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*Non-cash payments and their various impact on economic growth*

**Keywords:** non-cash turnover, economic growth, real GDP per capita

**JEL:** E50, E59, G23

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**Abstract**

**Theoretical background:** The aim of the study is to assess the impact of traditional forms of non-cash payments on economic growth measured by real GDP per capita in the countries of Central and Eastern Europe (CEE) and Western Europe. The following research hypothesis was formulated: the impact of non-cash payments on economic growth is stronger in Central and Eastern European countries than in Western European countries. The research hypothesis was verified on the basis of empirical analysis of panel data gathered for the years 2005–2018 for the CEE and Western European countries. The following 10 CEE countries participated in the research: Slovakia, Bulgaria, Poland, Czech Republic, Hungary, Romania, Lithuania, Latvia, Estonia, Slovenia and 8 countries from Western Europe: France, Austria, Belgium, Germany, Netherlands, Luxembourg, Ireland, Great Britain. A literature review covering theoretical studies on the impact of cashless turnover on the economy, as well as the results of current empirical studies on this issue and numerous reports indicate the positive impact of cashless turnover on the economy. The increased use of electronic payments makes the economy more efficient, reduces transaction costs and contributes to improving the flow of goods and services. Until then, there is no clear evidence of how the adoption of non-cash payments could affect the economy. Despite the fact that non-cash payments have a positive impact on business activities, it should also be remembered that they may also create various types of threats.

**Purpose of the article:** to assess the impact of traditional forms of non-cash payments on economic growth measured by real GDP per capita in Central and Eastern Europe (CEE) and Western Europe.

**Research methods:** panel regression method on data for Central and Eastern Europe and Western Europe, classical least squares method.

**Main findings:** the results of the empirical study (likewise in literature) indicate a significant, positive impact of non-cash payments on real GDP per capita growth. Impact on real GDP per capita is only effective for the CEE countries. It may be said that in Western European countries the level of non-cash transactions reached a certain degree of saturation, which does not mean a significant growth in real GDP per capita. This is proved by ineffective iterations performed on various functional forms of the econometric model on panel data. In the group of CEE countries, the value of transactions with payment cards has the greatest impact on real GDP per capita. An explained variable as an explanatory variable (real GDP per capita) has been delayed by one period, which complies with research conducted so far that the effect of the impact of non-cash transactions on the economy requires time. Added value: analysis of current literature on the impact of non-cash payments on economic growth and an empirical analysis.

*Non-cash payments and their various impact on economic growth*

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**Introduction**

Cash and non-cash transactions are complementary elements of the payment system [Bank for International Settlements, 2003]. Non-cash turnover is defined as cash settlements in which both sides - the debtor and the creditor have a bank account and no cash is used at any stage [NBP, 2008, p. 9]. A. B. Paul and O. Friday [Paul, Friday, 2012, pp. 31-32] formulated a similar definition. Therefore, it might be concluded that non-cash settlements are a substitute for cash due to the fact that they correspond to the classic functions of real money: value measure, accumulation, exchange, unit of account [Arnold, 2007, pp. 574-581].

As a result of technological and IT development, new payment instruments appear, enabling payments without physical use of cash. Among the traditional payment instruments the following instruments may be distinguished: credit transfer, direct debit, checks, payment cards, and recently electronic payments are of increasing importance. Unlike traditional cash, non-cash payments have many advantages. One of them is the reduction of thefts and other crimes associated with cash payments [Armey et al., 2014, pp. 46 - 57]. What is more, non-cash payments are beneficial for counterparties. The various available forms of payment increase their income, which improves their operational efficiency and reduces operating costs [Alliance, 2003]. Non-cash payments were also considered hygienic for food sellers (Paul, Friday, 2012, pp. 31-36). Electronic payments are an important factor in the growth of consumption, production, domestic product and employment. The authors of the report "The Impact of Electronic Payments on Economic Growth", Moodys Analytics, claim that electronic payments have a positive impact on the public finance situation and the creation of a more stable and open business environment. According to them, these payments also contribute to reducing the range of the shadow economy and unregistered cash transactions. As a result, an increase in tax revenues may be noticed and also a decrease of cash handling costs, payment guarantees for retailers and the coverage of financial services by further consumer groups. The international survey on the impact of electronic payments on economic growth carried out in the years 2011-2015 in 70 countries that together account for 95% of global GDP proves that through promoting electronic payments, an average of 2,6 million new jobs were created annually [Zandi et al., 2016, pp. 3-7].

