

## **INVESTIGATION OF CAUSALITY OF FORMATION OF DEPOSIT RESOURCES OF INDIVIDUALS IN UKRAINE**

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**Introduction.** The dynamic development of Ukraine's economy largely depends on the efficiency of the banking system, one of the main sources of which serve the deposits of individuals. So, for the last time more and more attention of researchers attracts domestic issues of efficient system which would ensure adjusted cash flow from depositors to the banking institutions of the country and could provide real economy by investment resources. Deposit insurance system, which operates in Ukraine, was created to protect the rights and interests of depositors, strengthening confidence in the banking system of Ukraine, establishing incentives to attract funds into the banking system of Ukraine. The main problem in this aspect of research raises the possibility of attracting sufficient volume of deposits of individuals in banking institutions in our country and identify causes which influence on amount of deposit resources of the country attracted from individuals.

Among recent works concerning this issue should be highlighted work of Zvonova E. [1], Kozmenko S., Savchenko T. [2], Orlova O., Kozhukhov D. [3], Tkachenko N. [4]. However, the current research does not affect manifestation of effects of various factors on the volume of deposit resources of individuals in Ukrainians banks.

The purpose of this article is to study the relationships and interdependencies between indicators of deposits of individuals and deposits of individuals per capita and indicators of social and economic development of Ukraine and the level of development of the banking system of our country.

In econometrics most popular concept of causality is causality by Granger [5]. The basis of determining causality is well known postulate that the future cannot influence the past. This postulate Granger considered in the information aspect in order to determine can variable  $x$  be the reason of variable  $y$ , should find out how

much of the dispersion in the current value of the variable  $y$  can be explained by past values of the variable  $y$  and whether adding past values of variable  $x$  improve this explanation. The variable  $x$  is called the cause of  $y$  if  $x$  helps in the prediction  $y$  in terms of reducing the dispersion.

We examine Granger causality for two variables – the amount of deposits of individuals and the amount of deposits of individuals per capita. The following form of our model looks:

$$x_t = \sum_{j=1}^p a_j x_{t-j} + \sum_{j=1}^p b_j y_{t-j} + \varepsilon_t, \quad (1)$$

$$y_t = \sum_{j=1}^p c_j x_{t-j} + \sum_{j=1}^p d_j y_{t-j} + \xi_t. \quad (2)$$

The absence of a causal link from  $x$  to  $y$  means that  $c_j = 0$  for  $j = 1, \dots, p$ , i.e. the last value of  $x$  don't influence on  $y$ . The absence of a causal link from  $y$  to  $x$  means that  $b_j = 0$  for  $j = 1, \dots, p$ .

Thus, if  $x$  is the cause of  $y$ , the lag' coefficients of  $x$  in the equation (2) should be significant. If this condition is satisfied only in one direction, then say that  $x$  is causative by Granger for  $y$  or that there is a one-way causality from  $x$  to  $y$ . On the other hand, if  $y$  is the reason of  $x$ , than lag' coefficients  $y$  in equation (1) should be significant. If the lag' coefficients are significant in both cases, then talk about two-way causality or feedback. If none of the sets of lag' coefficients were not statistically significant and then we say that  $x$  and  $y$  are independent.

When the process is stationary, then the hypothesis of a causal connection can be checked by using the F-statistics. The null hypothesis is that one variable is not causative by Granger for another variable. The length of the lag should be chosen based on the most remote lag that can still help in forecasting.

In our research the identifying of Granger causality may indicate the impact of chosen factors on the level of deposits of individuals.

As a prerequisite for Granger causality studies have investigated stationary series, we must check its performance.

Research of the stationarity we fulfil with the help of Augmented Dickey-Fuller Test and Phillips-Perron Test [6].

