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CORRELATION ANALYSIS OF THE IMPROVEMENT OF PAYMENT SYSTEMS IN UZBEKISTAN

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Abstract: In the process of globalization, the widespread penetration of digital technologies into the activities of economic entities leads to the appearance of improved payment instruments, as well as modern manifestations of the activities of payment systems. The article discusses the indicators of payment systems in Uzbekistan and their impact on GDP growth. Thus, the influencing factors on GDP growth are determined using statistical-econometric methods, and the corresponding conclusions are given.
Key words: payment systems, transactions made through payment terminals, ATMs, remote users of banking services, GDP, r-Pearson correlation.

Introduction

Data on payment instruments (checks, credit transfers, direct debit, and payment cards) are considered a specific resource for the implementation of a short-term forecast of economic activity. Irving Fisher explains his equation, which reflects the theory of quantity: "An elementary equation means that the money paid on the basis of any transaction is equivalent to goods purchased at a trading price" (Fisher, 1912). We see that payment data are widely used for macroeconomic forecasting in the research of new monetarist economists (Williamson and Wright, 2010, and Schneider and Piazzesi, 2015).

Literature review

Researchers from Italy (Valentina Aprillano and R., 2019), Portugal (Esteves and R., 2009-2017), the USA (Barnett and R., 2016) performed a study on the explore of payment transactions because the indicators of the payment system have a strong correlation with the main macroeconomic indicators. This will help in forecasting gross domestic product.

The fact that the indicators of payment systems are insufficiently studied in the scientific research of our local scientists related to macroeconomic indicators further increases the relevance of this analyze.

The study analyzes the impact of the following indicators of the payment system (2010-2020) on the national economy:

1) the volume of payments made through the Interbank payment system of the Central Bank of the Republic of Uzbekistan,
2) change in the volume of transactions made through payment terminals,
3) the number of ATMs and information kiosks installed,
4) the number of remote users of banking services.

The influence of these factors on the country's GDP was analyzed using econometric methods, and forecasts for the next three years based on research.

Table 1

Probable factors affecting the gross domestic product in improving the electronic payment system in the national economy

№	Factors	Conditional unit of measurement
1	The volume of payments made through the Interbank payment system of the Central Bank of the Republic of Uzbekistan F1	Billion. sum
2	The volume of transactions made through payment terminals F2	pieces
3	The number of ATMs and information kiosks installed F3	pieces
4	The number of remote users of banking services F4	Billion. sum

Analysis and results

We will review the effect of the r-Pearson correlation on the impact of productivity on the national economy.

Table 2

Correlation analysis of indicators of the payment system and gross domestic product

Probability	GDP	F1	F2	F3	F4
GDP	1.000000				
F1	0.8085	1.000000			
F2	0.9868	0.8093	1.000000		
F3	0.9618	0.8651	0.9564	1.000000	
F4	0.9645	0.7165	0.9451	0.8747	1.000000

In calculating the 5% significance, based on the statistical table, the coefficients of the r-Pearson correlation table were recognized as statistically significant, the correlation relationship between GDP and the volume of payments through interbank payment systems, the number of ATMs and information kiosks installed, the number of remote users of payment systems and the number of transactions made through payment terminals was determined, the correlation coefficient is respectively in 0.8085; 0.9868, , 0.9618 and 0.9645.

When choosing regression factors, it is necessary that these factors do not have an internal connection with permanence. In addition, the presence of problems with multicorrelation ($r_{yx_1} > r_{x_2x_1}, r_{yx_2} > r_{x_2x_1}$) among these factors raises doubts about the reliability of the results. As can be seen from the table data, there is no problem of multicorrelation among the indicators we have chosen that affect GDP.

As a general representation of the regression equation, it can be expressed as follows:

$Y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_5 + \cdots + \beta_n x_n + \varepsilon_n$

$\alpha -$ initial value of a variable (constant);

$\beta_1, \beta_2, \ldots \beta_n - -$scope of influence on causal factors;

$x_1, x_2, \ldots x_n -$ factors affecting;

ε_n – other factors.

We analyzed 3 possible regression models using factors that turned out to be related to determine if there is a correlation with GDP.

