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Development Strategies for National Economies After Covid-19 Pandemic

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Abstract: What are the economy sectors will help countries overcome the crisis caused by the COVID-19 pandemic? How countries should rezone their investment strategies to bolster recovery in main economy sectors? Using the Cobb-Douglas model, the importance of agriculture, energy, education, and ICT industries for GDP growth was proven. It was confirmed that agriculture and industry will be key sectors in the post-crisis period for Ukraine, Poland and Austria. During the time of economic uncertainty growth, ICT and e-commerce sectors are principal tools that will sustain the population's well-being.

Keywords: COVID-19, ICT, education, industry, agriculture

1. Introduction

The COVID-19 pandemic had a considerable impact on the development of the digital economy, both the global and the national levels. The process of internalization greatly slowed down, the influence level of globalization processes decreased, which certainly will lead to a strong backlog of some countries from the developed to the technical and innovation and directions. The selected vector of the direct foreign investment direction in developed countries in 2018-2019 will probably not change, which would slow down economic growth in many countries.

The structure of the world economy will change under the influence of external and internal threats to national economies. The governments of most countries will be forced to take into account all components of national security and create conditions to ensure a certain level of employment in their countries. The level of employment will depend on the ability of strategic sectors of the economy and industries which have a high level of

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technical and innovative security to create a national network of enterprises to create the required number of jobs. Governments will have to determine the strategy of supporting industries such as set of tools for economic entities and wide-scale support of SMEs. Taking into account the economic losses of the state in the quarantine period, many questions arise, such as in which areas is the population most involved in, which of them require certain levels of education involved in a particular area, which industries will work on the elements of national security, and which industries can lead the country out of crises.

With the rapidly spreading infection rates all around the world and the introduction of strict quarantine conditions, the level of economic uncertainty had risen sharply. Scientists are increasingly expressing their own opinions on the economic consequences of the pandemic and possible scenarios for the development of national economies in the period and after COVID-19.

The issue of economic uncertainty and its impact on the US national economy has been studied by scientists S. Baker, N. Bloom, S. Davis and S. Terry (2020). The researchers studied the impact of stock market volatility, economic uncertainty and the results of a business survey on economic uncertainty on real US GDP using the GARCH model. It was determined that by the end of the second quarter of 2020, real GDP will decline by 9%, and by the end of 2020 is projected to decline from 11% to 20%.

Scientist N. Fernandes (2020), in his study of the economic effect of COVID-19 on the world economy, considers the dynamics of GDP depending on the scenarios of getting out of the quarantine. Thus, according to the most realistic scenario of resumption of all industries at the end of June, the dynamics of GDP in Austria will be -8.1% compared to the previous year, while Poland will witness a lower reduction – -4.2%. The researcher estimated that with the resumption of all leading industries in 1.5 months after the introduction of quarantine, the loss of real world GDP will be -2.8%, in 3 months – -6.3%, and in case of extension of quarantine to 4.5 months real world GDP – -10.7%.

Australian scientists W. McKibbin and R. Fernando (2020) developed seven scenarios for the development of a pandemic in the world, based on which the economic consequences of COVID-19 were estimated using mathematical modeling. The study used data from 20 countries and identified their economic losses due to the pandemic by estimating losses in six major sectors of the economy, including energy, agriculture, manufacturing and services. On the basis of constructed models, the impact of the pandemic on labor supply in leading industries, business costs, total consumption, governance expenditure and the real GDP was identified. The authors argue that the most likely decline of GDP by the end of 2020 in Austria will be -4.6% to baseline, and in the US losses will be -4.8%. According to scientists, the main driving force of the world economy today is investing in healthcare in both poor and rich countries.

Academic L. Boone (2020) also investigated the loss of GDP as a result of the pandemic. According to the results of his work for European countries, GDP losses will range from -0.2% compared to the baseline level to -1.3%. In the world as a whole, GDP losses will range from -0.5% to -1.5%.