In the Augmented Dickey-Fuller Test a zero (alternative) hypothesis is the fact that time series are non-stationary (stationary) and can be described by one of three models:

$$\Delta x_t = \varphi x_{t-1} + \alpha + \beta t + \sum_{j=1}^{p-1} \theta_j \Delta x_{t-j} + \varepsilon_t, \quad t = p+1, \dots, T, \quad (3)$$

$$\Delta x_t = \varphi x_{t-1} + \alpha + \sum_{j=1}^{p-1} \theta_j \Delta x_{t-j} + \varepsilon_t, \quad t = p+1, \dots, T, \quad (4)$$

$$\Delta x_t = \varphi x_{t-1} + \sum_{j=1}^{p-1} \theta_j \Delta x_{t-j} + \varepsilon_t, \quad t = p+1, \dots, T, \quad (5)$$

$\varepsilon_t$  – normally distributed independent random variables with zero mathematical expectation;

$\varphi, \alpha$  i  $\beta$  – valued parameters.

An implementation of the basic hypothesis is checked by using statistics for the first regression model that includes free term and temporary linear trend.

Implementation of basic hypothesis is checked by using statistics for the second regression model that includes free term.

Implementation of basic hypothesis is checked by using statistics for the third regression model (without free term and temporary linear trend).

Parameters of the model are estimated by the least squares method  $\varphi, \alpha, \beta$  and calculated value of  $t$ -statistics  $t_\varphi$  to test the null hypothesis  $\varphi=0$ . The resulting value is compared to a critical level  $t$ . The hypothesis of non-stationarity of time series is rejected if  $t_\varphi < t$ .

In the Phillips-Perron Test (*PP*-test) testing the null hypothesis of non-stationarity of time series  $x_t$  s reduced to hypothesis testing  $\varphi=0$  based on statistical model:

$$\Delta x_t = \varphi x_{t-1} + \alpha + \beta t + u_t, \quad t = 2, \dots, T, \quad (6)$$

$\alpha, \beta$  – model parameters, which can be 0;

$E|u_t|^\delta \leq C < \infty$ , for  $\delta > 2$  – mathematical expectation of a random variable  $u_t$ .

Unlike Augmented Dickey-Fuller Test, random components  $u_t$  can be autocorrelate, have different dispersions and do not necessarily conform to the normal distribution. *PP*- test on  $t$ -statistic, adjusted for possible autocorrelation and heteroskedasticity of time series  $u_t$ .

Applying these tests to the investigated time series made it possible to draw conclusions on their stationarity (Table 1).

Table 1 – Results of the research stationarity volume of deposits of individuals and factors that may affect them

Indicator	ADF H0: I(1)			PP H0: I(1)			Conclusion
	<i>N</i>	<i>C</i>	<i>T,C</i>	<i>N</i>	<i>C</i>	<i>T,C</i>	
Deposits of individuals, million UAH	3,345	-0,189	-3,540**	2,966	-0,189	-2,785	I(1)
1 % level of significance	-2,615	-3,578	-4,176	-2,615	-3,578	-4,166	
5 % level of significance	-1,948	-2,925	-3,513	-1,948	-2,925	-3,509	
10 % level of significance	-1,612	-2,601	-3,187	-1,612	-2,601	-3,184	
Deposits of individuals per capita, UAH	1,727	0,256	-3,524**	4,173	0,323	-3,011	I(1)
1 % level of significance	-2,617	-3,578	-4,176	-2,615	-3,578	-4,166	
5 % level of significance	-1,948	-2,925	-3,513	-1,948	-2,925	-3,509	
10 % level of significance	-1,612	-2,601	-3,187	-1,612	-2,601	-3,184	
Population of Ukraine, persons	-2,114**	0,607	-1,403	-2,153**	0,813	-1,403	I(1)
1 % level of significance	-2,615	-3,578	-4,166	-2,615	-3,578	-4,166	
5 % level of significance	-1,948	-2,925	-3,509	-1,948	-2,925	-3,509	
10 % level of significance	-1,612	-2,601	-3,184	-1,612	-2,601	-3,184	
GDP at current prices, million UAH	1,865	-0,456	-4,381***	3,564	-0,102	-8,464***	I(1)
1 % level of significance	-2,621	-3,616	-4,212	-2,615	-3,578	-4,166	
5 % level of significance	-1,949	-2,941	-3,530	-1,948	-2,925	-3,509	
10 % level of significance	-1,612	-2,609	-3,196	-1,612	-2,601	-3,184	
GDP per capita, UAH	2,133	0,024	-4,752***	3,605	0,234	-6,469	I(1)
1 % level of significance	-2,621	-3,616	-4,212	-2,615	-3,578	-4,166	
5 % level of significance	-1,949	-2,941	-3,530	-1,948	-2,925	-3,509	
10 % level of significance	-1,612	-2,609	-3,196	-1,612	-2,601	-3,184	
Population income, million UAH	-3,026***	-2,852*	0,206	1,806	-0,770	-5,874***	I(1)
1 % level of significance	-2,625	-3,610	-4,212	-2,615	-3,578	-4,166	
5 % level of significance	-1,950	-2,939	-3,530	-1,948	-2,925	-3,509	
10 % level of significance	-1,612	-2,608	-3,196	-1,612	-2,601	-3,184	

