level of economic development (Vinnitsa, Khmelnytskyy) were less sensitive to the global financial crisis than the oblasts with a high level of economic development (Odessa, Luhansk and Donetsk).

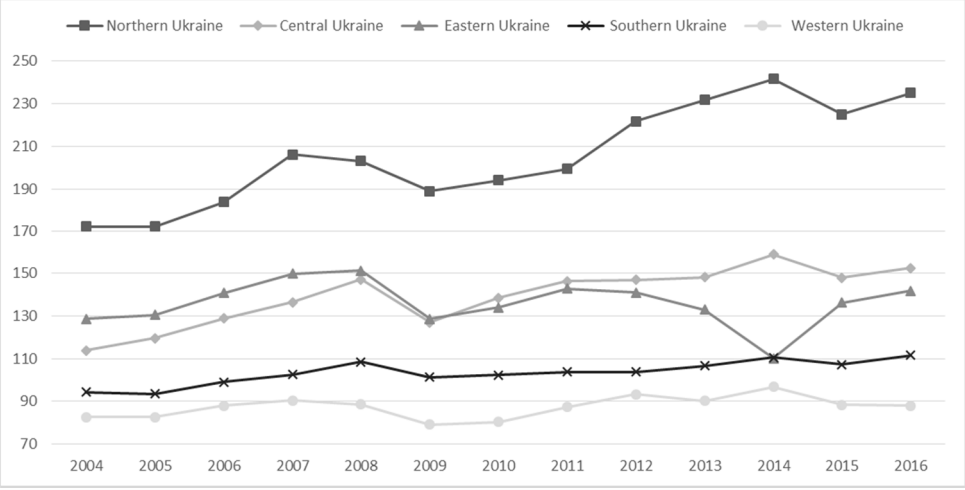
The decline in GDP can be seen after 2014, largely due to the armed conflict in the east of Ukraine and the occupation of the Crimean Autonomous Republic and the related internal economic crisis. Particularly drastic was the fall in GDP *per capita* in 2014 in the oblasts of Donetsk -29.4% and Luhansk -43.3%.Around 8% decline in this variable was recorded in the period 2015–2016 in the following oblasts: Transcarpathia, Ivano-Frankivsk, Rivne and Chernivtsi.

Graph 1 shows that during the analysed period a significant increase in GDP *per capita* was visible in the northern part of Ukraine. GDP growth in northern Ukraine's oblasts was decisively influenced by Kyiv, the capital city, which is the centre of the country's economic development, as evidenced by other indicators such as exports and investments, which accounted for 23.6% and 29.6% of Ukraine's exports and investments in 2016 (respectively).To this should be added the high degree of urbanization in this group of oblasts (76.5%).Graph 1 also shows a decrease in GDP in 2015 to 224,89 thousand hryvnias compared to 241,60 thousand hryvnias in 2015.

In the analysed period the level of GDP *per capita* in the eastern and central part of Ukraine was similarly shaped. The first decrease of 13.55% and 14.97% in the central and eastern part was recorded in 2009, which was influenced by the global financial crisis, as well as a decrease (by 7.6%) in coal mining, which is one of the main sources of income in the Eastern Ukraine oblasts. Another decrease in 2014 (by 17.18%) in the Eastern Ukraine oblasts was already related to the military aggression in the Donetsk and Luhansk oblasts. The conflict has worsened cooperation between industrial oblasts located in Eastern Ukraine, which has also had an impact on the decline in GDP in this part of the country.

The southern and western parts of Ukraine were characterised by rather stable dynamics of GDP *per capita*. In both groups there is a decrease in GDP in 2009 by 6.5% in Southern Ukraine and 10.7% in Western Ukraine.

In the analysed period two turning points in the development of the GDP level are visible. The first one is a decrease in 2009 related to the global financial crisis and the gas conflict with Russia and the second in 2014–2015 related to the conflict with the Russian Federation. On average, in the analysed period, the highest GDP levels were found in the northern (205.7 thousand hryvnia) and the central (139.3 thousand hryvnia) Ukraine. The average GDP *per capita* group consisted of the Eastern Ukraine oblasts of 136 thousand hryvnia, while Western and Southern Ukraine recorded the lowest GDP *per capita* levels of 87.4 thousand hryvnia and 103.5 thousand hryvnia respectively.



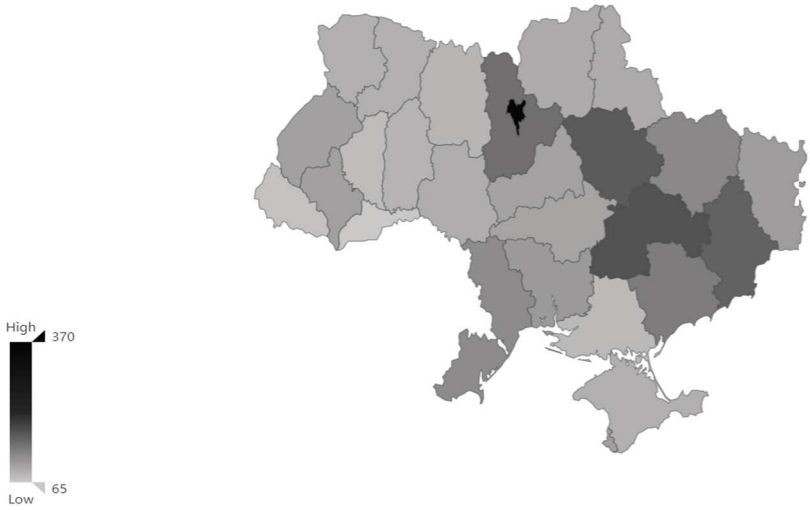
Graph 1. GDP *per capita* in groups of oblasts (in thousands of hryvnia, fixed prices 2016)

Source: own elaboration based on data from http://database.ukrcensus.gov.ua.