The study of M. Maliszewska, A. Mattoo, D. Mensbrugghe (2020) used indicators of the dynamics of foreign trade expenditures, tourism revenues and declining demand for quarantined services to estimate GDP growth. The results show a likely decline of world GDP by 2%, in developing countries – by 2.5%, and in industrialized countries – by 1.8%. The authors emphasize that it is too early to estimate the real impact of the pandemic on the GDP of countries, as it is unknown how countries will react to the outbreak in the fourth quarter of 2020.

In general, bearing in mind the epidemiological situation and its visible economic consequences, the world needs decisive action in the areas of healthcare and administrative governance. Countries need long-term strategic plans that will respond to any scenario of crisis. Thus, industries such as aviation and tourism, which for some countries are one of the most profitable areas of the economy, have suffered the greatest losses. Significantly reduced incomes in agricultural and manufacturing industries are present as well.

2. Materials and methods

Economic structure of Austria, Poland and Ukraine

Three countries were selected for analysis: Austria, Poland and Ukraine. The choice stemmed from the fact that all three countries are unitary states, have the same structure of the budget system and similar natural resources. At the same time, Austria is an industrial country, Poland lags slightly behind in economic development and in last place among the three – Ukraine. The structure of the economies of the selected countries is given in Table 1.

Ukraine has the largest share of agriculture in the structure of the economy – 12.6%. For comparison, in the global economic structure, agriculture was 4% in 2018. Information and communication sector is developing in Ukraine more than in Austria and Poland. Actually it means that Ukraine lags behind as in Poland and Austria ICT services are more popular. All countries have a significant share of industry, which is comparable to the world level – 27.8%. The biggest share of investment in industry is in Poland (25%), the second place takes Austria (24.7%) and in Ukraine share of investment is also on the similar level (22.1%). All in all, countries have lots of similarities in economies structure and can be analyzed in one research.

In the previous study Cobb-Douglas models was built for Ukraine, Poland and Austria based on data from 2010-2017 and was proved that internet penetration and the number of internet buyers have a significant positive correlation with GDP.

Thus, four main industries are selected for the study: industries of energy, agriculture, education, ICT and e-commerce. It is assumed that in terms of the threat of a pandemic the most popular industries are ICT and e-commerce, agriculture, the sphere of energy, and education. In the context of global crises, these industries provide the basic needs of the state and the population. An analysis and evaluation of these sectors in the structure of national economies, the employment rate in them and the connection of these indicators

with indicators of socio-economic development will prove or refute the above scientific hypothesis.

Table 1. Structure of economy in Ukraine, Poland and Austria

Share of real value added	Ukraine	Poland	Austria
Agriculture, forestry, fishing	12.6%	2.4%	1.3%
Industry including energy	24.7%	25.0%	22.1%
Construction	2.7%	7.7%	6.7%
Trade, repairs, transport, accomm., Food services	24.6%	26.0%	22.6%
Information, communication	4.5%	4.3%	3.6%
Finance and insurance	3.4%	4.2%	4.0%
Real estate	7.2%	4.8%	9.9%
Professional, scientific, support services	4.9%	8.8%	9.8%
Public admin., Defense, education, health, social work	14.1%	14.6%	17.3%

Statistical approach to identify economic effects of COVID-19

Numerous scientific studies present forecasts of the morbidity development in different countries around the world based on the scenarios of population behavior and the reaction of administrative authorities. At the same time, the economic consequences of strict quarantine conditions have already become quite visible.

For industrialized countries, the introduction of quarantine conditions has become another challenge. According to International Labour Organisation data, the industrial production index for European countries in February 2020 was 2.6% lower than in the previous year. Given that quarantine took place in March, economic losses in the industrial sector of the economy will be even lower.

Globalization processes slowed down significantly, which led to the expected decline in global merchandise trade values by 26.9% in the second quarter of 2020 compared to the previous quarter according to data from United Nations Conference of Trade and Development. Moreover, a significant drop in the Free Market Commodity Price Index (FMCPI) is threatening, as for the first time in history the index fell by 20% rapidly.