The aim of the article is to assess the impact of traditional forms of non-cash payments on economic growth measured in real GDP per capita in the countries of Central and Eastern Europe (CEE) and Western Europe. The following research hypothesis was formulated: the impact of non-cash payments on economic growth is stronger in Central and Eastern European countries than in Western European countries. The study involved 10 CEE countries such as: Slovakia, Bulgaria, Poland, Czech Republic, Hungary, Romania, Lithuania, Latvia, Estonia, Slovenia and 8 countries from Western Europe: France, Austria, Belgium, Germany, Netherlands, Luxembourg, Ireland, Great Britain. European Union countries were grouped according to the geographical classification of the United Nations [ONZ: https://unstats.un.org/unsd/methodology/m49/]. This target will be achieved through a review of current literature and conducting own empirical research on the example of the CEE and Western European countries.

The research consists of four parts. In the first part, a review of the literature on the impact of non-cash turnover on economic growth is presented. In the second part, research hypotheses and the method of their verification are indicated. The third part contains the description of the adopted research methodology, and the fourth one - the results of the empirical study on the example of European countries - the CEE and Western European countries, and the conclusions that might be drawn on the basis of this study.

**Literature review**

The impact of non-cash payments on the economy may be analyzed through the diffusion of innovation theory. This concept appeared in 1962 and was developed by Rogers [Rogers, Rogers, 1995]. The diffusion of innovation theory says that the adoption of a new idea or innovation is caused by the interaction between people through interpersonal networks. In this context, the dissemination of non-cash payments should occur right where consumers seek improvement, convenience during the time of transactions, and companies search for new profit opportunities. The consequences of diffusion in non-cash payments depend on how the society is ready to quickly accept non-cash payments at various stages of the innovation process, which are: knowledge of the existence of non-cash payments, belief in a positive attitude to non-cash payments, the decision to accept non-cash payments, implementation of non-cash payments and confirmation of accepting a non-cash payment on a basis of positive results.

A literature review covering theoretical studies on the impact of cashless turnover on the economy, as well as the results of current empirical studies on this issue and numerous reports indicate the positive impact of cashless turnover on the economy. Among others, positive relations between non-cash payments and economic growth were noticed by I. Hasan, T. Renzis and De H. Schmiedel [Hasan et al., 2012, pp. 1-41]. They examined the relationship between retail payments and general economic growth based on data from 27 countries over the years 1995-2009. Their research results have shown that electronic retail payments (e-payments) stimulate overall economic growth, consumption and trade [Ibid., Pp. 21–22]. Electronic payment may be defined as a payment that is initiated, executed and received electronically [European Central Bank, 2010]. E-payments made through payment cards have become a special feature of modern economics [Arai 2004, pp. 1-24]. The strongest impact on economic growth was observed in case of card payments and then in case of credit transfer and direct debit. Furthermore, research results indicate that checks have a relatively small impact on economic growth as well as on consumption and trade. The hypothesis that the processes of harmonization and integration of retail markets have a positive impact on the development of trade and consumption - mainly due to the creation of the payment-integration area (SEPA) - has been positively verified. In addition, research shows that the impact of retail payments on economic growth is more evident in euro area countries than in countries that do not belong to the euro area. M. Cirasino M. and J. A. Garcia [Cirasino et al., 2008, pp. 1-78] noticed a beneficial effect of non-cash transactions on economic growth. They reckon that this system simplifies commercial transactions not only for consumers, but also for businesses, which has a significant impact on the economy. The main advantages of using non-cash payment methods are: speed of transactions and security [Ibid., p. 21]. The positive impact of non-cash payments on the economy was also noticed by Father Slozko and A. Pelo. In their research, they proved that there is a positive correlation between the growth of e-payments and the growth of GDP. They came to the conclusion that the use of non-cash payments is closely related to the level of economic development of a given country [Slozko and Pelo, 2014, pp. 130-140]. On the one hand, a higher level of prosperity and financial system development in richer countries encourages cashless transactions, while on the other hand, non-cash payments contribute to economic acceleration. O. S. Oyewole, El-Maude, J. Gambo, M. Abba and M. E. Onuh have a similar opinion on this subject. Moreover, they pointed out that only cash machines had a positive impact on economic growth, while other electronic payment channels had a negative impact [Oyewole et al., 2013, 913–918]. H. H. Tee and H. B. Ong analyzed the effects of using non-cash payments such as: check, payment card, telegraphic transfer - payment via real-time or offline request and electronic money in five European Union countries: Austria, Belgium, France, Germany and Portugal over the years 2000–2012 [Tee and Ong, 2016, pp. 1-9]. They reached the conclusion that the impact of non-cash payments on economic growth, expressed by the relation of Gross Domestic Product to the Consumer Price Index (CPI) may only be observed in the longer period. This means that any policy that promotes non-cash payments does not have an immediate impact on the economy and works only over the longer term.

