

THE IMPACT OF INDICATORS OF MACROECONOMIC STABILITY ON THE DESTRUCTIVE MANIFESTATION OF COVID-19 IN UKRAINE

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Abstract: *This article summarizes the arguments and counterarguments in the framework of the scientific discussion on the problem of identifying, using the Granger test, the components of macroeconomic stability of Ukraine most sensitive to the destructive impact of Covid-19. The study's primary goal is to select from among many macroeconomic indicators precisely those that cause epidemiological surges in morbidity and mortality of the population using the example of the Covid-19 pandemic. The systematization of literary sources and approaches to solving the problem of finding determinants that affect the course of the pandemic shows many views among the scientists of the world. Still, they do not establish a single opinion. The study of the topic of identifying the influence of indicators of macroeconomic stability on the destructive impact of the pandemic in work is carried out in the following logical sequence: 1) systematization of literary sources according to the topic of the study; 2) creation of a statistical database that meets the requirements of the chosen methods; 3) bringing the obtained time series to a comparative form and achieving their stationarity; 4) conducting a two-sided test to identify causality. The methodological tools of the research methods were the Dickey-Fuller test for detecting a unit root and stationarity of a series, ways to achieve stationarity of a series using different methods, and a two-sided Granger test for detecting the causality of indicators. The object of the study is Ukraine; the term of the study is the beginning of the pandemic from February 2020 to December 2021. The article presents the results of an empirical analysis of the identification of the components of macroeconomic stability of Ukraine most sensitive to the destructive impact of Covid-19, which showed that such indicators exist and the causal relationship exists in both directions. The study empirically confirms and theoretically proves that the most influential factors are the consumer price index and inflation, which cause the variability of the number of infected and deaths in Ukraine. The study results can help create regional and national patterns of resistance to the destructive impact of the pandemic on macroeconomic stability.*

Keywords: macroeconomic stability, Granger test, Dickey-Fuller test, Covid-19 pandemic, stationarity of the series.

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Introduction

The Covid-19 pandemic changed the world, changed people's attitude toward their health, forced them to discuss the issue of vaccination, focused attention on the concepts of social distance, and overestimated the need for most people in a social environment, which was lacking during the first strict quarantines, etc. However, these issues are related only to the social aspect, and there are changes in political life, cultural and scientific spheres, environmental and educational spheres, financial, budgetary and economic, etc. In every field, many questions can be identified that have been transformed by the pandemic, but no scientist can disperse his research to cover everything that has undergone changes. That is why this study focuses on identifying indicators of macroeconomic stability that affected the destructive manifestation of the Covid-19 pandemic in Ukraine, and vice versa, and how the number of infected and dead affects the country's macroeconomic development.

Literature Review

Among the many scientific works devoted to studying the pandemic and its consequences for the world, a special place is occupied by the direction connecting it with the transformation of macroeconomic indicators and the complication of achieving macroeconomic stability. In particular, (Demiessie, H. G., 2020) investigated how uncertainty in the country changed macroeconomic indicators and levelled macroeconomic stability. The authors (Proaño, C. R., 2020) conclude that the pandemic poses many multifaceted challenges to macroeconomic stability and demonstrates huge disparities between developing and developed economies. Researchers (McKibbin, W., & Fernando, R., 2020) have developed seven possible scenarios for the development of the world economy under the influence of the pandemic; they believe that an effective way to fight can be a significant increase in investments in the health care system of all countries of the world, especially less developed ones. According to the authors (Loayza, N., & Pennings, S., M., 2020), the global economic crisis that arose in connection with the pandemic exceeds the consequences of the financial crisis of 2008 because to contain the spread of the virus; it is necessary to introduce restrictive measures for enterprises, that is precisely why there is an impact of the pandemic on the macroeconomic indicators of every country in the world. However, this influence is differentiated, which is why the results of a similar study for one country will differ for another.