Table 3

Statistical analysis of GDP regression and factors affecting it (Model 1)

Dependent Variable: GDP				
Method: Least Squares				
Sample (adjusted)): 2010y – 2020y				
Included observations: 11				
Variables	**Coefficient**	**St. mistaken**	**t-stat**	**Prob.**
C	80311.71	26208.37	3.06	0.022
F1	-0.0049393	0.0327768	-0.15	0.885
F2	17.18964	11.29303	1.52	0.179
F3	0.0176318	0.0072159	2.44	0.050
F4	2.557266	0.747874	3.42	0.014
R-square	0.992536		St deviation of the dependent variable	176548.3
Sum of residues kv	2.33e+09		St error of the model	19691.36
F(4, 6)	199.4627		Adapted R-square	0.987560
Proximity to logarithmic reality	−121.0419		Prob(F-statistic)	1.65e-06
Schwarz criteria	254.0732		Akaike Criteria	252.0837
The rho parameter	0.205927		Hannah-Quin crireria	250.8296
F-stat	272801.9		Durbin-Watson statistics	1.358102

Based on the statistical analysis of the GDP regression and the factors affecting it, we can make a regression equation based on the first model

$$\mathbf{y = 80311.71 - 0.0049 * x_1 + 17.1896 * x_2 + 0.0176 * x_3 + 2.5572 * x_4 + \varepsilon}$$

Among the factors in this regression, the number of payments made through the Interbank Payment System (0.885>0.005), as well as the number of ATMs and information kiosks installed (0.179>0.005) does not have a 5 percent significance. And an increase in the number of remote users of payment systems by 1 unit will lead to an increase in GDP by 17.6 million soums, an rise in the number of transactions through payment terminals by 1 billion. sum will lead to an increase in GDP by 2.55 billion sum.

Since the amount of payments made through the Interbank payments payment system does not have a 5% significance level, we exclude it from the range of factors affecting GDP in the second model and conduct a regression statistical analysis with the remaining factors.

Table 4

Statistical analysis of GDP regression and factors affecting it (Model 2)

Dependent Variable: GDP				
Method: Least Squares				
Sample (adjusted)): 2010y – 2020y				
Included observations: 11				
Variables	**Coefficient**	**St. mistaken**	**t-stat**	**Prob.**
C	76891.64	12157.76	6.32	0.0004
F2	17.17936	10.47489	1.64	0.1450
F3	0.0170966	0.0058266	2.93	0.0219
F4	2.569809	0.6893959	3.73	0.0074
R-square	0.992508		St deviation of the dependent variable	176548.3
Sum of residues kv	2.34e+09		St error of the model	18265.13
F(4, 6)	309.0966		Adapted R-square	0.989297
Proximity to logarithmic reality	−121.0626		Prob(F-statistic)	8.45e-08
Schwarz criteria	251.7169		Akaike Criteria	250.1253
The rho parameter	0.172952		Hannah-Quin crireria	249.1220
F-stat	272801.9		Durbin-Watson statistics	1.433086

Based on the statistical analysis of the GDP regression and the factors affecting it, we can make a regression equation based on the second model

$$\mathbf{y = 76891.64 + 17.1793 * x_1 + 0.0170 * x_2 + 2.5698 * x_3 + \varepsilon}$$

Among the factors in this regression, the number of installed ATMs and kiosks (0.1450>0.05) is not statistically significant at the level of 5% significance, and an increase in the number of remote users of payment systems by one unit will lead to an increase in GDP by 17.9 million sum. In addition, an increase for transactions made through payment terminals by 1 billion sum will lead to an increase in GDP by 2.57 billion sum.

Since the number of ATMs and kiosks installed does not have a 5% significance level, we exclude it in the third model from the range of factors affecting GDP and conduct a regression statistical analysis with the remaining factors.

Table 5

Statistical analysis of GDP regression and factors affecting it (Model 3)

Dependent Variable: GDP				
Method: Least Squares				
Sample (adjusted)): 2010y – 2020y				
Included observations: 11				
Variables	**Coefficient**	**St. mistaken**	**t-stat**	**Prob.**
C	80803.61	13120.23	6.159	0.0003
F2	0.024922	0.0036802	6.772	0.0001
F4	3.436954	0.4868769	7.059	0.0001
R-square	0.989629		St deviation of the dependent variable	176548.3
Sum of residues kv	3.23e+09		St error of the model	20101.77
F(4, 6)	381.6810		Adapted R-square	0.987036
Proximity to logarithmic reality	−122.8510		Prob(F-statistic)	1.16e-08
Schwarz criteria	252.8957		Akaike Criteria	251.7020
The rho parameter	0.096041		Hannah-Quin crireria	250.9496
F-stat	272801.99		Durbin-Watson statistics	1.626741

Based on the statistical analysis of the GDP regression and the factors affecting it, we can make a regression equation based on the third model:

$$\mathbf{y = 80803.61 + 0.024922 * x_1 + 3.436954 * x_2 + \varepsilon}$$

All the factors in this regression are statistically significant with a 5% significance level, and it is expected that an increase in the number of remote users of payment systems per number will increase GDP by 24.92 million sum, and in the case of an increase in the transaction amount through payment terminals by 1 billion sum, GDP will be increased by 3.43 billion sum.

In order to choose a reliable model from the three models listed above, we will consider the indicators of the Akaike criterion and the Schwars criterion, as well as the presence of first- and second-order autocorrelation.

Based on the statistical table of the 5% significance level of the Darbin Watson standard, the condition for the absence of autocorrelation between GDP and the analyzed factors is 1.54<DW<2.46.