Numerous supply chain disruptions and rising unemployment around the world threaten agriculture production. About half of agricultural production in developing European countries is at risk due to improper supply chain processes according to data from United Nations Statistical Commission. Based on the fact that approximately 15% of the structure of Ukraine's economy is accounted by agriculture, it is logical to predict significant losses of GDP due to the introduction of quarantine conditions.

It should be noted that the closure of all educational institutions in Ukraine, Poland and Austria is unlikely to have visible economic consequences, but in the long run, the long-term lack of an established education regime will lead to a decline in student skills.

Taking into account the high correlation between the workforce and business success,

it is important to consider the impact of the pandemic on the labor market. Statistical studies from International Labour Organisation show a decrease in working hours in Europe and Central Asia by 3% during the first quarter of 2020, and for the second quarter is projected to decrease by about 12.9%. According to International Labour Organisation data most young workers are employed in agriculture, forestry and fishing (28.9%) and the impact of the pandemic on this sector is estimated as low-medium. Industry has the highest negative correlation with the pandemic, and education has the lowest. Moreover, there is a high risk of unemployment for groups of workers with upper – middle and high incomes, so it is likely that highly qualified staff will be laid off. In European countries, 5 million young workers aged 15-24 (41%) and 28 million people aged 25+ (32%) are at risk of redundancy according to International Labour Organisation data.

Under quarantine, the most popular area was Internet trade. Figure. 1 shows internet penetration for the period from 2000 to 2018. We see that the dynamics of the Internet in all countries coincide with the global trend, but Ukraine is lagging behind. Thus, probably for Ukraine one of the most effective ways to improve the quality of life in a pandemic will be to cover a larger area with the Internet connection.

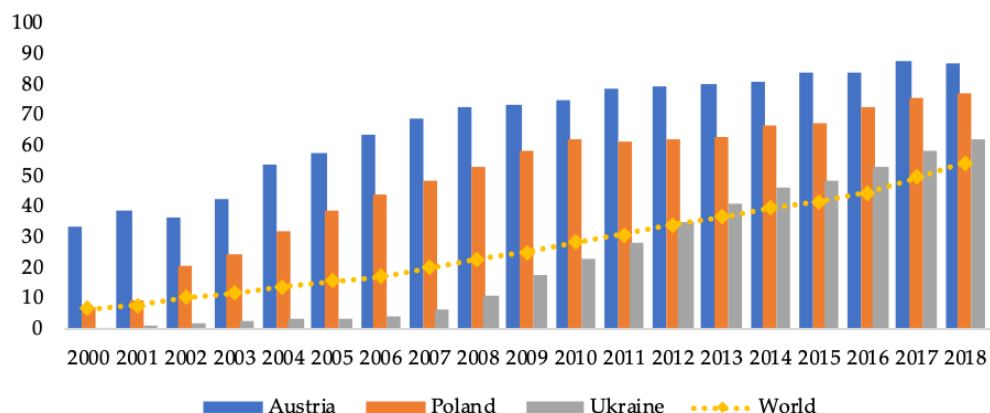


Figure 1. Internet penetration in Ukraine, Poland and Austria according to data from World Bank

To sum up, the COVID-19 pandemic caused difficult economic situations in Ukraine, Poland and Austria. Moreover, Ukraine may have worse social conditions as internet penetration in country is the lowest one.

Methodology

In order to analyze the impact of the four sectors of the economy (industry, agriculture, education, ICT and e-commerce), we decided to use the Cobb-Douglas model. It is assumed that four models will be built for each country, each of which will correspond to the influence of a particular sector of the economy. For each sector of the economy, two

indicators were selected: investment in the industry and the number of people employed in the industry. The model looks like:

$$GDP_i = a \text{ Inv}b1_{ij} \text{ Emp}b2_{ij}, \quad (1)$$

where GDP_i – gross domestic product in country i , a – a stable coefficient that represents the GDP level without investment and employment influence, Inv_{ij} – investments in country i and sector j , Emp_{ij} – employment rate in country i and sector j , $b1$ and $b2$ – coefficients of elasticity of independent variables.