Also, a large number of scientists in their research use the Granger test to confirm hypotheses of the existence of a relationship between indicators. In particular, in the study (Ibragimov, E. A. 2022), (Sharma, G. D., et al., 2021), an algorithm was used to identify the relationship between the country's development and the innovative development of European countries, which changed during the pandemic. Scientists (Zherdetska, L., & Tkach, V., 2021) claim that the modern banking system does not have a positive effect on the sustainable development of the economy; this was confirmed by using the Granger causality test. Other scientists used the Granger method precisely to study the impact on the course of the pandemic and to check how exactly the negative consequences of the pandemic cause the transformation of various spheres of life. In particular, (Godovykh, M. et al. 2021) investigated the impact of the pandemic on the tourism industry and concluded that the media coverage of accurate statistics on the infected with Covid-19 causes changes in attitudes towards tourism. Also, interesting research by the authors (Sharif, A., et al., 2020), (Sahoo, P.K., 2021), (Cepni, O., et al., 2022), (Hong, Y., et al., 2022) found a causal relationship between the impact of the pandemic and the US stock market, the growth of cryptocurrencies, and highlighted the issue of uncertainty regarding Covid-19 and the possibility predict the volatility of the cryptocurrency market. Therefore, in the world scientific community, the study of the manifestation of the impact of the pandemic on the macroeconomic indicators of the development of countries is sufficiently studied even for such a short period of the existence of the pandemic.

However, each study finds different relevant levers for other countries and indicates a differentiated course of the pandemic and the same impact. Therefore, the purpose of this study is to select from among a large number of macroeconomic indicators precisely those that cause epidemiological spikes in morbidity and mortality of the population using the example of the Covid-19 pandemic in Ukraine.

Methodology and research methods

Step 1. Creation of a statistical research base

To conduct a study to identify the components of the macroeconomic stability of Ukraine most sensitive to the destructive impact of COVID-19, a statistical base of indicators was created: on the one hand, ten macroeconomic indicators - the consumer price index, export of goods, import of goods, the size of the general population, the index of actual industrial production, animal husbandry, retail turnover of retail and restaurant enterprises, the official exchange rate of the US dollar and the euro; on the other hand, indicators of the number of people infected with Covid-19 and the number of official deaths caused by Covid-19. All data are monthly from January 2020 to December 2021. The information base of the research was the websites of NABU, the State Statistics Service and the National Security Council of Ukraine. A preliminary analysis of the time series used for the study shows that most of them are not stationary. Therefore, for such indicators as the consumer price index, export of goods, import of goods, the size of the existing population, retail turnover of retail trade and restaurant enterprises, and the official exchange rate of the US dollar and the euro, we will find the increase for the month by subtracting the corresponding previous value from the level of the series. As a result, the time series length was reduced from 24 to 23.

Step 2. Stationary check

A necessary condition for applying the Granger test to identify causal relationships is the stationarity of the time series. The previous step made it possible to approach the studied series to stationarity. Still, for confidence, the Dickey-Fuller test was applied, which will help to detect the presence of a single root in the autoregression. To perform the Dickey-Fuller test to check the stationarity of the series, the EViews 12 software product was used, namely, the unit root calculation tool, taking into account the nature of the series, namely the presence of a trend or fluctuations around a constant. Using this toolkit, graphs of data dynamics (Fig. 1) and testing of the null hypothesis regarding the presence of a unit root (Fig. 2) were constructed for each time series.

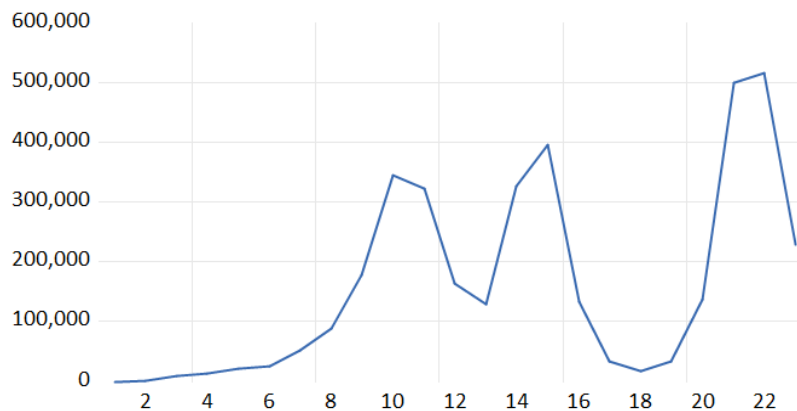


Figure 1. Dynamics of changes in the indicator “number of infected persons with the Covid-19 coronavirus infection” per month

Source: compiled by authors.