As can be seen in Graph 1 and Map 3, the regional variation in the level of GDP in Ukraine is significant. Moreover, when analysing the data in the given period, one can observe some trends in GDP *per capita* in the analysed groups of districts:

- the highest level of GDP was in Northern Ukraine with 205.7 thousand hryvnias[9];
- Eastern Ukraine (136 thousand hryvnias) and Central Ukraine (139.3 thousand hryvnias) also belong to the groups of oblasts with a high level of GDP;
- the lowest level of GDP *per capita* in the analysed period was in Western Ukraine 87.4 thousand hryvnias and Southern Ukraine 103.5 thousand hryvnias.

The highest level of GDP in Northern Ukraine is conditioned by a centralised approach to economic management. It is worth noting that in the transitional period of the Ukrainian economy (1990–2000), the regional policy of the state did not implement the proper systemic approach to the development of the oblasts, which resulted in the differentiation in their socio-economic development. To a large extent, the high level of GDP on the left side of the Dnieper River[10] is determined by historical, demographic and natural factors. In the eastern and northern oblasts, more developed industry as well as the extraction of natural resources, including in particular energy (coal, gas and oil), had a significant impact on the development of these oblasts. Within Ukraine, Dnipropetrovsk, Donetsk and Zaporizhsky are among the three oblasts with the largest production potential, to which the development of metallurgy in these oblasts has also contributed (Амоша, 2016).



Map 3. GDP *per capita* in Ukraine's oblasts (in thousands of hryvnias, fixed prices 2016)[11]

Source: as for map 1.

As far as Western Ukraine is concerned, the main sources of income in these oblasts are agriculture, trade and tourism. For historical and natural reasons, this part of Ukraine is

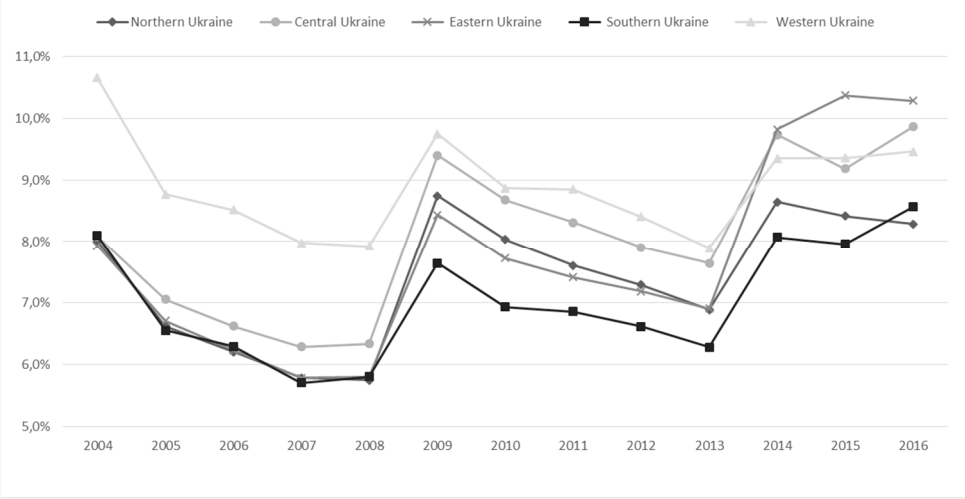
[9] On average, in the analysed period.
[10] With the exception of Kyiv, which is located on both sides of the river.
[11] On average, in the years 2005-2016.

economically less developed, but in recent years, thanks to international cooperation, the economic situation of the oblasts has been slowly improving, as can be seen in Table 1. The annexation of Crimea and high inflation in Ukraine after 2014 contributed to an increase in the development of tourism within Ukraine, which resulted in an increase in tourists in western oblasts (Lviv, Ivano-Frankivsk, Transcarpathia, Khmelnytskyy, Chernivtsi) and southern oblasts, in particular in Odessa, Mykolaiv and Kherson. However, as can be seen in the chart, map and table, the state's regional policy requires changes in the management of oblasts, and particularly important in this respect is the decentralisation of finances and the subsidy and stimulation of the development of small and medium-sized enterprises.

3. SPATIAL DIFFERENTIATION OF UNEMPLOYMENT RATES IN GROUPS OF UKRAINE'S OBLASTS

Another indicator on the basis of which the state of the economy can be assessed is the unemployment rate. In the period under review, the unemployment rate in all groups of Ukrainian oblasts was at a similar trajectories. From Graph 2 we can deduce that in the years 2004–2009 the unemployment rate in all oblasts, with the exception of Western Ukraine, was at a similar level and fluctuated around 6–9%, while in Western Ukrainian oblasts it was 8–11%.

Until 2008, in the five surveyed groups of oblasts, the level of unemployment was on a downward trend and in 2009, after the global financial crisis and the gas conflict, there was a drastic increase in the unemployment rate. In the following years the level of unemployment fell, and in 2014 there was again a significant increase in unemployment, which was associated with the annexation of Crimea and the Russian-Ukrainian conflict in the east of Ukraine. In the oblasts of Eastern, Southern and Central Ukraine the trend of increasing unemployment continued in the following years, while in Western and Northern Ukraine the level of unemployment remained at a similar level.