We use logarithm to find the required coefficients of elasticity $b1$ and $b2$ from the linear regression. The regression equation will look like this:

$$\ln(GDP_i) = \ln(a) + b1 \ln(\text{Inv}_{ij}) + b2 \ln(\text{Emp}_{ij}), \quad (2)$$

Thus, solving successive regression equations for each sector of the economy and each country, we find the coefficients of elasticity of independent variables.

Objectives of the study

Based on literature review and on existed trends in Poland, Austrian and Ukrainian economies we try to achieve the main objectives of this study. Our key objectives that we want to achieve are:

- Provide a deep analysis of the impact of Covid-19 pandemic on economies of Poland, Austria and Ukraine,
- Indicate key economy sectors and model their impact on GDP growth,
- Generate models that describe the impact of investment in key economy sectors and employment in it on GDP growth in Poland, Austria and Ukraine.

3. Results

The main purpose of this study was to test the hypothesis that industries such as agriculture, industry including energy, education, ICT and e-commerce are fundamentally important for Ukraine, Poland and Austria in terms of bringing countries out of crisis after quarantine. For the analysis, annual data has been taken from the World Bank for the period from 2000 to 2019 year. By evaluating regression models (2), the impact of investment in a particular industry and the number of employed people in the industry was assessed.

Rows of data that were used to build regression models were tested for stationarity using the ADF-test. The test results confirmed the stationary nature of the selected series. The constructed regression models were tested for autocorrelation using the Broysh-Godfrey test and for heteroskedasticity using the White test. For all models, the hypotheses of autocorrelation and heteroskedasticity were rejected.

Table 2 shows the results of modeling the impact of agriculture on GDP of the three countries and quality models.

Table 2. Results of regressions for the impact of agriculture on GDP in Ukraine, Poland and Austria

	Country	Variables	Coefficients	p-value
Agriculture	Ukraine	ln (a)	14.66	6,99e ⁻⁰⁷
		ln (Inv)	0.43	9,90e ⁻⁰⁶
		ln (Emp)	0.35	0.02
		F-test	23.70	1.21e ⁻⁰⁵
		R ² adj	0.71	
	Poland	ln (a)	28.11	1,18e ⁻¹⁷
		ln (Inv)	0.05	0.09
		ln (Emp)	-0.88	3,55e ⁻¹³
		F-test	82.64	5,08e ⁻¹⁷
		R ² adj	0.98	
	Austria	ln (a)	23.02	0,09
		ln (Inv)	0.19	0.04
		ln (Emp)	-0.39	0.05
		F-test	89.46	9,46e ⁻¹⁰
		R ² adj	0.90	

We can see that the largest coefficients of elasticity are presented for Ukraine. With an increase of investment in agriculture by 1%, the country's GDP grows by 0.43%, and with an increase of employment in the industry by 1%, GDP grows by 0.35%. Significant negative employment elasticity coefficients were obtained for Poland and Austria, which is most likely due to the growing tendency to attract foreign labor. The results for both countries can be interpreted as the independence of GDP from the dynamics of employment in agriculture. For Poland, an additional 1% of investment in agriculture leads to GDP growth of 0.05%, and for Austria – by 0.19%.

After that, the impact of investment and employment in industry including energy on the dynamics of GDP of the three countries was examined. The simulation results are shown in Table 3.

For Ukraine, the coefficient of determination was 0.66, which indicates a moderate relationship between independent factors and GDP. At the same time, the growth of investment in the industry by 1: leads to a growth of GDP by 0.33%, and with the growth of employment in industry including energy by 1%, GDP grows by 0.2%. Similar results were obtained for Poland: an increase of investment by 1% leads to an increase in the country's GDP by 0.54%, and with an increase of employment by 1%, GDP increases by 0.17%. For Austria, the logical coefficient of elasticity of GDP and investment in the industry is 0.46, and for employment the ratio is negative and is -0.35%, which is probably due to the intensification of production, and thus - a decrease in employment in industry including energy does not reduce Austria's GDP.