Null Hypothesis: COV_INF has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 1 (Automatic - based on SIC, maxlag=2)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.358360	0.0125
Test critical values:		
1% level	-4.467895	
5% level	-3.644963	
10% level	-3.261452	

*Mackinnon (1996) one-sided p-values.

Figure 2. Results of the Dickey-Fuller test for the indicator “number of infected persons with the Covid-19 coronavirus infection”

Source: compiled by authors.

The analysis of the results makes it possible to conclude that the time series reflecting the increase in the number of new patients with Covid-19 in Ukraine has an increasing trend and some cyclicity, which was taken into account when performing the Dickey-Fuller test. The analysis of Figure 2 makes it possible to conclude that the studied time series is stationary because the value of $p=0.0125$, is less than the critical value of 0.05. In this way, all studied time series were checked; the result is shown in Table 1.

Table 1. Results of testing time series for stationarity

Indicator	p	Conclusion	Indicator	p	Conclusion
The number of people infected with Covid-19	0.0125	stationary	Index of real industrial production	0.0868	non-stationary
The number of people who died from Covid-19	0.0016	stationary	Retail turnover of enterprises of retail trade and restaurant business	0.0000	stationary
Consumer price index	0.0000	stationary	The size of the existing population	0.0001	stationary
Core inflation	0.0000	stationary	The official exchange rate of dollar	0.0000	stationary
Export of goods	0.0007	stationary	Official exchange rate of euro	0.0001	stationary
Import of goods	0.0077	stationary	Livestock index	0.3399	non-stationary

Source: compiled by authors.

Therefore, the analysis of the table of the results of the time series test for stationarity using the Dickey-Fuller test makes it possible to identify two non-stationary series of the livestock index and the index of real industrial production, which in this form cannot be used in the next stage of the study. Therefore, for both indicators, the method of differences and a repeated check for stationarity will be applied. As a result of these actions, stationarity was achieved.

Step 3. Identification of causal relationships

To check which macroeconomic indicators of Ukraine have become most sensitive to the destructive impact of Covid-19, namely the change in the rate of spread of the coronavirus across the country or the number of deaths, the Granger causality test was applied. Its essence is that when constructing the first regression dependence, in which the dependent variable is a certain macroeconomic indicator, and the independent variables are the lags of the indicator responsible for the impact of Covid-19, and the second regression model, in which the roles of the dependent and independent variables change.

The EViews 12 software product, namely the group statistics tool for different lag values, was used to conduct the Granger test. By sorting through different pairs of variables: on the one hand, 2 indicators of the destructive

impact of Covid-19, on the other hand, 10 indicators of the macroeconomic development of Ukraine, the Granger test was conducted 80 times, because the application of the test with different number of lags has different results. It was revealed which pairs of variables are causally connected. The results of the conducted test are presented for the pair of variables “Number of infected persons with Covid-19 - Import of goods” in Figure 3.

So, the analysis of the obtained results shows, namely, the largest value of the Fisher test and the p-value is less than the critical value (0.05) only in the case of a lag equal to 4. That is, the number of people infected with Covid-19 is the reason for the variability of the volume of imports of goods in Ukraine.

Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
I does not Granger Cause COV_INF	21	2.28193	0.1343
COV_INF does not Granger Cause I		3.30895	0.0627
Lags: 3			
Null Hypothesis:	Obs	F-Statistic	Prob.
COV_INF does not Granger Cause I	20	2.80430	0.0814
I does not Granger Cause COV_INF		1.34790	0.3019
Lags: 4			
Null Hypothesis:	Obs	F-Statistic	Prob.
COV_INF does not Granger Cause I	19	3.57668	0.0465
I does not Granger Cause COV_INF		1.37282	0.3108
Lags: 5			
Null Hypothesis:	Obs	F-Statistic	Prob.
COV_INF does not Granger Cause I	18	2.35220	0.1477
I does not Granger Cause COV_INF		1.21419	0.3926

Figure 3. Results of the Granger test for the pair of variables “Number of infected persons with Covid-19 - Import of goods”

Source: compiled by authors.