The latest results on the impact of cashless transactions on economic growth are published in the annual reports of the authors and analysts of the Moody’s agency: V. Singh and M. Zandi [Zandi et al., 2016, 1-31]. On the basis of the research on the macroeconomic data of 70 countries in the world in 2011–2015, it was noted that retail payments contribute to the growth of trade and consumption, which in turn supports production and overall economic growth. In the analyzed sample it was pointed out that there is a positive correlation between the penetration and use of payment cards, and economic growth. The increasing use of electronic payments, including especially credit and prepaid debit cards, not only resulted in an increase in consumption by 0,2% in emerging markets and 0,14% in developed countries, but also an increase in GDP by 0,11% and 0,08% respectively, which corresponds to a total of USD 297 billion. The increased use of electronic payments makes the economy more efficient, reduces transaction costs and contributes to improving the flow of goods and services. As a result of the growing popularity of electronic payments, a general increase in employment in the entire 70 surveyed countries by 2,6 million was also noticed during the period considered. The largest increases in jobs were recorded in China - an average of 427,000 new jobs a year and in India - 336,000. Studies have shown that the development of electronic payments itself may not be enough to increase the welfare of the country. In order to receive the best effect, also a developed financial system and a "healthy" economy are needed. With a view to promoting non-cash transactions, the authors of the report recommend that state authorities limit the regulations to the necessary minimum, favor the creation of developed financial infrastructure and support consumption growth. In addition, the adoption of an electronic transaction has a significant meaning for the transparency of settlements between counterparties and also encourages to reduce the fraud that accompanies transactions involving cash (Mieseigha and Ogbodo, 2013, pp. 11-16).

The research results presented above were mainly based on the analysis of the impact of non-cash payments - mostly by cards - on the components of global demand. A slightly different approach in the analyzes of economic growth was applied by researchers - among others A. Jail or M. Idrees, who based their economic growth study on an analysis of supply and on transformations of the production function of Solow or Cobb-Douglas [Jalil and Idrees, 2013, pp. 383-388]. They analyzed the scale of the impact of education and technical progress on the creation of national income in various economies.

Despite the fact that non-cash payments have a positive impact on business activities, it should also be remembered that they may also create various types of threats. Although technological progress has enabled improvement and innovation in the electronic payment system from a basic ATM card transaction through internet transfer, there are still current problems related to the security of users of these instruments. Phishing emails are just some of the shortcomings of non-cash payments (Oyewole et al., 2013). The risk of losing money weakens consumer confidence in making electronic payments. J. Park using macroeconomic data of 70 countries from the least developed Bangladesh to the developed United States over the years 2002–2004 proved that the development of non-cash payments contributes to the phenomenon of corruption, which reduces the quality of private investment, and that in turn leads to a reduction of economic growth [Park, 2012, pp. 907-929]. C. N. Ezuwore-Obodoekwe, A. S. Eyisi, S. E. Emengini, A. F. Chukwubuzo discovered, on the example of Nigeria, that the transition from cash to non-cash forms of payment causes the loss of autonomy of that central bank [Ezuwore-Obodoekwe et al., 2014, pp. 30-42]. If the central bank loses its ability to control money supply, then inflation in the economy increases [Al-laham and Altarawneh 2009, pp. 339-349]. As a result, the central bank's monetary policy instruments become ineffective to control the interest rate and money supply. Moreover, they concluded that the promotion of electronic money significantly reduces the demand for central bank reserves reported by commercial banks, limits the ability of the central bank to control the money supply, increases the speed of money circulation, decreases international monetary control and changes the money multiplier [Al-Laham et al. , 2009, pp. 339-349]. Until then, there is no clear evidence of how the adoption of non-cash payments could affect the economy.