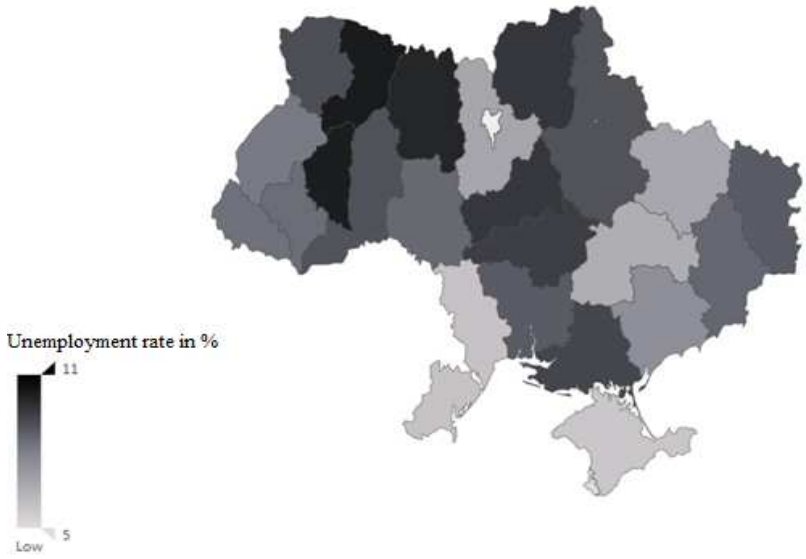


Graph 2. Differentiation of unemployment rates in groups of oblasts in 2004–2016

Source: as in Graph 1.

When analysing Graph 2 and Map 4 we can see similarity in the years when the global financial crisis took place and the annexation of Crimea and the Russian-Ukrainian conflict, i.e. in 2009 and 2014.

In 2016, the highest unemployment rate was recorded in the group of oblasts belonging to Eastern Ukraine (10.3%) and the lowest in Northern Ukrainian oblasts (8.3%). Due to the fact that the percentage of people employed in industry accounted for 16% (Амоша, 2016), and this sector dominated in the oblasts of Eastern and Southern Ukraine, the increase in unemployment in these oblasts had an impact on internal migration.



Map 4. Unemployment rate in groups of oblasts of Ukraine[12]

Source: as in map 1.

In the analysed period, the highest level of unemployment was recorded in Western Ukraine at 8.9% (average in the analysed period), especially in the Rivne (10.3%) and Ternopil oblasts (10.3%), as opposed to Southern Ukraine, where the unemployment rate was the lowest (7.0%). Between 2004 and 2013 the unemployment rate was the lowest in the Autonomous Republic of Crimea at 5.7%, while between 2004 and 2016 the lowest unemployment rate was in the Odessa oblast at 5.9%.

In general, the following oblasts can be considered as having a high unemployment rate: Rivne (10.3%), Ternopil (10.3%), Zhytomyr (10.1%), Chernihiv (9.6%), Cherkasy (9.6%), Kirovorohrad (9.5%) and Kherson (9.3%).

And the oblasts with a lower level of unemployment are: Autonomous Republic of Crimea (5.7%) and the oblasts: Odessa (5.9%), Dnipropetrovsk (6.5%), Kharkiv (6.7%), Kyiv (6.8%), Zaporizhya (7.5%) and Lviv (8.1%).

[12] On average, in the years 2004–2016.

Table 2. Unemployment rate in Ukraine's oblasts

Oblast*	Unemployment rate in %		Average annual changes in the unemployment rate in p.p.		
	2004-2009	2010-2016	2004-2008	2009-2014	2015-2016**
Autonomous Republic of Crimea	5.60	5.95	-0.54	0.19	-
Cherkasy	9.60	9.65	-0.82	0.34	0.06
Chernihiv	8.70	10.43	-0.47	0.59	0.04
Chernivtsi	9.60	8.44	-0.95	0.11	-0.18
City of Kiev	4.20	6.07	-0.42	0.60	-0.04
Dnipropetrovsk	5.80	7.17	-0.31	0.50	-0.09
Donetsk	6.60	10.18	-0.41	0.89	1.56
Ivano-Frankivsk	8.70	8.18	-0.58	0.03	0.35
Kharkiv	6.50	6.94	-0.65	0.41	-0.69
Kherson	9.10	9.47	-0.60	0.27	0.66
Khmelnytskyy	9.00	9.00	-0.77	0.23	0.02
Kiev oblast	6.80	6.79	-0.62	0.36	-0.59
Kirovorohrad	9.00	9.83	-0.74	0.52	0.60
Luhansk	8.50	7.80	-0.60	0.16	-0.41
Lviv	7.50	9.89	-0.65	0.80	2.33
Mykolaiv	9.10	8.49	-0.59	0.13	0.29
Odessa	5.50	6.16	-0.61	0.36	0.03
Poltava	7.50	10.27	-0.23	0.84	0.58
Rivne	10.30	10.31	-0.93	0.31	-0.02
Sevastopol	4.40	5.97	-0.41	0.42	-
Sumy	8.70	9.27	-0.76	0.35	-0.13
Ternopil	9.80	10.68	-0.78	0.42	0.07
Transcarpathia	7.50	9.02	-0.45	0.47	0.39
Vinnytsya	7.40	9.43	-0.39	0.68	-0.38
Volyn	9.00	9.13	-0.62	0.26	0.83
Zaporizhya	6.90	8.06	-0.50	0.41	0.77
Zhytomyr	9.70	10.38	-0.63	0.47	-0.15

* And two cities with special status.
** For the Autonomous Republic of Crimea and Sevastopol data available until 2013.