Income per capita, UAH	-2,169**	-2,263	-0,434	2,286	-0,459	-6,262	I(1)
1 % level of significance	-2,626	-3,610	-4,212	-2,615	-3,578	-4,166	
5 % level of significance	-1,950	-2,939	-3,530	-1,948	-2,925	-3,509	
10 % level of significance	-1,612	-2,608	-3,196	-1,612	-2,601	-3,184	
Personal expenditures, million UAH	-0,520	-1,457	-2,636	2,126	-0,532	-5,211***	I(1)
1 % level of significance	-2,621	-3,597	-4,186	-2,615	-3,578	-4,166	
5 % level of significance	-1,949	-2,933	-3,518	-1,948	-2,925	-3,509	
10 % level of significance	-1,612	-2,605	-3,190	-1,612	-2,601	-3,184	
Spending per capita, UAH	-0,760	-0,751	-3,130	2,769	-0,125	-5,529***	I(1)
1 % level of significance	-2,620	-3,601	-4,186	-2,615	-3,578	-4,166	
5 % level of significance	-1,949	-2,935	-3,518	-1,948	-2,925	-3,509	
10 % level of significance	-1,612	-2,306	-3,190	-1,612	-2,601	-3,184	
Consumer price index (CPI), %	0,350	-5,477***	-5,474***	0,264	-5,488***	-5,474***	I(0)
1 % level of significance	-2,619	-3,578	-4,166	-2,615	-3,578	-4,166	
5 % level of significance	-1,950	-2,925	-3,509	-1,948	-2,925	-3,509	
10 % level of significance	-1,612	-2,601	-3,184	-1,612	-2,601	-3,184	
Economically active population, thousand persons	-1,001	-0,233	-1,302	-1,130	0,098	-1,236	I(1)
1 % level of significance	-2,615	-3,578	-4,166	-2,615	-3,578	-4,166	
5 % level of significance	-1,948	-2,925	-3,509	-1,948	-2,925	-3,509	
10 % level of significance	-1,612	-2,601	-3,184	-1,612	-2,601	-3,184	
Number of banks with banking license	0,440	-1,570	0,026	0,440	-1,600	-0,246	I(1)
1 % level of significance	-2,615	-3,578	-4,166	-2,615	-3,578	-4,166	
5 % level of significance	-1,948	-2,925	-3,509	-1,948	-2,925	-3,509	
10 % level of significance	-1,612	-2,601	-3,184	-1,612	-2,601	-3,184	
Assets of banks, million UAH	2,424	-0,816	-0,973	1,675	-0,825	-1,324	I(1)
1 % level of significance	-2,615	-3,578	-4,166	-2,615	-3,578	-4,166	
5 % level of significance	-1,948	-2,925	-3,509	-1,948	-2,925	-3,509	
10 % level of significance	-1,612	-2,601	-3,184	-1,612	-2,601	-3,184	
Net income / loss of banks, million UAH	-2,702***	-2,672*	-2,616	-2,737***	-2,709*	-2,654	I(1)
1 % level of significance	-2,615	-3,578	-4,166	-2,615	-3,578	-4,166	
5 % level of significance	-1,948	-2,925	-3,509	-1,948	-2,925	-3,509	
10 % level of significance	-1,612	-2,601	-3,184	-1,612	-2,601	-3,184	
The guaranteed amount, UAH	0,968	-0,510	-2,479	1,037	-0,437	-2,479	I(1)
1 % level of significance	-2,615	-3,578	-4,166	-2,615	-3,578	-4,166	
5 % level of significance	-1,948	-2,925	-3,509	-1,948	-2,925	-3,509	
10 % level of significance	-1,612	-2,601	-3,184	-1,612	-2,601	-3,184	