**Research methods**

To achieve the aim, panel data was analyzed for CEE and Western European countries and panel models were built using the classical least squares method. The original functional form of the model is consistent with that found in literature [Zandi et al., 2016, p. 14; *Electronic Payments, E-Commerce and Economic Activity: Theoretical Review and Evidence for Developed and Emerging Market Economies,* 2013, p. 50; Tee H, Ong H., 2016, p. 4]:

realGDPpercapita it = α1 + β1 credit\_transfer it + β2 direct\_debits it + β3 card\_payments it + β4 e-money\_payments it + Vit

where:

realGDPpercapita it - explained variable, real GDP per capita in the country *i* and in the period *t*,

α1 – absolute term,

credit\_transfer it - value of transactions via credit transfer in the country *i* and in period *t*,

direct\_debits it - value of transactions via direct debit in the country *i* and in period *t*,

card\_payments it – value of transactions using payment cards in the country *i* and in period *t*,

money\_payments it – value of electronic transactions in the country *i* and in period *t*,

*β1, β2, β3, β4* - structural parameters of the model,

Vit - total random error, consisting of a purely random part εit and the individual effect ui referring to a specific i unit of the panel (νit = εit + ui) [Kufel 2007, p. 164].

Statistics such as R2, residual standard error and residual sum of squares, F statistics, chi-square test and Hausman test were used to verify the models. Firstly, for each group of countries of the explained variable a general model was built that included all explanatory variables and then a detailed model that contained only explanatory variables that have a statistically significant impact on real GDP per capita.

The study used data for 10 countries of Central and Eastern Europe[[1]](#footnote-1) (112 observations) and for 8 countries from Western Europe[[2]](#footnote-2) (77 observations) in the years 2005–2018. The research includes a total of 184 observations. The variables used to verify research hypotheses are described in the table below.

Table 1. Description of variables

|  |  |  |  |
| --- | --- | --- | --- |
|  | Variable | Source | Description of variable |
| explained variable | real GDP per capita | Eurostat, Database | real GDP, i.e. nominal GDP / GDP deflator per person (in euro) |
| explanatory variables | credit\_transfer | EBC Statistical Data Warehouse, SDW EBC | value of transactions via credit transfer (in million euro per 1 million inhabitants) |
| direct\_debits | EBC Statistical Data Warehouse, SDW EBC | value of transactions via direct debit (in million euro per 1 million inhabitants) |
| Cheques | EBC Statistical Data Warehouse, SDW EBC | value of transactions via checks (in million euro per 1 million inhabitants) |
| card\_payments | EBC Statistical Data Warehouse, SDW EBC | value of transactions using a payment card: debit, credit or charge of American Express or Diners (in million euro per 1 million inhabitants) |
| e-money\_payments | EBC Statistical Data Warehouse, SDW EBC | value of transactions using electronic money, where electronic money is monetary value stored on an electronic device: server or card (in million euro per 1 million inhabitants) |

Source: Own elaboration.

Real gross domestic product is calculated by dividing gross domestic product (GDP) by its consumer price index (CPI). Real GDP in 2005-2018 was obtained from Eurostat international financial statistics. Real GDP has been used as an indicator of economic growth [Apergis and Payne, 2010, p. 3; Slesman et al .; 2015, pp. 214-226; Wang et al. 2016, Cevik et al. 2016, pp. 360-371; Conti, 2014, pp. 199-211]. Data on the value of transactions using electronic transfer, direct debit, card payments, checks and electronic payments for 2005–2018 were collected from the European Central Bank, Statistical Data Warehouse.

**Results**

Empirical analysis was begun by identifying mean, median, minimum, maximum, standard deviation, coefficient of variation and coefficient of skewness for selected variables, Table 2.