Table 3. Results of regressions for the impact of industry on GDP in Ukraine, Poland and Austria

	Country	Variables	Coefficients	p-value
Industry	Ukraine	ln (a)	17.83	5.61e ⁻⁰⁸
		ln (Inv)	0.33	2,26e ⁻⁰⁵
		ln (Emp)	0.20	0,06
		F-test	14.55	6,19e ⁻⁰⁴
		R ² adj	0.66	
	Poland	ln (a)	12.83	4.28e ⁻¹³
		ln (Inv)	0.54	7,12e ⁻¹⁵
		ln (Emp)	0.17	0,01
		F-test	54.68	2,45e ⁻¹⁶
		R ² adj	0.98	
	Austria	ln (a)	16.29	0,06
		ln (Inv)	0.46	0.02
		ln (Emp)	-0.35	0.04
		F-test	99.47	2,88e ⁻¹⁰
		R ² adj	0.98	

Table 4 shows the results of modeling the impact of ICT and e-commerce to GDP. The coefficients of elasticity for all countries are positive, which indicates the viability and importance of industries for the studied countries.

Table 4. Results of regressions for the impact of ICT and e-commerce on GDP in Ukraine, Poland and Austria

	Country	Variables	Coefficients	p-value
ICT and e-commerce	Ukraine	ln (a)	24.43	1,47e ⁻¹⁵
		ln (Inv)	0.06	0.15
		ln (Emp)	0.01	0,01
		F-test	4.70	0.02
		R ² adj	0.30	
	Poland	ln (a)	23.20	1,86e ⁻²⁸
		ln (Inv)	0.17	1,77e ⁻¹⁴
		ln (Emp)	0.03	3,81e ⁰³
		F-test	116.16	1,27e ⁻¹⁸
		R ² adj	0.99	
	Austria	ln (a)	24.59	5.41e ⁻¹³
		ln (Inv)	0.06	0.04
		ln (Emp)	0.19	0.16
		F-test	45.59	9.43e ⁻⁰⁶
		R ² adj	0.88	

The growth of investments in ICT and e-commerce by 1% leads to the growth of GDP in Ukraine and Austria by 0.06%, in Poland – by 0.17%. With every 1% growth in employment in ICT and e-commerce, GDP in Ukraine grows by 0.01%, in Poland – by 0.03%, in Austria – by 0.19%. It should be noted that the coefficient of determination for the model in Ukraine is 0.3 and indicates a weak dependence of the studied indicators and the country's GDP. This result is expected, as the ICT and e-commerce industry has started to develop actively recently and probably according to the data until 2019 has no clear impact on Ukraine's GDP.

It was also important to examine the impact of the education sector on countries' GDP, as the learning process has slowed significantly and the quality of students' knowledge during quarantine is likely to suffer, which could lead to negative economic consequences in the future. The simulation results for the education sector are given in Table 5.

Table 5. Results of regressions for the impact of education on GDP in Ukraine, Poland and Austria

	Country	Variables	Coefficients	p-value
Education	Ukraine	ln (a)	22.45	2,88e ⁻⁰⁹
		ln (Inv)	1.12	0.10
		ln (Emp)	0.08	0.07
		F-test	2.02	0.17
		R ² adj	0,52	
	Poland	ln (a)	23.20	1.87e ⁻²⁸
		ln (Inv)	0.17	1.78e ⁻¹⁴
		ln (Emp)	0.03	3,81e ⁻⁰³
		F-test	181.16	1.28e ⁻¹⁸
		R ² adj	0.99	
	Austria	ln (a)	24.53	9.78e ⁻¹²
		ln (Inv)	0.06	0.07
		ln (Emp)	0.21	0.17
		F-test	25.55	1,95e ⁻⁰⁴
		R ² adj	0.82	

Thus, based on regression models of the impact of each of the four main sectors of the economy on the GDP of Ukraine, Poland and Austria, the nature of the relation was quantified and the coefficients of elasticity of investment in the industry and employment in these sectors were found. Given that positive elasticities of investment and GDP are calculated for each country, it can be argued that industries such as agriculture, industry including energy, education, ICT and e-commerce are fundamentally crucial for bringing countries out of crisis after the COVID-19 pandemic.