Source: as in Table 2.

Analysing the sub-period 2004–2009 it can be noticed that the highest unemployment rates were recorded in the oblasts of Western Ukraine (Rivne, 10.3%), Northern Ukraine (Zhytomyr, 9.7%), Central Ukraine (Cherkasy, 9.6%), Southern Ukraine (Mikolayiv, 9.1%), and Eastern Ukraine (Luhansk, 7.5%).On the other hand, the lowest unemployment rates in the abovementioned sub-period were recorded in Western Ukraine (Transcarpathia, 7.5%), Northern Ukraine (Kyiv, 4.2%), Central Ukraine (Dnipropetrovsk, 5.78%), Southern Ukraine (Sevastopol, 4.4%), and Eastern Ukraine (Kharkiv, 6.5%).

In the second sub-period (2010–2016), in the analysed groups of oblasts the unemployment rates averaged 7.9% – Northern Ukraine, 8.8% – Central Ukraine, 8.5% – Eastern Ukraine, 7.3% – Southern Ukraine, and 8.9% – Western Ukraine.

In both sub-periods it can be noted that higher unemployment rates were recorded in Western Ukraine oblasts and lower in Southern Ukraine oblasts. However, before the global financial crisis, a strong downward trend in the unemployment rate was observed in Western Ukraine oblasts, while the average decrease in the unemployment rate in these oblasts amounted about to -0.7 percentage points.

In the years of development of the Ukrainian economy (2004–2008), the decrease in the unemployment rate in the oblasts fluctuated between 0.2–1.0 percentage points between 2009 and 2014, i.e. after the financial crisis, an increase in the unemployment rate of about 0.5 percentage points was noted. Significant changes in unemployment rates were visible in 2014, when the unemployment rate increased in all oblasts. It is also worth noting that due to the Russian-Ukrainian conflict in Eastern Ukraine, unemployment rates were significantly higher, and the unemployment rate in Western Ukraine oblasts was much less responsive to the conflict.

4. STATISTICAL ANALYSES OF THE INCREASE IN UNEMPLOYMENT RATES IN UKRAINE

4.1. Determinants of unemployment rate growth-theoretical approach

In order to define the determinants of the increase in unemployment rates, it is possible, using the definition of the unemployment rate, to depend on the value of the previous period's unemployment rate and the GDP growth rate. For this purpose, the following definition can be used (Tokarski, 2005) or (Dykas, 2011):

$$u(t)=\frac{U(t)}{U(t)+L(t)}=1-\frac{L(t)}{N(t)} \tag{1}$$

where (for any given moment $t>0$) $u(t)$ is the unemployment rate, $U(t)$ is the number of unemployed, $L(t)$ is the number of employed, and $N(t)$ is the labour supply.

Differentiating with respect to time t equation (1) we obtain an increase in the unemployment rate given by the following derivative:

$$\dot{u}(t)=-\frac{\dot{L}(t)N(t)-L(t)\dot{N}(t)}{N^2(t)}=\frac{L(t)}{N(t)}\left[\frac{\dot{N}(t)}{N(t)}-\frac{\dot{L}(t)}{L(t)}\right],$$

From the above derivative and from equation (1) it appears that:

$$\dot{u}(t)=(1-u(t))\left(\frac{\dot{N}(t)}{N(t)}-\frac{\dot{L}(t)}{L(t)}\right). \tag{2}$$

In equation (2) it can be assumed that the growth rate of the number of employed $\left(\frac{\dot{L}(t)}{L(t)}\right)$ is a certain, increasing function of the growth rate of production (g). It follows

from this that there is a certain representation (f), such that $\frac{\dot{L}(t)}{L(t)} = f(g)$ and $\frac{df}{dg} > 0$, and this in turn, this allows the increase in the unemployment rate to be described with the following dependence (Majchrowska et al., 2013):

$$\dot{u}(t) = (1 - u(t))\left[\frac{\dot{N}(t)}{N(t)} - f(g)\right]. \tag{3}$$

Analysing equation (3) one can conclude that the increase in the unemployment rate depends on the product growth rate (g), the labour supply growth rate $\left(\frac{\dot{N}(t)}{N(t)}\right)$ and the unemployment rate $(u(t))$. Moreover, the increase in the unemployment rate is a decreasing function of the product growth rate (g), and an increasing function of the labour supply growth rate $\left(\frac{\dot{N}(t)}{N(t)}\right)$. If the growth rate of labour force is higher (lower) than the growth rate of the number of employed, then the increase in the unemployment rate is a decreasing (increasing) function of the unemployment rate.