Table 2. Statistical parameters of analyzed variables

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variable | Unit of measure | Mean | Median | Minimum | Maximum | Standard deviation | Coeff. of variation | Coeff. of skewness |
| Central and Eastern Europe |
| credit\_transfer | mln euro per 1 mln inhabitants | 159 209,77 | 142 433,13 | 9 207,11 | 1 059 348,79 | 132 752,69 | 83,38 | 3,90 |
| direct\_debits | mln euro per 1 mln inhabitants | 3 485,60 | 215,43 | 18,23 | 75 389,30 | 11 911,12 | 341,72 | 4,80 |
| cheques | mln euro per 1 mln inhabitants | 102,52 | 11,74 | 0,00 | 1 196,00 | 228,76 | 223,14 | 3,27 |
| card\_payments | mln euro per 1 mln inhabitants | 1 240,79 | 954,63 | 50,46 | 4 843,25 | 971,71 | 78,31 | 1,05 |
| e-money\_payments | mln euro per 1 mln inhabitants | 23,57 | 2,11 | 0,00 | 836,37 | 116,94 | 496,18 | 6,86 |
| real GDP per capita | euro per 1 mln inhabitants | 11 221,43 | 10 800,00 | 4 200,00 | 20 200,00 | 3 785,33 | 33,73 | 0,23 |
| Western Europe |
| credit\_transfer | mln euro per 1 mln inhabitants | 770 531,50 | 384 627,78 | 31 432,80 | 3 032 558,43 | 726 995,92 | 94,35 | 1,42 |
| direct\_debits | mln euro per 1 mln inhabitants | 27 652,78 | 18 854,17 | 4 275,19 | 165 537,91 | 32 357,83 | 117,01 | 3,28 |
| cheques | mln euro per 1 mln inhabitants | 21 647,55 | 5 132,57 | 41,06 | 215 672,85 | 42 677,77 | 197,15 | 3,35 |
| card\_payments | mln euro per 1 mln inhabitants | 6 594,47 | 5 757,60 | 1 771,56 | 17 973,07 | 3 681,14 | 55,82 | 1,24 |
| e-money\_payments | mln euro per 1 mln inhabitants | 12 703,36 | 18,87 | 0,63 | 213 993,50 | 40 180,45 | 316,30 | 3,61 |
| real GDP per capita | euro per capita | 40 758,93 | 35 150,00 | 29 200,00 | 84 400,00 | 15 481,61 | 37,98 | 1,97 |

Source: Own elaboration using the Statistica program.

All selected variables for the countries of Central and Eastern Europe and Western Europe are characterized by right-side asymmetry. The highest value of transactions in both groups of countries was made using credit transfers, and the lowest by electronic payments and then checks. The average value of transactions using payment cards, likewise the value of transactions via direct debits, checks or electronic payments, was higher for Western European countries than for Central and Eastern European countries. Only the average value of transactions via credit transfers proved to be higher in the countries of Central and Eastern Europe (159.209,77 million per capita).

 The level of correlation of the explained variable and explanatory variables was then verified and also the correlation between the explanatory variables (Table 3).

Table 3. Spearman's correlation coefficients

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| variables | credit\_transfer | direct\_debits | Cheques | card\_payments | e-money\_payment | real GDP per capita |
| CEE countries |
| credit\_transfer | 1,000000 | **0,362893** | **-0,343030** | **0,448888** | 0,096235 | **0,479045** |
| direct\_debits | **0,362893** | 1,000000 | -0,185376 | **0,720079** | -0,273752 | **0,855875** |
| cheques | **-0,343030** | -0,185376 | 1,000000 | **-0,396216** | **-0,545034** | -0,096099 |
| card\_payments | **0,448888** | **0,720079** | **-0,396216** | 1,000000 | 0,186414 | **0,797276** |
| e-money\_payments | 0,096235 | -0,273752 | **-0,545034** | 0,186414 | 1,000000 | 0,007644 |
| real GDP per capita | **0,479045** | **0,855875** | -0,096099 | **0,797276** | 0,007644 | **1,000000** |
| Western European countries |
| credit\_transfer | 1,000000 | 0,004050 | **-0,294649** | **0,767132** | **0,892039** | **0,804357** |
| direct\_debits | 0,004050 | 1,000000 | -0,148842 | **-0,422619** | -0,098350 | -0,179284 |
| cheques | **-0,294649** | -0,148842 | 1,000000 | -0,027105 | -0,173201 | -0,223632 |
| card\_payments | **0,767132** | **-0,422619** | -0,027105 | 1,000000 | **0,784736** | **0,731574** |
| e-money\_payments | **0,892039** | -0,098350 | -0,173201 | **0,784736** | 1,000000 | **0,796813** |
| real GDP per capita | **0,804357** | -0,179284 | -0,223632 | **0,731574** | **0,796813** | 1,000000 |

\* correlation coefficients marked in bold are relevant for p <0,05

Source: Own elaboration.