Results

As a result of conducting a similar algorithm with each pair of indicators of macroeconomic stability on the one hand, and the result of the destructive impact of the pandemic on the other hand, for the number of lags 2,3,4,5, the results presented in Table 2 were obtained.

Table 2. Results of applying the Granger test

Variables	Result*	Variables	Result*
Number of infected - Import of goods	+(4)	Import of goods - Number of infected	-
Number of infected people - Consumer Price Index	-	Consumer price index - Number of infected	+(2,3,4)
The number of infected - Inflation	-	Inflation - Number of infected people	-
Number of infected - Export of goods	-	Export of goods - Number of infected	-
The number of infected - Livestock index	-	Livestock index - Number of infected	-
The number of infected people - Euro exchange rate	-	Euro exchange rate - Number of infected people	-
The number of infected people - Dollar exchange rate	-	Dollar exchange rate - Number of infected people	-
Number of infected people - Population	+(2,3)	Population - Number of infected people	-
The number of infected people - Retail turnover	-	Retail turnover - Number of infected	-
Number of infected - Production index	-	Production index - Number of infected	-

Table 2 (cont.). Results of applying the Granger test

Variables	Result*	Variables	Result*
Number of people who died - Import of goods	+(2,3,4)	Import of goods - Number of people who died	-
Number of people who died - Consumer Price Index	-	Consumer price index - Number of people who died	+(3,4,5)
The number of people who died - Inflation	+(5)	Inflation - Number of people who died	+ (3)
Number of people who died - Export of goods	-	Export of goods - Number of people who died	-
The number of people who died - Livestock index	-	Livestock index - Number of people who died	-
The number of people who died - Euro exchange rate	-	Euro exchange rate - Number of people who died	-
Number of people who died - Dollar exchange rate	+(5)	Dollar exchange rate - Number of people who died	-
The number of people who died - Population	+(2)	Population - Number of people who died	-
The number of people who died - Retail turnover	-	Retail turnover - Number of people who died	-
The number of people who died - Index of production		Production index - Number of people who died	

Notes: * «->» - no causal relationship was found; "+" - there is a causal connection, and it is indicated at what number of lags it was detected.

Source: compiled by authors.

Therefore, the study of causality among all twenty pairs indicates the absence of a causal relationship in both directions among the following variables: the number of people infected with Covid-19 in Ukraine is the cause of the variability of inflation, the volume of exports, the livestock index, the official exchange rates of the euro and the dollar, the importance of retail turnover, the index of actual industrial production, and vice versa; the number of people who died due to Covid-19 in Ukraine affected the volume of exports, the livestock index, the official exchange rate of the euro, the importance of retail turnover, the index of actual industrial production, and vice versa. However, a couple of indicators were found that became the causes of the destructive effect of the pandemic: the consumer price index is the cause of the variability of the number of infected people and the number of people who died from the coronavirus according to the Granger test, it turned out that inflation is the cause of the variability of the number of people who died. That is, the real incomes of the population and the purchasing power of the citizens of Ukraine directly affect the protection against harmful diseases and the ability of the people to take care of themselves.

In addition, a reverse causality was found according to the Granger test; that is, the speed of the spread of the disease directly affects the import of goods into the country and the population, and the number of deaths causes different variability in the import of goods, inflation, the change in the official dollar exchange rate and the population. Regarding the impact on the population, this, unfortunately, is logical because, in the first place, many people die because of Covid-19. However, sharp increases in morbidity cause the introduction of quarantine restrictions, which negatively affects many macroeconomic indicators. Closure due to a total lockdown of enterprises reduces imports, devalues the national currency, and as a result, increases inflation in the country.

Conclusions

Thus, the identified macroeconomic indicators that will cause the destructive manifestation of COVID-19 in Ukraine to indicate that the most important factors are the consumer price index and inflation, which cause variability in the number of infected and the number of deaths. Therefore, we believe that there is a need for the state to carry out medical reform so that the population does not depend on the level of prices and inflation when receiving quality medical services and necessary medicines. On the other hand, the destructive effects of the pandemic are causing transformation at the macroeconomic level. In particular, the exchange rate of foreign currencies and the import of goods. The study results can help create regional and national patterns of resistance to the destructive impact of the pandemic on macroeconomic stability.

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