4.2. Determinants of the increase in unemployment rates in Ukraine-statistical analyses

Based on the above theoretical considerations concerning the development of unemployment rate increments (equation (3)), it is possible to estimate the parameters of the following equation:

$$\Delta u_{it} = \alpha_0 - \alpha_1 u_{it-1} + \alpha_2 d_{\Delta u} u_{it-1} - \alpha_3 \Delta \ln(PKB_{it}) \tag{4}$$

where: $u_{it} = \frac{U_{it}}{U_{it} + L_{it}}$ is the unemployment rate recorded in the *i*-th labour market in year *t*;

$\Delta \ln(PKB_{it})$ is the growth rate of GDP *per capita* in the *i*-th oblast in year *t*;

α_0 – constant measuring the increase in the unemployment rate, which would have occurred at zero unemployment in the previous period and at zero GDP growth rate;

α_1 – variable that determines the strength of the impact of the unemployment rate from the previous period, when this variable does not increase, on the increase in the current unemployment rate;

α_2 – measures the impact of the previous period's unemployment rate on the increase in this variable as the rate rises;

α_3 – describes the dependence of the growth rate of the registered unemployment rate on the GDP growth rate;

$d_{\Delta u}$ – dummy variable, this variable takes the value 1 when the registered unemployment rate rises, 0 otherwise (Dykas et al., 2014).

The interpretation of parameters α_1 and α_2 is dictated, first of all, by the dichotomic variable $d_{\Delta u}$ .This is due to the fact that this variable, in the equation describing the increase in unemployment rates, acts as a switch variable, which corrects the impact of the unemployment rate from the previous period on the change in the current unemployment rate by taking into account whether there has been an increase or decrease in this variable (Dykas et al., 2013).

An analysis of equation (4) shows that with zero GDP growth rate and zero unemployment rate in the previous period, there would be the same increases in unemployment rate in all oblasts. For this reason equation (4) has been extended by introducing fixed effects, resulting in the following equation:

$$\Delta u_{it} = \alpha_0 - \alpha_1 u_{it-1} + \sum_{j=2}^{l} \varphi_j d_j + \alpha_2 d_{\Delta u} u_{it-1} - \alpha_3 \Delta \ln\left(PKB_{it}\right) \tag{5}$$

where by:
d_j is the dummy variable for the *j*-th non-base oblast and *l* is the number of oblasts;
φ_j is a parameter determining how much the increase in current unemployment in the *j*-th non-base oblast would differ from the base oblast, if there were zero unemployment rate in the previous period and zero GDP *per capita* growth rate.

The parameters of equations (4)–(5) were estimated by the least squares method (LS) and generalised method of moments (GMM).The results of these estimates, for Ukraine, Central Ukraine, Northern Ukraine, Southern Ukraine, Western Ukraine, and Eastern Ukraine are summarized in Tables 3 and 4.

Table 3. Estimates of the parameters of growth of unemployment rates at the level of all oblasts of Ukraine and broken down by oblasts of Western, Eastern, Central, Northern and Southern Ukraine in the years 2005–2016

Independent variables	Estimation method			
	LS	LS with FE	GMM	GMM with FE
All Ukrainian oblasts				
u_{it-1}	0.195*** (-9.821)	-0.328*** (-11.305)	0.174*** (-7.776)	-0.270*** (-8.705)
$d_w u_{it-1}$	0.182*** (17.311)	0.179*** (17.439)	0.190*** (11.404)	0.161*** (11.994)
$\Delta \ln Y_{it}$	0.0494*** (-11.357)	-0.0486*** (-11.127)	0.0204*** (-1.291)	-0.0529*** (-4.349)
R^2	0.701	0.749	0.655	0.749
adj. R^2	0.699	0.723	0.652	0.721
Sample	2005–2016		2006–2016	
Number of observations	318		291	
5 oblasts of Central Ukraine				
u_{it-1}	0.278*** (-4.827)	-0.413*** (-5.905)	0.319*** (-3.196)	-0.419*** (-4.142)

$d_w u_{it-1}$	0.212*** (8.045)	0.216*** (8.596)	0.245*** (4.218)	0.221*** (4.803)
$\Delta \ln Y_{it}$	0.0442*** (-3.001)	-0.0399*** (-2.848)	0.0100 (0.136)	-0.0250 (-0.457)
R^2	0.693	0.746	0.599	0.730
adj. R^2	0.677	0.712	0.575	0.690
Sample	2005–2016		2006–2016	
Number of observations	60		55	
5 oblasts of Northern Ukraine				
u_{it-1}	0.170*** (-3.706)	-0.348*** (-3.344)	0.139*** (-2.790)	-0.308*** (-3.468)
$d_w u_{it-1}$	0.187*** (6.231)	0.162*** (5.183)	0.203*** (4.621)	0.150*** (4.070)
$\Delta \ln Y_{it}$	0.0660*** (-3.910)	-0.0640*** (-3.781)	-0.0147 (-0.320)	-0.0552 (-1.519)
R^2	0.647	0.682	0.587	0.691
adj. R^2	0.628	0.640	0.562	0.645
Sample	2005–2016		2006–2016	
Number of observations	60		55	
4 oblasts of Eastern Ukraine				
u_{it-1}	0.0482 (0.817)	0.0434 (0.712)	0.0394 (0.662)	0.0386 (0.623)
$d_w u_{it-1}$	0.0608 (1.743)	0.0560 (1.596)	0.0350 (0.940)	0.0258 (0.624)
$\Delta \ln Y_{it}$	-0.0710*** (-11.202)	-0.0708*** (-10.357)	-0.0753** (-7.123)	-0.0773*** (-6.806)
R^2	0.770	0.774	0.772	0.776
Adj. R^2	0.754	0.741	0.755	0.739
Sample	2005–2016		2006–2016	
Number of observations	48		44	
5 oblasts of Southern Ukraine				
u_{it-1}	-0.178 (-4.449)	-0.413 (-4.957)	-0.149 (-3.192)	-0.324 (-3.333)
$d_w u_{it-1}$	0.178 (7.710)	0.156 (6.552)	0.172 (6.210)	0.155 (6.010)
$\Delta \ln Y_{it}$	-0.0656 (-4.602)	-0.0643 (-4.762)	0.000998 (0.0248)	-0.0153 (-0.498)
R^2	0.683	0.748	0.543	0.669
adj. R^2	0.664	0.710	0.513	0.613
Sample	2005–2016		2006–2016	
Number of observations	54		49	
8 oblasts of Western Ukraine				
u_{it-1}	-0.295*** (-5.551)	-0.464*** (-7.029)	-0.176*** (-2.766)	-0.331*** (-4.195)
$d_w u_{it-1}$	0.159***	0.142***	0.181***	0.154***