The correlation of the explained variable and the explanatory variables is statistically significant for variables for the countries of Central and Eastern Europe: for the value of transactions using credit transfers, direct debits and payment cards, while it was insignificant for payments using checks and electronic payments. However, in Western European countries, only payments using credit transfers, direct debits and electronic payments were statistically significant. Spearman's rank correlation coefficient calculated in the group of Central and Eastern European countries for real GDP per capita and transaction value using direct debit or using payment cards with an absolute value of 0,856 and 0,797 respectively, means rather strong linear relation between the analyzed features, because the higher absolute value of the coefficient, the stronger the linear relation, whereas a positive correlation indicates that an increase in one indicator leads to an increase in the other indicator. Similar conclusions might be drawn for the explanatory variables for Western European countries of the value of transactions using credit transfers, payment cards as well as electronic payments and the explained variable - real GDP per capita. In the group of CEE countries there is a fairly strong positive correlation between the value of transactions using direct debit and the value of transactions using payment cards, a correlation coefficient of 0,72, and a fairly significant correlation between the value of transactions using a credit transfers and the value of transactions using payment cards. Furthermore, it is observed that a decrease in the value of transactions using checks causes an increase in the value of transactions using payment cards. However, in the group of Western European countries it may be noticed that as the value of transactions via credit transfers and the value of electronic transactions increases, the value of transactions using payment cards also increases, a correlation coefficient of about 0,78.

Estimation of models verifying the research hypothesis was performed using regression analysis. Panel models for the CEE and Western European countries were built using the classical least squares method. For each group of countries for explained variable, a general model was presented which included all explanatory variables and also a detailed model, which only contained explanatory variables that had a statistically significant impact on economic growth. The results of estimation for the group of CEE countries are presented in Table 4.

Table 4. Estimation results - Central and Eastern European countries

|  |  |
| --- | --- |
| Panel LSM estimation using 112 observations |   |
| 10 cross-sectional data units included |   |
| Dependent variable (Y :) l\_realGDPpercapita |   |
| Robust standard errors (robust HAC) |   |
|  | coefficient | standard error | z | p-value | relevance\* |   |
| const | 7,48343 | 0,409121 | 18,29 | 9,68E-75 | \*\*\* |   |
| l\_credit\_transfer | 0,101218 | 0,021244 | 4,765 | 1,89E-06 | \*\*\* |   |
| l\_direct\_debits | 0,060277 | 0,005716 | 10,55 | 5,31E-26 | \*\*\* |   |
| l\_card\_payments | 0,230745 | 0,019817 | 11,64 | 2,47E-31 | \*\*\* |   |
| l\_realGDPperca~\_1 | 0,142319 | 0,031604 | 4,503 | 6,70E-06 | \*\*\* |   |
| Arithmetic mean of dependent variable 9,298177 | Standard deviation of dependent variable | 0,31871 |   |   |   |   |
| Residual sum of squares | 2,333763 |  Residual standard error | 0,147685 |
| R2 coefficient of determination: 0,793013 | Adjusted R-squared | 0,785276 |   |
| F(4,9)= 408,1133 | p-value for F test: | F=3,66E-10 |
| Logarithm of credibility =57,85584 | Akaike Information Criterion | −105,7117 |
| Schwarz Bayes criterion: −92,11918 | Hannan–Quinn Information Criterion | −100,1968 |
| rho1 residual autocorrelation: −0,293537 | Durbin-Watson statistic | 2,259016 |
| Test for normal distribution of residuals | Null hypothesis: the random component has a normal distribution |
| Test statistic: Chi-square(2) = 0,510184 | z as p-value = 0,774845 |

\* significant variable at a level of significance of 1%

Source: Own elaboration.

Due to different units of measurement, the dependent and independent variables have been transformed using the logarithm function. Taking into account the Akaike information criterion, the Schwarz Bayes criterion and the Hannan-Quinn criterion, the best estimated model takes the following form:

ln(realGDPpercapita it) = 7,48 + 0,10 ln (credit\_transfer it) + 0,06 ln(direct\_debits it) + 0,23ln(card\_payments it) + 0,14 ln(realGDPpercapita it-1) + Vit

Verification of significance of variables

Based on the Student's t statistics, statistical significance was verified for absolute term and for explanatory variables at the level of significance α = 0,01. Taking into account that p < α=0,01, the hypothesis H0 should be rejected and H1 should be approved. With a probability of making a mistake of 0,01, the absolute term and explanatory variables: the value of transactions using credit transfers, the value of transactions via direct debit, the value of transactions using payment cards and real GDP per capita delayed are statistically significant. The parameters of the model obtained as a result of estimates have signs as expected.