Legend:

\*\*\* – deviation H(0) at the 1 % level of significance

\*\* – deviation H(0) at the 5 % level of significance

\* – deviation H(0) at the 10 % level of significance

As we can see, on the basis of tests, we cannot reject the hypothesis of non-stationarity I(1) of all indicators except CPI.

As a prerequisite for using Granger test is investigated stationary series, we bring them to a stationary species. For doing this, we pass a number of levels to their first differences and check them for stationarity [7, 8].

The calculation of the first difference time series conducted using the following formula:

$$\Delta x_t = x_t - x_{t-1}, \quad t = 2, \dots, T. \quad (7)$$

The resulting time series of first differences we checked for stationarity with the help of above tests.

Table 2 – Results of the research stationarity of first differences of volume of deposits of individuals and factors that may affect them

Indicator in first differences	ADF H0: I(1)			PP H0: I(1)			Conclusion
	<i>N</i>	<i>C</i>	<i>T,C</i>	<i>N</i>	<i>C</i>	<i>T,C</i>	
Deposits of individuals, million UAH	-2,369**	-7,271***	-7,147***	-5,644***	-7,241***	-7,147***	I(0)
1 % level of significance	-2,617	-3,581	-4,171	-2,616	-3,581	-4,171	
5 % level of significance	-1,948	-2,927	-3,511	-1,948	-2,927	-3,511	
10 % level of significance	-1,612	-2,601	-3,186	-1,612	-2,601	-3,186	
Deposits of individuals per capita, UAH	-2,201**	-8,362***	-8,350***	-6,049***	-8,362***	-8,350***	I(0)
1 % level of significance	-2,617	-3,581	-4,171	-2,616	-3,581	-4,171	
5 % level of significance	-1,948	-2,927	-3,511	-1,948	-2,927	-3,511	
10 % level of significance	-1,612	-2,601	-3,186	-1,612	-2,601	-3,186	
Population of Ukraine, persons	-6,365***	-6,904***	-7,061***	-6,364***	-6,904***	-7,061***	I(0)
1 % level of significance	-2,616	-3,581	-4,171	-2,616	-3,581	-4,171	
5 % level of significance	-1,948	-2,927	-3,511	-1,948	-2,927	-3,511	
10 % level of significance	-1,612	-2,601	-3,186	-1,612	-2,601	-3,186	
GDP at current prices, million UAH	-1,701*	-3,118**	-3,064	-7,095***	-15,270***	-15,181***	I(0)
1 % level of significance	-2,621	-3,616	-4,219	-2,616	-3,581	-4,171	
5 % level of significance	-1,949	-2,941	-3,533	-1,948	-2,927	-3,511	
10 % level of significance	-1,612	-2,609	-3,198	-1,612	-2,601	-3,186	
GDP per capita, UAH	-1,451	-3,758***	-3,710**	-6,817***	-11,432***	-11,696***	I(0)
1 % level of significance	-2,621	-3,621	-4,227	-2,616	-3,581	-4,171	
5 % level of significance	-1,949	-2,943	-3,537	-1,948	-2,927	-3,511	
10 % level of significance	-1,612	-2,610	-3,200	-1,612	-2,601	-3,186	