	(8.639)	(7.742)	(7.320)	(6.951)
$\Delta \ln Y_{it}$	-0.0292*** (-2.855)	-0.0292*** (-3.010)	0.0168 (0.609)	-0.00823 (-0.366)
R^2	0.685	0.741	0.570	0.691
adj. R^2	0.675	0.711	0.555	0.650
Sample	2005–2016		2006–2016	
Number of observations	96		88	

Table 4. Estimates of parameters of growth of unemployment rates at the level of Eastern and Southern Ukrainian oblasts in the years 2006–2013

4 oblasts of Eastern Ukraine				
u_{it-1}	-0.366*** (-3.142)	-0.371*** (-3.104)	-0.337*** (-2.371)	-0.371*** (-2.571)
$d_w u_{it-1}$	-0.0242*** (-0.649)	-0.0241*** (-0.619)	-0.0409*** (-0.876)	-0.0468*** (-0.975)
$\Delta \ln Y_{it}$	-0.0756*** (-6.837)	-0.0751*** (-6.520)	-0.0787*** (-2.0341)	-0.0740*** (-2.109)
R^2	0.732	0.748	0.739	0.772
adj. R^2	0.707	0.696	0.711	0.718
Sample	2005–2013		2006–2013	
Number of observations	36		32	
5 oblasts of Southern Ukraine				
u_{it-1}	-0.184*** (-3.941)	-0.458*** (-4.413)	-0.147*** (-2.595)	-0.332*** (-2.561)
$d_w u_{it-1}$	0.175*** (5.183)	0.132*** (3.583)	0.167*** (4.279)	0.138*** (3.404)
$\Delta \ln Y_{it}$	-0.0630*** (-3.913)	-0.0642** (-4.201)	0.00482 (0.113)	-0.00996 (-0.277)
R^2	0.631	0.707	0.464	0.588
adj. R^2	0.604	0.651	0.419	0.498
Sample	2005–2013		2006–2013	
Number of observations	45		40	

The values of statistics t-Student are given in paranthesis, R^2 (adj. R^2) is the coefficient of determination (adjusted determination coefficient), *** means statistically significant variables at a level not exceeding 1%, ** means statistically significant variables at a level not exceeding 5%, * means statistically significant variables at a level not exceeding 1%.

Tables 3 and 4 present the estimated parameters of equations (4) and (5) of the increase in unemployment rates in Ukraine as a whole and in division into Central, Northern, Eastern, Southern and Western Ukraine. The study attempts to capture the impact of the Russian-Ukrainian conflict on the determinants of unemployment in the oblasts affected by the conflict. For this reason, two time horizons have been assumed for the Eastern and Southern Ukraine oblasts, the first of which is the years 2005–2016, which period resulted from the availability of relevant statistical data. The second one covers the period before the Russian-Ukrainian conflict, i.e. 2005–2013.From the data presented in tables (1)–(2) the following conclusions can be drawn:

- Throughout Ukraine, the increase in the unemployment rate was explained by the variability of unemployment rates from the previous period and the GDP growth rate with the LS estimation of 7% and 65% with the GMM estimation. Estimates of the parameters of equation (4) show that under conditions of non-growing unemployment, each subsequent decrease in the unemployment level by 1% in the previous period translated into a decrease in the current unemployment rate of about 0.17–0.19 percentage points, while introducing the fixed effects of a decrease in the current unemployment rate throughout Ukraine amounted to about 0.27–0.33 percentage points, depending on the estimation method. On the other hand, in the conditions of growing unemployment, the increase in the unemployment rate in the previous period translated into an increase in this rate by about 0.18–0.19 percentage points. Taking into account the fixed effects, the increase in unemployment from the previous period translated into an increase in the current unemployment rate by about 0.16–0.18 percentage points. A 1% increase in the GDP growth rate throughout Ukraine translated into a decrease in current unemployment of about 0.05 percentage points.
- In Central Ukraine's 5 oblasts, with unemployment rates not rising, each subsequent 1% decrease in the unemployment rate resulted in a decrease in the current level of unemployment, while the decrease differed depending on the estimation method. For LS estimates, it was 0.28 percentage points, whereas when considering GMM estimates, the decrease was 0.27 percentage points. Taking into account the fixed effects, the decrease in the current unemployment rate was about 0.41–0.42 percentage points. In the context of rising unemployment, an increase of one percentage point in the unemployment rate translated into an increase in the current level of unemployment in Central Ukraine oblasts by 0.21–0.25 percentage points regardless of the estimation method. The elasticity of the increase in unemployment rates in relation to the GDP growth rate was about -0.04, which means that the increase in the GDP growth rate by one percentage point translated into a decrease in the unemployment rate by 0.04 percentage point for the parameters estimated by the LS method. The estimated GMM elasticity of unemployment growth in relation to the GDP growth rate turned out to be statistically insignificant. Current unemployment increases were explained by the variability of unemployment rates from the previous year and by GDP growth rates of 67–71% (with LS estimation) and 58–69% (with GMM estimation).