The standard error of residuals is: 0,147785, which means that the real values ​​of real GDP per capita deviate from theoretical values ​​by an average of 0,148.

79,30% variation was explained by the model. The adjusted coefficient of determination was at a similar level.

The F test was also conducted, which determines the overall significance of all parameters, where hypotheses were formulated:

H0: all parameters are irrelevant

H1: at least one parameter is relevant.

P-value for test F = 3,66e-10. Due to the fact that p <α, it means that H0 should be rejected and H1 should be approved. The logarithm of credibility had a value of 57,85584.

In order to verify a hypothesis, at the significance level α = 0,05, about the lack of residual autocorrelation, the following hypotheses were formulated:

H0: ꬶ = 0 (no residual autocorrelation)

H1: ꬶ <0 (negative residual autocorrelation occurs because r is <0)

The Durbin-Watson test was conducted and its value of test statistic is 2,259016.

DW test statistic for a 5% significance level was compared with the critical values ​​for n = 118 and k = 4, where:

dL = 1,6303

dU = 1,7702.

Because d> du then we assume H0, there is no autocorrelation.

Moreover, standard errors resistant to autocorrelation and heteroscedasticity (HAC) were used.

A normality of distribution test was also conducted - chi-squared compliance test (χ 2), where:

H0: distribution is a normal distribution

H1: distribution is not normal

The critical value of the test: ***χ2*** with a probability of α = 0,05 is 5,99146.

Due to the fact that the calculated value of the χ2 test was 0,510, and therefore the condition: *χ2<χ20.05*, where it should be stated that there is no reason to reject the null hypothesis.

A similar approach was used for Western European economies. The research was initially conducted on all variables, and then for variables that showed a correlation between real GDP per capita, that is the value of transactions using credit transfers, payment cards and electronic payments.

The numbers characterizing the sample results of panel estimations by the method of least squares were presented in Table 5.

Table 5. Estimation results - Western European countries

|  |
| --- |
| Panel LSM estimation using 77 observations |
| 8 cross-sectional data units included |
| Dependent variable (Y :) l\_realGDPpercapita |
| Robust standard errors (robust HAC) |
|  | coefficient | standard error | z | p-value | relevance |   |
| Const | 6,64785 | 1,38876 | 4,787 | 1,69E-06 | \*\*\* |   |
| l\_emoney\_payments | 0,041436 | 0,013946 | 2,971 | 0,003 | \*\*\* |   |
| l\_credit\_transfer | 0,153132 | 0,087417 | 1,752 | 0,0798 | \* |   |
| l\_card\_payments | 0,098722 | 0,035208 | 2,804 | 0,005 | \*\*\* |   |
| l\_realGDPperca~\_1 | 0,087999 | 0,034034 | 2,586 | 0,0097 | \*\*\* |   |
| Arithmetic mean of dependent variable 10,60424 | Standard deviation of dependent variable 0,336437 |
| Residual sum of squares | 2,13198 | Residual standard error | 0,172078 |
| R2 coefficient of determination: 0,752166 | Adjusted R-squared | 0,738397 |
| F(4, 7) = 888,6306 | p-value for F test:  | 1,51E-09 |
| Logarithm of credibility: 28,83177 | Akaike Information Criterion | −47,66355 |
| Schwarz Bayes criterion: −35,94452 | Hannan–Quinn Information Criterion | −42,97604 |
| rho1 residual autocorrelation = 0,013433 | Durbin-Watson statistic | 1,908896 |
| Test for normal distribution of residuals |
| Null hypothesis: the random component has a normal distribution |
| Test statistic: Chi-square = | 190,094 |
| z as p-value = | 5,27E-42 |

Source: Own elaboration.

As far as the model for Western European countries is concerned, despite many iterations and using various functional forms, it was not possible to estimate statistically the correct model. The greatest drawback of each estimated model was the incorrect distribution of residues. The model adjustment to empirical data was about 70%, which may result, among others, from the fact that certain determinants affecting the development of real GDP per capita in the discussed group of countries were not included in the model.

To sum up, it may be stated that the specified factors for the group of CEE countries clearly explain the level of real GDP per capita.