We also use the Breusch-Godfrey test to check for secondary autocorrelation.

Table 6.

The results of the Darbin-Watson and Breusch-Godfrey test of the study of the presence of autocorrelation of regression models of GDP and factors affecting it

	Models order number	Darbin-Watson statistics	Conditional unit of measurement	Breusha-Godfri test	Conditional unit of measurement
1	1-model	1.358102	1.54<DW<2.46	0.7240	P>0.05
2	2-model	1.433086	1.54<DW<2.46	0.3070	P>0.05
3	3-model	1.626741	1.54<DW<2.46	0.8125	P>0.05

As can be seen from the data in this table, there is no first-order autocorrelation in the remainders of the third model, so it is worth choosing this model.

We use the Breusch-Pagan test to check for the presence of heteroscedasticity in the random error of the selected regression model.

The Breusch-Pagan test, as a null hypothesis, assumes that this model does not have heteroscedasticity. If the probability is greater than R>0.05, there is no heteroscedasticity, the random error of the selected regression residuals will be homoscedastic.

Table 7

The results of the selected regression modeling of the Breusch-Pagan test for GDP and the factors influencing it

(Breusch-Pagan)
Method: Least Squares
Sample (adjusted)): 2010y – 2020 y
(Dependent Variable): uhat

Variables	Coefficient	St. mistaken	t-stat	Prob.
Const	0.427557	0.701530	0.6095	0.5591
F2	−3.59576e-07	1.96779e-07	−1.827	0.1051
F4	3.78114e-05	2.60330e-05	1.452	0.1844

Sum of quadrvts = 3.96213

Test statistics: LM = 1.981067,
Prob.= P (2) > 1.981067) = 0.371378

Since the results of the Breusch-Pagan test were P>0.13, we could see that there is no heteroscedasticity in this model, the random error of the selected regression residuals is homoscedastic.

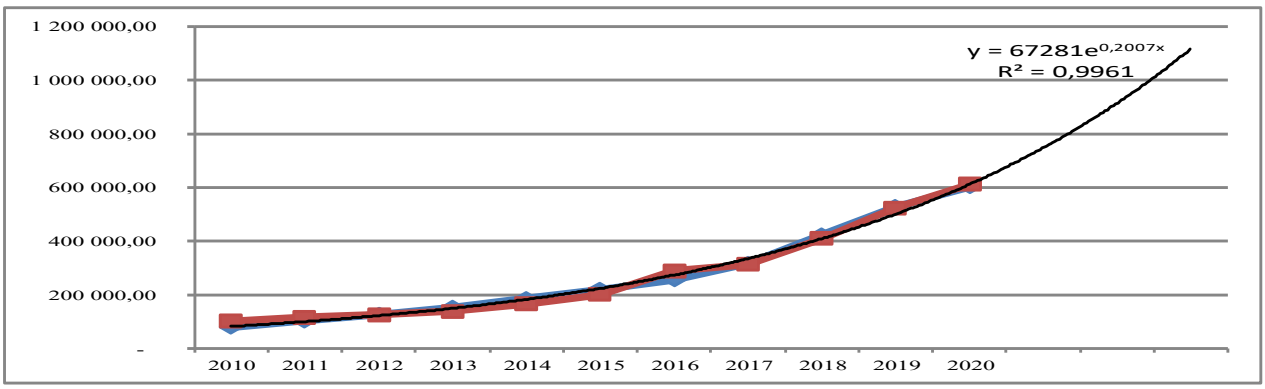
Therefore, given that the model we have chosen has passed the regression evaluation tests positively, this means the reliability of the forecast indicators performed based on this model.

So now, using the above calculations and the adopted third model, we present the forecast indicators for the next 3 years to GDP and the factors affecting it.

The third model we chose got the following appearance:

$$\mathbf{y = 80803.61 + 0.024922 * x_1 + 3.436954 * x_2 + \varepsilon}$$

We calculate the number of remote users of payment systems (X1), forecast indicators for the number of transactions made through payment terminals (X2), and determine forecast indicators for the next three years for GDP (Y) using the formula above.



The equation of the graph has the form $\mathbf{y=67281e^{0.2007x,}}$ and the fact that the indicator R^2 is very close to 1, that is, it is equal to the coefficient 0.9961, can be based on our acceptance of this forecast.

Conclusions and recommendations

The result of our analysis carried out above shows that the indicators of payment systems have a direct impact on macroeconomic indicators and, using their correlation, we can make short-term forecasts of GDP. Based on empirical analysis, it was proved that an increase in the turnover of non-cash payments, that is, the volume of transactions received through payment terminals, would serve not only to prevent the hidden economy, but also to significantly increase GDP. In addition, we have also proved that the widespread use of digital technologies in payment systems, the growth in the number of remote users of banking services have a positive impact on the growth of the national economy of Uzbekistan.

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