4. Discussion

Based on the Cobb-Douglas model, the hypothesis that it is necessary to reorient investments in agriculture, industry including energy, education, ICT and e-commerce to statistically bring countries out of the crisis was statistically confirmed. Given the growing number of diseases and the threat of recurrence of quarantine in the autumn, it is important to redistribute investment in such a way as to ensure the functioning of fundamentally important sectors of the economy.

For Ukraine, the most important sector that can support the economic situation and significantly increase GDP is agriculture. In a pandemic, it is important to reorient investment in the industry and create opportunities for the coordinated work of staff employed in this area. In this case, the emphasis should be on foreign economic relations: to choose markets, to establish processes for the supply of goods for export and to agree on agreements with importing countries. It is important to support the industry with investment, as the correlation between investment and the economic situation of the country is significant. An increase of 1% in investment in agriculture allows for a GDP growth of 0.43%. Somewhat less connection has been found between investments in industry, including energy, with the GDP of Ukraine. With every 1% growth in investments in the industry, the GDP increases by 0.33. The impact of education and ICT on Ukraine's GDP is positive, although indirect due to the small amount of investment compared to agriculture and industry. Industries are fundamentally important for the country, because, given the Internet penetration in Ukraine, which is 62% as of 2018, it is difficult to overestimate the severity of the situation during quarantine in areas where communication coverage is minimal. The low level of coverage also reduces the quality of education in some regions, so it is necessary to create conditions for unhindered learning by investing in ICT.

Based on the modeling of the impact of employment in agriculture on the GDP of Poland and Austria, negative coefficients were obtained, so a decrease in the level of employment in the industry does not lead to a fall in GDP. The result can be explained, firstly, by the increasing intensification of production, and secondly, the involvement of foreign workers in the industry. Given that a large number of foreign workers have returned to their countries under quarantine, it is essential for Poland and Austria to distribute investment in such a way that in late summer and early autumn the necessary labor is attracted by national citizens. Similarly, for Austria in the industry sector it is necessary to meet the demand for labor by national workers.

For Poland and Austria, which are provided with 80% Internet coverage, quarantine did not significantly reduce the efficiency of the learning process. Undoubtedly, investment in ICT and education is a necessity for ensuring a smooth learning process, as well as to reduce the level of uncertainty among the population and to continue all work online.

Thus, we can conclude that the pandemic COVID-19 and quarantine have reduced the effectiveness of the leading sectors, but competent investment policy and fast reaction of administrative bodies to the challenges of economic space have the potential to reduce the negative economic consequences for the country.

Given the speed of change in the economic situation of countries, growing economic uncertainty and declining efficiency in most sectors of the economy, it is important to re-analyze the impact of investment in leading industries on economic performance in 2020. The results of such a study will be able to interpret the real impact of investment in quarantine, and thus will form an investment strategy that will meet the demand of major sectors of the economy and gradually bring countries out of crisis.

5. Conclusion

Taking into consideration the rapid growth of economic uncertainty in all countries, it is important to formulate a clear strategy to overcome the crisis caused by the COVID- 19 pandemic. Based on regression modeling, it was confirmed that for Ukraine, Poland and Austria there are four main industries that, with the right distribution of investment, will bring the economies out of crisis.

For all three countries, the importance of investing in industry, including the energy sector, was identified, and the effectiveness of investing in agriculture was confirmed. ICT and e-commerce is also an important sector, as e-commerce is gaining popularity during quarantine and is becoming an integral part of business and the general public. Competent investment policy in the ICT and e-commerce sector will allow countries to improve the quality of life and significantly slow down the growth of uncertainty. The indirect impact of the education sector on countries' GDP has been identified, but the strategic importance of this sector is difficult to overestimate. In the post-crisis period, it is important to involve highly qualified personnel in the technological restructuring of enterprises and the readjustment of economic processes that will meet the new challenges of the pandemic.

According to modelling results, investment flows in national economies will have a tendency to redirect from the financial sector into industrial, agricultural and education sectors. It means that a reassessment of national economic policies and strategic priorities will be essential as well as a focus on national economic security.

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