**Discussions**

In Western European countries the average real GDP per capita was found to be higher than in Central and Eastern European countries. The average value of transactions using credit transfers, direct debits, payment cards or electronic money also proved to be higher. Although the countries of Central and Eastern Europe have not yet reached the level of development of Western Europe, but they are making great progress - it is commonly said that what took 40 years in Western Europe, in CEE countries was realized in 10 years. Even though currently Central and Eastern Europe is developing faster compared to Western European countries, it is still perceived as less developed. Its advantage, however, is not a gradual but a step increase, thanks to which it may quickly catch up with Western European countries. In the CEE countries, the changes are occurring much faster, which ultimately means that these countries are moving directly from the past towards the future quicker than Western European countries.

The latest statistics concerning the share of contactless payments in the total of non-cash transactions with Mastercard cards in Poland were published in 2018 by Mastercard. The ranking is dominated by countries from Central and Eastern Europe [https://www.cashless.pl/4753-Liczba-platnosci-zblizeniowych-na-polskim-rynku]:

Czech Republic - 93 percent

Poland - 85 percent

Slovakia – 83 percent

Hungary - 83 percent

Montenegro - 71 percent

Romania - 69 percent

Greece - 61 percent

Russia - 60 percent

Belarus - 57 percent

Serbia - 57 percent

As far as Poland is concerned, its good position also results from the openness of consumers to various types of innovations. In Western European countries contactless payments are just beginning to gain popularity thanks to the rapidly growing payment infrastructure. The estimated GDP reactivity as a result of the increase in the value of transactions with payment cards in the CEE countries is higher than in Western European countries, whilst the average level of the value of transactions was more than 5 times higher in the analyzed period. This is not surprising, taking into account that Western European countries have more established payment networks, more developed infrastructure - cards are accepted by most traders. Cash payments are still common in the CEE. In more developed economies, where the use of cards has already reached a mature level, the use of cards is progressing at a slower rate. Indeed the recession slowed down the growth of card use, the most strongly, however, among more developed countries, while among CEE economies it did not matter that much. That explains the fact that the CEE countries may have a greater impact on GDP by increasing the card penetration rate, and therefore - the increase in the value of card transactions. This may be achieved through the development of retail payment infrastructure so as to match the economies with a higher level of GDP - promoting payment mechanisms, enabling merchants to accept electronic payments.

**Conclusions**

An impact on real GDP per capita is effective only in case of CEE countries. While for the economies of the CEE countries non-cash turnover has a significant influence, for Western European countries not necessarily. It might be said that in Western European countries the level of non-cash turnover reached a certain degree of saturation, which does not significantly translate into an increase in real GDP per capita. This is evidenced by the ineffective iterations performed on various functional forms of the econometric model on panel data. The hypothesis in the article that the impact of non-cash payments on economic growth is stronger in Central and Eastern European countries than in Western European countries has been positively verified. The model estimated for the CEE countries indicates that the impact of non-cash payments on economic growth measured in real GDP per capita is positive. The greatest influence on the explained variable has the value of transactions involving payment cards - an increase in the value of transactions using this payment instrument by 1 percentage point causes real GDP per capita increase by 0,23 percentage point. Moreover, the increase in the value of transactions via credit transfers by 1 percentage point increases real GDP per capita by 0,10 percentage point. It is also worth mentioning that transactions with direct debits have a positive impact on the explained variable in the CEE countries - real GDP growth by 0,06 percentage point. The explained variable as an explanatory variable has been delayed by one period, which is consistent with the research conducted so far that the effect of the impact of non-cash turnover on the economy requires time. It is worth pointing out that the explanatory variable - payments involving electronic money in the model for the CEE countries, proved statically insignificant.

The impact of accepting non-cash payments on economic growth may only be observed in the longer term. Therefore activities promoting non-cash payments will not have an immediate impact on the economy. What is more, the impact of non-cash transactions on economic growth may vary depending on the form of making non-cash payments. Whilst the positive relationship is proven, its strength, which is difficult to determine, is not known. Various models used in current studies indicate the positive impact of non-cash turnover on economic growth. It is an open question, what determines the direction and strength of the impact of non-cash turnover on economic development in various countries. In this respect, the research results are ambiguous.

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1. Slovakia, Bulgaria, Poland, Czech Republic, Hungary, Romania, Lithuania, Latvia, Estonia, Slovenia. [↑](#footnote-ref-1)
2. France, Austria, Belgium, Germany, Netherlands, Luxembourg, Ireland, Great Britain. [↑](#footnote-ref-2)