Population income, million UAH	-0,921	0,596	1,459	-8,897**	-16,039***	-15,721**	I(0)
1 % level of significance	-2,629	-3,610	-4,211	-2,616	-3,581	-4,171	
5 % level of significance	-1,950	-2,939	-3,530	-1,948	-2,927	-3,511	
10 % level of significance	-1,611	-2,608	-3,196	-1,612	-2,601	-3,186	
Income per capita, UAH	-0,635	-0,445	0,430	-8,758***	-20,375***	-20,376***	I(0)
1 % level of significance	-2,626	-3,610	-4,211	-2,616	-3,581	-4,171	
5 % level of significance	-1,950	-2,939	-3,530	-1,948	-2,927	-3,511	
10 % level of significance	-1,612	-2,608	-3,196	-1,612	-2,601	-3,186	
Personal expenditures, million UAH	-1,230	-1,466	-1,123	-10,161***	-18,764***	-18,417***	I(0)
1 % level of significance	-2,621	-3,597	-4,192	-2,616	-3,581	-4,171	
5 % level of significance	-1,949	-2,933	-3,521	-1,948	-2,927	-3,511	
10 % level of significance	-1,612	-2,605	-3,191	-1,612	-2,601	-3,186	
Spending per capita, UAH	-0,913	-2,842*	-2,493	-9,836***	-19,187***	-20,305***	I(0)
1 % level of significance	-2,620	-3,601	-4,199	-2,616	-3,581	-4,171	
5 % level of significance	-1,949	-2,935	-3,524	-1,948	-2,927	-3,511	
10 % level of significance	-1,612	-2,606	-3,193	-1,612	-2,601	-3,186	
Economically active population, thousand persons	-6,468***	-6,560***	-0,398	-6,473***	-6,622***	-8,374	I(0)
1 % level of significance	-2,616	-3,581	-4,186	-2,616	-3,581	-4,171	
5 % level of significance	-1,948	-2,927	-3,518	-1,948	-2,927	-3,511	
10 % level of significance	-1,612	-2,601	-3,190	-1,612	-2,601	-3,186	
Number of banks with banking license	-4,924***	-4,869***	-5,271***	-4,985***	-4,928***	-5,198	I(0)
1 % level of significance	-2,616	-3,581	-4,171	-2,616	-3,581	-4,171	
5 % level of significance	-1,948	-2,927	-3,511	-1,948	-2,927	-3,511	
10 % level of significance	-1,612	-2,601	-3,186	-1,612	-2,601	-3,186	
Assets of banks, million UAH	-5,021***	-6,086***	-6,069***	-5,303***	-6,131***	-6,109***	I(0)
1 % level of significance	-2,616	-3,581	-4,171	-2,616	-3,581	-4,171	
5 % level of significance	-1,948	-2,927	-3,511	-1,948	-2,927	-3,511	
10 % level of significance	-1,612	-2,601	-3,186	-1,612	-2,601	-3,186	
Net income / loss of banks, million	-7,379***	-7,299***	-7,233***	-7,766***	-7,665***	-7,606***	I(0)



$\Delta(\text{net\_profit})$	-	-	-	←***	←**	←*	←**	-	-
$\Delta(\text{number\_of\_banks})$	-	-	-	-	-	←*	←*	-	-
$\Delta(\text{population})$	←**	←**	→***	→***	←***	←**	←*	←*	-
$\Delta(\text{spendings})$	→*** ←*	→* ←**	→* ←**	→* ←*	→* ←***	←***	→* ←***	→* ←**	←**
$\Delta(\text{spendings\_per\_capita})$	→**	→* ←**	→* ←**	→* ←**	→* ←***	→* ←***	→* ←***	→** ←**	→* ←**