- The variability in the growth rate of the unemployed in Northern Ukraine oblasts was explained by the variability of unemployment rates from the previous period and by GDP growth rates of 56–69%.With unemployment rates not rising, each subsequent 1% increase in the level of unemployment in the previous period translated into a decrease in current unemployment by 0.17 percentage points for parameters estimated by the LS method. After the application of the fixed effects, the decrease was 0.35 percentage points, for the parameters estimated by GMM the decrease was (respectively) 0.14 and 0.31 percentage points. In the case of rising unemployment, the increase in current unemployment caused by a 1% increase in the unemployment rate in Northern Ukraine in the previous period was similar to that in Ukraine as a whole and amounted to approximately 0.2 percentage points. Moreover, the increase in the GDP growth rate in Northern Ukraine oblasts translated into a decrease in the current level of unemployment by about 0.06–0.07 percentage points (for LS estimates), while GMM estimates of this parameter turned out to be statistically insignificant.
- Comparing the estimates of the parameters of equations (4) and (5) for Western Ukraine and other Ukrainian oblasts, it can be concluded that the direction and strength of correlation between the explained variable and the explanatory variables were similar. Moreover, the unemployment rate from the previous period and the GDP growth rate explained the increase in current unemployment in about 68–71% in the estimations of the LS and in 54–67% for GMM estimates. Considering the results of the estimation of Western Ukraine oblasts, it can be seen that in a situation of non-increasing unemployment, each subsequent decrease in the unemployment rate in the previous period translated into an increase in the current unemployment rate by about 0.17–0.30 percentage points. The introduction of fixed effects translated into a greater decrease in the current unemployment rate, a decrease in unemployment by one percentage point translated into a decrease in current unemployment in the range of 0.33–0.46 percentage points. In the conditions of growing unemployment, each increase in unemployment influenced the increase in the unemployment rate by about 0.16–0.18 percentage points, while taking into account the spatial effects, a lower increase in the current unemployment rate could be observed. The parameter describing the elasticity of unemployment growth in relation to the GDP growth rate in case of GMM estimates turned out to be statistically insignificant. However, according to LS estimates, an increase in the GDP growth rate by 1% translated into a decrease in current unemployment by about 0.03 percentage points.
- In the case of Eastern Ukraine, the estimated parameters of equations (4)–(5) for the period 2005–2016, in addition to the parameter reflecting the elasticity of the increase in unemployment relative to the GDP growth rate, proved statistically insignificant. For this reason, the parameters of equations (4)–(5) in the years 2005–2013, i.e. before the Russian-Ukrainian conflict, have been estimated for the Eastern Ukrainian oblasts. Between 2005 and 2013, the volatility of the current unemployment rate was explained by the volatility of the previous period's unemployment rates and a GDP growth rate at 70–72%.Moreover, in this time horizon, with unemployment not growing, the decrease in unemployment by each next percentage point translated into an increase in current unemployment by about 0.34–0.37 percentage points. However, in the conditions of growing unemployment, the increase of this variable by one percentage point translated into a decrease in the current level of unemployment by about

0.02 percentage points (for LS estimates) and 0.04–0.05 percentage points (for GMM estimates).The flexibility of the increase in unemployment rates in relation to the GDP growth rate was negative and amounted to 0.07–0.08, which means that the increase in the GDP growth rate by one percentage point translated into a decrease in the current unemployment rate by about 0.07–0.08 percentage points.

- Due to the fact that in addition to the oblasts of Eastern Ukraine, part of the oblasts of Southern Ukraine were affected by the Russian-Ukrainian conflict, this sample was also divided into two periods. The first maximum range resulting from the availability of statistical data, i.e. 2005–2016 and the pre-conflict period, i.e. 2006-2013. In 2005–2016 in the Southern Ukrainian oblasts – in conditions of non-growing unemployment – each subsequent drop in unemployment in the previous period translated into a decrease in current unemployment by about 0.15–0.18 percentage points without taking into account the fixed effects and by about 0.32–0.41 percentage points taking into account these effects. Similar changes could be observed in the years 2005–2013, i.e. in the years before the conflict. In conditions of growing unemployment, the increase in the unemployment rate in the previous period by 1 percentage point translated into an increase in the current unemployment rate by about 0.16–0.18 percentage points, regardless of the assumed time horizon, without taking into account fixed effects. On the other hand, when introducing the spatial factor by taking into account the fixed effects, a smaller increase in current unemployment could be observed, the increase amounted to 0.13–0.16 percentage points. The parameter determining the elasticity of the current increase in unemployment in relation to the GDP growth rate for GMM estimates, as in the case of Eastern Ukrainian oblasts, proved to be statistically insignificant. According to LS estimates, a 1 percentage point increase in the GDP growth rate translated into a decrease in the current unemployment rate by about 0.063–0.066 percentage points.

5. SUMMARY

The analysis of GDP *per capita*, as well as the unemployment rate, in the period 2004–2016 made it possible to distinguish two turning points for the Ukrainian economy. The first in 2009 caused by the global financial crisis and gas conflict with Russia, and the second in 2014–2015 caused by the Russian-Ukrainian conflict and the annexation of the Autonomous Republic of Crimea. In both cases, we can see a significant deterioration in the state of the economy (a drop in GDP *per capita* and an increase in unemployment). However, when analysing the statistical data, we can see that the implementation of the global external threat, which was the global financial crisis, did not have such an effect on Ukraine's economy as the breach of national security and sovereignty. This resulted in a drastic decrease in the main economic indicators, including a decrease in labour demand and the number of employees, in the most developed oblasts of Ukraine, which contributed to the deterioration of the whole economy and stopped its development (Chugaievska, Tokarski, 2018).

Before the Russian-Ukrainian conflict, Donetsk, Dnipropetrovsk, Kharkiv, Odessa and Kyiv were among the most developed oblasts (in terms of GDP). In turn, the least developed oblasts were those belonging to the group of Western Ukraine, including Chernivtsi and Ternopil, Volyn, Kherson Oblast and the city of Sevastopol in Southern Ukraine. After the

conflict, the first three leaders did not change, but the economic situation in Luhansk oblast deteriorated significantly, and the level of GDP in this oblast decreased to a large extent.

In the vast majority of oblasts with a higher GDP level, a lower unemployment rate was recorded and vice versa, in oblasts with a low GDP level, there was a high unemployment rate (Chugaievska, Tokarski, 2018).

When analysing the impact of changes in the GDP growth rate on the increase in current unemployment, it can be seen that the oblasts classified as Southern Ukraine, Northern Ukraine and Eastern Ukraine reacted to a greater extent to changes on the product side. It can therefore be concluded that these groups of oblasts were more pro-cyclical. In contrast, the Central and Western Ukraine oblasts were less responsive to changes in the product market. This can be explained by the fact that Northern Ukraine is home to the main service centre of Kyiv-Ukraine, bearing in mind also that the global financial crisis spread through networks and had a major impact on financial centres, changes in the GDP side in this oblast had a greater impact on current unemployment. Some oblasts of Southern Ukraine and Eastern Ukraine were affected by the Russian-Ukrainian conflict, which intensified changes on the product side, thus implying higher flexibility of current unemployment in relation to the GDP growth rate compared to the other groups of oblasts.

To sum up, we can see that the Russian-Ukrainian conflict that took place in the oblasts of Eastern and Southern Ukraine led to a crisis in the Ukrainian economy and a decline in its development, mainly due to the fact that it covered oblasts with a high level of GDP *per capita* (e.g. the Donetsk and Luhansk oblasts).

REFERENCES

Chugaievska, N., Tokarski, T. (2018). *Wpływ zmian PKB na przestrzenne zróżnicowanie bezrobocia na Ukrainie*. *"Wiadomości Statystyczne"*, No. 3 (682).

Dykas, P. (2011). *Determinanty przestrzennego zróżnicowania stóp bezrobocia rejestrowanego w województwie podkarpackim*. „*Studia Prawno-Ekonomiczne"* t. LXXXIII.

Dykas, P., Misiak, T. (2014). *Determinanty podstawowych zmiennych rynku pracy w polskich powiatach w latach 2002–2011." Gospodarka Narodowa"*, No. 6/2014.

Dykas, P., Misiak, T., Tokarski, T. (2013). *Czynniki kształtujące regionalne zróżnicowanie stóp bezrobocia rejestrowanego w latach 2002–2010*. „*Humanities and Social Sciences*", Vol. XVIII/1.

Majchrowska, A., Mroczek, K., Tokarski, T. (2013). *Zróżnicowanie stóp bezrobocia rejestrowanego w układzie powiatowym w latach 2002–2011*. „*Gospodarka Narodowa"*, Nr 9/2013.

Tokarski, T. (2005). *Statystyczna analiza regionalnego zróżnicowania wydajności pracy, zatrudnienia i bezrobocia w Polsce,* Warszawa: Wydawnictwo PTE.

Амоша, О.І., Булєєв, І.П., Землянкін, А.І., Збаразська, Л.О., Харазішвілі, Ю.М. (2017). *Промисловість України – 2016: стан та перспективи розвитку*. Київ: НАН України, Ін-т економіки промсті.

Грига, В.Ю. (2013). *Економічна динаміка регіонального розвитку в Україні*. „*Науковий вісник Ужгородського університету"*, No. 4.

„*Економіка регіонів у 2015 році: нові реалії і можливості в умовах започаткованих реформ*" , НІСД, 2015.

"*Інноваційний розвиток промисловості як складова структурної трансформації економіки України*". – К.: НІСД, 2013.

Міхель, Д.О. (2009). *Основні аспекти геополітичного положення України та її зовнішньополітичний вимір*. *Наукові праці [Чорноморського державного університету імені Петра Могили]*. *Сер.: Політологія* (110, Вип. 97).

Офіційний сайт державної служби статистики України. [Access: 1.09.2018]. Access on the internet: http://www.ukrstat.gov.ua

Офіційний сайт міністерства економічного розвитку і торгівлі України. [Access: 1.09.2018]. Access on the internet http://me.gov.ua.

Юрченко, К.Г. *Впливфінансової децентралізації на соціально-економічний розвиток регіонів*. [Access: 1.09.2018]. Аналітична записка. Access on the internet: http://www.niss.gov.ua/articles/2458/

DOI: 10.7862/rz.2019.hss.11

The text was submitted to the editorial office: February 2019.
The text was accepted for publication: June 2019.