Legend:  
→\*\*\* – deviation H(0) for  $x \rightarrow y$  at the 1 % level of significance  
→\*\* – deviation H(0) for  $x \rightarrow y$  at the 5 % level of significance  
→\* – deviation H(0) for  $x \rightarrow y$  at the 10 % level of significance  
←\*\*\* – deviation H(0) for  $y \rightarrow x$  at the 1 % level of significance  
←\*\* – deviation H(0) for  $y \rightarrow x$  at the 5 % level of significance  
←\* – deviation H(0) for  $y \rightarrow x$  at the 10 % level of significance  
-- lack of causal connection type  $x \rightarrow y$  and  $y \rightarrow x$  (adoption H(0))

Table 4 – Research on the Granger causality rate for deposits of individuals per capita (in first differences)

Indicator	Lag	1	2	3	4	5	6	7	8	9
	$\Delta(\text{assets})$		-	→*	→**	-	-	-	-	-
cpi		-	-	-	-	-	-	-	-	-
$\Delta(\text{economically\_active\_popu})$		→** ←*	←***	←***	←***	←***	←***	←***	←**	←**
$\Delta(\text{gdp})$		→*	←***	←* →*	-	-	-	→*	→**	-
$\Delta(\text{gdp\_per\_capita})$		→*	←***	→*	-	-	-	→*	→**	-
$\Delta(\text{guaranted\_amount})$		→*	-	→*	→*	-	-	-	-	-
$\Delta(\text{income})$		→**	→* ←**	←*	→*	←*	-	-	←*	-
$\Delta(\text{income\_per\_capita})$		→**	→* ←**	←***	→* ←*	←**	←*	-	←**	←*
$\Delta(\text{net\_profit})$		-	-	-	←***	←**	←*	←**	-	-
$\Delta(\text{number\_of\_banks})$		-	-	-	-	-	←*	←*	-	-
$\Delta(\text{population})$		←**	←**	←**	←***	←***	←**	←**	←*	-
$\Delta(\text{spendings})$		→***	→** ←**	→*	→* ←**	→* ←***	←***	←***	→* ←**	←**
$\Delta(\text{spendings\_per\_capita})$		→***	→** ←*	→**	→* ←**	→** ←***	→* ←***	→* ←***	→** ←**	←**

Legend:  
→\*\*\* – deviation H(0) for  $x \rightarrow y$  at the 1 % level of significance  
→\*\* – deviation H(0) for  $x \rightarrow y$  at the 5 % level of significance  
→\* – deviation H(0) for  $x \rightarrow y$  at the 10 % level of significance  
←\*\*\* – deviation H(0) for  $y \rightarrow x$  at the 1 % level of significance  
←\*\* – deviation H(0) for  $y \rightarrow x$  at the 5 % level of significance  
←\* – deviation H(0) for  $y \rightarrow x$  at the 10 % level of significance  
-- lack of causal connection type  $x \rightarrow y$  and  $y \rightarrow x$  (adoption H(0))

Thus, in Ukraine, the greatest impact for total level of deposits of individuals (including deposits of individuals per capita) have following indicators (5% level of significance or less): economically active population, income (including per capita)



spending (including per capita) GDP (including per capita). In addition, for level of deposits of individuals have influence the level of population, and for deposits per capita have influence an indicator of banks' assets. Also it should be noted that the Ukrainian economy is inherently lag in 8 quarters (2 years).

**Conclusions.** The present study allows the following conclusions. The results can be explained from a financial point of view, GDP is the main indicator upon which researchers determine the level and pace of economic development. GDP growth accompanied by increased number of employees and rising living standards accompanied by a growth amount of deposits in banks. It should be noted that the amount of coverage in the Ukrainian system of deposit insurance has an impact only on the 10% level of significance and as for assets of Ukrainians banks; they have a very significant influence on the amount of deposit resources with a lag of 3 months. The results suggest the desire of the population to reduce their costs in the future and, consequently, implementation of deposits in the banking system of Ukraine (to ensure preventive measures to reduce the potential level of life), which is one of the main features of economic thinking of Ukrainian investor.

The conducted research forms the basis for further research in the field of attracting additional financial resources in the banking system and building an effective deposit insurance system in Ukraine.

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